U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Guidelines for Sound Insulation of Structures Exposed to Aircraft Noise

Date: 6/8/2022
Initiated By: APP-400

AC No: 150/5000-9B
Change:

1. **Purpose.**

This advisory circular (AC) provides guidelines to develop and implement a sound insulation program (SIP).

2. **Cancellation.**

This AC cancels AC 150/5000-9A, *Announcement of Availability--Report No. DOT/FAA/PP/92-5, "Guidelines for the Sound Insulation of Residences Exposed to Aircraft Operations"* dated July 2, 1993, and changes the title of the AC to "*Guidelines for Sound Insulation of Structures Exposed to Aircraft Noise".*

3. **Application.**

This AC is intended for use by the Federal Aviation Administration (FAA), airport operators,[1] airport sponsors,[2] and airport consultants or contractors to develop and manage sound insulation programs (SIPs) established to mitigate noise impacts to structures[3] exposed to aircraft noise around airports. The FAA considers the standards and processes described in this AC essential for the fidelity of SIPs. However, this AC does not constitute a regulation and is not legally binding in its own right and it will not be relied upon as a separate basis by the FAA for affirmative enforcement action or other administrative penalties. Conformity with this AC is voluntary and

[1] Airport operator means the operator of an airport as defined in 49 U.S.C. § 47501 (2)(A) and (B) which states "for an airport serving air carriers that have certificates from the Secretary of Transportation, any person holding an airport operating certificate issued under 49 U.S.C. § 44706 and for any other airport, the person operating the airport".

[2] Airport Sponsor means a federal financial assistance recipient as defined in 49 U.S.C. § 47102(26)(A) and (B) which states "a public agency that submits to the Secretary […]an application for financial assistance" and "a private owner of a public-use airport that submits to the Secretary […] an application for financial assistance for the airport" and in FAA Order 5100.38D-Change 1 (Airport Improvement Handbook), Chapter 2, Section 2-2, page 2-1 through 2-2. For the purposes of this AC, not all airport sponsors are airport operators, and several programs at airports are managed by program sponsors, not airport operators. Therefore, airport operator or sponsor is used throughout unless otherwise specified.

[3] Residences, public buildings (e.g., educational and medical facilities, places of worship), and historic properties that are eligible for sound insulation are referred to as "structures" in this AC.

nonconformity will not affect rights and obligations under existing statutes and regulations, except for circumstances involving federal financial assistance.[4] This AC is effective on the date of publication. Airports with established SIPs should consult with FAA regarding changes to airport operations that may require re-evaluation and following the standards and processes in this AC.

4. **Principal Changes.**

The previous AC focused on technical aspects of developing SIPs, such as sound exposure and insulation metrics. However, information regarding other aspects of SIP implementation was limited or outdated. This AC provides standards, processes and procedures, and guidelines for all phases of developing and implementing a SIP as well as technical updates[5] associated with SIP development, including property surveys, acoustic engineering principles and testing methods, establishing boundaries, and determining noise level reductions. Therefore, principal changes included, but were not limited to, details on roles and responsibilities and procedures for SIP initiation through completion; standards for acoustic testing, funding opportunities, and project costs; and considerations for community outreach, project phasing, and sound insulation treatments.

Robert Craven
Director, Office of Airport Planning and Programming

[4] Use of standards and guidelines in this AC is mandatory for relevant sound insulation projects funded though Federal grant assistance programs, including the Airport Improvement Program (see Grant Assurance #34) and projects funded through the Passenger Facility Charge Program (see PFC Assurance #9).

[5] Technical updates to this AC included incorporating sources such as the Transportation Research Board's Airport Cooperative Research Program Reports, specifically the "Guidelines for Airport Sound Insulation Programs" (Report 89) and "Evaluating Methods for Determining Interior Noise Levels Used in Airport Sound Insulation Programs" (Report 152). Additionally, this AC includes methods for measuring the aircraft noise level reduction of building façades as described in Aerospace Recommended Practice: Airport Noise Level Reduction Measurement of Building Facades report (ARP6973)

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CHAPTER 1. INTRODUCTION

1.1 Introduction

1.1.1 The goal of a Sound Insulation Program (SIP) is to develop a plan and approach to implementing sound insulation treatment to mitigate or minimize the effects of noise from aircraft and other airport operations in communities near airports. Specifically, when sound insulation treatment for structures[6] determined to be non-compatible with aviation noise is recommended as a result of the analysis completed as part of a Noise Compatibility Program (NCP) or analysis prepared in compliance environmental protection laws, such as the National Environmental Policy Act of 1969 (NEPA). Not all airports have SIPs; however, airports that have or plan to develop SIPs, tailor these to address the local community and rely on the SIP development process to determine items such as who is eligible for sound insulation treatment and the timeline for SIP implementation.

1.1.2 This chapter presents the purpose, background, and an overview of information relevant to the purpose and content of this advisory circular (AC). The remaining chapters and appendices address the following topics or information:

- Chapter 2 - Roles and Responsibilities. Describes responsibilities of the Federal Aviation Administration (FAA), airport operators or sponsors, and airport contractors or consultants.
- Chapter 3 - Development of a Sound Insulation Program. Outlines process and procedures for SIP development, including preparation of a Program Policy and Procedure Manual (PPM).
- Chapter 4 - Project Cost Development and Funding. Describes SIP funding opportunities, cost development, and contracting and procurement.
- Chapter 5 - Community Outreach. Outlines the strategies for conducting community outreach during development and implementation of SIPs.
- Chapter 6 - Defining and Implementing Individual Phase Components. Explains recommended strategies for phasing SIPs in relation to funding, identification of non-compatible buildings, determination of phase boundaries, and acoustical testing and construction.
- Chapter 7 - Sound Insulation Treatment Strategies. Identifies sound insulation treatments considerations based on architectural design, interior features, and exterior influences. This chapter also addresses other design and construction considerations.
- Chapter 8 - Acoustical Engineering and Testing. Defines the acoustical testing process to measure and calculate interior noise level reductions, the application of modeled results, field measurement adjustment, and acoustical retesting.

[6] Residences, public buildings (e.g., educational and medical facilities, places of worship), and historic properties that are eligible for sound insulation are referred to as "structures" in this AC.

- Chapter 9 - Reporting and Closeout. Describes best practices for reporting and closeout requirements.
- Appendices with additional information:
  - Appendix A Roles and Responsibilities Matrix
  - Appendix B Definitions and Acronyms
  - Appendix C Sample Checklists and Other Forms

1.2 **Purpose**

1.2.1 The purpose of this AC is to provide standards, processes and procedures, and guidelines for the development and implementation of SIPs to mitigate aircraft noise impacts around airports. This AC is intended for use by Federal Aviation Administration (FAA) personnel, airport operators,[7] airport sponsors,[8] and airport consultants or contractors to ensure a SIP is prepared and implemented with applicable requirements and in concert with laws, regulations, and policies that have a bearing on SIPs (see section 1.4), and are accurately presented to the public. This AC includes uniform procedures to define and implement a SIP for structures determined to be non-compatible with aviation noise, standardized acoustic testing methodology to identify non-compatible structures, and best practices for use in public outreach efforts to ensure informed expectations of SIPs.

1.2.2 As indicated in the preface to this AC, the FAA considers the standards and procedures in this AC essential for the fidelity of SIPs, however, this AC does not constitute a regulation, is not legally binding in its own right, and it will not be relied upon as a separate basis by the FAA for affirmative enforcement action or other administrative penalties. Conformity with this AC is voluntary and nonconformity will not affect rights and obligations under existing laws and regulations, except for circumstances involving federal financial assistance as follows:

- Use of standards and guidelines in this AC is mandatory for projects funded through Federal grant assistance programs, including the Airport Improvement Program (see Grant Assurance #34); and
- Use of standards and guidelines in this AC is mandatory for projects funded through the Passenger Facility Charge (PFC) Program (see PFC Assurance #9).

[7] Airport operator means the operator of an airport as defined in 49 U.S.C. § 47501 (2)(A) and (B) which states "for an airport serving air carriers that have certificates from the Secretary of Transportation, any person holding an airport operating certificate issued under 49 U.S.C. § 44706 and for any other airport, the person operating the airport".

[8] Airport Sponsor means a federal financial assistance recipient as defined in 49 U.S.C. §47102(26)(A) and (B) which states "a public agency that submits to the Secretary […]an application for financial assistance" and "a private owner of a public-use airport that submits to the Secretary […] an application for financial assistance for the airport" and in FAA Order 5100.38D-Change 1 (Airport Improvement Handbook), Chapter 2, Section 2-2, page 2-1 through 2-2. For the purposes of this AC, not all airport sponsors are airport operators, and several programs at airports are managed by program sponsors, not airport operators. Therefore, airport operator or sponsor is used throughout unless otherwise specified.

1.3 Background

Since the enactment of the Aviation Safety and Noise Abatement Act (ASNA) and promulgation of regulations governing Noise Compatibility Programs, (14 Code of Federal Regulations (CFR) Part 150), the FAA has played a key role in encouraging airport noise compatibility planning and strives to reduce noise impacts in ways within its purview, including supporting airports with the implementation of SIPs by providing financial assistance for sound insulation treatment for residences and public buildings, land use measures such as the acquisition of surrounding properties, and funding research initiatives for noise mitigation. Airport operators or sponsors may receive financial assistance from the FAA to implement measures to achieve noise compatibility pursuant to 14 CFR Part 150 (commonly referred to as the "Part 150 Process" or "Part 150 study") or as part of a federal action[9] per applicable environmental protection laws and regulations (see section 1.4). However, airport operators or sponsors do not have to use the Part 150 process to achieve noise compatibility. Some airports can establish a successful program to achieve noise compatibility outside of the Part 150 process, by working proactively with neighboring communities and user groups to address similar objectives.

1.4 Relevant Laws, Regulations, and Policies

This section provides an overview of laws, regulations, and policies that have a bearing on the development and implementation of SIPs, including determining funding eligibility (e.g., residents eligible for sound insulation treatment or land acquisition opportunities). Details about how these apply are also discussed throughout, in other chapters, when relevant.

1.4.1 Aviation Safety and Noise Abatement Act

The ASNA of 1979[10] was enacted in February 1980 to provide assistance to encourage airport operators to prepare and carry out noise compatibility programs, among other purposes. ASNA required the promulgation of regulations to meet three key requirements: (1) Establish a single system for considering aviation noise around airport communities that has a highly reliable relationship between projected noise exposure and surveyed reactions of individuals to noise; and is applied uniformly in measuring noise at airports and the surrounding area; (2) Establish a single system for determining noise exposure from airport operations, which takes into account noise intensity, duration of exposure, frequency of operations, and time of occurrence; and (3) Identify land uses which are normally compatible with various exposures of individuals to noise.

1.4.2 14 CFR Part 150 Airport Noise Compatibility Program

To implement the requirements established under the ASNA, the FAA published 14 CFR Part 150. This regulation describes standards, procedures, and methodologies governing the development, submission, and review of noise compatibility programs (NCPs), including the associated noise exposure maps (NEMs). It also established a

[9] A federal action may involve federal funding and/or a project subject to federal control and responsibility.
[10] Aviation Safety and Noise Abatement Act of 1979, Pub. L. No. 96-193 (Feb. 27, 1979).

single system for measuring noise exposure and outlines compatible land uses for varying noise exposure levels from airport operations. The Part 150 process provides a structured approach for collaboration between the airport, airlines, other airport users, neighboring communities, and the FAA. It results in the airport's submission of NEMs and NCPs to the FAA,[11] which describes the proposed methods to achieve land use compatibility. A variety of different strategies to reduce the impacts of noise and achieve compatibly can be considered during the Part 150 process, such as changes in operational procedures (e.g., take-offs or landings or routing flight paths over less noise sensitive areas), purchasing land near airports to maintain compatible land use or installing sound insulation for homes, schools, and other buildings near the airport that meet the required standards. Therefore, the development of a SIP is a common component of the Part 150 process and the resulting NCP. A SIP is useful in identifying and prioritizing the installation of sound insulation treatment for properties exposed to aircraft noise around airports. This prioritization is largely based on boundaries defined in a SIP which are determined during Part 150 process using NEMs. NEMs must be current to determine impacted structures, therefore, initial boundaries in a SIP will be updated if updated NEMs reflect shifts in noise exposure.

1.4.3 FAA Final Policy on Part 150 *Approval of Noise Mitigation Measures Effect on the Use of Federal Grants for Noise Mitigation Projects* (63 Federal Register 16409, April 3, 1998), establishes that residential property constructed after October 1, 1998 and within the DNL 65 dB, or above, contour of an NEM published prior to the property's construction, is not approved for remedial noise mitigation. This also applies to partial renovations and additions.

1.4.4 National Environmental Policy Act of 1969

NEPA requires federal agencies to examine the environmental impacts of their proposed actions within the United States and its territories. A NEPA document[12] provides an assessment of the potential effects a major federal action may have on the human environment. Major federal actions include activities that federal agencies fully or partially fund, regulate, conduct, or approve. Therefore, FAA analyzes the environmental effects associated with a proposed action and prepares the appropriate NEPA documentation. During the NEPA process, noise impacts and mitigation measures for significant noise impacts[13] may be identified and analyzed and noise mitigation commitments are documented in a decision document (e.g., a Record of Decision (ROD) associated with an Environmental Impact Statement (EIS) or Finding

[11] The FAA approves or disapproves NCP conformance with 14 CFR Part 150, however, this approval does not imply funding eligibility.

[12] For the purposes of this explanation, a NEPA document is an environmental assessment or environmental impact statement. An environmental assessment is more concise and less detailed than an environmental impact statement.

[13] In FAA Order 1050.1F, "Environmental Impacts: Policies and Procedures," FAA identifies its significance threshold as an "increase [in] noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be [newly] exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe.". FAA adoption of DNL 65 dBA in the NEPA significance threshold was based on the "significance" of aviation noise exposure at or above that level, as described in "general guidelines for noise compatibility" and reflected in the Part 150 land use compatibility guidelines.

of No Significant Impact (FONSI)/ROD associated with an Environmental Assessment (EA)). If a decision document under NEPA includes sound insulation treatment for structures as a mitigation measure, this information will be used to support the definition of the boundaries outlined in a SIP. In addition, noise mitigation commitments defined in a ROD or FONSI/ROD will not change unless project modifications result in new or altered significant noise impacts.[14] For information about compliance with NEPA, refer to FAA policies and procedures for implementing NEPA, FAA Order 1050.1, Environmental Impacts: Policies and Procedures.

1.4.5 National Historic Preservation Act of 1966

Section 106 of the National Historic Preservation Act (NHPA), 54 United States Code (U.S.C.) § 306108 and its implementing regulations, 36 CFR Part 800 require federal agencies to consider the effects of federally funded projects on historic properties (i.e., listed or eligible for listing, in the National Register of Historic Places), and when applicable, consult with the State Historic Preservation Officer (SHPO) and provide other consulting parties and the public an opportunity to comment on these projects prior to the expenditure of any federal funds. Therefore, any sound insulation treatment project to be funded through AIP grants or PFC revenue is subject to review under Section 106 and airport operators or sponsors must coordinate with the FAA prior to starting initial phases (e.g., design/pre-construction testing) for installing sound insulation treatment so that compliance with Section 106 is adequately addressed.

1.4.6 Section 4(f) of the Department of Transportation Act of 1966

Section 4(f) of the Department of Transportation Act of 1966 (now codified in 49 U.S.C. § 303 and 23 U.S.C. §138) is triggered by funding or approval from a DOT agency for a project that proposes use of resources protected under Section 4(f) including historic property or land from a publicly owned park, recreation area, or wildlife. Consideration should be given to better integrate and streamline Section 4(f) and Section 106 of the NHPA with the NEPA process. Consideration of these requirements should also be given during the Part 150 process.

1.4.7 FAA Order 5100.38, Airport Improvement Program Handbook.

The AIP Handbook provides guidance on eligibility and justification for noise abatement and mitigation measures under the AIP. The AIP Handbook is regularly updated in response to changes to AIP-related legislation in U.S. Code (U.S.C.). This AC refers to the AIP Handbook for determinations of AIP eligibility. As defined by the AIP Handbook, eligibility for noise projects—or qualified for funding through AIP grants—is determined by modeled noise impact and noise level reduction (NLR) values determined through testing. If an NCP or decision document under NEPA (e.g., FONSI/ROD associated with an EA or ROD associated with an EIS) includes a noise abatement or mitigation measure not explicitly identified as eligible for funding in the AIP Handbook, the ADO must coordinate with FAA's Airport Planning and Environmental (APP-400) and Airports Financial Assistance Divisions (APP-500) for

[14] If this is the case, a new or supplemental analysis under NEPA may be required. Consult with designated Regional or Airport District Office Environmental Protection Specialists to determine the appropriate NEPA approach.

an eligibility determination. Additional information on AIP grants and the AIP Handbook is available on the Internet at: https://www.faa.gov/airports/aip/.

1.4.8 FAA Order 5500.1, Passenger Facility Charge.

Passenger Facility Charges (PFCs) are authorized by 49 U.S.C. § 40117. Included in the Aviation Safety and Capacity Expansion Act of 1990 (Pub. L. No. 101-508), this provision authorizes the Secretary of Transportation to allow an airport operator or sponsor to impose a fee for each paying passenger of an air carrier enplaned at (or departing from) the airport. These fees can be used to finance eligible airport projects at the airport, including sound insulation programs. Under 49 U.S.C. § 40117, the airport operator or sponsor must receive approval from FAA before implementing a PFC program. Additional information on PFC-eligible projects is included in FAA Order 5500.1, Passenger Facility Charge.

CHAPTER 2. ROLES AND RESPONSIBILITIES

2.1 Overview

This chapter describes the roles and responsibilities of the various entities within the FAA, airport operators or sponsors, airport consultants and contractors, and property owners that are involved in SIPs. The Responsibility Matrix in Appendix A presents the roles and responsibilities for each entity described in this section in terms of whether they are responsible, assist, are consulted, or are informed.

2.2 FAA Personnel

2.2.1 FAA personnel may include contacts from the district, region, and headquarter offices. In this AC, Airports District Office (ADO) refers to the FAA Office of Airports personnel that work directly with the airport operator or sponsor. In the Office of Airports regions with no ADOs, "ADO" refers to the Regional Office (RO) that works directly with the airport operator or sponsor. In addition, the structure of FAA offices are not all the same, therefore, multiple individuals may perform some or all of the specified roles explained in this Chapter based on how district and regional offices are structured. NOTE: The FAA approves and accepts the following documents ***before*** the airport operator or sponsor begins the SIP process:

- NEM – ADO Manager or Office of Airports Regional Director accepts NEMs.
- NCP – Regional Director approves NCPs and prepares Records of Approval except in certain instances.[15]
- NEPA documents (e.g., the Environmental Assessments (EA) and associated Findings of No Significant Impact (FONSI)/Record of Decision (ROD) or Environmental Impact Statements (EIS) and associated ROD.[16]

2.2.2 FAA Noise Subject Matter Expert (SME).

The FAA Noise SME is the designated noise program specialist in each ADO or RO. The Noise SME has the following responsibilities:

- Conducts technical reviews of all aspects of noise programs and noise projects that may be considered for AIP grants or PFC revenue.
- Reviews scopes of work and coordinates comments and changes with the FAA Program Manager and airport operator or sponsor.

[15] In accordance with DOT/FAA Delegation Authority Order 1100-154A, for those Noise Compatibility Programs which contain proposed mandatory use restrictions, coordination with the Office of Airport Planning and Programming (APP-400) is required before the FAA region makes a determination of the sufficiency of the documentation for the 180-day review period. Mandatory use restrictions include, but are not limited to, time-of-day restrictions or curfews; denial of the use of the airport or specified runways on an airport for noise reasons; cumulative or single-event noise limitations for an airport or for a specified runway on the airport; airport or runway capacity limitations for noise reasons; and other types of differential treatment of users based on noise, including operating fees.[Appendix 4, Section 3.C.(2)(b)]

[16] In certain situations Airport Planning and Environmental (APP-400) approves RODs unless approval authority has been delegated to the region or ADO on a case-by-case basis (refer to FAA Order 1100.154 Delegations of Authority).

- Reviews and accepts airport operators or sponsors SIP Policies and Procedures Manual (PPM), particularly the Acoustical Test Plan (see PPM requirements in Chapter 3 and Acoustical Testing Plan in Chapter 8). Provides comments to the airport operator or sponsor about any elements of the PPM not in accordance with FAA policy or that would make the program ineligible for FAA funding.

2.2.3 FAA Program Manager

The FAA Program Manager works directly with the airport operator or sponsor and has the following responsibilities:

- Assists in the development of SIP funding strategies with the airport operator or sponsor (in consultation with the FAA planner and others as appropriate).
- Reviews and approves the PPM and scope of work for sound insulation projects (in consultation with the FAA Noise SME).
- Makes decisions regarding AIP grant or PFC eligibility per the AIP Handbook or PFC Order. For items not specifically addressed or clearly defined in the AIP Handbook, works with the FAA Region to determine eligibility and coordinates as appropriate with APP-400 and APP-500 for a written determination.
- Attends project meetings (including public meeting as appropriate) and leads pre-design discussions.
- Provides feedback throughout the SIP process.
- Coordinates with APP-400/500 to approve additional testing (if necessary).
- Ensures compliance with NEPA and other applicable environmental protection or special purpose laws such as Section 106 of the NHPA.
- Receives and reviews quarterly reports for grants through grant closeout.

2.2.4 FAA Headquarters, Airport Planning and Environmental (APP-400) and Airports Financial Assistance (APP-500) Divisions

APP-400 outlines and addresses national policy and guidance on Part 150 programs, SIPs, and NEPA implementation. APP-500 provides national policy and guidance on financial assistance through AIP grants and PFC programs. These divisions coordinate with the ROs and ADOs for SIP establishment and implementation on an as-needed basis.

2.3 Airport Operator or Sponsor and Consultant Team

2.3.1 In general, the airport operator or sponsor is responsible for defining the project team composition (comprising airport personnel and consultants; see Chapter 3), preparing the PPM, developing a financial plan for implementation, developing the program phasing (see Chapter 6), and implementing the SIP.

2.3.2 Airport operators or sponsors should consider creating a formal roles and responsibilities matrix that identifies each position title and member role for the SIP team. The Responsibility Matrix in 9.4.3Appendix A can be used as a template to help

the airport operator or sponsor assign the position titles needed and identify the tasks for which each will be responsible.

2.3.3 The roles and responsibilities of professional disciplines and technical experts that will make up the airport operator or sponsor and consultant team are described further in this section. The composition of the team could be a combination of the airport's in-house personnel and consulting support personnel and could include the following positions:

2.3.4 Airport Authority, Board, or Approving Officials

All SIPs must meet the program requirements for noise level reduction (NLR), accuracy of noise contours, reporting, and other factors defined by the 14 CFR Part 150 Record of Approval or mitigation commitments defined in a ROD. The Airport Authority, Board, or approving official(s) are ultimately responsible for providing milestone documentation, application for funding, quarterly reporting, and closeout information to the FAA.

2.3.5 Airport Program Manager

2.3.5.1 A Program Manager ensures all project work from SIP development, implementation, and close out is completed in accordance with the AIP Handbook and PFC Order in a timely manner. The Program Manager is also responsible for the airport operator or sponsor's quarterly reporting and project closeout (see Chapter 9). The airport operator's Program Manager can be a member of the airport personnel or a consultant team.

2.3.5.2 The specific responsibilities of the Program Manager include:

- Supervise and oversee SIP development and implementation.
- Assist with defining SIP objectives and priorities.
- Prepare bid packages, oversee the bid process, and review legal documents.
- Ensure efficient and timely completion of a SIP, which includes:
  - Development of SIP schedules, tasks, and budgets;
  - Contract compliance;
  - Managing consultant team and conducting routine team meetings;
  - Submitting weekly/monthly/quarterly status reports on schedule, tasks, and budget for the SIP; and
  - Providing progress reports to the Airport Authority, Board or approving officials, and the FAA.
- Supervise the development of design documents for construction material options.
- Select display materials and develop presentations of sound insulation products and construction processes for presenting to property owners.[17]

[17] In the category of property owner, this AC includes structure owners and other public entities.

- Manage the program website and advertisements.
- Actively participate in the public outreach process (review public outreach activity plans, conduct and attend public meetings).
- Coordinate and assist in SIP closeout activities to the FAA.

2.3.6 Airport Operator or Sponsor's Sound Insulation Program Team

2.3.6.1 Depending on the size of the program, the development and implementation team could include a variety of personnel responsibilities. It is up to the airport operator or sponsor's Program Manager to determine the appropriate team composition, including the use of consultants. The team is responsible for identifying program objectives, designing the program, construction and testing, and overall implementation of the SIP.

2.3.6.2 The program development and implementation team can be comprised of, but not limited to, the team members listed in Table 2-1. Team composition will vary depending on the complexity of the SIP and local issues. The roles identified in Table 2-1 can be filled by airport personnel or consultants as needed. Airport operator or sponsors should customize their program structure to meet their unique situation.

Table 2-1. Airport Operator or Sponsor's SIP Development and Implementation Team Roles and Responsibilities

Position	Responsibility
Property Owner Liaison	• Assist in the coordination of program activities with the team and impacted property owners; notify and communicate with the participants. • Document interactions with property owners. • Attend regular development and implementation team meetings and all public meetings. • Assist in property owner orientation session, distribute property owner handbooks, and project documentation. • Provide legal documents to property owners, answer questions and concerns, and coordinate property owner schedules with the program team as needed. • Attend the design review meeting and pre-bid open house.

Position	Responsibility
	• Update, maintain, and document file and database information and assist in invoicing and payments. • Assist the Program Manager in preparing closeout documents for submittal to the FAA.
Legal Consultant	• Prepare all legal documents, including title certifications, participation agreements, avigation easements, lender consent documents, subordination agreements, etc. • Provide recommendations for changes in legal documents. • Record and document all avigation easements. • Review and discuss legal issues as needed with airport operator or sponsor's Program Manager.
Design Consultant/Project Architect	• Identify potential code issues for pre-existing deficiencies that may be related to the scope of the sound insulation program work; prepare pre-existing deficiency report for submittal to the airport operator or sponsor, including the legal release and corrections needed in properties with deficiencies. • Coordinate with acoustical engineer. • Conduct a design (property) survey at each impacted property, prepare designs and design packages, review designs with property owners, review design revisions, and provide solutions to property owners on functionality and aesthetics. • Attend pre-design meeting and develop final scope of work that incorporates corrections and changes. • Determine construction cost estimates. • Prepare bid documents, attend pre-bid, respond to contractor questions, prepare

Position	Responsibility
	addenda, and participate in bid opening meetings. • Review contractors' bids and prepare a recommendation to award documents for the airport operator or sponsor to submit to the ADO. • Develop and initiate contractor training. • Document with photographs all impacted properties before, during, and after construction. • Review contractor's requests for information, change orders, Buy American waiver requests,[18] and submit to Program Manager. • Attend regular construction meetings and review contractor pay requests. • Develop technical construction plans and specifications and submit them to the ADO at 90 percent completion (for each phase of the SIP as the program progresses). The ADO will review within a reasonable timeframe. Depending on local building code requirements and the airport's sustainability goals, a Design Consultant/Project Architect may incorporate sustainable design measures. In this case, the Design Consultant/Project Architect would preferably be a LEED® Accredited Professional (LEED AP) to design and administer certification of any buildings if necessary. The Design Consultant/Project Architect could also provide these services: • Coordinate with the local utility and government to determine what rebate or incentive programs might be available, as well as ensure compliance of the SIP with

[18] Appendix Y of FAA Order 5100.38, AIP Handbook provides Buy American guidance, including market or product conditions that may exist requiring a waiver request allowable under 49 U.S.C. Section 50101(b).

Position	Responsibility
	any energy codes and ratings enforced by local, national, or international entities. • Identify and determine any other sustainability opportunities throughout the program.
Mechanical or Ventilation Engineer	• Conduct a design (property) survey to determine mechanical and ventilation requirements, inspect properties for observable deficiencies or non-conforming existing conditions that would impact changes necessary to support the SIP scope of work (such changes may be considered to be homeowner pre-work), and provide recommendations to correct deficiencies to the existing ventilation, insulation, and mechanical designs. • Design necessary heating, cooling, and ductwork, as well as modify ventilation design if the property survey determines it is necessary. • Provide schedules, details, and drawings to include in the plans' specifications. • Coordinate with the Design Consultant/Project Architect(s) throughout the process. • Inspect all completed mechanical, ventilation, and insulation work, and conduct pre- and post-construction ventilation tests. • Depending on the sustainability goals of the airport and SIP, conduct energy audits as necessary, and create policies and procedures to meet Environmental Protection Agency (EPA) EnergyStar performance criteria.
Hazardous Materials Consultant	• Create a testing and sampling protocol based on the project scope. • Conduct tests in impacted structures where hazardous materials may be located and record all materials found.

Position	Responsibility
	• Attend pre-design meetings and additional design meetings if hazardous materials are found in impacted structures. • Provide cost estimate for abatement work, develop abatement specifications and documentation, and perform periodic inspections to ensure the work is being performed in compliance with the contract documents. • Provide air quality monitoring, clearance testing, and hazardous materials assessment of the project based on the results of the hazardous materials testing of the impacted structures.
Electrical Engineer	• Determine if any observable deficiencies or non-conforming conditions exist that would impact changes necessary to support the SIP scope of work. Such changes may be considered homeowner pre-work. • Design electrical wiring and provide schedules, details, and drawings for inclusion in the plans and specifications. • Coordinate with the Design Consultants/Project Architects throughout the process. • Inspect all completed electrical work post-construction.
Structural Engineer	The structural engineer responsibilities may be performed by the Design Consultant/Project Architect because it is not always a necessity or requirement to have both an architect and an engineer.[19] When a structural engineer is part of the design and implementation team, their responsibilities are to:

[19] Some states allow engineering firms to do all the work described in this section, however, most states will not allow an architectural firm to do engineering work unless there are professional engineers on personnel to sign and affix a seal to the design map. The airport operator or sponsor's program manager should determine the applicable laws in the state that the SIP is being conducted.

Position	Responsibility
	• Determine the general condition of each structure. • Assess existing structural deficiencies observed by the Design Consultant/Project Architect that may impact SIP installations. • Assess whether SIP improvements would create issues within an existing structure. • Inspect all deficiency corrections, if necessary.
Construction Manager/Resident Engineer	The Construction Manager/Resident Engineer is familiar with the design of the project and coordinates closely with the Design Consultant/Project Architect before and during construction. Specific responsibilities of the Construction Manager/Resident Engineer include: • Help communicate pertinent information to construction personnel. • Develop the construction safety and phasing plan with the construction contractors and submit it to the Program Manager. The construction safety and phasing plan will ultimately be submitted to the ADO by the Program Manager at 60 percent completion of the technical construction plans and specifications. • Conduct daily site visits to all properties under construction. • Review change orders and pay requests from the contractor (the Design Consultant/Project Architect is responsible for developing and ultimately submitting change orders to the Program Manager). • Review compliance documentation prepared by Design Consultant/Project Architect of contractor disadvantaged business enterprise (DBE) requirements.

Position	Responsibility
	• Perform inspections before final inspection. • Attend regular construction meetings. • Perform final inspection and prepare necessary reporting and closeout paperwork.
Acoustical Engineer	• Develop the Acoustical Test Plans (ATP) with input from the Design Consultant/Project Architect. Provide the ATP to the Program Manager for review and submittal to the ADO. • Conduct testing of sound levels for a final determination of noise impact (see Chapter 8 for details on activities). • Determine design goals in consultation with the Design Consultants/Project Architects. • Consult and coordinate with Design Consultants/Project Architects throughout the design process. • Coordinate with the Design Consultants/Project Architects to determine the required level of pre- and post-testing. • Conduct acoustical testing. Ensure acoustical compliance when conducting those tests. • Review design documents. • Assist with inspection of materials, new product review, and review of requests for information and change orders in coordination with the Design Consultants/Project Architects and the Construction Manager/Resident Engineer. • Coordinate noise monitoring data for the airport based on the needs identified in the SIP.

Position	Responsibility
	• Prepare final report for acoustical performance to be submitted to the FAA.
Historic Preservation Professional	• Assist in identifying historic properties. • Work with State Historic Preservation Office to avoid, minimize, or mitigate adverse effects of sound insulation on historic properties.
Finance Manager	• Grant management. • Process pay requests. • Track project expenditures. • Prepare financial reports.

2.4 Property (Structure) Owner Responsibilities

SIPs are voluntary and property owners are not required to participate. For property owners who volunteer to participate, interior acoustical testing occurs to determine if their structures are impacted. Owners of impacted structures are responsible for understanding the SIP through coordination with the property owner liaison. Owners should sign an application if interested in the SIP, then sign an agreement for the airport to acknowledge that they understand the program and treatment strategy. If required by the airport operator or sponsor, property owners may be required to provide an avigation easement on their property in exchange for sound insulation. Owners are also informed that residences currently included in the DNL/CNEL 65 dB or greater contour may not be eligible for federal funding for sound insulation if interior acoustical testing doesn't demonstrate an impact or if contours change in future NEM updates.

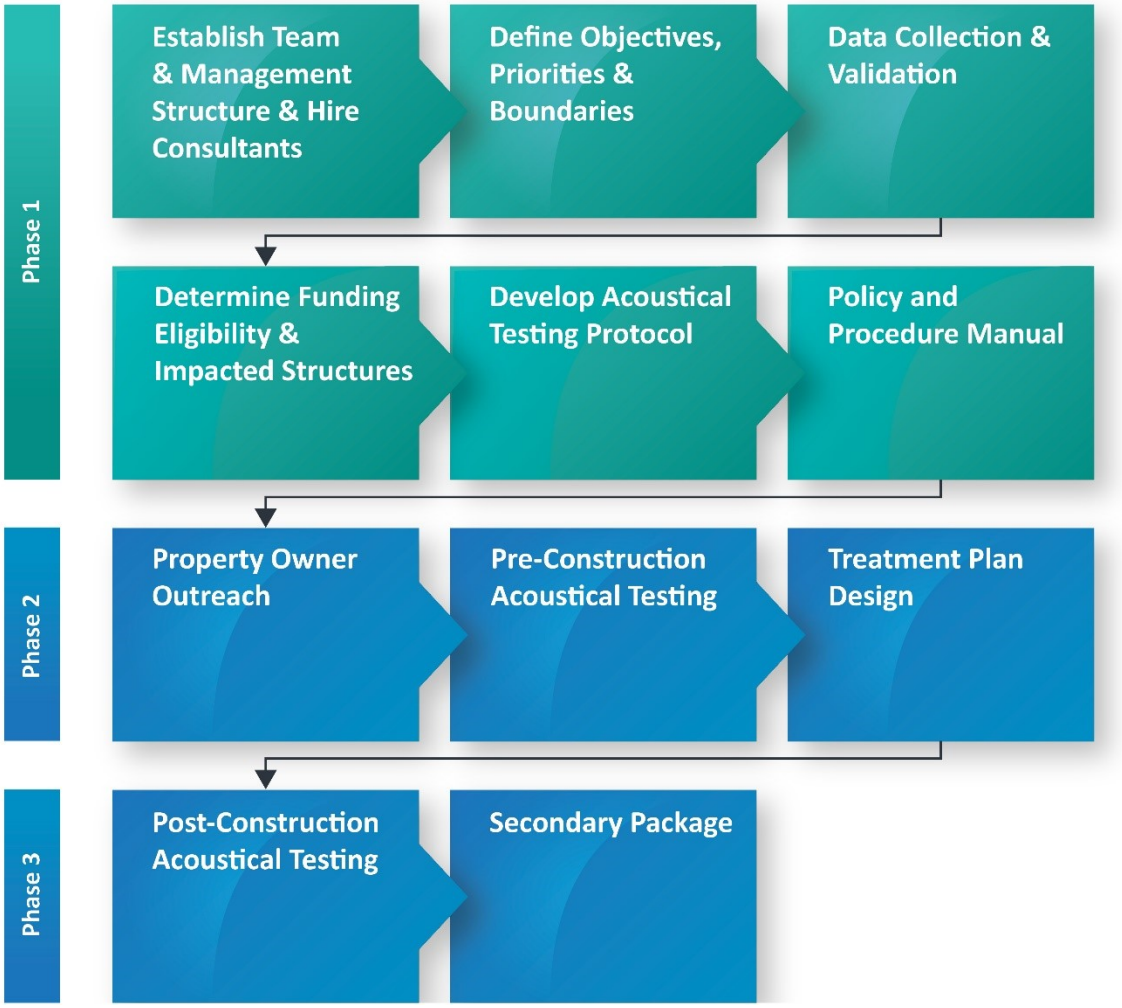
CHAPTER 3. SOUND INSULATION PROGRAM PROCESS

3.1 Overview

The development of a SIP generally begins when sound insulation is recommended to reduce impacts of aircraft noise to structures near airports. Noise mitigation measures are typically identified in a decision document associated with a NCP, decision documents associated with an analysis under NEPA,[20] or a request to impose and use Passenger Facility Charges (PFC) to implement noise mitigation measures. Airport operators or sponsors will follow a series of phases and steps to develop, implement, and close out a SIP, which includes FAA review and approval at key points in the SIP process. The SIP process overview illustrated in Figure 3-1 depicts the phases and steps described in this Chapter.

[20] A Record of Decision (ROD) or a Finding of No Significant Impact (FONSI/ROD)

Figure 3-1. Overview of the Sound Insulation Program Process



3.2 Initiate Sound Insulation Program Efforts (Phase 1)

The initial phase of the SIP process involves efforts to establish a team and management structure, defining the SIP objectives and priorities, preparing or verifying information pertinent to defining boundaries for eligible structures, identifying structures eligible for sound insulation treatment and federal financial assistance, and preparing a policy and procedure manual (PPM) to guide SIP implementation. The following subsections identify important considerations for each step of the initial phase.

3.2.1 Step One Establish a Team and Management Structure and Hire Consultants

As explained in Chapter 2, a SIP Team is responsible for all aspects of the development and implementation of an airport's SIP, including objectives, designing the program, construction, and testing. The SIP Team composition will vary depending on the complexity of the SIP and local community issues so the airport operators or sponsors

should customize their structure to meet their unique situation. Refer to Table 2-1 in Chapter 2 for the basic SIP team structure.

3.2.2 Step Two Define SIP Objectives, Priorities, and Boundaries

Since the purpose of sound insulation is to reduce the effects of aircraft noise inside impacted structures, in particular, habitable areas,[21] it is imperative to outline the objectives and priorities of the SIP based on a Noise Exposure Map (NEM) with respect to compatible and non-compatible land uses so there is a direct relationship between objectives, priorities, boundaries and sound insulation treatment options defined for a SIP.

3.2.3 Additional factors that should be considered when outlining objectives and priorities and defining boundaries for compatible/non-compatible land uses of the SIP in a PPM include:

3.2.3.1 Controlling Documents. For the purposes of this AC, the Record of Approval (ROA) associated with current NCPs/NEMs, the Record of Decision (ROD), Finding of No Significant Impact (FONSI)/ ROD,[22] and PFC project approval are "controlling documents". This is important because the controlling document is needed when defining the boundaries for a SIP. For example, compatible land uses identified in NEMs/NCPs are based on the definition provided in 14 CFR Part 150, Table 1. However, if a state or local governmental entity with jurisdiction and land use enforcement authority define land use compatibility differently, the state or local government entity's definition takes precedent.

3.2.3.2 Relationship of Acoustic Modifications to Design Objectives. This is important because acoustic modifications, as defined in the AIP Handbook for doors, windows, etc., are used to achieve the design objectives of a SIP. Other measures not defined in the AIP Handbook are not allowed unless the ADO and RO, in coordination with APP-400 and APP-500 approve them in advance. In this case, the ADO must keep a copy of the airport operator or sponsor's request to use other measures and the FAA approval of the request in the project files.

3.2.3.3 Federal Financial Assistance. When an airport operator or sponsor will be relying on federal financial assistance from the FAA (e.g., via AIP grants or PFC revenue) to accomplish noise mitigation, the sound insulation

[21] Areas considered to be habitable generally include areas for educational instruction, living, sleeping, eating, or cooking. Facilities located in leased storefront property are not included.

[22] If the controlling document for the SIP is a mitigation commitment identified in a FONSI/ROD or ROD associated with an analysis under NEPA, that commitment remains binding until it is completed or until it is no longer warranted (e.g. the project does not move forward into construction/operation).

treatment should be designed to meet the minimal 5 dB NRL requirement.[23] If the airport operator or sponsor will not be relying on federal financial assistance (e.g., not seeking AIP grants or PFC revenue) to accomplish noise mitigation, this requirement does not apply. In addition, a phased approach to implementing a SIP may be necessary to account for adequate funding (locally and federally) to implement the SIP. For example, for longer-term and/or more complex SIPs, implementation efforts will occur over time based on several factors, including funding availability.

3.2.3.4 Block Rounding. When applying block rounding, the program boundaries may be adjusted to account for block rounding in residential areas. Block rounding expands the SIP boundaries to include parcels that are contiguous to the DNL 65 dB noise contour area.[24] This prevents SIP boundaries from splitting a block. FAA Order 5100.38, AIP Handbook outlines options for block rounding. Before owners can be offered sound insulation for additional structures or areas outside the boundary, the ADO reviews and agrees with the extended boundaries.

3.2.3.5 Neighborhood Equity. Neighborhood equity is distinct from block rounding. The program boundaries may be adjusted to account for neighborhood equity in residential areas. Neighborhood equity allows an airport operator or sponsor to provide a separate treatment package for a percentage of residences that do not meet the interior noise level requirements, but are scattered among residences that do meet the criteria. The AIP Handbook describes options for neighborhood equity for boundaries. Before additional structures or areas outside the boundary can be included in the SIP, the ADO reviews and agrees with the properties to be included.

3.2.4 Step Three Data Collection and Validation

Review the controlling documents and associated analyses and verify or re-evaluate when defining the boundaries for the SIP program. This is especially important for longer-term (e.g., SIPs that may take five or more years to complete) and/or more complex (e.g., multiple locations and structures) SIP implementation.

3.2.4.1 A SIP developed for noise mitigation recommendations outlined in a NCP will be completed as stipulated unless there are changes in the operation of the airport that would create any substantial, new non-compatible use in any area depicted on the NEM beyond what is forecast for a period of at least five years after the date of the NEM submission. Typical changes in airport operations that may change noise exposure, and subsequently, may

[23] If the sound insulation treatment design accommodates more than the 5 dB NLR reduction, and the airport operator or sponsor is seeking federal funding, advance coordination with the FAA ADO and/or RO is required to determine next steps.

[24] In locations where structures are proximal to or will expand beyond the contiguous DNL 65 dB noise contour area, advance coordination with the FAA ADO and/or RO is required to determine next steps for applying the block rounding approach.

change the land use designation include, but are not limited to: aircraft operation frequency, a reapportionment between day/night flight schedules, and changes in aircraft fleet mix.

3.2.4.2 Before developing a formal NEM update, the airport operator or sponsor may conduct an analysis without public involvement to validate the current NEM or determine if a formal update is needed. When considering whether a formal update is needed, refer to 14 CFR 150.21(d)(1), which indicates a change that creates a substantial new non-compatible use is one that results in an increase in the yearly day-night average sound level of 1.5 dB or greater in either a land area previously determined to be compatible but is made non-compatible or in a land area previously determined to be non-compatible and whose non-compatibility is now significantly increased. This also applies if there is a decrease in the yearly day-night average sound level of 1.5 dB or greater. If a formal update is needed, the airport operator or sponsor shall, in accordance with 14 CFR 150.21(d)(1), prepare and submit a revised NEM to the FAA.

Note: Validating and updating NEMs to account for potential changes in noise contours is needed when first establishing a SIP and when it is relative to SIP implementation timeframes for existing SIPs (see Chapter 6 for phasing a SIP). This will result in greater clarity to property owners on SIP parameters. In scenarios where a SIP was established prior to the publication of this AC and the airport sponsor or operator is implementing a phased approach, consult with the FAA ADO or RO regarding changes to the existing and ongoing SIP. The FAA ADO and RO should also consult with APP-400 for next steps.

3.2.5 Step Four Determining Funding Eligibility and Impacted Structures for Sound Insulation

There are several methods by which structures may be considered impacted and eligible for FAA funding. The most common methods are through an FAA-approved 14 CFR Part 150 program or a decision document (e.g., FONSI/ROD or ROD) associated with a NEPA evaluation. FAA Order 5100.38, AIP Handbook, Table R-1 also notes that noise mitigation that is included in a land use compatibility plan prepared by a local jurisdiction surrounding a medium or large hub airport that either (1) has not prepared a 14 CFR Part 150 program or (2) has not updated a 14 CFR Part 150 program in the preceding 10 years may not be eligible for financial assistance from the FAA. Per 49 USC § 47141(f), grants for projects approved under an FAA accepted compatible land use plan are only allowable until September 30, 2023. After this date, the ADO must check the current legislation to see if the sunset date was extended. A facility used primarily for medical or educational purposes (typically, hospitals, and schools) may be considered for FAA funding if it is adversely impacted per 49 U.S.C. § 47504(c)(2)(D), regardless if the airport has a 14 CFR Part 150 program. Finally, PFC noise eligible projects may qualify for FAA funding per FAA Order 5500.1 paragraph 4-6.c, which states in part that "…PFC eligible noise projects which are not AIP eligible include any

project that would qualify for inclusion in a Part 150 NCP, even though the public agency has not undertaken and/or completed a Part 150 NCP or the project is not included in an implemented NCP. However, the eligibility of any proposed PFC noise project not in an approved Part 150 NCP must be supported by noise contours, which could be prepared in conjunction with a Part 150 study, airport master plan, environmental assessment or other suitable planning analysis. Additional considerations for determining funding eligibility and impacts include:

3.2.5.1 Addressing Impact Requirements under 14 CFR Part 150 process. Several impact requirements should be met before land uses identified as "normally non-compatible" can be tested to determine if they are actually non-compatible:

- An airport operator or sponsor must have completed an NCP in accordance with the requirements of the statute.
- The airport operator or sponsor must have recommended a SIP as an NCP measure to reduce non-compatible land uses around the airport.
- The FAA must have approved the SIP as an NCP measure in its ROA for the subject NCP.
- With each AIP grant application associated with a SIP, the airport operator or sponsor must submit the most recent supporting NEM that has been reviewed and approved by the FAA.

3.2.5.2 Building Construction Date Requirement. A building's construction date is important in determining the mitigation considerations encompassing the structure. The building permit of a structure must have been issued prior to October 1, 1998[25] unless the airport operator or sponsor has demonstrated to the FAA that no published noise contours existed at that time. If a noise contour is published after October 1, 1998, the building permit of a structure must have been issued prior to the date the contour was published. Structures are not eligible to be included in a SIP if they were permitted after NEMs (14 CFR Part 150) or noise contours (for NEPA studies) that have been made available to the public indicate that the underlying property is normally non-compatible for the type of structure. New non-compatible land uses created by subsequent airport expansion or development may also be considered impacted by aviation noise.

[25] October 1, 1998 is the date included in the FAA Final Policy on Part 150 Approval of Noise Mitigation Measures: Effect on the Use of Federal Grants for Noise Mitigation Projects, Federal Register: April 3, 1998 (Volume 63, Number 64), Rules and Regulations, Page 16409-16414. The policy states, "As of October 1, 1998, the FAA will approve under 14 CFR Part 150 (Part 150) only remedial noise mitigation measures for existing non-compatible development and only preventative noise mitigation in areas of new non-compatible development." Remedial measures include sound insulation. Preventive measures include zoning and other land use regulations. Exceptions to this policy are outlined in the Federal Register notice. Exceptions are supported by justification and submitted to FAA for consideration on a case-by-case basis.

3.2.5.3 If the project meets the criteria explained above, the following, criteria apply:

- All structures proposed for consideration in the program are located on parcels that have property lines within or intersecting the boundaries of a non-compatible noise contour. In addition, the parcel in question also needs to be within the noise contour at the time it was published for this to apply.
- In accordance with the AIP Handbook, the airport operator or sponsor submits a proposal to apply block rounding to a phase boundary, applicable only to residential structures, for FAA approval.[26]

3.2.5.4 The airport operator or sponsor should contact all owners of structures located within the SIP boundary that meet the criteria outlined herein to identify those wishing to have their structure tested to determine if their structure is impacted.

3.2.5.5 Pre-construction acoustical testing to determine which structures are impacted and can participate in the SIP is arranged according to public outreach protocols defined by the airport operator or sponsor, and completed to determine potential impacts in accordance with Chapter 8 and the AIP Handbook. Structures are considered to be impacted if the test results for the structure's interior finds the interior noise level is at or above DNL/CNEL 45 dB for residences or Sound Equivalent Level (Leq) at or above 45 dB for educational facilities.

3.2.5.6 If there are a relatively small number of residential structures in the program boundary area that do not meet the interior noise level requirements that are dispersed among residences that do, an airport operator or sponsor may submit a neighborhood equity proposal to the FAA per the requirements outlined in the AIP Handbook. Per FAA policy, the ADO must not approve neighborhood equity for more than 10% of the residences in the neighborhood (as logically bounded by either streets or other geographic delineation) or 20 residences in a phase of the noise insulation program, whichever is less.[27] If approved, the extent of improvements offered under a neighborhood equity proposal is limited (such as caulking, weather stripping, and installation of storm doors or ventilation packages) when compared to full SIP phase improvements.

[26] An airport operator or sponsor can propose to expand the noise mitigation boundary just beyond the DNL/CNEL 65 dB contour to include parcels proximal to the contour area. Advance coordination with FAA ADO and/or RO is recommended to determine appropriateness of applying the block rounding considerations for FAA acceptance are included in FAA Order 5100.38, AIP Handbook.

[27] In rare cases, ADO may determine that the program will benefit by providing noise equity packages to more than the 10%/20% residence limit. In this instance, the ADO must have written approval from APP-1 to exceed this limit.

3.2.5.7 Requirements for Facilities Used Primarily for Medical or Educational Purposes.[28] Under the authority of 49 U.S.C. § 47504(c)(2)(D), a facility used primarily for medical or educational purposes that is impacted by noise can be considered for sound insulation, even if it has not been evaluated under 14 CFR Part 150 or NEPA. For the structure to be considered, the airport operator or sponsor prepares and submits to the FAA:

- A NEM using the current version of the FAA's accepted noise modeling software that demonstrates the structure is located within a noise exposure contour that is normally non-compatible for such land use.
- The corresponding aircraft operational and fleet assumptions that were used to develop the submitted NEM.

3.2.5.8 Once this information is received, the FAA reviews and determines that the submitted NEM meets the acceptability criteria that would apply had it been submitted under 14 CFR Part 150. The FAA also reviews and validates that the structure(s) is located within a noise exposure contour that is normally non-compatible for such land use.

3.2.5.9 The below additional steps apply to facilities used primarily for medical or educational purposes regardless of how they were identified as potentially requiring sound insulation (i.e. through the completion of an NCP, analysis supporting a NEPA decision document, or neither of these):

- Interior testing of the structure(s) in accordance with the testing protocol (see Chapter 8) and Appendix R of the AIP Handbook must be completed by the applicant. Structures are considered for sound insulation if the test results indicate an interior noise level at or above DNL/CNEL 45 dB.
- Interior testing for educational facilities will consider the following parameters:
    - The noise level is represented effectively by the Leq for the hours of operation (typically daytime) rather than the 24-hour period measured by DNL. Leq quantifies noise that varies over a continuous period of time—in this case over the school day—into a single value in decibels.
    - The single-event Sound Exposure Level (SEL) can be used with Leq long-term averaging as a more practical measure of determining existing and improved interior NLRs. SEL measures discrete, short-duration transient noise instances such as an aircraft flyover. Single loud events can be disruptive to teaching and learning, so these are important to consider for schools.

[28] The ADO/RO should contact APP-400 in situations where the use and type of medical facility, educational facility, or place of worship is unclear. For example, differing understandings how these facilities are being defined or considered qualified or questions about transient lodging eligibility.

3.2.5.10 Testing Requirements when National Environmental Policy Act Decision Document is the Controlling Document. If the controlling document is a NEPA decision document (i.e., FONSI/ROD or ROD) and the project is eligible for AIP grants or PFC revenue, the project-related mitigation commitments remain until the commitment is completed or it is no longer warranted (e.g., the project does not move forward into construction). However, interior testing is still required for individual structures to be designated as impacted. In order to be considered for AIP grants or PFC revenue, the airport operator or sponsor must complete interior testing for the structure(s) in accordance with the testing protocol (see Chapter 8) and the AIP Handbook for final consideration for a sound insulation project. Structures are considered impacted and candidates for sound insulation if the interior test results for the structure indicate a noise level at or above DNL/CNEL 45 dB as stipulated in the FAA Order 5100.38, AIP Handbook. For NEPA related controlling documents published before August 17, 2012 (PGL12-09), mitigation requirements will be reviewed by the FAA on a case-by-case basis.

3.2.5.11 If structures are similar in construction type, then operators may choose to conduct pre-construction sampling, testing a smaller number of structures in the phase boundary. The SIP testing plan and analysis are discussed in detail in Chapter 8.

3.2.6 Step Five Develop Acoustical Testing Protocol

Preparing the acoustical testing protocol to outline and explain the acoustical testing process is integral to ensuring the acoustical testing is conducted accurately and efficiently. Determining and documenting the interior noise levels of structures potentially impacted by aircraft noise, as identified in NCPs and depicted in NEMs, is also necessary if the airport operator or sponsor will be seeking federal financial assistance. The acoustical testing process outlined in the acoustical testing protocol should adhere to the testing protocol discussed in Chapter 8 and the AIP Handbook.

3.2.7 Step Six Policy and Procedure Manual

A Policy and Procedure Manual (PPM) should be prepared to establish why a SIP for the airport is being undertaken and how it will be implemented. In general, developing and following a PPM is imperative to ensure compliance with applicable FAA and state or local requirements, that the process is as transparent as possible, and aligns with community expectations. For example, if a SIP is being developed pursuant to 14 CFR Part 150, the PPM must explain how the initial boundaries defined in the NEM are not static, could shift given operational changes at the airport, and indicate any limitations associated with the boundaries. The PPM can be refined, as needed, as the SIP progresses, based on lessons learned or changing priorities and schedules. Since the PPM also outlines the funding strategy that guides the phasing of funding requests

submitted to the FAA and the installation of sound insulation treatments, this may also be revised as the program progresses. The minimum required content of PPMs is listed below.

I. Overview of the SIP process

II. Administration

a. Roles and responsibilities of the SIP team

b. Coordination and communication protocols within the airport operator or sponsor's personnel, between the SIP team and airport operator or sponsor, and with FAA

III. Stakeholder Involvement and Public Outreach

a. Coordination and communication protocols with the public and other stakeholders

b. Criteria for prioritizing participation

c. Consideration of residences other than single-family permanent structures[29] and other special situations associated with public buildings (criteria and approval responsibility)

d. New owner participation in the program (in cases where a previous owner opted out)

e. Applicability of block rounding and neighborhood equity (see Section 6.3)

f. Handling complaints on design or construction

g. Common templates for standard documents and forms that will be used throughout the program. Chapter 9 describes sample documents in more detail and includes some of the following examples:

- Letters to residents describing the program phase and soliciting interest in acoustic testing to determine noise impact
- Disclosure of property owner's responsibilities
- Discussion of program limitations
- Easement language (if the airport wishes to require it as a condition of participation)
- Testing and inspection forms

IV. Contractor Outreach

a. Prime contractor prequalification policy

b. Review process for prime contractor statements of qualification

[29] Modular structures (permanent structures on a foundation) can be considered for sound insulation, but require an assessment by acoustical engineers and a Design Consultant/Project Architect. They must be approved by FAA if an airport operator or sponsor is requesting AIP/PFC funding. Manufactured structures (mobile or nonpermanent) are not practical for sound insulation treatments.

c. Contractor training and certification procedures

V. Design Policy, Process and Procedures

a. Acoustical testing protocol to determine program participation (see Chapter 8)

b. Addressing nonconforming building codes and pre-existing deficiencies

c. Consideration of mixed-use residential properties (most sensitive land use according to 14 CFR Part 150)[30]

d. Handling of requests for exceptions (requires early coordination with the ADO to determine eligibility of exceptions)

e. Consideration and inclusion of sustainability-related items to address local building codes or the airport's sustainability goals (e.g. enhanced indoor environmental quality)

f. Addressing special design considerations for historic properties to avoid, minimize, or mitigate adverse effects

g. Addressing other design requirements and considerations imposed by authorities having jurisdiction

VI. Construction

a. Pre-construction submittals, procurement materials, and meetings

b. Construction administration and inspection process

3.2.8 The Program Manager reviews and approves PPMs with assistance from the FAA Noise SME.[31] As explained in Chapter 2, the FAA Noise SME will review the PPM in consultation with the FAA ADO Program Manager. The SME will provide comments to the airport operator on elements of the manual that are not in accordance with FAA policy or would not be considered for FAA funding. If the FAA finds the PPM is not acceptable, the ADO should notify the Region, which should, in turn, notify APP-400 and APP-500. If the airport operator or sponsor does not make the required revisions, the FAA notifies the airport operator or sponsor that the particular element of the program will not be considered for federal participation and will be limited to local funds.

3.3 Implementation Phase (Phase 2)

SIP implementation involves efforts such as community outreach, preconstruction testing and treatment plan designs, and sound insulation treatment installations. The following subsections identify important considerations for each step of the implementation phase.

[30] Only the non-compatible portions of mixed use would be eligible.
[31] If the SIP is being implemented with AIP or PFC funding, FAA must review and approve the PPM before completion and public release.

3.3.1 Step One Property Owner Outreach

The outreach process starts after the program boundary is defined and policies and protocols are reviewed and approved by FAA to engage property owners identified within the program boundary. Airport operator or sponsors should contact potentially impacted property owners, provide a description of the SIP, and require property owners to sign a participation agreement if they volunteer to be included in the program. The airport operator or sponsor should express to structure owners that noise contours and impact determinations for sound insulation treatment can change before the treatments are installed. The FAA recommends that airport operator or sponsors require property owners to sign an avigation easement agreement.[32] Examples of these documents are provided in Appendix B of ACRP Report 89, *Guidelines for Airport Sound Insulation Programs*.[33] More detail on community outreach is discussed in Chapter 5 of this AC.

3.3.2 Step Two Pre-Construction Acoustical Testing

Airport operator or sponsors prepare acoustical testing protocols and conduct pre-construction acoustical testing to determine impacts and assist in the finalization of product and treatment recommendations. The pre-construction testing establishes a baseline for the structures within the phase boundary and provides each structure with accurate treatment suggestions to decrease interior noise levels. Depending on the type of structures in the program boundary, not all structures must be tested.

3.3.3 Step Three Treatment Plan Design

The design process begins after the airport operator or sponsor has identified, and FAA has confirmed, potentially impacted structures for sound insulation. This process may involve the following steps when appropriate:

- Developing a detailed Scope of Work by the airport operator or sponsor and design team to comply with design policies, approved products, and recommended treatments.
- Completing property owner outreach, pre-construction acoustical testing, and documentation of the existing conditions of each structure through assessment surveys, and indoor air quality and hazardous materials testing.
- Completing a treatment plan design prior to advertising bids. Otherwise, the grant could remain open for an excessive period of time (which is inconsistent with the AIP Handbook).

[32] An avigation easement grants rights of overflight in the airspace above or near a property. It also grants the right to create noise or other effects that may result from the lawful operation of aircraft, and the right to remove any obstructions to overflight, in the nearby airspace.
[33] ACRP Report 89, Guidelines for Airport Sound Insulation Programs (2013).

- Releasing the project for bidding. The project should be awarded to the lowest qualified bidder following the 2 CFR Part 200 rules of procurement and the AIP Handbook.

3.3.4 Additional SIP implementation considerations:

- Airports that will be implementing long term and/or more complex SIPs may need to revisit steps that normally occur during the initial development of a SIP, such as validating and updating NEMs, updating PPMs and implementation schedules. Airport operators or sponsors should coordinate and consult with the FAA early to address any changes to airport operations that will require updates to existing documentation that supports SIP implementation.

3.4 Close Out Phase (Phase 3)

Once the installation of sound insulation treatment is completed, the airport can initiate efforts to close out the SIP. The following subsections identify important considerations for each step of the close out phase.

3.4.1 Step One Post-Construction Acoustical Testing

For projects involving federal funding, airport operators must conduct post-construction acoustical testing to ensure they have met the goals of the insulation program. Not all structures must be tested, depending on the type of structures in the program boundary. If structures are similar in construction type, operators may choose to conduct post-construction sampling, testing a smaller number of structures in the phase boundary. Details on the SIP testing plan are described in Chapter 6.

3.4.2 Step Two Secondary Package

Offer secondary package if necessary to achieve noise compatibility if post construction testing of structures results in objectives not being met.

CHAPTER 4. ESTIMATING PROJECT COSTS AND FUNDING

4.1 Funding.

4.1.1 Airport operator or sponsors should determine project funding sources during the administration phase of a SIP. Airports have multiple funding options for SIPs, which includes:

- AIP grants, as described in the 2019 FAA Order 5100.38D - Change 1, Chapter 2 (i.e., the AIP Handbook),
- PFC revenue, as described in the 2001 FAA Order 5500.1 Passenger Facility Charge, Chapter 1, Section 2
- Airport revenue, including, but not limited to revenue collected from an airport's disposal of noise land.[34]
- State or local agency grants are also available sources of funding in addition to the three options above that have a federal approval requirement associated with them.

4.1.2 In addition to funding sound insulation projects, airport operators or sponsors can also consider if there are other programs that provide options for assisting homeowners and improve land use compatibility. For example, some counties offer a Voluntary Sales Assistance (VSA) Program.[35] VSA programs can support eligible homeowners who want to sell their home on the open market and relocate outside the DNL/CNEL 65 dB noise contour area. The owner receives compensation from the county and in exchange the county receives a Conveyance and Release Agreement. Some counties also offer Voluntary Conveyance and Release programs. These programs are for eligible homeowners who wish to stay in their homes. They receive a benefit payment in exchange for a recorded Conveyance and Release Agreement on their property.

4.1.3 When airport operators or sponsors, planning agencies, and other organizations accept funds from FAA-administered airport financial assistance programs, such as AIP grants, they must agree to certain obligations (or assurances). The assurances may be attached to the grant for federal assistance and become part of the final grant offer or in restrictive covenants to property deeds. The duration of these obligations depends on several factors, including recipient and project types. There are two types of assurances that may be relevant to developing SIPs: (1) Airport Sponsor Assurances and (2) Noise Compatibility Assurances for Non-Airport Sponsors. Additional information about grant assurances is available on the Internet at https://www.faa.gov/airports/aip/grant_assurances

4.1.4 The FAA does not reimburse the airport for the full cost of the project. Reimbursement can vary depending on the project size and type of airport (primary versus non-

[34] Land an airport operator or sponsor purchased using AIP funds for noise mitigation
[35] Broward County Florida provides a Voluntary Sales Assistance program and a Voluntary Conveyance and Release Program.

primary). FAA Order 5100.38, AIP Handbook discusses additional reimbursement for pre- and post-construction testing, and procurement processes.

4.2 Cost Development.

4.2.1 To maximize the use of available funding sources, airport operators or sponsors should establish goals and priorities to ensure timely implementation. Early establishment of goals and priorities for cost development can allow for evaluation and tracking of costs throughout the SIP process. Issues can be more easily resolved with early clarification on program costs.

4.2.2 Airport operator or sponsors should work closely with all departments and consultants involved in the SIP process to determine cost estimates for each of its activities. Airport operators or sponsors may also consider hiring a professional to assist in the cost development. It may be helpful to compare previous SIP costs. While not all Part 150 studies determine cost development for SIPs, if a Part 150 study was previously conducted, costs may have been evaluated within that study.

4.2.3 Prioritization of the program stages are imperative to allocate funding to each area. Airport operators or sponsors should create a list of all items and potential issues within the program, and prioritize the list based on importance and necessary cost. Airport operators or sponsors can create multiple lists for each area and the related stakeholders. The lists can be provided to stakeholders for review and comment. Prioritization may be needed throughout multiple phases or areas of the program.

4.2.4 Multiple areas of a SIP should be included in determining the cost of the program. Table 4-1 describes examples of program elements to consider in determining program cost:

Table 4-1. Program Elements to Consider in Determining Program Cost

Program Element	Consideration
Administration	Administrative duties can be assigned to internal personnel or external personnel hired by the airport operator or sponsor. Evaluation should be completed to determine the need for an internal Administrator rather than hiring an external one, as this can be an important factor in the cost of administration. The airport operator or sponsor will have the initial and overall task of administering the program. However, other areas of responsibility can be delegated as needed. Airport operators or sponsors should establish policies for program administration to ensure consistency if changes in management or consultants occur during the program process.
Public Relations (Community Outreach)	Airport operators or sponsors should consider all areas of public relations for the program. This includes advertisements, collaterals, meetings, and other areas of public relations. Start-up and continuing costs should be evaluated.
Facilities	Separate from the existing facilities used by each department, contractor, or consultant, this consideration includes additional facilities used during the program such as meeting/workshop rooms, store rooms, show rooms, demonstration structures, and more.
Fees	Fees associated with the program are primarily fees for professional workers. Fees can vary based on project size and available funding, but generally include all contractors and/or consultants associated with the project. Consultant fees associated with construction can be extensive due to constant collaboration with the contractor and airport operator or sponsor. AC 150/5100-14, *Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects*, describes these fees in detail.

Program Element	Consideration
Testing and Construction	Airport operators or sponsors should consider pre- and post-construction testing for eligible structures. To be funded via AIP grants, refer to Appendix R, Section R-11 "Pre-and Post-Testing Criteria for Noise Insulation Projects", Table R-4 in FAA Order 5100.38D, Change 1, February 26, 2019. Construction fees are the largest cost of the program. They require the most detail and time to complete.

4.2.5 Construction costs can be estimated by multiple methods. Benchmarking, unit pricing, pilot programs, and contractor estimates are common methods. Pilot programs offer a unique and more precise approach. Implementing a pilot program can allow for changes in treatment methods, and policies and procedures that affect cost estimates before implementing the full-scale program.

4.2.6 After components have been prioritized, airport operators should create a budget for each program area. This helps the airport operator meet all goals without exceeding budgets and allocated funding. In addition to managing costs, the airport operator should be aware of items throughout the program that can vary in cost. Examples include contract employee wages, testing requirements that may increase over time, deficiencies in structures or buildings, and environmental issues. Treatments offered to the community may also affect the cost of the program. Treatment options can be different depending on the SIP and location of the structures.

4.2.7 Lastly, airport operators should consider the type, brand, and quality of the materials and products that will be purchased for the program. These purchases can vary in price depending on the type of structure or its geographic location. Evaluations should be conducted with the contractor to discuss the products and materials that are the most appropriate for the SIP.

4.3 Contracting and Procurement.

4.3.1 Selection guidance for architectural and engineering consultants is provided in FAA AC 150/5100-14, *Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects.* Under this guidance, airports select consultants based on qualifications and negotiation of a reasonable price. Airports using AIP funding shall ensure the SIP complies with AIP guidance. This includes conducting an independent cost estimate of the selected architectural and engineering consultants' fees. Airports not using AIP funding should ensure the SIP complies with all local and state requirements, starting with the team selection.

4.3.2 Since projects are typically multi-year projects, outreach to construction contractors will be ongoing throughout the project. The process begins during outreach to property

owners, before the design and construction phase. This process is necessary to identify qualified contractors for bidding on and performing the project. The primary goal is to have a large selection of qualified bidders. Training should be provided to all selected contractors to describe all SIP processes and procedures.

4.3.3 For projects funded through AIP grants, an independent cost estimate of the selected contractor's fees is required prior to award. Usually the Design Consultant/Project Architect does the independent cost estimate for the construction contracts.

CHAPTER 5. COMMUNITY OUTREACH

5.1 Community Involvement.

5.1.1 The FAA's community involvement policy establishes the agency's commitment to community interests. The goals of the FAA's community involvement policy are to:

- Provide active, early, and continuous public involvement.
- Provide reasonable public access to information.
- Provide the public an opportunity to comment prior to key decisions.
- Solicit and consider public input on plans, proposals, alternatives, impacts, mitigation, and final decisions.

FAA's Community Involvement Manual published in 2016 as well as the most recent version of Advisory Circular 150/5050-4, Community Involvement in Airport Planning are useful resources which can be used when developing a community involvement plan for SIPs.

5.1.2 The intent of these goals is to improve the effectiveness of the FAA's public involvement activities, ensure well-informed decisions, and encourage innovative methods for involving the public. The FAA extends this policy to all planning initiatives and studies receiving federal funding, or which require FAA approvals for implementation, including SIPs. Community outreach within a SIP needs to be a continuation of public involvement efforts conducted during the preceding Part 150 study or NEPA analysis. Within the SIP process, community outreach begins before the design process and continues through the end of the construction phase.

5.1.3 The main steps that should be taken as part of community outreach are summarized below and shown in Figure 5-1.

5.2 Plan.

5.2.1 Successful community outreach should be planned early enough so parties can obtain the necessary resources and data to interact effectively. Defining the goals and objectives of community outreach efforts will guide the process by determining who will be engaged, the level of participation, and the types of public involvement tools and techniques that will be used. As noted earlier, planning for community outreach in the SIP should closely follow the public involvement process used in the preceding Part 150 or NEPA studies.

5.2.2 The airport operator or sponsor should submit the proposed outreach plan and materials to the FAA ADO Program Manager for review and comment. Receiving FAA input will ensure that public information corresponds to the general scale of the SIP.

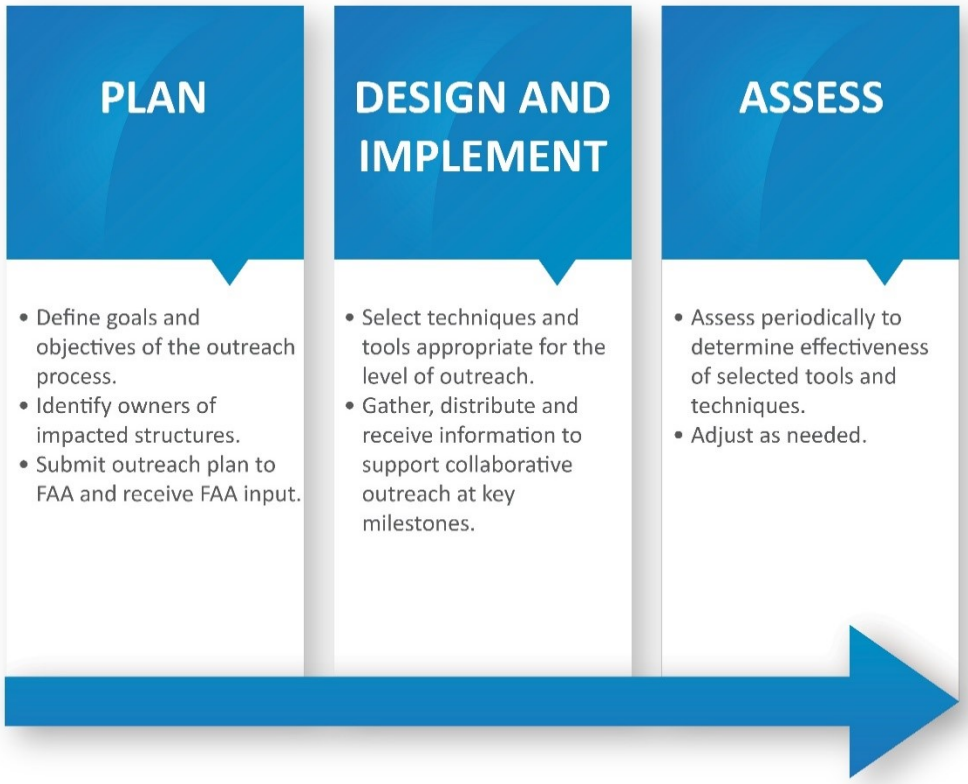
5.3 **Design and Implement.**

One of the most important steps is to select the most effective communication techniques and tools. Tools include public meetings, the formation of special committees, data collection techniques, program offices, and the use of internet and mobile technologies (personal cell phones, tablets, instant voting technology, etc.). The communication strategy needs to remain flexible and open to new ideas because these tools are evolving with the advent of new technology and media platforms and not all communications techniques and tools are equally effective for all communities. Special care is required to meet the needs of affected communities such as the visually impaired, hearing disabled, English as a second language communities, low-income communities, and minority communities. Communications methods should be tailored to the needs of the affected community, and with their input.

5.3.1 The program and implementation team should ensure the following information is addressed, understood by the airport, and expressed to the community during the outreach process:

- An explanation of the study and how the sound insulation mitigation project came about, either through a Part 150 or NEPA Study.
- The Part 150 NEM being used is reflective of current conditions at the airport and has been accepted by the FAA.
- An explanation of the two requirements for determining qualification for treatment, namely that:
  - The residence is located in a DNL/CNEL 65 dB or greater noise contour.
  - The average interior noise levels for habitable rooms must be equal to or greater than DNL/CNEL 45 dB.
- Provide collateral materials discussing the program and the method of communication to potentially impacted participants.

Figure 5-1. Community Outreach Process



5.3.2 **Milestones.**

Within the SIP, important milestones should be communicated and coordinated with the community. This includes:

- Identifying potentially impacted structures within the program area.
- Creating a phasing plan based on funding availability and project size.
- Sending program information and offer letters to residents for pre-construction testing to determine if the structure is impacted, including required forms and documentation.[36]
- If initial participation agreement (if utilized) and application is confirmed, conducting pre-construction testing and site assessment on structures identified within the potentially impacted program area.
- Identifying impacted structures if a structure meets the testing criteria and including them in the SIP.
- Executing final participation agreements and avigation easements.
- Conducting and completing construction of sound insulation based on phasing plan.
- Conducting post-construction testing to verify the required NLR or interior noise level has been accomplished.

[36] Letters should only be sent to those within the proposed phase, particularly for multi-year projects.

5.3.3 **Coordination.**

5.3.3.1 Demographic Analysis.

Before contacting potentially impacted residents, airport operators or sponsors should complete an analysis of the program area, including demographics and economic factors. Understanding the individuals living in the program area helps establish appropriate goals and plans that will better serve the community. Demographics include age, income, and primary language. When determining the demographics of the area, airport operators or sponsors should consider the use and function of the facilities (educational, medical, or place of worship), geographic location, and number of people that might work at, reside in, or use facility services (e.g. personnel, students, patients, or members of a congregation). Airport operators or sponsors can identify the area's demographics by conducting door-to-door questionnaires, distributing surveys (online or mailings), and reviewing census reports, using the American Community Survey, along with other methods.

5.3.3.2 Cultural, Language, and Socioeconomic Considerations.

Depending on the demographic findings, the airport operator or sponsor may need to accommodate the culture and language of the surrounding area. Accommodations include providing translations of all documents, and interpreters at local meetings or individual site assessments.

5.3.3.3 Socioeconomic considerations are also important to consider within the program area. This may determine the method in which documentation and collateral materials are developed and delivered to accommodate for the residents' education, background, and location (e.g., access to Internet). For instance, are email and social media the best communication tools or are direct mailings and announcements in community newsletters more appropriate? Airport operators or sponsors may also consider hiring a local representative to help with outreach efforts. This may add an additional level of trust or comfort for the community when learning about the program.

5.3.4 **Communication.**

Communicating with the public is important for gaining support and trust from the community. To be successful, an airport operator or sponsor should understand its target audience and create a consistent and concise message that is easily understood.

5.3.4.1 Notification Methods.

The first step in the communication process is to understand the target audience. Depending on the target audience, various notification methods can be considered. The notification methods also depend on the program size, airport size, funding, demographics, and other relative factors. Consistent, frequent, two-way communication with the community is important to avoid misinformation or misinterpretation of program goals and requirements.

5.3.4.1.1 The most common notification methods include:

- Written correspondence
- Airport website
- Personal visits to structures
- Newspaper advertisements or other publication methods
- Videos
- Public service announcements
- Public or community meetings, open houses, and workshops
- Social media posts

5.3.4.1.2 Airport operator or sponsors should ensure consistent, frequent, individualized communication with all property owners who may potentially be impacted.

5.3.4.1.3 Airport operator or sponsors should notify or meet with local elected officials who represent residents involved in noise mitigation.

5.3.4.1.4 Airport operator or sponsors should also notify or meet with planning and zoning, and building permits and inspections personnel who will be involved in the local approval process.

5.3.4.1.5 Holding a property owner's orientation can be an effective way to inform property owners of the study requirements, impact requirements, program boundaries, and the steps that will be taken if the individual's property is considered for sound insulation.

5.3.5 **Messaging.**

5.3.5.1 **Airport Leadership.**

A community's attitude toward the program may be based on airport leadership's involvement and attitude toward the program. To that end, airport leadership should be identifiable and active in the SIP process. Communities will gain trust with positive, actively engaged leadership.

5.3.5.2 **Communication to Non-Qualified Residences.**

To ensure consistent messaging throughout the program, it may be appropriate for airport operators or sponsors to create and develop a policy for communicating to those who do not qualify for sound insulation. A letter with a description of why the resident is not impacted significantly by airport noise to qualify, within the definitions established in the airport industry, may be provided to explain the determination. Also, a letter to the local elected officials who represent the non-qualified residents may be provided in case the resident contacts their elected representative for guidance.

5.3.5.3 **Individual Communication.**

Individual communication to each resident can increase trust and provide a better basis for receiving feedback on the program. It also allows the airport operator or sponsor to understand the type of communication method that suits those individuals. Airport operators or sponsors should provide contact information for the person assigned to represent a specific area of the project. The designated representative should be available to listen to the community's comments and concerns, and consistently address questions on the program.

5.3.5.4 **Transparency.**

To build trust with the community, the airport operator or sponsor should ensure the SIP process is transparent by remaining truthful and open about the program. To succeed, service-oriented personnel should be part of outreach efforts. Whether personnel are airport employees or are hired for the program, these personnel should have the information necessary to answer questions, comments, and concerns from the public. Personnel should have a positive, helpful attitude when answering the public's questions. Lack of transparency can create negative perceptions of the SIP and lead to public opposition to the program, and future airport development projects.

5.3.5.5 **News Media.**

Airport operators or sponsors may consider using news media to get information to the public. Many airport operators or sponsors use local events to advertise their programs, and encourage the media to attend and report on the SIP. News articles and press releases can also reach a large population.

5.3.5.6 **Internet and Social Media.**

The internet can be an important resource for the community to learn more about the program and find contact information for communicating their questions and concerns. Airport operators or sponsors who develop a website for their program should ensure information is frequently updated

and describes the current status of the program. Using the same branding, tone, and message on a project website as other materials is essential to establishing continuity and credibility.

5.3.5.6.1 Social media platforms are a common form of distributing information and seeking input. Airport operators or sponsors should know the types of social media tools used in the community and determine which type of media/technology is best for the project. Existing or project-specific personnel should create and update information on the website and/or social media platforms.[37]

5.3.5.7 **Program Offices.**

Depending upon the size of the program, it may be reasonable for airport operators or sponsors to consider using a program office for the SIP. A program office provides a community with a single location to contact SIP personnel. It also provides a dedicated work area for the program personnel. If a program office is used, assigning, leasing, or renting space, and the provision of office equipment should be considered during SIP cost development (Chapter 4).

5.3.5.7.1 It may also be reasonable for airport operators or sponsors to consider a product showroom to display the types of equipment, materials, and products that will be used in the SIP process. This may help stakeholders in the community become better informed on the sound insulation process. It is the airport operator's or sponsor's responsibility to organize and determine the location of the product showroom to accommodate the contractor's materials/equipment. Airport operators or sponsors may also consider providing a sample structure so property owners can see an insulated structure. Purchasing a residence to serve as a product showroom is not allowable under AIP. However, there may be instances where this strategy may be used when non-compatible structures are within the 75+ dB contour.[38] Despite this, the airport operator or sponsor should consider a fixed or mobile structure that can be easily moved from site to site, or to community meetings. The cost of completing the demonstration structure, with treatments, is coordinated with the FAA. This expense should be considered when developing a program.

[37] When selecting social media platforms to use, other factors to consider include prevalence in the community and ability to manage comment moderation.

[38] In scenarios where a non-compatible structure is located within the 75+ dB contour, it would not be eligible for sound insulation and the airport operator or sponsor should acquire it. Following acquisition and prior to demolition, it could be repurposed as a model home for sound insulation; however, the cost of insulating that home would not be eligible.

5.4 Assess, Reevaluate, and Update as Necessary.

Assessing community outreach efforts periodically can help the airport operator or sponsor (and FAA) determine if the selected tools are effective, and whether resources have been effectively and efficiently allocated. When effectiveness is evaluated throughout the process, airport operators or sponsors can adjust the outreach program so that it achieves the desired outcome.

CHAPTER 6. DEVELOPING A SOUND INSULATION PROGRAM

6.1 Introduction

Airport operations are dynamic and as airport operations change, so can noise contours. Changes that have the potential to cause a shift to noise contours initially analyzed include sizeable changes in aircraft types, airport operations schedules, runway utilization, and new runway construction. Unless the airport operator or sponsor has a small program where the SIP can be completed in five years or less, an airport operator's or sponsor's financial constraints may be a primary reason a SIP will be implemented over time, in multiple phases. The PPM being developed for a SIP should include a phasing plan that allows for practical and financially realistic implementation and identifies the process and timing for reevaluations of information and plans, including, but not limited to SIP boundaries, NEMs and acoustical testing protocols. This chapter describes considerations and recommendations for developing a plan for SIP implementation, including developing a "phasing plan" for SIPs which may be implemented over many years and more than one phase. This chapter includes information on funding, scheduling, and boundary considerations. The Program Activities Checklist in 0 can be used to facilitate development of a phased approach for SIPs.

6.2 Funding, Scheduling, and Strategic Phasing.

6.2.1 Funding.

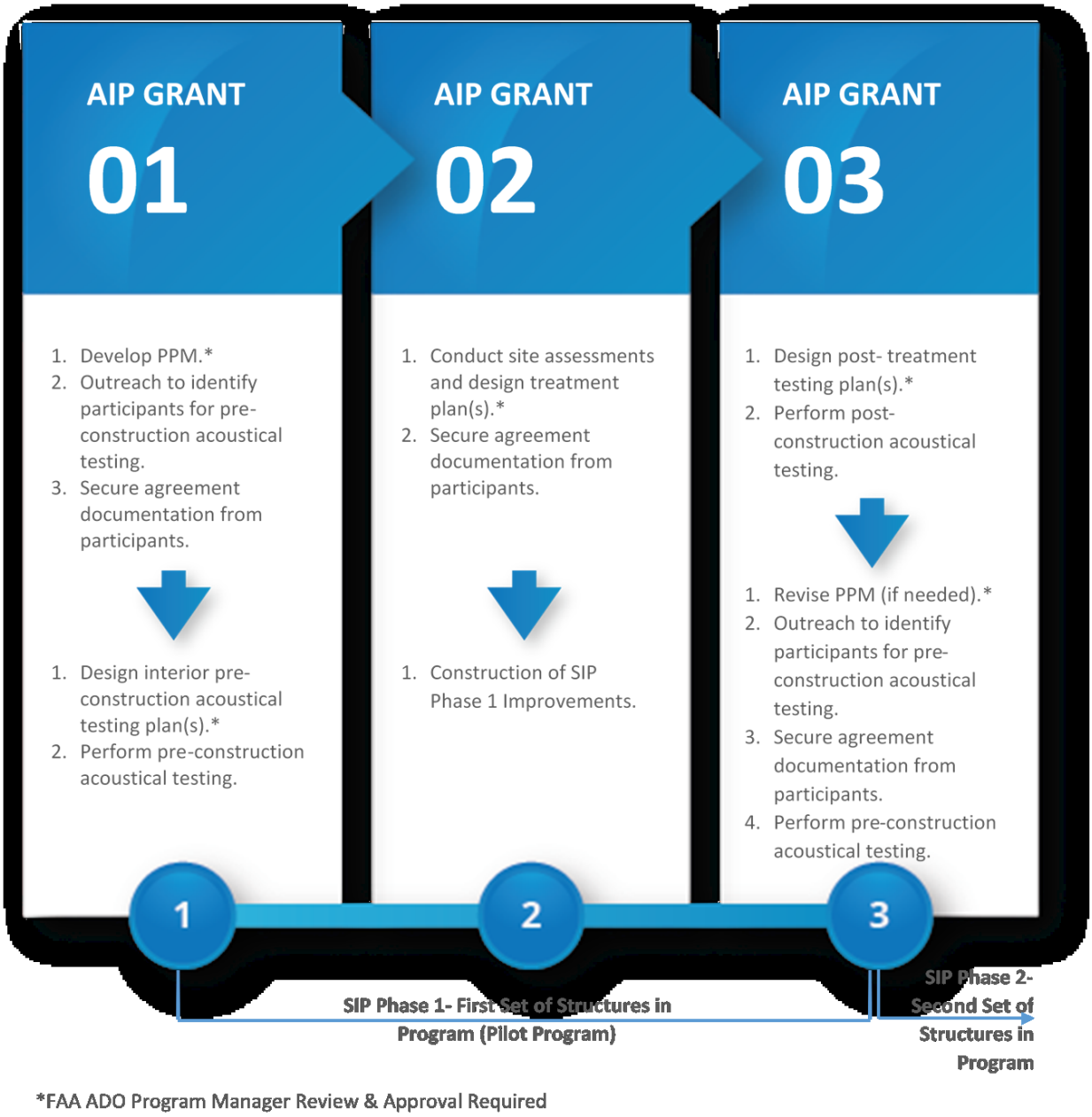
The airport operator or sponsor should couple a financial or funding plan with a constructability overview to determine reasonable phasing criteria and include this in the PPM. The boundaries for each SIP phase, which are based on the pace of program implementation, are constrained by the airport's fund-matching capability. More details on funding are described in Chapter 4.

6.2.2 Scheduling.

6.2.2.0 To develop a successful timeline, airport operators or sponsors should consider the entities that will review various steps in the program, community outreach efforts, and any deadlines imposed by FAA grants. For example, FAA review and approvals, property owner coordination, and local building department permit review and approval times should be considered in all schedules.

6.2.2.1 Each SIP phase is planned for completion within five years from the date the FAA validates the supporting NEMs (when a Part 150 program is the document establishing the SIP). Doing so improves the likelihood that the structures being treated are still considered impacted when the SIP improvements are made. It also ensures the airport operator's or sponsor's closeout documentation can be completed in compliance with FAA grant obligations. Figure 6-1 shows how SIP phasing can be structured under multiple AIP grants.

Figure 6-1. Sample SIP Phasing Under AIP Grants



*FAA ADO Program Manager Review & Approval Required

6.2.3 Strategic Phasing.

6.2.3.1 Phasing allows for adequate program funding (both locally and federally) and adapting to changes in noise contours (e.g., a SIP boundaries defined by a Part 150 study).

6.2.3.2 In a phased approach to SIP implementation, the first phase is often a small-scale "pilot" project. This allows airport operators or sponsors to develop the procedures, policies, treatments, cost estimates, etc., and test

them on a small but representative set of structures. This will ensure the program is appropriate for the rest of the impacted structures and additional phases.

6.2.3.3 Another consideration during development of the phasing plan is to identify the availability and capacity of qualified firms/consultants/ contractors capable of handling large and/or complex SIP projects.

6.3 **Determination of Phase Boundaries.**

6.3.1 When developing a phasing plan, airports should consider identifying the number and type of structures that can reasonably be completed within a five-year period from a funding and constructability standpoint. To determine each phase, prioritization can be determined by many different factors (i.e., geographic location, funding level, treatment type, number of potentially impacted buildings, number of property owners that will accept the program, time for testing each area within the phase, airport construction, and the level of noise exposure at the present and over the next five years). The FAA recommends airports prioritize based on the highest level of noise exposure.

6.3.2 Where numerous properties are within the same exposure levels, the airport operator or sponsor will need to set additional priorities. These need to be set in consultation with the FAA Program Manager. They can include criteria such as prioritizing structures that benefit the largest number of individuals compared to the amount of time spent in the structures, for example:

- Schools before residences
- Residences before places of worship
- Multi-family residences before single family residences

6.3.3 Grouping structures together geographically, and with similar modification requirements, increases efficiency and helps airports justify the phasing method to the community. If there are multiple types of structures under the same noise exposure level, an airport will need to decide which type of structure (single-family residences, multi-family residences, educational facilities, etc.) will receive mitigation first.

6.3.4 Use of Block Rounding.

Block rounding can also be considered when identifying the phase boundaries. It consists of incorporating an entire neighborhood block to prevent a phase boundary from intercepting or splitting the block beyond the DNL 65 dB contour. Per FAA policy, an airport operator or sponsor can propose to expand the noise mitigation boundary just beyond the DNL 65 dB contour to include parcels contiguous to the

contour area.[39] Conditions for FAA acceptance of the proposal are contained in the AIP Handbook.

6.3.5 Use of Neighborhood Equity.

6.3.5.1 If there are a relatively small number of residential structures within the defined study area (up to 10% within a neighborhood as defined by the AIP Handbook) that do not meet the interior noise level requirements dispersed among residences that do, an airport operator or sponsor may submit a neighborhood equity proposal to the FAA. This should be per the requirements outlined in the AIP Handbook.

6.3.5.2 Neighborhood equity proposals typically cover secondary treatments. These include improvements such as caulking, weather stripping, and installation of storm doors or ventilation packages.

6.4 Identification of Non-compatible (Impacted) Structures.

As discussed in Chapter 3, the airport operator or sponsor needs to understand the impact requirements for all buildings depending on structure type. Potentially impacted buildings should be identified and construction data should be collected. Single and multi-family residential buildings, public buildings, historic properties, and unique structures should be identified.

6.4.1 Windshield Survey.

6.4.1.1 A windshield survey, or drive-by survey that gathers whatever preliminary information can be seen from the street, should be conducted to identify potentially compatible and non-compatible structures. The survey can begin, however, with geographic information systems (GIS) data to identify information about potentially impacted structures. The GIS data should be consistent with the study preceding the SIP (a Part 150 study or NEPA analysis).

6.4.1.2 The windshield survey, further described in the AIP Handbook, should collect the following information:

- Identification and confirmation of the residential and nonresidential buildings within the program boundary.
- Photographs of each structure.
- Catalog of building type, style, construction type, and general condition (as visible from the exterior), and "year built."

6.4.1.3 The information collected from the windshield survey will also help identify the types of structures within the program boundary, and help

[39] In locations where structures are proximal to or will expand beyond the contiguous DNL 65 dB noise contour area, advance coordination with the FAA ADO and/or RO is required to determine next steps for applying the block rounding approach

operators determine the potential acoustical treatment protocols and neighborhood treatment standards.

6.4.1.3.1 The survey helps categorize properties to the extent possible. Based on the FAA Final Policy on Part 150 *Approval of Noise Mitigation Measures Effect on the Use of Federal Grants for Noise Mitigation Projects* (63 Federal Register 16409, April 3, 1998), residential property constructed after October 1, 1998 and within the DNL 65 dB, or above, contour of an NEM published prior to the property's construction, is not approved for remedial noise mitigation. This also applies to partial renovations and additions. Those should be justified and submitted to FAA for evaluation on a case-by-case basis.

6.4.2 Determining Interior Noise Level.

6.4.2.1 A noise-impacted structure must have interior noise levels that are DNL/CNEL 45 dB or greater[40] with the windows closed to be considered non-compatible. For educational facilities, the structure must have interior noise levels that are Leq 45 dB based on the length of the school day, or greater with the windows closed, to be considered non-compatible.

6.4.2.2 Habitable areas for residences include areas for living, sleeping, eating, and/or cooking. Educational facilities are limited to classrooms, libraries, fixed-seat auditoriums, and educators' offices. Areas of a structure that do not meet building code requirements are not considered habitable.

6.4.2.3 Detailed descriptions of proper testing to determine interior noise levels are provided in Chapter 8.

6.5 Treatment Options and Procurement.

6.5.1 Treatment Goals and Feasibility.

6.5.1.1 Since the primary goal of the SIP and treatment measures are to attain an average interior noise level below DNL/CNEL 45 dB and at least a 5 dB NLR, the first step is to determine the existing exterior and interior noise levels. The Design Consultant/Project Architect(s) can then understand the required treatment for those structures. This information can be obtained by testing all structures[41] in the pilot program or by completing an analysis to determine the noise level based on the structure type (this option may be selected for a neighborhood setting where all structures

[40] The 45 dB standard has been adopted by the FAA for interior noise based on 46 Federal Register 8316 (January 26, 1981). It was further clarified in 1992 by the Federal Interagency Committee on Noise (FICON) findings that 45 dB is the interior noise level that will accommodate indoor conversations or sleep.

[41] Per the AIP Handbook, APP-400 approval is required for testing more than 30% of residences of a particular type.

have the same structure type). Some structures may require more than an average 5 dB NLR to attain an interior DNL/CNEL of less than 45 dB for the average interior noise level.

6.5.1.2 The Design Consultant/Project Architect(s) should also consider the local building codes in the area where the sound insulation work is being performed. It is advisable to contact the local building officials to discuss the SIP and its objectives. If multiple municipalities are involved in the program, the airport operator's or sponsor's Program Manager may request FAA approval to apply the strictest code/rules of the municipalities for building codes throughout the SIP process for consistency in the program. The Design Consultant/Project Architect(s) should also consult with other federal, state, or local departments that may have restrictions on the type of material used for certain aspects of the project.

6.5.1.3 In addition to measurable goals for reducing interior noise levels, airport operators or sponsors should be active and engaging with the community utilizing the program. For example, the airport operator or sponsor can be active in communicating the types of treatments and products with residents for a better understanding of the program at the earliest stages, and be available to answer questions and address concerns.

6.5.2 Treatment Options for Different Types of Structures.

6.5.2.1 Determining how noise enters a structure is essential to developing a proper treatment method. Windows, doors, walls, roof, gaps, and cracks are the major sources of noise paths into structures.

6.5.2.2 A region's climate should also be considered. Solar heat may determine the type of material to be used on the structures, especially for window treatments, to be sure windows meet energy code requirements.

6.5.2.3 Proper measures should be created to mitigate potential adverse impacts. Sound insulation goals remain the same for each type of structure (an average interior noise level of less than DNL/CNEL 45 dB, and at least a 5 dB NLR).

6.5.2.4 **Residential Structures.**

6.5.2.4.1 Local and state building codes should be reviewed and considered when determining appropriate residential structure treatments. A code analysis should be provided at the beginning of the design process, and linked to a description of the program's scope of work. In addition, condominium and neighborhood associations with covenants should review the products and materials used for insulation of the structures prior to installation. For example, residential treatments that are externally visible (i.e., doors)

should be assessed to determine the types of doors appropriate for the neighborhood.

6.5.2.4.2 Treatments and methods should consider different housing types. Table 6-1 lists common types of structures and their typical sound insulation treatments. The table is not inclusive of all building types. It is up to the airport operator's or sponsor's design team to develop necessary treatments. The AIP Handbook discusses justification and funding eligibility of sound insulation treatments for residential structures. Not all example treatments may be eligible for AIP grants. In general, treatments are mostly driven by the roof structure, window glazing configuration, exterior door condition, and wall assembly configuration. Window and door treatments are usually the main noise mitigation treatments.

Table 6-1. Examples of Common Types of Residential Structures and Typical Treatments[42]

Structure Type	Characteristics and Insulation Treatments
Cape	Low roofs and may not have an attic. Typically, one and half-story built on concrete slab or foundations. Treatments typically include windows, doors, ventilation if none exists, and ceiling treatments at inclined ceilings if barrier material is not sufficient.
Ranch	Small-pitched roofs and attic space. Typically, one-story built on concrete slab or foundations. Noise exposure from underneath the structure is less common. Treatments typically focused on replacing (or caulking) windows and doors, and sealing attic openings.
Raised or Split Ranch	These structures typically contain two stories built on concrete slab with a half foundation. Treatments typically focused on replacing (or caulking) windows and doors, wall insulation, and sealing attic openings.
A-Frame Contemporary	These structures have a large pitched roof typically with large windows. Typical treatments include windows, doors, ventilation systems, and ceiling and roof treatments.

[42] The FAA must approve measures not listed in the AIP Handbook. See Table R-6, Noise Compatibility Planning/Project Requirements, in the AIP Handbook.

Structure Type	Characteristics and Insulation Treatments
Row Houses Structures	These typically have multiple single-family structures within a row of buildings with flat or pitched roofs. Typical treatments include windows and doors and attic insulation, with opportunities for improvements in exterior wall insulation only.
Structure Additions	Due to the variations in types of additions and the original structure type, a detailed assessment is required to determine the appropriate sound insulation treatments.
Mobile or Manufactured	Manufactured structures (mobile/nonpermanent) are not practical for sound insulation treatments because treatments are not designed for this type of construction.

6.5.2.5 **Public Buildings and Other Facilities.**

6.5.2.5.1 Public buildings and other facilities generally include educational facilities, places of worship, day care centers and medical facilities. Sound insulation treatments for public buildings and other facilities are like those of residential buildings, and similarly have local building codes that need to be acknowledged. Treatment requirements for public buildings and other facilities are often unique to the design and construction of the structures. Therefore the AIP Handbook notes the flexibility of sound insulation treatment methods for public buildings.

6.5.2.5.2 Some public buildings and other facilities may have specific regulations and requirements to consider. For example, because noise can affect students' ability to learn, educational facilities may have different local regulations and NLR requirements, and may require additional FAA review time to consider recommended design measures.

6.5.2.5.3 Schedules and timelines should be created to allow the appropriate amount of time for each step of the process, including review by the public building/facility owner. Airport operators or sponsors and the project team should also work closely with the local government and owners of the buildings to ensure all regulations, requirements, and concerns are addressed.

6.5.2.6 **Historic Properties and the Section 106 Process.**

6.5.2.6.1 As indicated in section 1.4.3, per Section 106 of the NHPA and its implementing regulations, 36 CFR Part 800, the FAA must consider the effects of federally funded projects on historic properties and when applicable, consult with the State Historic Preservation Officer (SHPO) and provide other consulting parties and the public an opportunity to

comment on projects prior to the expenditure of any federal funds. Therefore, any sound insulation treatment project to be funded by the FAA that has the potential to affect historic properties is subject to review under Section 106.

6.5.2.6.2 Airport operators or sponsors must coordinate with the FAA before starting initial phases for installing sound insulation treatment (e.g., design/pre-construction testing) and may not start construction (e.g., installing) until compliance with Section 106 is adequately addressed. The latter concerning construction is especially important because under section 110(k) of the NHPA, Federal agencies are prohibited from providing grants, licenses, or other assistance to applicants who intentionally, significantly, and adversely affect historic properties.[43] FAA encourages airport operators or sponsors to coordinate with FAA early, either during the development of the SIP or when submitting grant requests for sound insulation treatment projects (or both) to avoid any complications from this provision. In addition, the airport operator's or sponsor's sound insulation treatment guidelines must include a Programmatic Agreement that complies with the Secretary of Interiors Standards for Treatment of Historic Properties.

6.5.2.6.3 When the SIP is funded with AIP or PFC, the FAA must also comply with NEPA, and to the fullest extent possible, integrate the requirements of the Section 106 review with the NEPA process so these are addressed concurrently, rather than consecutively. If one or both of these are required, airport operators or sponsors are also encouraged to consider building in sufficient time for SIP implementation schedules to account for a Section 106 review and consultation and the analysis under NEPA, where appropriate.

6.5.2.6.4 The FAA is ultimately responsible for ensuring Section 106 compliance and will formally initiate the Section 106 review when making a decision to fund an airport operator's or sponsor's request for financial assistance to implement sound insulation treatment projects as presented in a SIP. However, FAA cannot meet its obligations without the cooperation and assistance of airport operators or sponsors. For more information on how to assist the FAA in the Section 106 review and consultation process, refer to the FAA Section 106 Handbook, "How to Assess the Effects of FAA Actions on Historic Properties under Section 106 of the National Historic Preservation Act" and the Secretary of the Interior's "Professional Qualification Standards For Archeology And Historic Preservation". The

[43] Section 110(k) states "Each Federal agency shall ensure that the agency will not grant a loan, loan guarantee, permit, license, or other assistance to an applicant who, with intent to avoid the requirements of section 106, has intentionally significantly adversely affected a historic property to which the grant would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the agency, after consultation with the Council, determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant."

following subsections summarize some key points for the Section 106 review that involve an airport sponsor's or operator's assistance.

6.5.2.6.5 Identifying Historic Properties. The review process under Section 106 addresses whether a proposed project has an effect on historic properties and whether any effect on the historic property will be adverse. However, prior to assessing effects, the list of historic properties will need to be identified.[44] Airport operators or sponsors can assist FAA with this step. Historic properties include buildings, archaeological sites, districts, objects, and landscapes that are listed or eligible for listing in the National Register of Historic Places, herein "National Register." The criteria for National Register eligibility is defined in 36 CFR Part 60.4. The list of historic properties is maintained by the National Park Service (NPS) and is available on the Internet at the NPS's National Register site. Additional information about state and local designation or the eligibility of historic properties should be considered and is typically available from State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officer (THPO), local historical societies, public libraries, and local government archives.

6.5.2.6.6 Assessing Effects. FAA needs to understand the potential effects of the proposed sound insulation treatment projects and recommendations for avoiding, minimizing, or mitigating any adverse effects. For example, this can mean modifying the sound insulation treatment to preserve the historic properties' original design, material, or architectural style and, where possible, using historically appropriate replacement materials or a compatible substitute material that replicates the original design. Unique or unusual properties may require an individualized treatment plan. This is another reason it is imperative to coordinate with the FAA during the grant request and/or pre-construction phases for installing sound insulation treatment identified in a SIP.

6.5.2.6.7 Initiating Consultation. Instructions for initiating the Section 106 process can be found on SHPO websites; however, the airport operator or sponsor can assist the FAA with the required, basic information listed below for the FAA's consultation:

- A written description of the sound insulation treatment design including whether this will entail visual disturbances, ground disturbance, demolition, restoration, or renovation.
- A map, photographs, and/or drawings clearly depicting the Area of Potential Effects (APE) (36 CFR 800.16(d)) and a description of the potential effects on historic properties within the APE, if any. Note:

[44] Depending on the type and age of historic properties, defining characteristics may include the style, materials, and construction techniques, particularly those used in windows, exterior wall cladding, and roofs. These may be similar for properties throughout the region or vary widely from one neighborhood to the next.

For a sound insulation treatment project to have an effect on historic properties, it must have the potential to alter the characteristics that qualify that property for inclusion in or eligibility for the National Register.

- Descriptions of all known properties and/or historic districts that are listed or eligible for listing, in the National Register
- Descriptions and evaluations of potentially affected historic properties should be based on background research on historic properties, oral history interviews, field surveys and/or investigations, and past planning, research, and studies, and should include a property's location, the year of its construction and previous ownership (as applicable).
- An explanation why the 36 CFR 800.5(a)(1) criteria for an adverse effects were found applicable or inapplicable, including any conditions or future actions to avoid, minimize, or mitigate adverse effects.

6.5.3 Site Assessment (Structure Inventory Assessment/Structure Inventory).

The design team is responsible for conducting a site assessment[45] of the impacted structures. Also known as a structure inventory, site assessments are conducted to determine the current condition of the structure receiving sound insulation treatment. Pre-construction acoustical testing, discussed in Chapter 8, can be included in the site assessments. During the site assessment, a design team member provides the property owner with a list of sound insulation treatment options. The design team member discusses each treatment option in detail so the property owner can identify a selected treatment package. Once a treatment package is selected, a member of the design team discusses the next steps, proposed treatment and modifications, and scheduling of the construction process with the property owner. At the end of the site assessment, the design team should provide documentation of the work that will be completed and indicate the option the property owner selected.

6.5.4 Procurement.

6.5.4.1 Before purchasing any materials or products for sound insulating structures, the design team should complete assessments, measurements, and pre-construction testing. The design team may need to coordinate with the community or property owner associations. After assessments, measurements, testing, and aesthetics have been considered and determined, the design team writes the construction documents and prepares graphics for communicating the design and administering the contract. Construction documents include bidding requirements and contract documents, which include a "specifications" section. The specifications developed by the design team describe the work, design,

[45] Airport operators or sponsors should consult with the ADO and the ADO should confer with APP-400 if unusual situations occur. For example, results of a site assessment indicates dilapidated structures or residences that for obvious reasons are not safe, decent, and sanitary.

materials, quality of workmanship, any applicable codes, performance requirements, descriptions, and procedures for an alternate material. Identifying products that balance quality and cost-effectiveness are important for the program budget and community buy-in. This should be accounted for in the cost development process discussed in Chapter 4. After the Program Manager approves construction documents, contractors will develop bids that include material and labor costs (with overhead and profit) and any contingencies.

6.5.4.2 The AIP Handbook discusses procurement requirements for the airport operator or sponsor. Airport operators or sponsors should also contact the local ADO if there are questions about procurement requirements. The FAA also provides a document for airport operators or sponsors to use when developing contracts. It assists with applicability and identifies other useful information for the procurement process.[46] Airport operators or sponsors may also use 2 CFR Part 200[47] for additional procurement information. The regulations discuss the following procurement methods:

- Micro-Purchase - A purchase of supplies or services using simplified acquisition procedures to expedite purchases of relatively inexpensive items and minimize administrative burden and cost.
- Small Purchase - Relatively simple and informal procurement methods for securing services, supplies, or other property that do not cost more than the Simplified Acquisition Threshold. Price or rate quotations should be obtained from an adequate number of qualified sources.
- Competitive Sealed Bids – A Publicly solicited, firm fixed-price contract is awarded to the responsible bidder whose bid, conforming to all the material terms and conditions of the invitation for bids, is the lowest in price.
- Competitive Proposal - Normally conducted with more than one source submitting an offer. Either a fixed price or cost-reimbursement type contract is awarded. It is generally used when conditions are not appropriate for the use of sealed bids.
- Procurement by Noncompetitive Proposals - Solicitation of a proposal from only one source. This is typically used when there is only one provider of a service or product, or there is an emergency scenario where time is of the essence.

6.5.4.3 According to 2 CFR Part 200, airport operators or sponsors must provide open competition for all procurement transactions and provide equal opportunity for minority and women's business enterprises throughout the bid process. These items are discussed in the AIP Handbook.

[46] The most recent copy of the *Required Contract Provisions for AIP and Obligated Airport Operators is* at: https://www.faa.gov/airports/aip/procurement/federal_contract_provisions/.
[47] Title 2 CFR Part 200, *Uniform Administrative Requirements, Cost Principles, and Audit Requirements*, Subpart D, § 200.317 - 200.326, https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title02/2cfr200_main_02.tpl.

CHAPTER 7. SOUND INSULATION TREATMENT STRATEGIES

7.1 **Background**.

7.1.1 Noise can enter a structure through multiple points such as windows, doors, cracks, walls, roofs, ventilators, and chimneys. Airport operators or sponsors should work closely with the Design Consultant/Project Architect(s) to determine the best method of insulation for the structures based on the points at which the largest amount of noise enters the structure. Most SIPs include either a retrofit or a replacement in most areas where noise is entering a structure. The Design Consultant/Project Architect(s) should determine the best method during site assessment and field measurements.

7.1.2 As discussed in Chapter 6, the Design Consultant/Project Architect(s) needs to consider building codes and the habitable space within the structure to determine locations to install the sound insulation. This will help determine retrofitting or replacement needs to reduce outside noise from entering a structure.

7.1.3 A rating system known as the sound transmission class (STC) can be used to determine the reduction of noise within a structure. STC ratings indicate how well a building partition attenuates, or decreases, airborne sound from human speech. It is widely used to rate interior partitions, ceilings/floors, doors, windows, and exterior wall configurations.

7.1.4 An alternative outdoor/indoor transmission class (OITC) rating can also apply as it indicates the outdoor-to-indoor reduction of transportation noise. This is useful for specifying sound insulation treatment products to ensure sufficient low-frequency noise reduction.

7.2 **Windows and Doors.**

7.2.1 The Design Consultant/Project Architect(s) should consider fenestration[48] when evaluating structures during the site assessment and determining the treatments for each structure. The Design Consultant/Project Architect(s) should ensure the quality of the product, aesthetics of the structure, maintenance of the window or door product, installation effort, and reduction of noise. The noise-reduction considerations include the type of material used to reduce sound from entering the structure, proper caulking and sealant, and the thickness of the wall. To ensure proper installation, the Design Consultant/Project Architect(s) should provide flashing[49] details in the construction documents they provide to the airport operator or sponsor. This is an important step to ensure proper fenestration installation. Significant weather characteristics and code requirements within the region of the airport help determine the type of materials and products for installation.

[48] Fenestration is the arrangement of windows and doors on a building**.**
[49] Flashing is the use of waterproof materials to redirect or stop water flow.

7.2.2 The process includes two types of installation methods: retrofit or unit installation. Retrofitting is installing a different material within an existing frame or wall. Retrofit installations decrease the time spent working on the structure, which in turn causes less disruption to property owners. However, it can only be used if the material will easily fit into the existing structure. Once the retrofit is complete, proper sealants will need to be used in the frame. Unit installations (replacements) are appropriate when retrofits are not practicable. This could be due to existing framing size or wall depth, deterioration of the opening, or lack of square openings to accommodate new windows and doors. In many cases, replacements are preferred and recommended for door installations.

7.2.3 Windows.

7.2.3.1 If windows are to be retrofitted or replaced, the Design Consultant/Project Architect(s) will review multiple considerations. The Design Consultant/Project Architect(s) will need to consider items such as the Solar Heat Gain (SHG) factor[50] associated with the type of glass installed in the window frame. The type of glass in the window can determine the following four items:

- Amount of heat entering the room
- Amount of condensation build-up on the glass
- The level of noise reduction
- Resistance to wind pressure that is required particularly in high velocity wind zones

7.2.3.2 Different types of windows such as vertical sliding, horizontal sliding, projecting, fixed, or other windows of unique shapes and sizes contribute to costs differently. Unique windows can increase cost if the product required for installation is not readily available. Increasing or decreasing the size of the window is not recommended unless it meets other requirements, such as resistance to wind pressure. Window cost considerations should be determined during cost development (as discussed in Chapter 4). If necessary, the Design Consultant/Project Architect(s), consultants, and acoustical consultant(s) should assess the construction around the windows to determine the level of effort and type of replacement.

7.2.3.3 If a structure has windows with metal security bars on the exterior of the window, the Design Consultant/Project Architect(s) will need to consider the appropriate approach to removing and reinstalling them. This could include reinstalling the bars after window installation or leaving this work for the property owner. The design team and/or contractors can make decisions with the Construction Manager/Resident Engineer based on

[50] The rate of loss of non-solar heat (the insulated value) can be expressed as its Solar Heat Gain (SHG) factor. Solar radiation that enters through the window glass can be expressed as heat gain.

local building codes. The PPM should include specifics on procedures and policies for handling unique residential windows.

7.2.4 Doors.

7.2.4.1 Exterior door treatment types depend on climate in the area. The most common types of exterior doors are wood panel, flush wood, fiberglass, and metal/steel. Any door used should have the necessary sound insulation properties and meet local U-value requirements.

7.2.4.2 Methods used to reduce noise transmission through doors include increasing the mass of the door and providing good seals at the perimeter. If increasing the mass of the door is not feasible, a secondary (storm) door may be added to the outside of the door. Certain types of doors will typically include the use of a secondary door to add an extra level of sound insulation. For example, wood doors are typically combined with a secondary door.

7.2.4.3 A secondary door can be of a different material. However, the primary and secondary doors should include a mechanical seal (gasket) to fill the gaps between the door and its frame at the threshold, jambs, and head. While typically created by different manufacturers, a combination of the two doors should provide the additional insulation necessary for the structure.

7.2.4.4 Sound insulated patio doors are common and can be provided to property owners as a treatment option. Typical patio doors include sliding and swinging doors made from vinyl, wood, or aluminum. Any patio door, or patio door in combination with a secondary door, should have the necessary sound insulation properties.

7.3 **Ventilation.**

7.3.1 If a ventilation system is used, the primary source of outside air entering a structure should be through the ventilation system rather than through walls, windows, doors, etc. The Design Consultant/Project Architect(s) should be cautious of the placement of the intake for the ventilation system. They should be located where minimal dust, dirt, and other impurities will enter the structure.

7.3.2 The Design Consultant/Project Architect(s) should evaluate building codes for determining the standard ventilation system. In addition to building codes, consultants must also follow appropriate energy codes. This may also determine the type of ventilation system used. The International Residential Code® (IRC) is used as the

minimum standard for ventilation systems in structures.[51] Other standards for ventilation systems include American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards. ASHRAE standards focus on indoor air quality for residential buildings.[52]

7.3.3 These standards and codes serve as the minimum requirements. If local codes and standards are in place, consultants should follow the most stringent standards and codes when installing ventilation systems. Refer to Appendix R in the AIP Handbook which discusses requirements for noise mitigation and the use of ventilation in residential buildings.

7.3.4 The Design Consultant/Project Architect(s) should coordinate with the local municipal officials for clarification on building codes, and be familiar with the codes and standards applicable to the program. Airport operators or sponsors can also consult with the ADO for clarification on building codes.

7.3.5 Indoor air quality may be considered in SIPs when developing ventilation strategies. Indoor pollutants can be physical, chemical, or biological. They can include contaminants such as mold/allergens, radon, carbon monoxide (CO), and carbon dioxide (CO2). Volatile organic compounds (VOCs) can also be indoor pollutants. Designers may specify products that have low VOCs. These items, although not specific to SIPs, are issues that should be considered for structures with a tight exterior envelope (defined as little or no exterior ventilation). ASHRAE standards are also used to ensure proper indoor air quality.[53]

7.4 Insulating Public Buildings.

Public building construction has greater insulation variety than residential structures. General sound insulation treatments may not be effective. Therefore, sound insulation treatment needs to be assessed on a building-by-building basis. Roof composition, openings, and ceiling construction have been typical target areas to address entry of noise. Effective noise mitigation measures in these areas also includes replacement of windows and doors.

7.5 Hazardous Materials.

7.5.1 For construction purposes, testing for hazardous materials should be included in the SIP. Testing of all structures should be completed to determine if hazardous materials are present in samples. The presence of hazardous materials can impact a structures' inclusion in the SIP.

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[51] To find the most recent version of the IRC, visit: https://www.iccsafe.org/products-and-services/i-codes/2018-i-codes/irc/.

[52] To find the most recent versions of ASHRAE standards, visit: https://www.ashrae.org/standards-research--technology/standards--guidelines/other-ashrae-standards-referenced-in-code.

[53] ASHRAE 62.1 & 62.2-2013, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, https://www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2.

7.5.2 Federal, state, and local requirements provide regulations on the removal of hazardous materials. Each state and municipality may have its own abatement policies and procedures. Therefore, airport operators or sponsors should consult with the state and local governments to ensure they employ proper removal and abatement procedures. As stated in the AIP Handbook, environmental remediation is not eligible for federal funding.

7.5.3 Table 7-1 describes the three hazardous materials typically found during structure inspections and dispositions. For the safety of contractors and residents, and to maintain compliance with environmental regulations, airport operators or sponsors should include a hazardous materials consultant on the project team. The consultant can assist with regulatory requirements and removing any hazardous materials.

Table 7-1. Hazardous Materials Typically Found During Structure Inspections

Hazardous Material	Typical Location and Disposition
Asbestos	Typically found in older residential structures, mostly in the ventilation systems or siding materials. Asbestos may be removed, altered, or disposed of as required per the contract. Federal, state, and local regulations must be followed throughout this process.
Lead	Typically found in paint in older residential structures. If not incorporated as part of the contract, property owners may be responsible for removing the lead from the area to be sound insulated. This may delay the insulation process until the activity is completed and approved. The Environmental Protection Agency provides guidance on the appropriate handling of lead paint.[54]
Mold and Radon	Although not defined as a hazardous material, mold and radon can affect environmental health. When mold is observed, property owners may be asked to remove the mold. SIPs should develop policies and procedures on how to properly handle the presence of mold and radon.

[54] Renovation, Repair, and Painting Program – Related Information, United States Environmental Protection Agency (https://www.epa.gov/lead/lead-abatement-inspection-and-risk-assessment).

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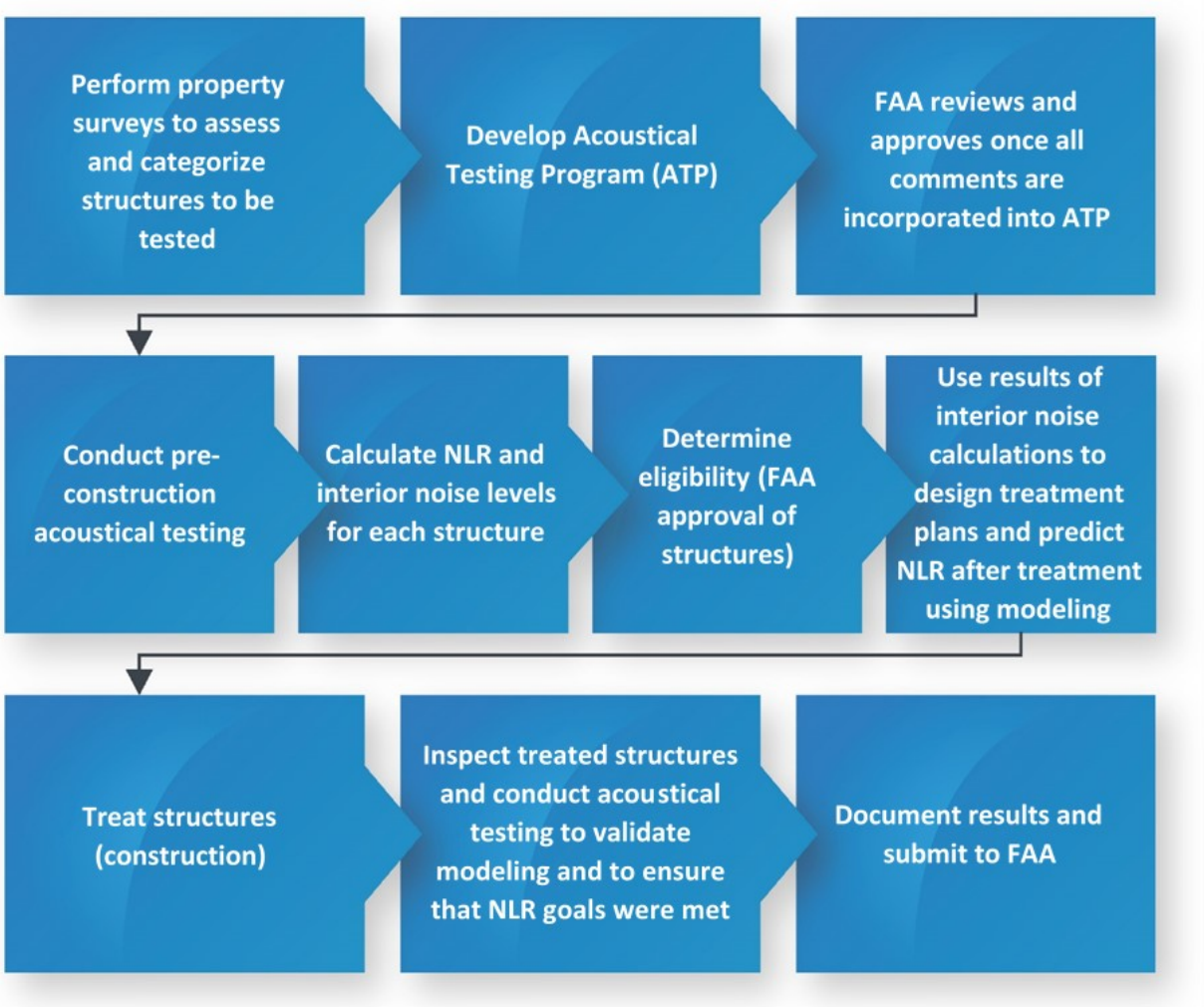
CHAPTER 8. ACOUSTICAL ENGINEERING AND TESTING

8.1 Background.

This chapter outlines the acoustical testing process to determine NLR and interior noise levels for both pre and post-construction testing requirements. Figure 8-1 illustrates the process for acoustical testing. In order to be considered for AIP grants or PFC funding, the airport operator or sponsor must complete interior testing for the structure(s) in accordance with this testing protocol and the AIP Handbook.

Figure 8-1. Acoustical Testing Process



8.2 Habitable Spaces Overview.

This section describes how a property's habitable spaces are analyzed to determine its average interior noise exposure. The following subsections define habitable spaces.

8.2.1 Habitable Rooms.

8.2.1.1 **Single- and Multi-Family Residences.**

8.2.1.1.1 The definitions of habitable and non-habitable rooms in single-family and multi-family residences are the same. Appendix R in the AIP Handbook defines habitable rooms for residences as living, sleeping, eating, or cooking areas. This includes living rooms, family rooms, dining rooms, bedrooms, kitchens, and dens. In limited cases, a sunroom that meets the latest edition of the International Residential Building Code (IRBC) definition of a Category V sunroom, and adopted by a variety of state building codes, may be considered habitable.

8.2.1.1.2 Bathrooms, closets, halls, vestibules, foyers, stairways, unfinished basements, storage, and utility spaces are not considered habitable space. In addition, spaces not allowed under local building codes are not considered habitable—for example, a garage converted to a bedroom or a basement converted to a bedroom.

8.2.1.1.3 In some cases, elements such as windows of non-habitable space might be entry points that contribute to unacceptable noise levels in adjacent habitable rooms. For example, a stairway window next to an open bedroom or an open closet with a window next to a bedroom may need to be considered for mitigation if it is considered an entry point to a habitable room. This should be determined when inspecting the structure.

8.2.1.2 **Educational Facilities.**

For educational facilities, habitable space is limited to classrooms, libraries, fixed-seat auditoriums, and educator offices. Non-habitable space in educational facilities is generally defined as areas such as gymnasiums, cafeterias, and hallways, even if these areas are used for incidental instruction. Educational facilities that are located in leased storefront property are not considered education facilities. A Part 150 NCP for the airport would describe the structures to be included in the mitigation plan.

8.2.1.3 **Other Facilities.**

Other facilities generally include places of worship, medical facilities, day care centers, and others. Habitable spaces within these facilities generally include areas where assembly or teaching occurs. Mitigation of a noise sensitive use in a commercially zoned structure shall not be included in SIPs (e.g. facilities located in leased storefront property). The NCP and associated ROA for the Part 150 study will describe the structures to be included for evaluation in the SIP.

8.2.2 Property Survey.

8.2.2.1 **Single-Family Residences.**

A preliminary survey of single-family residences, or a windshield survey, should assess and categorize the structure to the extent possible. This is also described in Section 6.4.1. The inspection of property interiors is not required for this survey.

8.2.2.2 **Multi-Family Residences.**

8.2.2.2.1 For any buildings identified as multi-family residences during the initial windshield survey, an additional survey known as a preliminary property survey should be conducted. This helps determine the use of building areas, types and numbers of building layouts, floor plans, and construction type and materials. The survey is undertaken with on-site property managers. The information will be used to select buildings, floor plans, and rooms that should be acoustically tested. It is also important to determine if the multi-family property is rental apartments (with one building owner) or condominiums (with individual ownership of each unit).

8.2.2.2.2 Photographs and notes are taken of all buildings.

8.2.2.2.3 The information to be collected during the property survey for multi-family residences is listed in Table 8-1.

Table 8-1. Property Survey Data Collection for Multi-Family Residences

Data Element	Information to Collect
Assessment of property	• Number of buildings on the property • Number of units • Number and types of various floor plans • Variations to any of the floor plans • Number and type of floor plans by building
Exterior construction styles	Number of levels, façade type, and roof style

Data Element	Information to Collect
Inspection of typical housing units	• Number and dimensions of habitable rooms • Type, size, and condition of windows in habitable rooms • Type, number, and condition of exterior doors/sliders in habitable rooms • Type of interior ceilings • Presence of unusual openings such as pet doors, mail slots, and fireplaces • Assessment of ventilation systems and fresh air ventilation components • Presence of acoustic insulation in attic spaces • Other factors that could impact the acoustical test results

8.2.2.3 **Educational Facilities.**

8.2.2.3.1 Preliminary property surveys of educational facilities determine building layouts, use of the building areas, use of the rooms, and type and materials of construction. Identifying the use of the building areas is important because the main purpose of this survey is to determine what rooms are used for educational purposes and considered for mitigation.

8.2.2.3.2 This on-site property survey is undertaken with on-site facility managers. The information will be used to select buildings, floor plans, and rooms to be acoustically tested.

8.2.2.3.3 Table 8-2 lists the information to be collected during the property survey of educational and other facilities.

Table 8-2. Property Survey Data Collection for Educational and Other Facilities

Data Element	Information to Collect
Assessment of property	• Number of buildings on the property • Number and type of rooms in each building • Use of the rooms in each building

Data Element	Information to Collect
Exterior construction styles	• Number of levels • Window type • Façade type • Roof style • Interior ceilings • Assessment of ventilation systems and fresh air ventilation components • Other factors that could impact acoustical test results

8.2.2.4 **Other Facilities.**

8.2.2.4.1 Preliminary property surveys of other facilities such as places of worship, medical buildings, and day care centers are needed to determine what areas are considered habitable. A review of the approved Part 150 NCP may be required to determine if a particular property type is in the mitigation program for consideration. A survey delineates the building layouts, use of the building areas, use of the rooms, and type and materials of construction. It is undertaken with on-site facility managers. The information will be used to select buildings, floor plans, and rooms that would be acoustically tested.

8.2.2.4.2 The information to be collected during the property survey of other facilities is listed in Table 8-2.

8.2.3 Development of an Acoustical Test Plan.

8.2.3.1 **Purpose of an Acoustical Test Plan.**

An Acoustical Test Plan (ATP) is developed to provide clear and consistent guidance for the airport and their consultants to begin implementation of a SIP. The ATP is also the official consultation plan with the FAA. The ATP has three major goals:

- Outline compliance with FAA policy
- Establish a framework for determining property testing
- Receive FAA approval for the testing program

8.2.3.2 **Components of an Acoustical Test Plan.**

The ATP should include these major sections:

- Introduction and Purpose
- Summary of Site Assessment and Windshield/Property Survey
- Description of Applicable Acoustical Criteria
- Summary of the Testing Plan

- Discussion of Acoustical Measurement Method
- Determination of the Exterior DNL/CNEL (or other noise metric)
- Determination of the Interior DNL/CNEL (or other noise metric)
- Description of Post-Construction Acoustical Testing

8.2.3.3 **Consultation with FAA.**

The draft ATP is developed with input from the airport operator or sponsor. Following approval by the airport operator or sponsor, the draft ATP is submitted to the FAA ADO for approval. Following FAA approval, all comments and changes are addressed in the final ATP. The final ATP becomes the overall work plan for all properties under consideration in the SIP.

8.3 Acoustical Testing.

8.3.1 Historically, there have been two methods used to measure the noise reduction of structures, the Flyover Measurement Method and the Loudspeaker Measurement Method. The Flyover Measurement Method employs aircraft as the exterior noise source. Since aircraft are the source of the noise, outside and inside noise measurements are made with aircraft overflights. This method has the advantage of simulating noise experienced by the residents; provided the measured overflights are representative of the airport's annual average daily operations for the year of interest. However, aircraft as noise sources are uncontrollable and the measurement results can sometimes be difficult to replicate if aircraft fly different tracks on different days, or utilize different runways. The result is that the data obtained is often representative only for the day of measurement. Furthermore, the testing procedure requires multiple noise monitors to conduct measurements simultaneously in multiple rooms. This can be time-consuming if airport runway usage does not match the need for measurements.

8.3.2 The Loudspeaker Measurement Method approach to measuring noise reduction has been to adapt the American Society for Testing and Materials (ASTM) E966-10 test procedure that incorporates an outdoor loudspeaker as the noise source, together with outdoor and indoor noise level measurements. The loudspeaker is a controlled source, so the data is more accurate and repeatable than when using aircraft as the source. It is also not subject to day-to-day variations in aircraft operations. However, the data obtained using the ASTM test procedure is not necessarily replicable by other consultants as procedural details for applying the method to realistic field situations are lacking. The loudspeaker test method presented in Section 8.5 is intended to provide the details necessary to obtain replicable results, is based on current research and has been incorporated into the SAE ARP 6973 Aerospace Recommended Practice: Aircraft Noise Level Reduction Measurement of Building Facades.

8.3.3 Research conducted at several airports has shown that the loudspeaker method leads to lower measured values of NLR for some rooms than the aircraft flyover test method, which includes the effects of shielding from direct exposure to the aircraft flight path. The difference for some rooms can be as much as 2 dB.

8.4 **Flyover Measurement Method.**

To determine estimates of NLR using the flyover measurement method, it is necessary to simultaneously measure the exterior and interior SEL from a series of aircraft flyovers. Because exposure differs for each flyover, it is important to conduct the measurements for a sufficiently large number of events to obtain a reliable average value of NLR. Statistical analysis is applied to establish an acceptable sample size to achieve a 95 percent confidence that the reported value of NLR is within ± 0.5 dB of the correct value (this usually results in at least 10 to 15 overflights). Note that the data obtained is often representative only for the time of measurement, as aircraft flight tracks and fleet mix may vary from hour to hour and day to day. The following subsections discuss the required measurement equipment, equipment setup and acquisition procedures, and the calculation procedures for the flyover measurement method.

8.4.1 Equipment.

8.4.1.1 Measurements of exterior and interior SELs require an integrated, time averaging, sound level meter (SLM) instrumentation system meeting the Type 1 requirements of American National Standards Institute (ANSI) S1.43 that includes a ½-inch microphone and protective windscreen. The sampling rate for such a system is preferably 0.5 second, but not greater than 1 second.

8.4.1.2 The measurement microphones should be covered by an open cell foam windscreen. This reduces the direct effect of moving air on the microphone, and protect the microphone from the environment (e.g., dust or possible mechanical contact with hard objects).

8.4.1.3 Calibration checks of the measurement equipment should be performed before the start and at the end of each set of measurements. The clocks on all SLMs should be synchronized daily with no more than a two-second difference.

8.4.2 Weather Conditions.

Sound level measurements should not be conducted when the wind speed exceeds 23 ft. /sec (15 mph).

8.4.3 Measurement of Exterior Sound Levels.

8.4.3.1 The exterior microphone should be positioned adjacent to the structure so it is exposed to the entire aircraft flyover, with no obstructions to interfere with the sound propagated from the aircraft. The microphone shall be placed at a height of 5 ft. above the ground. It should be located away from all structures, and reflections from large objects or buildings. Alternatively, the microphone can be placed 5 ft. above the roof of the test structure. Microphones should not be placed close to a busy roadway or another source of noise.

8.4.3.2 Sound level measurements should not be conducted in the presence of intermittent noise sources, such as truck pass-bys, public address system announcements, lawn mowers, construction equipment, etc. Noise sources should be disabled where possible, or measurements limited to time periods between background noise events.

8.4.3.3 During the measurements, the consultant should monitor the site from the outside to identify any contamination of the measured data due to non-aircraft events occurring at the same time as an aircraft event.

8.4.3.4 If event triggering is used, the trigger threshold should be chosen so that maximum sound levels during aircraft noise events are at least 10 dB above the threshold value. If this condition is not satisfied, the measurement is considered invalid.

8.4.4 Measurement of Interior Sound Levels.

8.4.4.1 The interior noise level in a habitable room is determined by arithmetically averaging the individual sound level measurements made simultaneously at two locations within the room. The microphones should be mounted on tripods at different heights, and positioned at least 2 feet from any major reflective surface (such as a wall, ceiling, or floor) and 2 feet from the center of the room. If open floor space is not available, the microphones may be mounted above soft furnishings (such as sofas, beds, soft chairs, etc.), but not immediately above hard furniture (such as tables).

8.4.4.2 All household noise sources should be temporarily deactivated during the measurements to the extent possible. This includes televisions, stereos, radios, ceiling fans, aquarium pumps, and ventilation systems in all rooms of the house. Loud pets and children should not be present in the test room. No speech should occur during the measurements. The microphones should not be placed close to household noise sources that cannot be deactivated, such as ticking clocks or refrigerators. These noise sources will be quieter than the aircraft flyover, but may be loud enough to trigger the measuring threshold of the sound level meter. The windows and doors should be firmly closed and latched.

8.4.4.3 The setup of all microphones/tripods must be documented with photos of each location, together with a simple sketch. Photos of all rooms where a microphone has been placed should document the room conditions for absorption and the condition of the elements in the rooms (windows, walls, exterior doors, roof/ceiling, or in-wall air conditioning unit).

8.4.5 Determination of Noise Level Reduction.

8.4.5.1 The sound level data for each recorded aircraft event should be examined to ensure that the maximum sound level for each event is at least 10 dB greater than the background sound level before and after the event. Events that do not meet this requirement should be deleted from subsequent analysis.

The noise level reduction for the test room, NLR_i, for the i^{th} aircraft flyover event is given by the following expression:

$$NLR_i = SEL_{ext,i} - SEL_{int,i}$$

where $SEL_{ext,i}$ is the single event level (SEL) measured by the exterior microphone and $SEL_{int,i}$ is the average measured interior SEL for the same event. The average noise level reduction for the room, NLR_{av} , taken over N aircraft events is then calculated by the expression:

$$NLR_{av} = \frac{1}{N} \sum_{i=1}^{N} NLR_i$$

In almost all situations, a minimum sample size, N, of 10 to 15 overflights is required to achieve a 95 percent confidence that the reported value of NLR is within ± 0.5 dB of the real value.

8.4.5.2 In performing the analysis, the measured data should be studied to identify any outliers, namely values of NLR that appear to be inconsistent with the remainder of the data. If the reason for the outlier value can be determined, and it is a once-only occurrence, or the data belongs to a different population, then the outlier value can be deleted from the calculation of NLR_{av}. Examples would be a single turboprop aircraft event in a data set of jet aircraft events, or contamination of the interior sound level. If the cause cannot be identified, the analysis should be conducted with and without the outlier. If the conclusions are significantly different, the outlier is influential. This should be noted in the report.

8.4.5.3 If there are multiple values that appear inconsistent, or if the standard deviation of the sample set is large, then the analysis can be conducted using the median value of the noise reduction data set.

8.4.5.4 An alternative approach is to calculate the 95 percent confidence level after each flyover using a spreadsheet, as the aircraft noise is measured, and events are downloaded from the sound level meters. The data from each event are entered into a spreadsheet and the 95 percent confidence interval updated after each event until it reaches ± 0.5 dB. The spreadsheets that calculate the NLR should be saved and included as part of the documentation for each property.

8.4.6 Documentation.

Photographs and other records are needed to document the acoustical testing set-up and on-site conditions. Table 8-3 provides a checklist of photographic and other requirements. The data to be recorded for each property and each measured aircraft noise event are shown in Table 8-4.

Table 8-3. Documentation Checklist Onsite Setup and Conditions

Required Documentation	Use and Purpose
Photographs of the exterior	Aids in identifying the property.
Exterior and interior microphone locations	Useful if post-construction measurements are taken and the same setup needs to be recreated.
Photographs of the room interiors	Documents absorption conditions in case additional (secondary) noise testing is required. Useful if post-construction measurements are taken to document the interior conditions (furniture).
Photographs and notes on the exterior elements in poor condition or exterior elements that have been replaced with modern products	Helps explain measurement results if needed.
A sketch of the floorplan that identifies the windows, doors, sliding doors, pull through air-conditioners, and microphone positions	Supplements correlated photographs by depicting the setting in plain view.

Table 8-4. Data to be Recorded in Field Testing for Flyover Measurement Method

Record for Each Property	Record for Each Measured Noise Event (Aircraft Flyover)
• Property address • DNL/CNEL contour zone value • Date and time of measurements • Name(s) of test personnel • Description of tested rooms • Photographs of microphone setups, room conditions, and element conditions • Sketch of room layout and microphone placement	• Date and time of the noise event • Type of aircraft • Type of aircraft operations (takeoff or landing) • Record of measured SEL for each event for each room, and for each microphone (interior and exterior)

8.5 **Loudspeaker Measurement Method.**

The loudspeaker method is designed to measure the noise reduction of a building façade using an external loudspeaker as the noise source. This is the preferred measurement method as the replicability of the measurements is increased by utilizing a controlled noise source. The following subsections describe procedures for the loudspeaker measurement method and the list below provides sources referred to or relied on in this AC, which includes research[55] sponsored by FAA and the airport industry's Airport Cooperative Research Program (ACRP):

- Study of Noise Level Reduction (NLR) Variation", April 2013. https://www.faa.gov/about/office_org/headquarters_offices/apl/research/science_integrated_modeling/media/BTV_NLR_report.pdf.
- "Review and Evaluation of Aircraft Noise Spectra used to Estimate Noise Level Reduction for Airport Sound Insulation Programs based on the Loudspeaker Test Method", March 2016. https://www.faa.gov/about/office_org/headquarters_offices/apl/research/science_integrated_modeling/media/pears_to43.pdf.
- Evaluating Methods for Determining Interior Noise Levels Used in Airport Sound Insulation Programs", ACRP 02-51, October 2015. https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3697.
- "Investigation of ASTM E966 Adjustment Factors", DOT/FAA/TC-18/15, April 2018. https://www.airporttech.tc.faa.gov/Products/Airport-Safety-Papers-Publications/Airport-Safety-Detail/ArtMID/3682/ArticleID/160/Investigation-of-ASTM-E966-Adjustment-Factors.
- "NLR Measurement Method Equalization and Normalization", DOT/FAA/TC-19/34, September 2019. https://www.airporttech.tc.faa.gov/Products/Airport-Safety-Papers-Publications/Airport-Safety-Detail/ArtMID/3682/ArticleID/2678/Noise-Level-Reduction-Measurement-Method-Equalization-and-Normalization
- SAE ARP 6973, "Aerospace Recommended Practice; Aircraft Noise Level Reduction Measurement of Building Facades", April 14, 2021. https://www.sae.org/standards/content/arp6973/

8.5.1 Specialized equipment as described in Section 8.5.6 is used to perform the measurements. A loudspeaker is used to generate the exterior sound exposure on the test façade. The height, distance to the façade, and angle of incidence of the loudspeaker are selected to ensure a uniform exposure over the entire façade (Sections 8.5.5.2 and 8.5.5.3. The level of the sound incident to the façade can be measured at the façade surface (Section 8.5.6.2) or close to the façade (Section 8.5.6.3, with adjustments applied to account for reflections from the façade. The incident sound level can also be determined using a calibrated loudspeaker (Section 8.5.6.4) that eliminates the need to apply such adjustments.

[55] As technology evolves and research continues on techniques and methods for measuring noise levels, this AC may be updated.

8.5.2 Selection of the most appropriate method for measuring the exterior incident sound level will depend on the layout of the room to be tested and external building environs. It may differ from room to room within the building. Section 8.5.9 provides pointers on selecting the most appropriate method for application in different field situations.

8.5.3 The average interior sound level in the room behind the façade is measured by means of a volume or spatial average scan over the central portion of the room (Section 8.5.7). The noise reduction (NR) is then defined as the difference between the exterior and interior sound levels, as a function of each of the one-third or octave frequency bands. The noise level reduction (NLR) is a single-number metric representing the difference between an A-weighted exterior aircraft noise spectrum and the corresponding A-weighted interior noise level in the room behind the façade (Section 8.5.10).

8.5.4 Equipment and Test Conditions.

8.5.4.1 **Measurement Frequency Range.**

8.5.4.1.1 Measurements of exterior and interior sound pressure levels and calculation of noise reduction should be recorded in one-third octave bands from 100 to 2500 Hz inclusive, or in octave bands from 125 to 2000 Hz inclusive.

8.5.4.1.2 The single-number NLR metric for most structures exposed to aircraft noise is determined largely by the noise reduction values in frequency bands from 100 to 1000 Hz, which is termed the main frequency range of interest.

8.5.4.2 **Loudspeaker Specifications.**

8.5.4.2.1 The loudspeaker used to generate the exterior sound field at the test façade should be a compact, single-unit system capable of generating an overall sound pressure level of at least 110 dB overall, and 105 dB A-Weighted, measured in the free-field at 3 ft. (0.91 m) on axis over the frequency range 100 to 2500 Hz.

8.5.4.2.2 The frequency and directivity specifications of the loudspeaker should be as follows:

- Output spectrum measured on axis should vary no more than ± 3 dB from 63 Hz to 2500 Hz.
- Horizontal (azimuthal) directivity (-6 dB): ±45 degrees at 1000 Hz.
- Vertical (elevation) directivity (-6 dB): ±45 degrees at 1000 Hz.

8.5.4.2.3 For measurements of noise reduction using a ground-level loudspeaker mounted on its side, the width of the loudspeaker cabinet should be such that the centers of the loudspeaker cone and high-frequency horn are no greater than 8 inches above the ground surface.

8.5.4.2.4 The electrical input signal to the loudspeaker should be random noise with equal energy per frequency band (also known as "pink noise").

8.5.4.3 **Instrumentation Specifications.**

8.5.4.3.1 Measurements of exterior and interior sound pressure levels require an integrated, time averaging instrumentation system meeting the Type 1 requirements of ANSI S1.43 that includes a ½-inch microphone and protective windscreen.

8.5.4.3.2 Calibration checks of the measurement equipment should be performed before the start and at the end of each set of measurements.

8.5.4.4 **Windscreen.**

The measurement microphone should be covered by an open cell foam windscreen to reduce the direct effect of moving air on the microphone and to protect the microphone from the environment, such as from dust or possible mechanical contact with hard objects.

8.5.4.5 **Background Noise.**

Sound level measurements should not be conducted in the presence of intermittent noise sources, such as aircraft flyovers, truck pass-bys, public address system announcements, lawn mowers, construction equipment, etc. Intermittent noise sources should be disabled where possible, or measurements limited to time periods between background noise events. Corrections for steady levels of background noise should be applied in accordance with the procedures described in Section 8.5.8.

8.5.4.6 **Weather Conditions.**

Measurements should not be conducted when the wind speed exceeds 23ft/sec (15 mph).

8.5.5 Loudspeaker Configuration.

8.5.5.1 **Background.**

The location of the loudspeaker noise source should be selected to provide an external sound field that is as uniform as possible over the entire surface of the façade(s) of the room to be tested. The parameters that affect uniformity are the distance from the façade, angle of incidence to the façade, and loudspeaker height above the ground.

8.5.5.2 **Loudspeaker Distance and Angle of Incidence.**

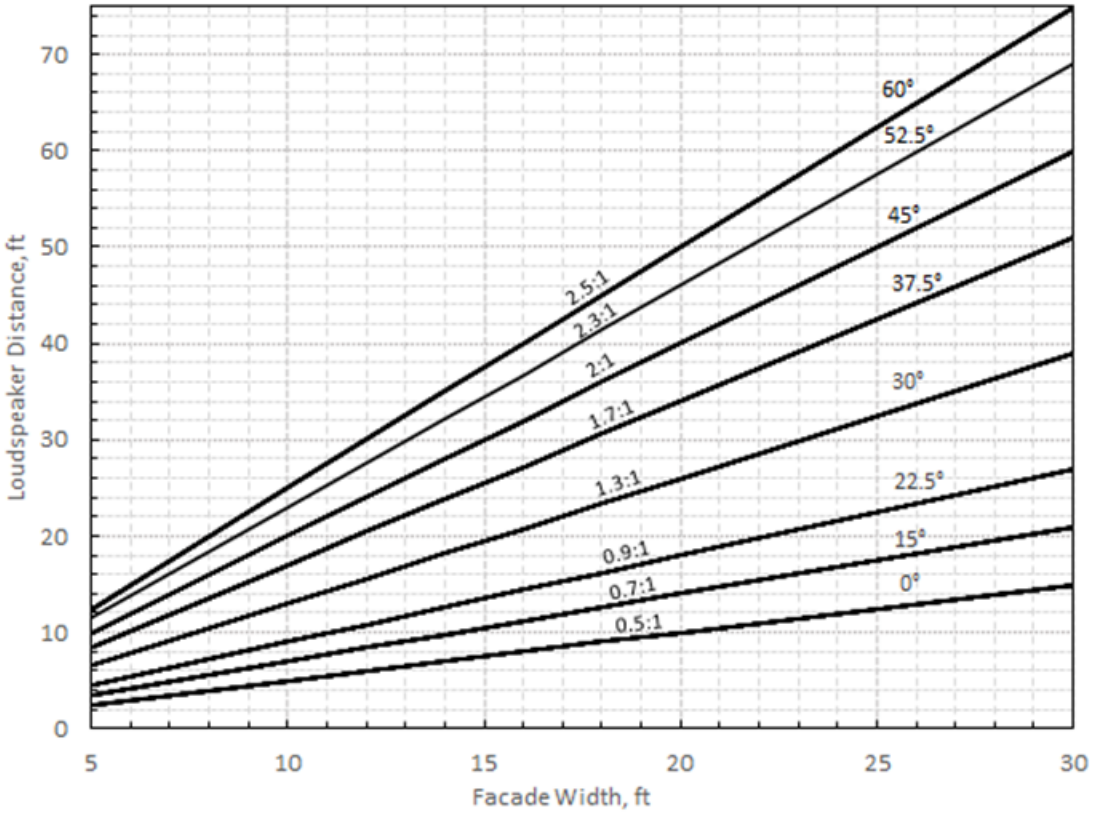
8.5.5.2.1 The distance of the loudspeaker and angle of incidence determine the variation of the sound level over the façade due to variations in propagation distances to different points on the façade. The variation of

sound level depends on the ratio of the loudspeaker distance to the lateral dimension of the façade: the larger the ratio, the lower the variation.

Loudspeaker placement starts with selecting the distance from the center of the façade and horizontal angle of incidence (the angle with the perpendicular to the façade) based on the width of the test façade using the design chart shown in Figure 8-2. For example, if the width of the test façade is 15 feet, then a maximum variation of 3 dB would be achieved with a loudspeaker distance of 30 feet at an angle of incidence of 45 degrees. If the available distance is limited to 20 feet, the angle of incidence should be reduced to 30 degrees to maintain the same sound level variation over the test area.

8.5.5.2.2 An industry best practice is to select the maximum distance possible, consistent with achieving the required signal-to-noise ratio in the room interior, at an angle of incidence of 45 degrees. Measurements at distances less than 10 ft. are not recommended. The uniformity of the sound level over a typical façade decreases more rapidly at these distances due to changes in loudspeaker directivity. Exceptions to this practice are allowed when space is limited, but they should be identified in the appendix to the test report.

Figure 8-2. Design Chart for Determining Loudspeaker Distance and Angle of Incidence to Achieve a Maximum Variation of 3 dB over a Façade Surface.



8.5.5.3 **Loudspeaker Height.**

8.5.5.3.1 Loudspeaker height determines the frequency at which the ground reflection interference with the direct propagation path occurs. Sound level uniformity over the façade is accomplished by selecting the loudspeaker height such that the fundamental interference frequency is either above or below the main frequency range of interest, namely 100 to 1000 Hz.

8.5.5.3.2 A best practice is for measurements of noise reduction to be performed with a ground level loudspeaker. In practice, it is necessary to lay the loudspeaker on its side to approximate a ground source, such that the center of the diaphragm is no greater than 8 inches above the ground surface.

8.5.5.3.3 In situations where it is impractical to place the loudspeaker on the ground, or when it is necessary to increase the signal level at the test façade, the loudspeaker should be mounted on a tripod at a height of not less than 10 ft. Measurements of noise reduction for structures where roof

transmission may be important may also require a loudspeaker height of 10 ft. (refer to Section 8.5.9.7).

8.5.6 Measurement of Exterior Sound Level.

8.5.6.1 **General.**

8.5.6.1.1 The noise reduction, $NR(f)$, of a building façade exposed to loudspeaker generated sound at a center frequency f of a one-third or octave band is defined as the difference between the sound pressure level, $L_{ext}\,(f)$, that would exist at the exterior of a building façade if the building and façade were not present, and the sound pressure level, $L_{int}\,(f)$, in the room behind the façade.

$$NR(f) = L_{ext}\,(f) - L_{int}\,(f)\,, dB$$

The exterior free-field sound level is a measure of the sound incident on the façade generated by the loudspeaker configuration selected according to the requirements specified in Sections 8.5.5.2 and 8.5.5.3.

8.5.6.1.2 Measurements of the exterior sound pressure level made with a microphone mounted at, or close to, the building façade will be influenced by reflections from the façade itself. Therefore adjustments for the measured level to be representative of the incident sound pressure level is required. The effect of reflections will modify the spectrum of the measured sound level to an extent, depending on the distance of the measurement from the façade. Because of this, the necessary adjustments will vary accordingly. The preferred procedure for measuring the exterior incident sound level is with a flush microphone method, or microphone mounted flush (within 1.5 inches) with the surface of the façade. This method combines consistency with suitability to allow for measurements under almost all field situations. The adjustment necessary to estimate the incident sound level in this case is -6 dB. Details of the procedure are presented in Section 8.5.6.2.

8.5.6.1.3 As there may be situations that prevent the use of the flush microphone method, the exterior incident sound level can also be measured through a near-façade scan at a distance between 4 and 6 feet from the façade. The adjustment necessary to estimate the incident sound level in this case is -3.5 dB. The adjusted sound level measured correlates well with that measured using the flush microphone, but there are limitations to its application. Details of the near-façade procedure and its limitations are presented in Section 8.5.6.3.

8.5.6.1.4 An alternative method for determining the exterior incident sound level that avoids direct measurement of the sound level at the façade and the application of an adjustment factor is the loudspeaker calibration method. Details of this procedure are provided in Section 8.5.6.4.

8.5.6.1.5 The application of these procedures to specific building configurations and field situations are described in Section 8.5.9.

8.5.6.2 **Flush Microphone Method.**

8.5.6.2.1 The preferred method for measuring the exterior sound level is performed with a microphone mounted flush with the façade and oriented with the diaphragm perpendicular to the façade surface such that the center of the diaphragm is within 1.5 inches of the surface. The average sound level over the surface of the façade can be obtained by either of the following methods:

a. The energy average of the sound levels measured at a number (at least 6) of randomly selected positions across the surface of the façade, none of which should be closer than 2 feet from the horizontal or vertical edges of the façade. The sound level measured at each position shall be averaged over a period of at least 5 seconds. The average sound level in a one-third octave or octave band, $L_{flush}(f)$, is calculated using the following expression:

$$L_{flush}(f) = 10Log\left\{\frac{1}{N}\sum_{n=1}^{N} 10^{L_n(f)/10}\right\}, \qquad dB$$

where $L_n(f)$ is the one-third octave or octave band sound level measured at the nth fixed point on the façade, and N is the number of measurement points.

Alternatively, the average exterior sound level of the randomly selected positions can be determined using a continuous measurement of 5 seconds at each position with the measurement paused as the microphone is moved from one position to another.

b. The average sound level, $L_{flush}(f)$, can be measured by a microphone scan over the surface of the façade with the center of the microphone diaphragm maintained within 1.5 inches of the surface at all points. The scan should not include areas within 2 feet of the horizontal and vertical edges of the façade. It should be performed in a sinusoid motion at a constant speed over this central area of the façade, including windows and doors (refer to Section 8.5.7.1.2 for exceptions). The time for each scan will depend on the dimensions of the façade surface, but should not be less than 20 seconds, a time sufficient to scan over a 30 ft.-wide façade. In performing the scan, the operator should avoid shielding the façade from direct noise generated by the loudspeaker.

8.5.6.2.2 The flush scan can be performed either with a standard 3.54-inch windscreen cut to provide a flat surface with a 1 to 1.5 inch spacing of the center of the diaphragm from the façade surface, or with a 2.5-inch diameter spherical windscreen that provides a spacing of 1.25 inches. In practice, the latter is preferred as it is easier to slide the spherical windscreen over the entire surface of the façade and maintain the required spacing without the operator having to adjust position.

8.5.6.2.3 For the flush sound level measurement, an adjustment of 6 dB is subtracted from the measured sound levels in each frequency band to account for reflections from the façade. The one-third octave or octave band incident sound level, $L_{ext}(f)$, is calculated using the following expression:

$$L_{ext}(f) = L_{flush}(f) - 6\ dB$$

The flush measurement method provides the value of noise reduction for the façade only. It does not include the effect of modifications to the noise reduction produced by attachments to the façade, such as roof overhangs, porches, verandas, etc. Procedures for these situations are described in Section 8.5.9.6.

8.5.6.3 **Near-Façade Microphone.**

8.5.6.3.1 If the surface of the façade is too irregular or is unapproachable, the exterior sound level, $L_{near}(f)$, can be measured at a near-façade position by performing a 3D volumetric microphone scan over the surface of the façade at a distance of 5 ± 1 feet from the façade. The scan should not include areas within 2 feet of the horizontal or vertical edges of the façade. The time for each scan will depend on the dimensions of the façade surface, but should not be less than 20 seconds, a time sufficient to scan over a façade of width 30 ft. In performing the scan, the operator should avoid shielding the façade from direct noise generated by the loudspeaker, and not be positioned between the scanned area and the façade.

8.5.6.3.2 For the near-façade sound level measurement, an adjustment of 3.5 dB is subtracted from the measured sound levels in each frequency band to account for reflections from the façade. The one-third octave or octave band incident sound level, $L_{ext}(f)$, is thus calculated using the following expression:

$$L_{ext}(f) = L_{near}(f) - 3.5\ dB$$

The near-façade measurement method should only be applied when the level measured by the microphone is unaffected by reflections from adjacent surfaces. The method should not be used when the loudspeaker distance to the façade is less than 15 feet. There are also additional guidelines for scanning when measuring noise reduction of corner rooms

(refer to Section 8.5.9.3). The near-façade method is not recommended for measurements adjacent to inside corners (refer to Section 8.5.9.4).

8.5.6.3.3 The near-façade measurement method provides the value of noise reduction for the façade only. It does not include the effect of modifications to the noise reduction produced by attachments to the façade, such as roof overhangs, porches, verandas, etc. Section 8.5.9.6 describes procedures for these situations.

8.5.6.4 **Loudspeaker Calibration Method.**

8.5.6.4.1 The exterior incident sound level to a test façade can also be determined by calibrating the loudspeaker for the specific test configuration such that the incident, free-field sound level to the façade can be predicted from the loudspeaker sound output, not by direct measurement at or near the façade. Since no sound level measurements are taken at or near the façade itself, the adjustments to account for façade reflections described in Sections 8.5.6.2 and 8.5.6.3 are not required.

8.5.6.4.2 The appropriate loudspeaker distance, d, and height, h, are first established according to the requirements specified in Section 8.5.5 for measuring the noise reduction of the given façade. Upon activation of the loudspeaker, the façade test involves a measurement of the loudspeaker output sound level, $L_3(f)$, by a monitor microphone at a distance of 3 ft. (0.91m) along the main axis of the loudspeaker diaphragm. A separate free-field calibration is then performed to develop the transfer function, $F(f)$, between the loudspeaker output sound level, $L_3(f)$, and the sound level incident to the test façade.

8.5.6.4.3 Calculation of the transfer function requires a measurement of the sound level, $\mathcal{L}_d(f)$, generated by the loudspeaker in a free-field environment at the same distance, d, and same configuration as the façade test, together with measurement of the loudspeaker output level, $\mathcal{L}_3(f)$, at a distance of 3.28 ft. This calibration process should be conducted over a ground surface similar to that between the loudspeaker and the façade being tested. The transfer function, $F(f)$, is then calculated as follows:

$$F(f) = \mathcal{L}_3(f) - \mathcal{L}_d(f)$$

The exterior incident sound level to the test façade, $L_{ext}(f)$ is then determined by applying the transfer function to the loudspeaker output level, $L_3(f)$, measured in the façade test.

$$L_{ext}(f) = L_3(f) + F(f)$$

8.5.6.4.4 The calibration method should only be applied when there is a clear free-field propagation path from loudspeaker to façade, with no intervening

fences or structures that are not part of the structure under test. It should also be where the level measured by the monitor microphone is unaffected by reflections from nearby surfaces. The method should not be applied when the distance from the loudspeaker to the façade is less than 15 ft.

8.5.6.4.5 The loudspeaker calibration measurement method provides the value of noise reduction for the façade that includes the effect of modifications to the noise reduction produced by attachments to the façade, such as roof overhangs, porches, verandas, etc., and from the effect of sound energy reflected from other nearby surfaces.

8.5.6.4.6 Calibration of the Loudspeaker.

The most efficient and recommended approach to loudspeaker calibration is to establish a comprehensive database for the test loudspeaker encompassing a wide range of loudspeaker configurations at a site that meets the free-field requirements of Section 8.5.6.4.4. The resulting database can then be applied as appropriate to measurements at each test site. This database should include one-third octave band or octave band sound level measurements for ground level and 10 ft. loudspeaker heights, at distances ranging from 15 to 35 ft. in steps of 5 ft. over hard (asphalt, concrete) and soft (grass) ground surfaces, together with the loudspeaker output levels, $\mathcal{L}_3(f)$, measured at a distance of 3 feet. The calibration data can be applied to tests conducted at intermediate distances by interpolating between the sound levels at adjoining distances. The loudspeaker calibration database should be updated annually.

Alternatively, the calibration process can be conducted with the specific loudspeaker configuration(s) selected for the façade test at or near the test site. This should be in a free-field area over a ground surface similar to that at the test site, and assumes the requirements of Section 8.5.6.4 are satisfied.

8.5.6.4.7 Calibration Measurement.

For each selected loudspeaker height, the calibrated sound level, $\mathcal{L}_d(f)$, for the loudspeaker should be measured at each loudspeaker distance, d, by means of a microphone scan over an area 8 ft. wide by 6 ft. high angled at 45 degrees to the loudspeaker axis consistent with the procedure for a flush measurement scan. The time for each scan should not be less than 20 seconds. The sound level, $\mathcal{L}_3(f)$, measured at the fixed monitoring microphone, 3 feet from the loudspeaker, should be recorded for measurements at each distance.

8.5.6.4.8 Calibration Monitoring Microphone.

The sound level, $\mathcal{L}_3(f)$, generated at a distance of 3 feet on the axis of the loudspeaker diaphragm should be recorded by a monitoring microphone. For calibration of a ground level loudspeaker, the monitoring microphone

should be securely placed at the center of a 2 ft. x 2 ft. sheet of ¾" plywood placed on the ground in front of the loudspeaker. There should be no reflecting surfaces within a rectangular area of length 10 ft. (along the loudspeaker to monitoring microphone axis) and width 12 ft. (perpendicular to the loudspeaker to monitoring microphone axis), centered on the mid-point of the loudspeaker to the monitoring microphone axis.

8.5.6.4.9 Requirements for Free-Field Calibration Site.

A free-field space to conduct the calibration is required so the path from loudspeaker to microphone will not include reflecting surfaces. There should be a rectangular area absent of reflecting surfaces of length 3d (along the loudspeaker-to-microphone axis) and width 2.8d (perpendicular to the loudspeaker-to-microphone axis), both centered on the mid-point of the loudspeaker-to-microphone axis, where d is the distance from the loudspeaker to the microphone. If this requirement cannot be satisfied in the space adjacent to the test location, the calibration should be conducted at a site that meets the free-field and ground surface requirements.

8.5.6.4.10 Calibration Site Ground Surface.

The calibration database should include measurements conducted over hard and soft surfaces. In most field situations that are proximate to houses, the ground surfaces over which measurements are conducted are not "hard" or "soft." They are best described as "mixed." As a result, an average of the one-third octave band or octave band calibration data for hard and soft surfaces, normalized to a reference value of the loudspeaker output, $\mathcal{L}_3(f)$, is appropriate for most house tests.

8.5.6.5 **Measurement of Exterior Background Noise.**

8.5.6.5.1 The average exterior background sound level shall be measured in one-third or octave bands before conducting a noise reduction test. The measurement should be conducted for a period of at least 15 seconds. Measurements of background noise and NLR should not be conducted during periods of intermittent noise, such as aircraft flyovers.

8.5.6.5.2 The background sound level should be measured at a position corresponding to the method used for measuring the exterior loudspeaker sound level. If the exterior loudspeaker level is measured using a flush microphone, the background level shall be measured at a single point on the façade surface. If the exterior loudspeaker level is measured using a near-field scan, the background level shall be measured at a single point in the center of the scan area. Adjustments for façade reflection shall not be applied in either case. If the loudspeaker calibration method is used, the background level shall be measured at the monitoring microphone.

8.5.7 Measurement of Interior Sound Level.

8.5.7.1 **Measurement of Average Interior Sound Level.**

8.5.7.1.1 The interior sound levels should be measured immediately before or after measurement of the exterior levels with the loudspeaker sound output unchanged. It is preferable, but not required, to use the same microphone for both measurements.

8.5.7.1.2 The sound level in the test room generated by the external loudspeaker will vary throughout the room, dependent on the amount of acoustical absorption present. The preferred method for measuring the average sound level is to manually perform a spatial 3-D scan at constant speed for at least 30 seconds over the central volume of the room, maintaining a clearance of at least 2 feet from any room surface. The microphone should be held at least at arm's length away from the body. The scan should be in the form of a sinusoid in the vertical direction during one continuous measurement. In rooms where the operator is required to move the body and feet to complete the volume scan, the measurement should be paused while the operator moves to a different position while moving throughout the central volume. Throughout the procedure, the field operator should not shield the microphone from the room façade exposed to the exterior noise source.

8.5.7.1.3 If a 3-D volume scan is difficult to perform in the test room, the average interior sound level can also be measured by means of two 2-D area scans at constant speed for at least 15 seconds each, one 3 feet from the exposed façade(s), and one at the other end of the test room, 3 feet from the interior wall(s), both maintaining a clearance of at least 2 feet from the floor and ceiling surfaces. The average interior sound level, $L_{int\,av}(f)$, is then calculated as the energy average of the two scans:

$$L_{int\,av}(f) = 10Log\left\{\frac{1}{2}\sum_{n=1}^{2} 10^{L_n(f)/10}\right\}, \qquad dB$$

where $L_n(f)$ is the average sound level of the n^{th} scan.

Alternatively, the average interior sound level can be determined using a continuous measurement with a pause in recording levels when moving between the two 2-D area scans.

8.5.7.1.4 Throughout the procedure the field operator must be alert to any contamination of the measured sound level from unrelated exterior and interior sounds, and shall repeat the measurement if such contamination

occurs. In this context, all hearing protection that may have been worn when conducting the exterior measurements shall be removed.

Noise generated by the field operator conducting the measurement should be minimized by restricting movement in the room as much as possible. Wherever possible, scans should be performed without moving the feet to avoid contamination from creaking floors. In larger rooms, where a change in position is necessary to perform a volume scan, the measurement should be paused while the field operator moves to a new position. Heavy or loose clothing and nylon or synthetic fabrics should be avoided as they may generate noise as the field operator performs the scan.

8.5.7.1.5 For the duration of the noise reduction test, all exterior and interior doors, and all prime and storm windows, in the test room should be closed. All household noise sources, such as ventilation systems, refrigerators, fans, televisions, etc., should be disconnected as necessary and to the extent possible to minimize background noise.

8.5.7.2 **Measurement in Open Floor Plans.**

The method for measuring noise reduction in an open floor plan room depends on whether exterior façades of the open plan room are exposed approximately equally to the exterior loudspeaker sound.

- If all exterior room façades are approximately equally exposed, then the interior sound level should be averaged over the entire open space.
- If room facades cannot be exposed equally, the separate measurements of noise reduction should be performed for each façade by averaging the sound level over the volume of the space adjacent to that section of the façade, and combined.

8.5.7.3 **Measurement of Interior Background Noise.**

The average background sound levels in the test room should be measured at a fixed point in the central volume in one-third or octave bands over a period of at least 20 seconds prior to conducting the noise reduction test. The field operator must remain stationary throughout the procedure. Measurement of background noise and NLR should not be conducted during periods of intermittent noise, such as aircraft overflights.

8.5.8 Correction for Background Noise.

In conducting measurements of noise reduction, wherever possible, the loudspeaker output should be selected so that both the exterior and interior octave band or one-third octave band sound levels are at least 10 dB greater than the background sound levels. If in subsequent processing of the data, the difference between the measured sound level, $L(f)$, and the background sound level, $L_b(f)$, is confirmed to be greater than 6 dB in

any frequency band, then the corrected value,$L_{corr}(f)$, for the level (prior to application of the adjustment factors in Section 8.5.6.2 and 8.5.6.3) is given by the expression:

$$L_{corr}(f) = 10log\left(10^{L(f)/10} - 10^{L_b(f)/10}\right)\ dB$$

If in subsequent processing of the data the difference between the measured sound levels, $L(f)$, and the background sound level $L_b(f)$ is less than 6 dB in any frequency band, then:

$$L_{corr}(f) = L(f) - 1.3\ dB$$

Field situations where the difference is less than 6 dB should be identified in the appendix to the test report, together with a statement that the corresponding value of noise reduction represents a lower limit (for interior background noise) or upper limit (for exterior background noise) of the correct value.

8.5.9 Noise Reduction Measurement for Typical Building Types.

Section 8.5.6 describes three methods for defining the exterior sound level. These are flush measurements, near-façade measurements, and loudspeaker calibration. These methods provide alternatives suitable for use in different field situations. The selection of the most appropriate method will depend on the layout of the test room and the external building environs. It may differ from room to room within a building.

The application of these three measurement methods to the measurement of noise reduction for typical building configurations is presented in this section. Prior to conducting noise reduction measurements, the overall layout of the building and each room to be tested should be inspected and the appropriate application method selected. The FAA recognizes the requirements for loudspeaker placement described in Section 8.5.5.2 cannot be satisfied in all field situations. In these cases, the configuration should be selected to be as close as possible to these requirements. Instances when the requirements cannot be satisfied should be noted in the appendix to the test report.

8.5.9.1 **Rooms with a Single Façade.**

The one-third octave or octave band noise reduction of the test façade, $NR(f)$, is calculated using the following equation:

$$NR(f) = L_{ext}(f) - L_{int}(f)\ dB$$

where $L_{ext}(f)$ is the average one-third octave or octave band sound level measured flush with the façade (Section 8.5.6.2), at a near-façade location (Section 8.5.6.3), with the appropriate adjustments for façade reflection, or estimated from the loudspeaker calibration method (Section 8.5.6.4). $L_{int}(f)$ is the corresponding average one-third octave or octave band interior sound level measured according to the procedure described in Section 8.5.7.

Measurements of the exterior incident sound level for facades with recessed elements, such as windows and doors, should be performed as follows:

- For a façade with recessed elements of depth of 3 to 4" or less, the incident sound level can be measured by means of a flush scan at a distance of less than 1.5" over the surface of the façade and recessed elements (refer to Section 8.5.6.2) by a near-facade scan (refer to Section 8.5.6.3), or estimated by the loudspeaker calibration method (refer to Section 8.5.6.4).
- For a façade with recessed elements of depth greater than 4", the incident sound level should be measured by a flush scan over the façade adjoining, but not including, the recessed elements, by a near-façade scan, or estimated by the loudspeaker calibration method.
- For recessed windows covered with insect screens, the screens should be removed where possible to enable flush scans over the surface. Alternatively, the incident level can be measured by a scan over the façade adjoining, but not including, the recessed elements, or with a near-façade scan, or estimated by the loudspeaker calibration method.

8.5.9.2 **Restricted Measurement Space**

Situations may arise when measuring the noise reduction of a room with a single façade where the distance to the façade of an adjoining structure or other reflecting surface is less than the minimum loudspeaker distance of 10 feet recommended in Section 8.5.6.4. An example is the single façade of a middle room on the side of a house that is close to an adjoining structure or fence. In these situations the loudspeaker should be as far as possible from the test façade within the space limitations imposed, with the main axis at an angle of incidence of 0 degrees (perpendicular) to the center of the façade or to the center of the acoustically weakest element on the facade. The loudspeaker height for these situations only should correspond to the center of the test façade for rooms on the first floor, and 10 feet for higher floors.

The exterior sound level on the exposed façade shall be measured using a flush microphone method described in Section 8.5.6.2.

8.5.9.3 **Measurement of Outside Corner Rooms with Two Façades.**

There are two methods for measuring the noise reduction of a room with two façades, usually an outside corner room. Measurement of the sound levels does not need to be performed on façades of corner rooms that do not contain windows, doors, or other significant sound transmitting elements. In such cases, the exterior sound level for the corner room is defined as that measured only on the façade containing significant sound transmitting elements.

a. The measurement of noise reduction for a corner room can be performed with the loudspeaker positioned diagonally to the corner,

(45 ± 10 degrees) provided that there are no obstructions from nearby structures or adjoining buildings to the propagation of sound from the loudspeaker to the full extent of each façade.

The distance from the loudspeaker to the corner of the room should be as large as possible, preferably at least 2 times the width of the largest façade forming the corner room. The loudspeaker height should be determined by the method described in Section 8.5.5.3.

The exterior sound levels can be measured using the flush microphone method according to Section 8.5.6.2, or the near-façade method according to Section 8.5.6.3. If the latter method is used, the scan should not include areas within 5 ft. of the room corner. If the exterior sound levels for each façade are measured separately, the average value is calculated on an energy and relative area basis using the expression:

$$L_{ext}(f) = 10log\left(S_1 * 10^{\,L_1(f)/10} + S_2 * 10^{\,L_2(f)/10}\right) - 10log(S_1 + S_2)$$

where $L_1(f)$ and $L_2(f)$ are the average one-third octave or octave band sound levels on the two façades of areas S_1 and S_2 respectively.

Alternatively, the average sound level flush with each façade can be directly measured by a continuous scan over the two facades, with a pause in recording levels when moving from one façade to the other.
The noise reduction, $NR(f)$, of the room with two façades is then determined using the following expression:

$$NR(f) = L_{ext}(f) - L_{int}(f)\ dB$$

where $L_{int}(f)\ is$ the measured interior sound level.

The exterior sound level can also be inferred from the loudspeaker calibration method (refer to Section 8.5.6.4) where the loudspeaker distance to the façade should be the distance to the center of the longest façade of the corner room.

b. If the loudspeaker cannot be positioned such that the conditions in Section 8.5.5.2 can be satisfied, or if there are obstructions from nearby structures or adjoining buildings to the propagation of sound from the loudspeaker to the full extent of each façade, or if there is limited space to locate the loudspeaker, then the noise reduction of each façade shall be measured separately according to the procedure described in Section 8.5.9.3. The two values should be combined to determine the noise reduction of the room. The noise reductions $NR_1(f)$ and $NR_2(f)$ of each façade are given by the following expressions:

$$NR_1(f) = L_{ext1}(f) - L_{int1}(f)\ dB$$

$$NR_2(f) = L_{ext2}(f) - L_{int2}(f)\ dB$$

where $L_{ext1}(f)$ and $L_{ext2}(f)$ are the measured exterior sound levels for façades 1 and 2 respectively, adjusted for façade reflection, and $L_{int1}(f)$ and $L_{int2}(f)$ are the corresponding measured interior sound levels for sound exposure to façades 1 and 2.

Exterior sound levels can be determined by measuring flush with the façade (Section 8.5.6.2), or at a near-façade location (Section 8.5.6.3), with the appropriate adjustments for façade reflection. The exterior sound level can also be inferred from the loudspeaker calibration method (Section 8.5.6.4).

The overall noise reduction, $NR(f)$, for the room with two façades is then given by the expression:

$$NR(f) = -10log\left(10^{-NR_1(f)/10} + 10^{-NR_2(f)/10}\right)$$

For the measurement of sound levels separately at each façade, the loudspeaker should be positioned at an angle of incidence determined from Figure 8-2, with the angle to the normal being away from the corner so as to ensure that the sound exposure to the non-exposed façade is at least 10 dB less than that on the exposed façade. The loudspeaker height should be determined by the method described in Section 8.5.5.3.

8.5.9.4 **Measurement of Inside Corners.**

8.5.9.4.1 An inside corner exists where two perpendicular façades of separate rooms intersect, and the noise reduction of only one of the façades is required. A typical example is an attached garage. The noise reduction of the test façade should be measured flush with the façade (Section 8.5.6.2). The measurement should not be performed over areas within 4 feet of an inside corner. The exterior sound level can also be inferred by using the loudspeaker calibration method (Section 8.5.6.4). It is not recommended that the near-façade method be used for measurements adjacent to inside corners.

8.5.9.4.2 The loudspeaker calibration measurement method provides a value of noise reduction for the façade that includes the effect of reflections from the perpendicular façade. The result is that the value of noise reduction measured using the loudspeaker calibration method may be slightly lower than that measured using the flush measurement method. The difference will generally be less than 1 dB.

8.5.9.5 **Measurement of Rooms with Multiple Façades.**

8.5.9.5.1 The noise reduction of a room with multiple facades can be measured either by measuring the noise reduction of each façade individually (refer to Section 8.5.9.1), or by adopting the procedure described in Sections 8.5.9.3 a. or b. (as appropriate) and combining the values of noise reduction for separate corner and single-façade measurements.

For measurements of individual facades, the loudspeaker distance and angle of incidence should be selected such that the sound levels on the test façade are at least 10 dB greater than the levels on adjoining facades. This may require measurements with a loudspeaker angle of incidence of 0 degrees. The noise reductions, $NR_n(f)$, of the n[th] façade is given by the following expression:

$$NR_n(f) = L_{ext,n}(f) - L_{int,n}(f)\ dB$$

where $L_{ext,n}(f)$, are the measured exterior sound levels for facades 1 through *n,* and $L_{int,n}(f)$, are the corresponding measured interior sound levels for sound exposure to facades 1 through *n*. Exterior sound levels can be determined by measuring flush with the façade (Section 8.5.6.2), at a near-façade location (Section 8.5.6.3), with appropriate adjustments for façade reflection, or inferred from the loudspeaker calibration method (Section 8.5.6.4). The overall noise reduction, $NR(f)$, for the room with *n* facades is then given by the expression:

$$NR(f) = -10log\sum_{n} 10^{-NR_n(f)/10}$$

where $NR_n(f)$ is the noise reduction for the n[th] facade.

8.5.9.5.2 If measurements of noise reduction are determined by measurements of corner and single façade noise reduction, the combined value of noise reduction is obtained using the following equation:

$$NR(f) = -10log\left(\sum_{m} 10^{-NR_{m,corner}(f)/10} + \sum_{n} 10^{-NR_{n,sf}(f)/10}\right)$$

where $NR_{m,corner}(f)$ is the noise reduction for the m[th] corner measurement, and $NR_{n,sf}(f)$ is the measured noise reduction of the n[th] single façade. In this case, the loudspeaker distance and angle of incidence for the single façade measurement should be selected such that the sound levels on the test façade are at least 10 dB greater than the levels on adjoining facades.

8.5.9.6 **Measurement of Structures with Permanent Attachments to a Façade**

Attachments to a structure, such as overhangs, porches, and verandas whether open or enclosed by insect screens or glazing, usually reduce the sound level incident to the main façade, this will, in turn, reduce the sound level in the room behind the façade. If these attachments are permanent, their influence on the noise reduction of the façade should be included in the measurement.

8.5.9.6.1 Full Porch or Veranda

A full porch or veranda is one that extends over the entire façade of the room to be tested. The NLR of a room with a porch or veranda (with or without an insect screen) shall be determined by measuring the exterior sound level at the porch or veranda opening that is parallel with the facade, not at the room façade. An adjustment of 3.5 dB is subtracted from the measured sound levels in each frequency band to account for reflections from the room façade. The one-third octave or octave band incident sound level, $L_{ext}(f)$, is thus calculated using the following expression:

$$L_{ext}(f) = L_{op}(f) - 3.5\ dB$$

where $L_{op}(f)$ is the sound level measured at the porch or veranda opening.

The exterior sound level at the porch or veranda opening can also be inferred from the loudspeaker calibration method (Section 8.5.6.4) provided that the conditions for its application are satisfied. In this case the exterior sound level is the inferred loudspeaker level at the porch opening.

Throughout the measurement the field operator should not shield the microphone from the loudspeaker noise source, or be positioned between the porch opening and the façade.

8.5.9.6.2 Partial Porch or Veranda

If the porch or veranda extends less than the full width of the room façade to be tested, the exterior sound level for the full façade should be calculated using the following expression:

$$L_{ext}(f) = 10log\left(S_1 * 10^{\,L_{op}(f)/10} + S_2 * 10^{\,L_2(f)/10}\right) - 10log(S_1 + S_2)$$

where $L_{op}(f)$ is the average one-third octave or octave band sound level measured at the porch opening of area S_1 , (with an adjustment of 3.5 dB), and $L_2(f)$ is the average one-third octave or octave band sound level measured at a distance from the façade equal to the depth of the porch on the remaining area, S_2 , of the façade (also with an adjustment of -3.5 dB).

Alternatively, the average exterior sound level can be directly measured by a continuous near-façade scan (refer to Section 8.5.6.3), with a pause in recording levels when moving from the porch opening measurement to a near-façade measurement and applying an overall adjustment of 3.5 dB.

If the porch or veranda is enclosed a continuous flush scan may be used, with a pause in recording levels when moving from the porch facade (windows open) to the room façade measurement, and applying an overall adjustment of 6 dB.

8.5.9.6.3 Corner Rooms with Porch or Veranda

Corner rooms may have a porch or veranda on one or both facades. The measurement procedure should follow Section 8.5.6.3, including the requirement that the exterior sound level measurement at the porch opening shall not include any porch or façade areas within 5 feet of a room corner.

8.5.9.7 **Corrections for Roof Transmission.**

For most buildings, sound transmission through the roof is not a significant contributor to overall NLR. Therefore, elevating the loudspeaker to achieve greater sound level uniformity is not necessary. In most cases, measurements of the noise reduction for 1-, 2-, and 3-story buildings can be performed with a ground-level or tripod-mounted loudspeaker at a height of 10 ft. However, some buildings with high transmission loss walls and windows or low transmission loss roofs require corrections to the measured values of noise reduction, for the top floors only, to account for sound transmission through the roof. The full range of procedures and corrections to be applied to the measured values of noise reduction for rooms on the top floors of typical building types is presented in Table 8-5.

Table 8-5. Corrections for Roof Transmission Exterior Façade

	Building Roof / Attic	Number of Stories	Attic Insulation	Acoustic Windows[1]	Loudspeaker Height (ft.)	Correction[2] (dB)
Siding or Stucco	Finished / Unfinished Attic	1,2,3	Yes/No	Yes/No	0 or 10	0.0
Brick or Concrete	Finished Attic	1,2,3	NA	Yes/No	0 or 10	0.0
Siding or Stucco	Unmodified Beam Ceiling	1	NA	Yes/No	0 ft. height not allowed	
					10	1.0
		2			0 ft. height not allowed	
					10	2.0
Brick or Concrete	Unmodified Beam Ceiling	1	NA	Yes/No	0 ft. height not allowed	
					10	1.5
		2			0 ft. height not allowed	
					10	3.0
Brick or Concrete	Unfinished Attic	1,2,3	Yes	No	0 or 10	0.0
			No			1.0
		1	Yes	Yes	0	1.5
					10	0.0
			No		0 ft. height not allowed	
					10	1.5
		2	Yes	Yes	0	2.0
					10	1.0
			No		0 ft. height not allowed	
					10	2.5
		3	Yes	Yes	0 ft. height not allowed	
					10	1.5
			No		0 ft. height not allowed	
					10	4.0

[1] Acoustic windows in top floor of building.
[2] Correction to be subtracted from measured NLR of top floor only.

8.5.9.8 **Measurement of Multiple Story Buildings.**

8.5.9.8.1 A best practice to minimize shielding from balcony floors is to select the maximum loudspeaker distance possible, consistent with achieving the

required signal-to-noise ratio in the room interior. An elevated loudspeaker (i.e. greater than 10 ft.) is not necessary for a 3-story building, provided that the sound levels produced at the higher façades are sufficient to maintain the necessary signal-to-noise ratio for the room interior measurements.

8.5.9.8.2 For façades with sliding glass doors and partially enclosed balconies with side walls, measurement of the exterior sound level should be performed at the balcony opening. An adjustment of 3.5 dB should be subtracted from the measured values to account for sound reflection from the façade. Measurements should not be made flush with the sliding glass door, as the level is influenced by the partial balcony enclosure. Alternatively, noise reduction can be measured using the loudspeaker calibration method without applying any adjustment factor.

8.5.9.8.3 Measurement of the noise reduction of façades with partially enclosed balconies should be made with a normal angle of incidence (0 degrees) so that the façade behind the balcony is fully exposed.

8.5.9.8.4 Measurement of the noise reduction of rooms in multi-story buildings with more than three stories should be inferred from measurements of rooms on lower floors with similar interior layouts.

8.5.10 Determination of Noise Level Reduction.

The NLR of a room is a single-number metric representing the difference between an A-weighted exterior aircraft noise spectrum and corresponding A-weighted interior noise level.

8.5.10.1 **Determining Aircraft Spectrum.**

The aircraft noise spectrum used in the calculation of NLR should be the single aircraft type that is most frequently operated for the runway ends adjacent to a particular community, as identified from FAA's Aviation Environmental Design Tool (AEDT) model. If an identical aircraft type is identified for all communities surrounding an airport, then a single aircraft noise spectrum can be generated using operations data for the entire airport. This method is recommended in research conducted for FAA ("*Review and Evaluation of Aircraft Noise Spectra used to Estimate Noise Level Reduction for Airport Sound Insulation Programs based on the Loudspeaker Test Method*"[56]). The steps in this procedure are as follows:

a. Using operations data from AEDT that produces the FAA-approved NEM for the airport, identify the runway ends at which arriving and departing flights impact the structure to be tested.

[56] https://www.faa.gov/about/office_org/headquarters_offices/apl/research/science_integrated_modeling/media/pears_to43.pdf.

b. Rank order the equivalent number of annual arrival and departure operations for each aircraft type for the identified runways. The equivalent number of operations for an airport with DNL contours is obtained by applying a multiplier of 10 for nighttime operations; for CNEL contours by applying multipliers of 3 and 10 for evening and nighttime operations, respectively; and for evaluation of educational facilities, places of worship, or other noise-sensitive buildings with exclusively daytime usage, by considering only daytime operations.
c. Select the aircraft type with the highest number of equivalent annual operations. Request the arrival and departure spectral class data for that aircraft from the ADO. This data will be in the form of unweighted one-third octave band sound levels normalized to 70 dB at 1 kHz.
d. Scale the arrival and departure spectra to the same overall, broadband, level over the frequency range 100 to 2500 Hz.
e. Combine the resulting arrival and departure spectra to develop a composite spectrum for the most frequently operated aircraft type using a weighted energy average based on the relative numbers of equivalent annual runway operations.
f. Scale the composite spectrum to a convenient and recognizable A-weighted level. Convert the one-third octave band data to octave bands when necessary.

The resulting aircraft noise spectrum, $L_{ext,ac}(f)$ can then be used to calculate the NLR of structures within that community.

8.5.10.2 **Calculation of Noise Level Reduction.**

The interior noise spectrum for exterior exposure to the average composite aircraft noise spectrum is determined by subtracting the noise reduction, $NR(f)$, measured according to the procedure detailed in Section 8.5.9, from the exterior aircraft one-third or octave band exterior noise spectrum, $L_{ext,ac}(f)$.

$$L_{int,ac}(f) = L_{ext,ac}(f) - NR(f)$$

If the measured outdoor or indoor levels generated by the loudspeaker are less than 10 dB greater than their respective outdoor or indoor background levels, then either the power to the loudspeaker needs to be increased, measures to reduce background noise need to be taken, or corrections should be applied according to Section 8.5.8.
The steps for calculating NLR are as follows:

The exterior A-weighted total level is:

$$L_{A,ext} = 10log\sum_{i=1}^{k} 10^{\frac{L_{ext,ac}(f)+A(f)}{10}}$$

The interior A-weighted total level is:

$$L_{A,int} = 10log\sum_{i=1}^{k} 10^{\frac{L_{int,ac}(f)+A(f)}{10}}$$

where "k" is the total number of one-third or full octave bands used, and $A(f)$ is the corresponding correction for A-weighting for each frequency band.

The NLR is then determined by:

$$NLR = L_{A,ext} - L_{A,int}$$

Table 8-6 presents an example of a calculation of NLR from octave band measured data.

Table 8-6. Example of Octave Band Calculation of NLR

	Octave Band Center Frequency, Hz					A-Weighted Total[1]
	125	250	500	1000	2000	
Exterior Background Level	66.2	58.4	50.2	48.5	45.6	55.6
Exterior Measured Level[2]	88.3	83.3	82.9	83.4	81.8	87.5
Corrected Exterior Level[3]	88.3	83.3	82.9	83.4	81.8	87.5
Interior Background Level	46.4	37.2	28.1	29.0	23.7	35.1
Interior Measured Level	69.7	61.1	61.5	59.9	56.5	64.2
Corrected Interior Level[3]	69.7	61.1	61.5	59.9	56.5	64.2
Noise Reduction (NR)	18.6	22.2	21.4	23.5	25.3	---
Aircraft Noise Level, $L_{av}(f)$	71.1	69.9	68.2	64.9	62.1	70.0
Calculated Interior Level	52.5	47.7	46.8	41.4	36.8	47.4
Noise Level Reduction (NLR), dB						**22.6**

[1] Weighted over the octave band frequency range 125 to 2000 Hz. Also note that these are depicted in 5dB increments in NEMs.
[2] Adjusted for free-field conditions
[3] Corrected for background noise

- *Exterior Background Level* – The measured exterior background octave band levels and the A-weighted total.
- *Exterior Measured Level* – The measured exterior façade octave band levels and the A-weighted total.
- *Corrected Exterior Level* – The measured exterior façade octave band levels, corrected for background noise and the A-weighted total.
- *Interior Background Level* – The measured interior background octave band levels and the A-weighted total.
- *Interior Measured Level* – The measured interior octave band levels and the A-weighted total.

- *Corrected Interior Level* – The measured interior octave band levels, corrected for background noise and the A-weighted total.
- *Noise Reduction* – The difference between the corrected exterior level and corrected interior level for each frequency band.
- *Aircraft Noise Level* – The composite average aircraft noise spectrum.
- *Calculated Interior Level* – The difference between the *Aircraft Noise Level* and the *Noise Reduction* for each frequency band.
- Noise Level Reduction (NLR) – The difference between the A-weighted Aircraft Noise Level and the A-weighted Interior Noise Level.

In this example, the exterior and interior noise levels generated by the loudspeaker are more than 10 dB greater than the background levels, so no corrections are required.

8.5.11 Documentation.

8.5.11.1 Table 8-7 lists the photographic and site-specific documentation that should be completed during field testing under the Loudspeaker Measurement Method. Digital format is recommended for data sheets and photographs.

8.5.11.2 All spreadsheets that calculate the noise reduction and NLR measurement results (see the example in Table 8-6) must be saved and included as part of the documentation for each property.

8.5.11.3 All instances of non-compliance with requirements must be included in an appendix to the test report.

Table 8-7. Data to be Recorded in Field Testing for the Loudspeaker Measurement Method

Photographs	Data Sheet Contents
• Exterior of the structure to aid in identifying the property. • Loudspeaker setup locations for each room. • Exterior elements that are in poor condition or that have been replaced with modern products. • Room interiors to document absorption conditions. The date and time on all SLMs should be synchronized with the camera time and date.	• Airport code • Site number • Property address • Resident name • Date and time of measurements • Weather conditions • Name(s) of test personnel • Sketch of room layout, loudspeaker and microphone placement, noting all exterior elements • Location of nearby structures • Loudspeaker height, distance, angle of incidence for each room • DNL contour zone

8.6 Determination of Interior Noise Levels for SIP Eligibility.

8.6.1 The noise metrics used to define interior noise levels in buildings depend on the structural type and use of the property, as shown in Table 8-8.

8.6.2 The Day-Night Average Noise Level (DNL), which includes a nighttime penalty component (an additional 10 dB between 10:00 p.m. to 7:00 a.m.), is a typical noise metric to define goals for residential structures (single- and multi-family residences). The Community Noise Equivalent Level (CNEL) is used in California. CNEL includes an evening and a nighttime penalty. Under CNEL, a 5 dB penalty is added between 7:00 p.m. and 10:00 p.m., and a 10-dB penalty is added between 10:00 p.m. and 7:00 a.m. These penalties are added to account for human sensitivity to nighttime noise. The FAA recognizes CNEL as an alternative noise metric for use in California. Therefore, FAA will accept either the DNL or CNEL metric for projects in California.

8.6.3 For educational facilities, the Equivalent Sound Level (Leq) is a typical noise metric for defining program goals. Leq quantifies noise that varies over a continuous period of time into a single value in decibels. The single value contains the same acoustic energy as the varying sound level during that time period. For educational facilities, the Leq is generally based on the number of hours of a typical school day (i.e., Leq^{8} represents the single noise level equivalent to noise over the 8 hours of a school day).

8.6.4 For other facilities, the noise metric should be based on the structure type and reviewed with the ADO before proceeding. For example, habitable areas in places of worship may dictate the use of DNL/CNEL, which has a nighttime component. Daycare centers may be more suited for the use of Leq since instruction usually takes place during the day.

Table 8-8. Appropriate Interior Noise Level Metrics by Structure Type

Structure Type	Appropriate Interior Noise Level Metric
Residential	DNL and, in California, CNEL
Educational	Leq for typical school day
Other	DNL (and CNEL in California) or Leq, based on type of use, and approved by the FAA ADO

8.6.5 The determination of potential interior noise levels begins with the development of exterior DNL/CNEL noise contours. These are based on the most recent set of FAA-accepted NEMs.

8.6.6 Single-Family Residences.

The testing protocol for single-family residences fall into one of two types: categorized or uncategorized. The airport operator or sponsor should consult with the ADO if clarification is needed to determine whether the property is categorized or uncategorized.

8.6.6.1 **Categorized Properties.**

For each phase or bid group, if the preliminary survey reveals that structures can be categorized and organized into groups of structures, the airport operator or sponsor will identify the percentage of structures in each category to be acoustically tested. Structures included in the testing should be selected randomly within each category.

8.6.6.2 **Uncategorized Properties.**

For each phase or bid group, when the preliminary survey identifies custom or one-of-a-kind properties, categorization is not possible. In these cases, testing of all unique structures is often necessary. The airport operator or sponsor should consult with the FAA ADO.

8.6.6.3 **Exterior DNL/CNEL.**

8.6.6.3.1 Exterior noise levels for single-family residences should be based on the FAA-accepted NEMs from the airport's Part 150 Study. If the appropriate contour is not clear the grid-point analysis from the AEDT model should be consulted using the location of the affected structure. If this is not available, the grid-point analysis can use a location on the residential property, although discretion should be used so a grid-point on a large

property is not placed far enough away from the structure to change the modeled DNL/CNEL level. Specific noise levels for each property should be set as shown in Table 8-9.

Table 8-9. Specific Noise Level Assumptions for Single Family Residences

Exterior DNL/CNEL	For Properties Located:	Assumption
75 dB	within the 70 to 75 dB noise contours	≥70 & ≤75 is assumed to be 75 dB
70 dB	within the 65 to 70 dB noise contours	≥65 & <70 is assumed to be 70 dB
65 dB	outside the 65 dB noise contours (approved for block rounding)	≥ 60 and <65 is assumed 60 dB.
Actual dB Grid Point Level	Outside of the 60 dB noise contour (rarely approved, consult with APP-400)	Use actual grid point level for less than 60 dB.

8.6.6.3.2 Acquisition should be the mitigation strategy for areas above DNL/CNEL 70 dB. The FAA does not normally approve sound insulation for areas above 70 DNL/CNEL. At noise levels above DNL/CNEL 70 dB, it becomes difficult to sound insulate. The airport operator or sponsor should consult with the ADO about acquisition strategies in these areas.

8.6.6.4 **Measured NLR.**

The airport operator or sponsor or their consultant will acoustically test all habitable rooms within a specific single-family residence. Measurements will be taken both outside and inside the habitable rooms as outlined in Section 8.3. This measured NLR is used to judge sound insulation programs.

8.6.6.5 **Interior DNL.**

The interior DNL/CNEL noise level is calculated by subtracting the measured NLR for a room from the exterior DNL/CNEL that is taken from an airport's FAA-accepted NEM. This equation is expressed below, as:

$$Exterior\ DNL/CNEL - NLR_{Room} = Interior\ DNL/CNEL_{Room}$$

8.6.6.6 **Determination of Average Interior DNL.**

8.6.6.6.1 An average interior DNL/CNEL should be developed for each property. The average should be the median value of the interior DNL/CNEL noise levels of all habitable rooms within the property tested.

8.6.6.6.2 Properties tested in each category that have interior DNL/CNEL noise levels equal to or greater than DNL/CNEL 45 dB are considered noise impacted. Results for properties less than DNL/CNEL 45 dB will not be considered noise impacted.

Note: If 50 percent or more of the properties tested in each category have an average interior DNL/CNEL noise level equal to or greater than DNL/CNEL 45 dB, the FAA may determine the entire category (100%) will be equal to or greater than DNL/CNEL 45 dB. The FAA may also determine that acoustical testing will be performed on 100% of the structures in the category.

Note: In any calculation using interior DNL/CNEL, the interior DNL/CNEL value should not be rounded up. For example, an interior DNL/CNEL of 44.7 should not be rounded up to DNL/CNEL 45. Rounded noise levels are invalid for the purposes of AIP/PFC funding.

8.6.7 Multi-Family Residences.

8.6.7.1 **Testing Sample.**

8.6.7.1.1 As outlined in Section 8.2.2, preliminary property surveys are required for all the properties in each phase or bid group considered for mitigation. The survey assesses and categorizes properties to the extent possible. Based on the FAA Final Policy on Part 150 *Approval of Noise Mitigation Measures Effect on the Use of Federal Grants for Noise Mitigation Projects* (63 Federal Register 16409, April 3, 1998), residential property constructed after October 1, 1998 and within the DNL 65 dB, or above, contour of an NEM published prior to the property's construction, is not approved for remedial noise mitigation. This also applies to partial renovations and additions. Those should be justified and submitted to FAA for evaluation on a case-by-case basis.

8.6.7.1.2 The test method varies slightly for multi-family properties, apartments, and condominiums. The difference in the testing plans is described in more detail in the following sections.

8.6.7.1.3 Apartment Buildings (Rental Property).

Apartment buildings generally have one owner with multiple tenants. Testing for apartments is based on the "Individual Building" acoustical testing plan. Unlike condominiums, apartments are more likely to have consistent exterior elements. This is because any changes are usually completed in one effort for each building or the entire complex. The property survey will identify all floor plan types and variation in all buildings on the property.

Floor plan types are usually studios, 1-bedroom, 2-bedroom, 3-bedroom plans, and can be further categorized as flats or townhouses. Variations on

the floor plans may include units that have extra windows or different exterior construction. Once all floor plan types have been identified, acoustical testing is conducted on at least 10 percent of each floor plan type/variation with a minimum of two units per floor plan type.

For small multi-family apartment buildings (6 units or less) testing on 100 percent of all units is recommended. Consultation with the FAA ADO is required to confirm when 100 percent testing is required.

The selection of the testing sample for apartment buildings is presented Figure 8-3**.**

Figure 8-3. Process for Selecting the Testing Sample for Apartment Buildings

8.6.7.1.4 Condominium Buildings (Owner-Occupied Property).

Condominiums are also based on the "Individual Building" acoustical testing plan and are individually owned,[57] similar to single-family structures. Unlike apartments, condominiums are more likely to have had exterior changes such as newer windows and doors. The property survey

[57] In some instances, units in condo buildings may not always be owner occupied. Therefore, use of the rental guidance for the rental units within a condo building may apply or other official documentation addressing rental units.

should identify all floor plan types and variations in all buildings on the property. Floor plan types are usually studios, 1-bedrooms, 2-bedrooms, and 3-bedrooms. They can be further categorized as flats or townhouses.

Variations on the floor plans may include units that have extra windows or different exterior construction. Variations also include replaced exterior windows and doors that could result in interior noise levels different from comparable units. Once all floor plan types have been identified, acoustical testing should be conducted on at least 10 percent of each floor plan type/variation, with a minimum of two units per floor plan type.

The selection of the testing sample for condominium buildings is presented in Figure 8-4.

8.6.7.2 **Exterior DNL/CNEL.**

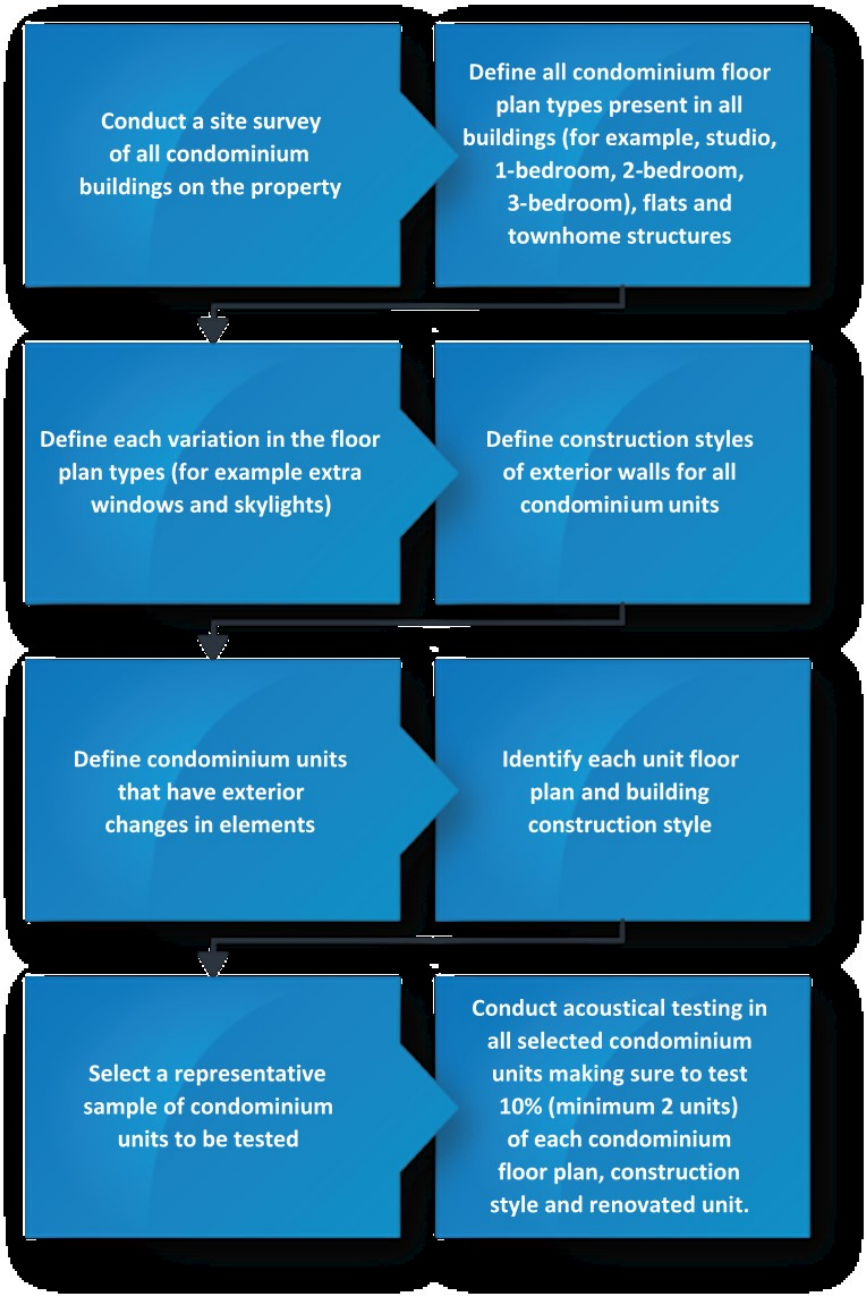
8.6.7.2.1 Exterior noise levels for multi-family residences should be based on the FAA-accepted noise contours in the NEMs. If the appropriate contour is not clear the grid-point analysis from the AEDT model, or the most recent model updated approved by the FAA, should be consulted using the location of the affected structure.

8.6.7.2.2 For apartment or condominium complexes with multiple buildings, the exterior noise levels should be based on the contour at the location of the apartment or condominium building that is being tested. Specific noise levels for each property should be set as shown in Table 8-10.

Table 8-10. Specific Noise Level Assumptions for Multi-Family Residences

Exterior DNL/CNEL	For Properties Located:	Assumption
75 dB	within the 70 to 75 dB noise contours	≥70 or ≤75 is assumed to be 75 dB
70 dB	within the 65 to 70 dB noise contours	≥65 or <70 is assumed to be 70 dB
65 dB	outside the 65 dB noise contours (approved for block rounding)	≥ 60 or <65 is assumed 60 dB.
Actual dB Grid Point Level	Outside of the 60 dB noise contour (rarely approved, consult with APP-400)	Use actual grid point level for less than 60 dB.

Figure 8-4. Process for Selecting the Testing Sample for Condominium Buildings



8.6.7.2.3 As stated, sound insulation is often not successful in areas above 70 DNL and should probably be acquired. The same applies to areas below 65 DNL. Therefore, FAA will not normally approve sound insulation in these areas. Consultation with the ADO is advised.

8.6.7.3 **Measured NLR.**

Since NLR is typically used to judge the overall effectiveness of sound insulation programs, airport operators or sponsors or their consultants will

conduct acoustical testing for all habitable rooms specified in the ATP. The purpose is to determine the NLR for the multi-family apartment or condominium property. Testing may be performed on a minimum of 10-30 percent of all floor plan types, construction styles, and variations. Measurements should be conducted both outside and inside of the habitable rooms following the methods outlined in Section 8.3.

8.6.7.4 **Interior DNL/CNEL.**

The interior DNL/CNEL noise level is calculated by subtracting the measured NLR for a room from the exterior DNL/CNEL from an airport's FAA-accepted NEM. This equation is expressed below, as:

Exterior DNL/CNEL – NLRRoom = Interior DNL/CNELRoom

8.6.7.5 **Determination of Average Interior DNL/CNEL.**

An average interior DNL/CNEL should be developed for each property. The average should be the median value of the interior DNL/CNEL noise levels of all habitable rooms within the property tested. In any calculation using interior DNL/CNEL, the interior value should not be rounded up. For example, a median interior DNL/CNEL of 44.7 should not be rounded up to 45. Rounded noise levels are invalid for the purposes of AIP/PFC funding.

8.6.7.6 **Apartment Buildings (Rental Property).**

8.6.7.6.1 As mentioned in Section 8.6.7.1.3, apartments generally have one owner and multiple tenants. The structures are more likely to have consistent exterior elements. Any changes would be usually made to the whole complex. In these cases, calculations may be based on the "Individual Building" plan.

8.6.7.6.2 Once the acoustical testing has been completed, the steps listed in Table 8-11 should be taken to develop an average interior DNL/CNEL for each of the buildings within the entire apartment complex.

8.6.7.6.3 Apartment complexes that have average interior DNL/CNEL noise levels equal to or greater than 45 dB may be considered to be noise impacted. Those properties less than DNL/CNEL 45 dB are not considered noise impacted. The mitigation treatment plan for noise impacted buildings within apartment complexes will be based on actual units impacted.

8.6.7.6.4 In any calculation that uses interior noise level, the interior noise level value should not be rounded up. An interior noise level of DNL/CNEL 44.7 dB should not be rounded up to 45 dB. Rounded noise levels are invalid for the purposes of AIP/PFC funding.

Table 8-11. Process for Determining Average Interior DNL for Apartment and Condominium Buildings

Step	Apartment and Condominium Building Process
Determine average interior DNL/CNEL for each unit tested	This is based on testing a minimum 10% of each floor plan type or construction style. Here's an example for a complex of 30 one-bedroom units and 15 two-bedrooms units: 10% of 30 one-bedroom units = 3 are tested 10% of 2 one-bedroom units = 1.5, so 2 are tested
Determine average interior DNL/CNEL for each floor plan type and construction type	Average all interior noise levels together for all similar floor plans/construction styles. Using the same example above for 1- and 2-bedroom units— 1. Average the three interior DNL/CNEL for all 1-bedroom units tested. 2. Average the two interior DNL/CNEL for all 2-bedroom units tested.
Determine average interior DNL/CNEL for each building and full complex	Multiply the average interior DNL/CNEL for each floor plan type/construction style by the number of units in each apartment building in the complex. For an apartment building with eight units— Four are one-bedroom units with an average XX DNL/CNEL Four are two-bedroom units with an average XX DNL/CNEL. The average interior DNL/CNEL for the building is the average of the 1-bedroom value times four, and the 2-bedroom DNL/CNEL times four. Following an average determination for each building, an average for the full complex should be developed as well.

8.6.7.7 **Condominium Buildings (Owner-Occupied Property).**

8.6.7.7.1 As stated in Section 8.6.7.1.4, condominiums are individually owned and similar to single-family structures. Therefore, they are more likely to have exterior changes in the elements (windows and doors) that changed the floor plan type. In these instances, the floor plans may be categorized. As a result, acoustical testing should also be based on the "Individual Building" testing plan and the final determination of interior noise levels presented in the ATP. The mitigation treatment plan for noise impacted buildings within condominium buildings will be based on actual units impacted.

8.6.7.7.2 Once the acoustical testing has been completed, the steps listed in Table 8-11 should be taken to develop an average interior DNL/CNEL for all the buildings in the complex.

8.6.7.7.3 Condominium complexes that have average interior DNL/CNEL noise levels equal to or greater than 45 dB may be considered to be noise impacted.

Note: Properties that have average interior DNL/CNEL noise levels less than 45 dB would not be considered noise impacted. However, the mitigation treatment plan will be based on actual units impacted. As in all the calculations using interior noise level, the interior noise level values should not be rounded up. An interior noise level of DNL/CNEL 44.7 dB should not be rounded up to 45 dB. Rounded noise levels are invalid for the purposes of AIP/PFC funding.

8.6.8 Educational Facilities.

8.6.8.1 **Testing Sample.**

8.6.8.1.1 Educational facilities are generally one-of-a-kind structures that may have expanded with multiple additions as the building use changed over time.

8.6.8.1.2 Multiple additions over time result in changes in construction materials and techniques. Roof construction, window-glazing, ventilation systems, room sizes, and finishes may be different. Therefore, it is important to do acoustical testing in all variations of rooms. Rooms such as libraries, fixed-seat auditoriums, and educator offices should each be tested separately.

8.6.8.1.3 For rooms that are similar (such as classrooms) a minimum of 10 percent should be tested with a minimum sample of two rooms, as long as the room sizes are identical and the year of construction does not differ. For example, if a facility has 10 classrooms of identical size in a building built in 1967 and four new classrooms of identical size added in 1982, then a minimum of two classrooms should be tested in the 1967 building. Two should be tested in the 1982 building.

8.6.8.1.4 The selection of the testing sample for educational facilities can be summarized with two guidelines:

- Perform acoustical testing in each room that is unique, i.e., libraries, fixed-seat auditoriums, and educator offices.
- Perform acoustical testing in a minimum of 10 percent of classrooms of similar size and construction style, with a minimum sample of two classrooms.

8.6.8.2 **Exterior Leq.**

8.6.8.2.1 Exterior noise levels for educational facilities should also be based on the FAA-accepted noise contours in the NEMs. However, for educational facilities, the Leq noise metric is used to represent the average noise level during the hours of the normal school day. The exterior Leq noise levels should be based on the noise contour or a specific grid point analysis using the AEDT model.

8.6.8.2.2 The first step in the assessment of educational facilities is to discuss with school officials the normal class hours and types of activities occurring outside of the normal classroom hours. Once the time period is known, the period of the Leq can be determined. In addition to day classes, schools of higher (post-secondary) education often have classes in the late afternoon and early evening. Normal hours for primary, middle, and secondary are usually daytime. They may have after-school programs and evening events.

8.6.8.2.3 Options to determine the appropriate Leq noise level include:

- Facility with normal classroom hours, plus after-school and evening activities – Use the Leq (day) or the 15-hour Leq noise metric from AEDT. The Leq (day) represents the Leq from 7:00 a.m. to 10:00 p.m. and is easily extracted from the AEDT modeled results.
- Facility with normal classroom hours – Obtain hourly operations data and run hourly Leq in AEDT for school hour period for average day or annual average day.

8.6.8.2.4 The determination of the appropriate Leq for educational facilities should be discussed in the ATP and approved by the ADO.

8.6.8.2.5 For educational facilities with multiple or very large buildings, the exterior noise levels should be based on the highest noise contour area of the complex and a grid-point analysis at the location of the building(s) located outside of the DNL 65 dB noise contour. Specific noise levels for educational facilities are listed in Table 8-12.

Table 8-12. Specific Noise Level Assumptions for Educational Facilities

Exterior DNL/CNEL	For Properties Located:	Assumption
75 dB	within the 70 to 75 dB noise contours	≥70 dB or ≤75 is rounded to 75 dB
70 dB	within the 65 to 70 dB noise contours	≥65 dB or <70 dB is rounded to 70 dB
Actual Grid Point Level, dB	outside the 65 dB noise contours	all Leqs of <65 use actual rounded grid point level

8.6.8.2.6 As stated, acquisition should be the mitigation strategy for areas above 70 DNL/CNEL. The FAA does not normally approve sound insulation for these areas because it is challenging to sound insulate structures at these noise levels. The airport operator or sponsor should consult with their ADO about acquisition strategies in these areas.

8.6.8.3 **Measured NLR.**

Airport sponsors, operators, or their consultants will conduct acoustical testing for all habitable rooms specified in the ATP for the educational property. As a consistent metric used throughout the sound insulation programs, the NLR is typically used to judge their overall effectiveness. Testing may be done on a minimum of 10 percent of all rooms that are similar such as classrooms (but must include at least 2 rooms), and on 100 percent of the rooms considered one-of-a-kind such as libraries. Measurements will be conducted both outside and inside of the habitable rooms as outlined in Section 8.3.

8.6.8.4 **Interior Leq.**

The interior Leq noise level is calculated by subtracting the overall or broadband measured NLR for a room from the exterior Leq from an airport's FAA-accepted NEM. This equation is expressed as:

Exterior Leq – NLRRoom = Interior LeqRoom

8.6.8.5 **Determination of Average Interior Leq.**

8.6.8.5.1 An average interior Leq should be developed for each building. The average should be the median value of the interior Leq noise levels of all habitable rooms within the property tested.

8.6.8.5.2 Buildings that have average interior Leq noise levels equal to or greater than 45 dB would be considered noise impacted. Properties that average Leq levels less than 45 dB would not be considered impacted.

Note: In any calculation using interior Leq, the interior Leq value should not be rounded up. An interior Leq of 44.7 should not be rounded up to 45. Rounded noise levels are invalid for the purposes of AIP/PFC funding.

8.6.9 Other Facilities.

Other facilities are structures such as places of worship and may include other one-of-a-kind structures such as medical buildings, daycare centers, or other structures where habitation, assembly, or teaching may occur.

8.6.9.1 **Testing Sample.**

Construction materials and techniques will vary widely. Roof construction, window glazing, air ventilation systems, room sizes, and finishes will be different. For these one-of-a-kind structures, it is likely

that no two rooms are the same. Therefore, airport sponsors or operators will do the acoustical testing in all variations of rooms. If identical rooms are present in these structures, then a minimum of two rooms should be tested. For large rooms within these structures, such as the nave or sanctuary in a place of worship, or a large hall with fixed seating, the minimum is two tests at two different locations within the room.

8.6.9.1.1 **Exterior DNL/Leq/Lmax.**

Exterior noise levels for other facilities should also be based on the FAA-accepted noise contours in the NEMs. However, the proper noise metric depends on the use of the facility. For example, residential portions of places of worship or fire stations may dictate the use of DNL/CNEL, which factors in the more sensitive nighttime component. Day care centers that offer instruction and educational activities may be more suited for the use of Leq. There are limited situations where Lmax may be the appropriate noise metric. Lmax could be considered when an airport has few operations but the aircraft are exceptionally loud. The proper noise metric to use for other facilities should be discussed in the ATP and reviewed with the ADO.

8.6.9.2 **Measured NLR.**

8.6.9.2.1 Airport sponsors or operators and their consultants will conduct acoustical testing for all habitable rooms specified in the ATP classified as *other facilities.* As for other SIP testing NLR will be used to judge the overall effectiveness of sound insulation.

8.6.9.2.2 It is reasonable to expect that 100 percent of the habitable rooms will need to be tested since they are likely to be individual, one-of-a-kind rooms. Measurements will be conducted both outside and inside of the habitable rooms as outlined in Section 8.3 and according to the standard procedures and industry-accepted guidelines outlined in the most current version of SAE ARP 6973.

8.6.9.2.3 The interior DNL/Leq/Lmax noise level is calculated by subtracting the overall measured NLR for a room from the exterior DNL/Leq/Lmax from an airport's FAA-accepted NEM. This equation is expressed below, as:

Exterior DNL/Leq/Lmax – NLR = Interior DNL/Leq/Lmax

8.6.9.3 **Determination of Average DNL/Leq/Lmax.**

8.6.9.3.1 As stated in the AIP Handbook an average interior DNL/Leq/Lmax should be developed for each property. The average should be the median value of the interior DNL/Leq/Lmax noise levels of all habitable room within the property.

8.6.9.3.2 Properties that have average interior DNL/Leq noise levels equal to or greater than 45 dB would be considered noise impacted. Properties with noise levels less than 45 dB would not. Properties using Lmax noise levels, however, may use different criteria level other than 45 dB.

Note: In any calculation using interior noise level, the interior noise level value should not be rounded up. An interior noise level of DNL/Leq 44.7 dB should not be rounded up to 45 dB. Rounded noise levels are invalid for the purposes of AIP/PFC funding.

8.7 Application of Modeled Results.

8.7.1 Background.

8.7.1.1 The NLR is typically determined through measurements, but it may also be calculated through acoustical modeling. Modeling of individual rooms or homes can result in a fair level of fidelity, but it cannot take into consideration all factors that determine noise reduction such as vents, leaks, and the condition of windows, doors, etc. Moreover, the acoustical properties of many structural elements are unknown, or at best, not well documented. Accordingly, the modeled results are not sufficiently accurate to determine airport sound insulation program eligibility. Therefore, acoustic modeling should be reserved, in most cases, for application to the design process.

8.7.1.2 In some cases, modeling NLR coupled with the aforementioned verification (field testing immediately prior to installing insulation) could be an approach when extenuating circumstances (such as public health) prevent widespread entry into homes for field testing. If extenuating circumstances exist and this is being contemplated, the ADO must consult with APP-400 on a case-by-case basis.

8.7.2 Modeling for Design Purposes.

8.7.2.1 As part of the design process for sound insulation programs, consultants may determine or predict how using (or replacing) different insulation products affect an NLR modeling their acoustical properties. The modeling is usually validated by measured data.

8.7.2.2 To project changes in an NLR, the consultant will typically model the existing room conditions, validate the modeled results with measured data, and then change the room conditions by entering data measured for new acoustical products such as windows or doors. The new windows and doors will result in the decibel change as modeled.

8.7.2.3 Differences in assumptions and approaches may lead to differences in the absolute estimate of NLR. However, modeling is a valuable and necessary part of the design process where calculation of *differences* in NLR resulting from modifications are required.

8.8 **Acoustical Retesting.**

During the initial testing, certain conditions may have existed in which acoustical testing was not ideal. This section discusses the process of retesting structures to determine interior noise levels.

8.8.1 Background.

8.8.1.1 The process for retesting is the same as for initial testing. Acoustical testing measures the NLR of all the habitable rooms.

8.8.1.2 An average interior DNL/CNEL should be developed for each property. The average should be the median value of the interior DNL/CNEL noise levels of all habitable rooms within the property tested.

8.8.2 Conditions for Retesting.

8.8.2.1 In certain situations, it would be advantageous for the property owner to have the structure retested, such as when the average interior DNL/CNEL may have been lower than actual conditions warranted. Less than ideal conditions include:

- A locked habitable room prevented access for testing.
- Local conditions such as lack of overflights (if using the overflight method of testing), may not have allowed testing of certain rooms during the initial test period.
- The exterior of the most sound-transmitting element in a room may have been blocked.
- Access to the interior of the most-sound transmitting element in a room may have been blocked.
- Hurricane shutters may be blocking the windows.
- Vehicles, such as motor homes or boats, may be blocking the element.
- The structure has an exceptional amount of material in the interior (furniture, window drapes, heavy carpeting).

8.8.2.2 Under these and similar conditions, retesting could result in different findings. A property could be determined as noise impacted.

8.8.3 Provisions for Retesting.

8.8.3.1 With the determination of noise impact based on interior DNL/CNEL levels being at, or greater, than 45 dB, a slight change in the noise level measurements and calculation can make a difference between a property being noise impacted, or not impacted. Therefore, FAA will accept the results from retesting based on the conditions outlined in Section 8.8.2. If the result of retesting indicates that a property now has interior DNL/CNEL levels at, or greater than 45 dB, the property may be considered noise impacted.

8.8.3.2 The ADO approves or disapproves a request for acoustical retesting.

8.9 Recommendations for Retesting.

To maintain as much consistency as possible during the retesting, it is important to recreate the original testing conditions and setup to the extent possible. To do this, airport operators or sponsors should consider these measures:

- Use the same acoustical consultant (if possible) to maintain a consistent measurement method.
- Ensure the measurement techniques of the engineers conducting the tests are similar, or at least based on a standard measurement method.
- Place the loudspeaker in the same location, verified by using documentation collected during the initial tests.
- Measure exterior and interior ambient levels to ensure that ambient levels do not impact the results.
- Use the same sound meters that were previously used, and conduct daily calibrations to minimize instruments' margins of error.
- Conduct the exterior noise measurements in the same location (flush, near-field, or free-field).
- Measure the interior noise in the same location (opposite the major sound-transmitting element in the room or opposite the exterior façade).
- Ensure that interior conditions are similar using documentation collected during the initial tests. Internal room acoustics such as the type of flooring, presence of drapes, and large soft furnishings can affect the measurements. Before and after photographs should be used for these comparisons.

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CHAPTER 9. REPORTING AND CLOSEOUT

9.1 Background.

Project reporting needs to be part of the program when established and practiced continuously throughout the implementation of a SIP. Continuous reporting allows for accurate records when closing out the project, responding to intra-agency information requests, or during an audit process. Airport operators or sponsors should consult with the local ADO early in the SIP process if they have any questions on reporting and closeout requirements. The AIP Handbook and 49 CFR 18.40 provide reporting, closeout guidelines, and procedures.

9.2 Quarterly and Annual Reporting.

9.2.1 The AIP Handbook discusses Quarterly Performance Reporting. Quarterly Performance Reports are required for federal grant projects. Construction projects, like those included in a SIP, follow all requirements listed in the AIP Handbook, such as:

- Submission of appropriate forms (FAA Form 5370-1, Construction Progress and Inspection Report).
- Submission of appropriate forms each fiscal quarter until the project is complete.
- Submission of additional forms if there is a major project change or schedule change, per FAA ADO, RO, or Headquarters requirements.

9.2.2 Monitoring and reporting guidelines are also provided in 49 CFR 18.40. These guidelines require the airport operators or sponsors, as grant recipients, to be responsible for all day-to-day-operations while complying with federal regulations and requirements. It also requires a quarterly performance report, due within 30-days of the end of each fiscal quarter. The report will typically require a range of information:

- Proposed objectives vs. actual accomplishments throughout the period (including all schedules).
  - Acoustical testing results
  - Pre and post construction
  - Outreach activities
  - Design status
  - Construction (sound insulation) progress, including addresses and mapping of structures tested, and those impacted and not impacted based on testing.
- Explanations for not meeting deadlines or proposed objectives (when applicable).
- Impacts to any other phases of the SIP.
- Explanation of additional funding needs or additional costs.

9.2.3 The AIP Handbook discusses Annual Reporting of Annual Residential Population Benefits. This section requires FAA ADOs to provide an annual report on the number of residents and students that benefit from noise compatibility projects to APP-400.

9.2.4 Reporting Documentation Organization.

9.2.4.1 It is recommended that airport operators or sponsors include an outline of reporting timelines and other commitments to FAA in the project scope of work. For ease of reference, it can list the required reporting documents, and formats for reporting and closeout.

9.2.4.2 Flow and Gantt charts can assist in organizing the project reporting process. The development of a step-by-step process can strengthen the relationship between the airport and the community by allowing the community to understand how progress in the program will be tracked and reported.

9.2.4.3 In addition to charts, airport operators or sponsors should develop a reporting and closeout schedule. They work closely with their ADO to determine timeline requirements, and address or anticipate important issues. As mentioned previously, 49 CFR 18.40 requires airport operators or sponsors to submit quarterly performance reports within 30-days of the end of the reporting period.

9.2.4.4 The reporting and closeout process can produce a large number of documents. Therefore, airport operators or sponsors may consider using a computer tracking system. Program tracking systems are discussed in more detail in Section 9.4.1.1. Airport operators or sponsors may also create a simple spreadsheet/database to track SIP progress. It could include the following fields/data items:

a. Property address and identification, with the location noted on the NEM
b. Property Owner (dates) – if owners decide not to participate in the program, then additional information is not needed after this entry
c. Initial owner outreach
d. Property owner orientation
e. Entry authorization received
f. Predesign Activities (dates)
g. Property inspection survey
h. Acoustical test results (pre- and post-construction)
i. Environmental tests
j. Property inspection report
k. Preliminary acoustic design report
l. Preliminary environmental test reports
m. Draft scope of work
n. Design budget
o. Design schedule

p. Task order prepared
q. Task order submittal
r. Design Activities (dates)
s. Design surveys
t. Schematic Design
u. Design Development
v. Construction Documents (drawings and specifications)
w. Avigation Easement Process
x. Certification of compliance with all required federal contract provisions, including Buy American
y. Issues
z. Notes
aa. Actions required

9.3 **Closeout Reporting.**

9.3.1 The FAA's goal is to close out active grants within three years from acceptance by the airport operator or sponsor, or as quickly as possible.[58] The regular and continuous reporting recommended throughout the SIP should result in an efficient closeout reporting process.

9.3.2 Airport operators or sponsors should submit closeout documents within 90 days of completing post-construction testing or construction, whichever is later. Any potential or real delay that may result in missing the target closeout date should be discussed with the FAA ADO.

9.3.3 When an airport operator or sponsor has multiple AIP grants in a SIP, they should submit closeout documents to the ADO within 90 days of completing the work that was included in the scope of work for that grant. For example, an operator may have a grant for conducting a Part 150 study; a subsequent grant for developing the SIP PPM, surveys and Testing Plan; a third grant for acoustical testing, and hazardous materials testing and design; and a fourth grant for construction of the first SIP phase. For each of these grants, the sponsor should submit closeout documents as soon as the work within each grant is completed (within 90 days of completion).

9.3.4 Project Work Completion: Final Documents.

9.3.4.1 The essential closeout documentation may vary depending on the project type and size. However, the closeout process will typically address the areas listed below. Areas may be omitted if they do not apply to the project. Airport operators or sponsors should consult with the ADO to determine closeout items to be submitted.

[58] Legislatively, the grant starts when the airport signs the agreement. Airport operators or sponsors should contact their ADO (or Regional Office for Regions without ADOs) for questions or clarifications on grant assurances.

a. As-built plans. Plans demonstrating the treatments (retrofit or unit installations) installed in each structure or public building.
b. Updated property map. The airport's land use plan may need to be updated to demonstrate the SIP accomplishments.
c. A list of structures sound insulated during the period, including construction start and end dates.
d. Address
e. Year structure constructed
f. Location noted on the NEM
g. A list of structures not participating or found not to be impacted by airport noise.
h. Structure addresses
i. Reason for non-participation
j. Certification of compliance with all required federal contract provisions, including Buy American.
k. Final construction project closeout report.[59] These must be submitted by the airport operator or sponsor with an accurate record of the project. The length and format may vary based on the project size and type. Airport operators or sponsors should consult with their ADO to determine the necessary items for this final report. Typically, unless otherwise specified, the report will include the following sections:
l. Project Summary – The location of the airport, grant agreement date, amount of grant amendments, narrative of the work accomplished, summary of key milestones, acoustical engineer's report, and contract time (includes explanations for weather delays and liquidated damages).
m. Executive Summary – Summary of compliance with federal grant assurances, program budget (with explanation of expenses), historic properties (discussing Section 106 actions), land use compatibility, labor and Buy American provisions, administrative, engineering, construction costs, and force account (the construction work requested, completed, and paid for outside of the main contract).
n. Project Cost Summary – List with descriptions of all project costs.
o. Partial Payment History Summary – Explanation and proof of all payments for grant reimbursement.
p. Change Order Summary – Included in the financial summary, it accounts for any changes to the budget affected by consultant contract amendments. Also includes construction change orders.
q. Final Inspection and Punch List Item Clearance – Includes punch list items, inspections, and reports from pre- and post-inspections.
r. Project Review Comments and Certification Summary – Completed in checklist format.
s. Disadvantaged Business Enterprise (DBE) Program Participation Summary – Typically the Equal Employment Opportunity office will

[59] See Appendix B of ACRP Report 89, Guidelines for Airport Sound Insulation Programs for sample Project Closeout Report.

fill in the DBE use forms. However, the airport operator or sponsor may need to provide background and basic information.

t. Final Payment Recommendation and Project Amendment Requirement – Includes any excess payments and fiscal adjustments.
u. Administrative Requirements – Includes final outlay report, summary of DBE use, property accountability, and submittal of federal grant assurances.
v. Financial Requirements – Includes final project cost summary, block grants, excess payments, and fiscal adjustments.

9.3.4.2 The final report form is required by 49 CFR § 18.41 and must be signed by the airport operator or sponsor or grant administrator.

9.4 Links to Tools, Forms, and Templates.

This section provides descriptions of the tools, forms, and templates that airports operators or sponsors, consultants, and contractors can utilize during the SIP process. Examples of some of these forms and templates are in Appendix B of ACRP Report 89, Guidelines for Airport Sound Insulation Programs and Appendix C.

9.4.1 Tools.

9.4.1.1 An airport operator or sponsor should consider a program-tracking system to assist in organizing extensive SIP files and documents. Case Management Systems and Document Management Systems are common program-tracking systems used during the SIP process. Sufficient training should be provided to the individuals using the system to ensure efficiency and accuracy. The systems can perform tasks such as:

a. Track program costs
b. Track eligible FAA reimbursable expenses
c. Identify impacted and non-impacted parcels
d. Identify all participating and non-participating property owners
e. Perform as a web-based tool
f. Include program database
g. Provide parcel mapping
h. Archive all program files in a searchable format
i. Track users and user rights
j. Host all program communications in a secure environment.[60]

9.4.1.2 Airport operators or sponsors should not rely on the tax assessor information from the Part 150 study. The tax assessor information may not include the appropriate amount of information needed for the SIP. Airport operators or sponsors should consider conducting a land use survey. This can be managed through Case Management Systems.

[60] Modified from ACRP Report 89, Guidelines for Sound Insulation Programs.

9.4.2 Forms.

FAA Form 5370-1, Construction Progress and Inspection Form[61] is used for AIP-funded projects to report progress on construction activities. The airport operator or sponsor maintains these forms and submits them to their ADO. The form is not required, but the FAA may request it. Airport operators or sponsors may use other forms with the same information.

9.4.3 Sample Documents.

Samples of the types of SIP documents described in Table 9-1 are included in Appendix B of ACRP Report 89, Guidelines for Airport Sound Insulation Programs.

Table 9-1. Examples of Types of SIP Documents

Document Type	Use and Content
Structure Owner Introductory Letter	• Sent to the structure owners that are within the DNL 65 dB contour (Part 150) or significantly noise impacted area (Record of Decision) to introduce the SIP, and request information. • Describes the program to the residents and briefly describes the SIP process. • May request structure owners complete an owner interest sheet and property survey.
Structure Owner Interest Sheet	• Sent to structure owners with the introductory letter to determine interest in being considered for the SIP. • Does not guarantee structure owners will test into the program, but determines how many structures will need to undergo pre-construction acoustical testing.
Structure Owner Property Survey	• Sent to structure owners with the introductory letter. • Includes questions on the existing conditions of the structure and if modifications have been completed in the past. • Provides the project team with an initial understanding of the structure and its occupants.

[61] See FAA AC 150/5370-12, Quality Management for Federally Funded Airport Construction Projects. The form can be downloaded from http://www.faa.gov/airports/resources/forms/.

Document Type	Use and Content
Structure Owner Property Survey Report	• Compilation of the results of the structure owner property surveys and preliminary property surveys that the airport operator or sponsor conducts. • Describes the overall project and program, the types of buildings, layout of each building, number of habitable rooms, images of each habitable room, and describes any previous modifications to the structure/building.
Participation Application	• Sent to all structure owners that completed the structure owner interest sheet and structure owner property survey. • Requires the participant to provide brief information regarding their structure and number of occupants. • Differs from the aforementioned structure owner property survey (a detailed questionnaire about the specifics of the structure). The participation application form provides owner information, contact information, brief property information, and a release of building records. • All information from the participant application should be confidential throughout the program. The application is considered an agreement to move forward with the testing portion of the SIP. It requires the owner's signature on the participation application and avigation easements (if necessary).
Impact Testing	• Includes the ATP and the Final Impact Determination. • The ATP provides information and describes the overall methodology of the impact testing, a summary of the property survey report, and the criteria for structures to be considered for participation in the SIP. • Plans are described for each type of structure within the program boundary. The final section of the ATP should describe the final impact determination.

Document Type	Use and Content
Structure Owner Participation Agreement	• Describes the terms and conditions of the SIP, defines terms, estimates hours of work during the construction period, and provides additional legal requirements. • Required as documentation of all property owner work/participation agreements. • Property owners should be notified of the noise program, fill out initial program application, sign a participation agreement (if private property owner), and participate in pre- and post-questionnaires. • Avigation easements can be included. However, the FAA does not require them.
Structure Owner Orientation Letter	• Sent to participants who have signed the participation agreement, and whose structures were found to be impacted and included in the SIP. • Provides information regarding the time and location of orientation meetings. This should be mandatory for impacted participants. • Should provide the appropriate SIP contact information to residents in case of questions or concerns.
Pre-existing Deficiency Structure Inspection Report	• Used to determine if any structural issues currently exist in the structure. • Prepared by the airport owner's project team. • Should provide enough detail so the structure owner and project team understand deficiencies that existed prior to construction. • Structure owners should review the report and sign a pre-existing deficiency release.
Pre-existing Deficiency Release	• Provided to structure owners for signature to confirm their agreement with the finding in the pre-existing deficiency structure inspection reports. Once the structure owner formally agrees, the SIP process may continue.

Document Type	Use and Content
Design Waivers	• May be required depending on the geographic location of the program. A moisture waiver may be required. A wood door waiver should be required to provide the project team the appropriate liability. • Moisture waivers may be required for structures that are located in areas of high humidity in which moisture can accumulate inside the structure. The waiver requires the structure owner to acknowledge that the construction for the project may have a negative effect on pre-existing moisture problems by increasing indoor air humidity. The structure owner agrees to assume responsibility of all the pre-existing moisture issues identified on the moisture waiver. • A wood door waiver is required if wood doors are to be installed on the structure. It explains the manufacturer's warranty and potential complications that may occur due to seasonal or environmental changes. The waiver states that the structure owner understands the potential impacts of the installation of a wood door. It ensures the consultant and airport operator or sponsor are not liable for any complications after installation due to potential effects listed in the waiver.

Document Type	Use and Content
Program Bid Documents	The bid process for general contractors for the construction portion of the SIP should include, at a minimum: bid advertisement; pre-bid meeting; instruction to bidders; general contractor statement of qualifications; bid form; contractor award recommendations; and award of contract. • Airport operators or sponsors should post the bid advertisement at least 30 days before a pre-bid meeting. The Airport operators or sponsors should submit evidence of the bid advertisement to the ADO (either at the time of advertising or in the AIP grant application). • The pre-bid meeting is provided for all interested general contractors. The agenda for the meeting should provide a project overview, special conditions, bidding requirements, project requirements, and other legal information. During the pre-bid meeting, potential bidders should be provided with instructions on the bidding process for the project. • General contractors then submit bid packages before the bid opening. The bid package should comply with requirements of the AIP Handbook. It generally includes qualifications of the contractor team, and costs of labor and materials, and a notarized and authorized signature from the contractor. The Contractor Award Recommendations letter is developed by the Design Consultant/Project Architect(s) and airport operator or sponsor to announce the winner of the general contractor bid process. It should provide the name of the general contracting company and describe how the company was chosen as the bid winner, along with a signatures from the consultant team, airport operator or sponsor, or both. This letter should be sent to the ADO for review and approval, or acceptance.

Document Type	Use and Content
Avigation Easement (and mortgage subordination form)	The FAA does not require avigation easements for AIP grants. However, FAA encourages airport operators or sponsors to receive easements from property owners if sound insulation is provided. • Easements provide documentation that the property is compatible under the NCP. Airports should consult with their legal counsel to determine the language to be included in an avigation easement. • A mortgage subordination form may be required to be signed by the resident's mortgage company. It provides the airport and project team permission to move forward with the avigation easement. A mortgage subordination fact sheet with additional information may be provided with the form. The final documentation avigation easement is signed by the airport operator or sponsor, structure owner, and any additional individuals that the airport or team find pertinent (e.g. city or county officials).
Weekly Progress Report	The airport operator or sponsor or FAA can require weekly Progress Reports. The project team should submit the reports. It should briefly describe the work completed in the current period, pertinent observations, and anticipated work for the upcoming period.
Final Project Closeout Report	In accordance with the grant closeout process, the final project closeout report must be submitted to the FAA at the end of the SIP (after all phases have been completed). The report should describe the program, process, and what was completed and include a cost summary and any recommendations.
Final Completion Documentation	The contractor, program manager/construction manager, and airport operator or sponsor should sign a Certificate of Final Completion. It should be submitted to the FAA along with the closeout report. This can be submitted to the FAA as each phase is completed and at the end of the entire SIP.

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APPENDIX A. ROLES AND RESPONSIBILITIES MATRIX

The table below shows letters for responsibilities as follows:

R: Responsible, **A**: Assists, **C**: Consulted, and **I**: Informed

Project Task	FAA ADO Project Manager	Airport operator or sponsor	Airport operator or sponsors Program Manager	Property Owner Liaison	Legal Consultant	Design Consultant / Project Architect	Mechanical or Ventilation Engineer	Hazardous Materials Consultant	Electrical Engineer	Structural Engineer	Acoustical Engineer	Construction Manager / Resident Engineer	Contractor	Historic Property Professional	Property (Structure) Owner
Select project team & administer contracts	I	R													
Communicate with Program Manager	I		R	I	I	I	I	I	I	I	I	I	I	I	I
Identify and prioritize program participants	C	R	A	I											
Notify and maintain contact with eligible participants	I	C	A	R											
Maintain parcel file & database information			A	R	A	C									
Prepare legal documents and conduct title search		C	I	A	R									I	
Handle all correspondence and questions from Property Owners		I	C	R	A	A									
Conduct pre-existing deficiency and hazardous materials inspection at each eligible property			C	A		R	A	A	A	A					
Prepare pre-existing report & legal release		I	I	A	C	R	C		C	C				C	
Prepare hazardous materials assessment report			I	A		C	R								
Record Avigation Easement			I	A	R										I
Conduct pre-construction and post-construction acoustical testing			I	A		C					R				
Conduct pre-construction and post-construction ventilation testing			I	A		C	R								
Conduct design survey to observe and define pre-existing ventilation characteristics			I	A		C	R								
Determine the replacement and/or addition of mechanical equipment			I			C	R							I	
Determine electrical panel upgrade and design wiring for mechanical equipment installation			I			C	A		R						
Determine the extent of a structural condition			I			C				R				I	
Identify historic properties and coordinate with SHPO														R	
Prepare ventilation, insulation and mechanical design recommendations			I			C	R								

Project Task	FAA ADO Project Manager	Airport operator or sponsor	Airport operator or sponsors Program Manager	Property Owner Liaison	Legal Consultant	Design Consultant / Project Architect	Mechanical or Ventilation Engineer	Hazardous Materials Consultant	Electrical Engineer	Structural Engineer	Acoustical Engineer	Construction Manager / Resident Engineer	Contractor	Historic Property Professional	Property (Structure) Owner
Develop abatement specifications and documents detailing abatement procedures and requirements			I			C	A	R							
Conduct new product review			I			A					R				
Conduct design review with property owner			I	A		R									C
Select window and door colors and styles for individual homes			I	A		C								A	
Prepare final plans and specifications			I			R	A	A	A	A	A			I	
Prepare bid documents	C	I	R	A	A	A	A	A	A	A	A				
A Review bids and prepare award recommendation	C	I	A			R						A			
Award and execute construction contract	C	R	A		A							I			
Perform specified modifications and install specified products per plans and specifications		I	I									C	R		I
Perform air quality monitoring during the abatement process			I	A		C		R							
Ensure Contractor DBE and payroll compliance			I		C	A						R	I		
Perform daily site visits in each property under construction			I	A		C						R		C	I
Photograph documentation of each home prior to and during construction			A									R		C	
Review contract RFIs and requests for change orders			I	I		C	C	C	C	C	C	R	C		I
Perform punch list walk-thru inspection for quality and completion of work			I	I		C						R	I		I
Correct punch list items and warranty issues			I	I		C						C	R		I
Review & approve General Contractor pay requests		I	C			A						R	C		
Perform final inspection		I	A			A						R	C		I
Provide warranty package to property owner			I	R								C	A		I
Assist with preparation of grant close-out report for FAA	I	C	R									A			

APPENDIX B. LIST OF DEFINITIONS AND ACRONYMS

B.1 Definitions.

This appendix contains definitions of terms and acronyms used in this advisory circular (AC). For easy reference, it also contains certain terms used in related ACs and Orders. Pertinent parts of U.S. Code of Federal Regulations (CFR), ACs, and other publications are available on www.faa.gov/.

Statues/Regulations	Term	Definition
2 CFR Part 200		Uniform Administrative Requirements, cost Principles, and Audit Requirements, Subpart D.
14 Code of Federal Regulations (CFR) Part 150		"Airport Noise Compatibility Planning," this regulation describes the procedures, standards, and methodology for developing noise exposure maps, noise compatibility programs, and the FAA's process for approving these programs. It also establishes a single system for measuring noise exposure and outlines compatible land uses for varying levels of exposure.
14 CFR Part 150 Record of Approval		FAA issues a record of approval at the conclusion of a Part 150 study. This includes actions that the airport recommends be taken and indicates only that the actions would, if implemented, be consistent with the purposes of 14 CFR Part 150. The approvals do not constitute decisions to implement the proposed actions or a commitment by the FAA to provide federal financial assistance for the actions.
49 USC § 47504		Noise Compatibility Programs.
	Acoustical Engineering	Branch of engineering dealing with sound, vibration, design, analysis, and control of sound. It is the application of acoustics in technology.
	Acoustical Test Plan	A document detailing the testing scope, testing activities, testing objectives target market, test environment, data requirements, safety considerations, and installation of the test article.

Statues/Regulations	Term	Definition
	Airport	Per 49 USC § 47102(2), an airport is an area of land or water used, or intended to be used, for aircraft landing and taking off.
	Airport Authority	An independent entity charged with the operation and oversight of an airport or group of airports. A group of airport commissioners, who are appointed to lead the authority by a government official, often govern these authorities. When the authority of an entity encompasses more than just the airports in an area (e.g., harbor facilities, rail facilities), the entity may be referred to as a port authority.
	Airport Operator	The administrator, sponsor, or manager of an airport that regularly serves scheduled passengers of a certificate holder (air carrier).
	Airport Property Map	An airport property map is a drawing depicting the airport property boundary, land or property interests (including method of acquisition and type of interest), and future proposed land acquisition. The Airport Property Map is required as part of an Airport Layout Plan drawing set if any of the airport land was acquired with federal funds or through an FAA administered land transfer program. An airport property map is not a substitute for a property inventory map, unless it is prepared in accordance with the requirements in the current version of Advisory Circular 150/5100-17, Land Acquisition and Relocation Assistance for Airport Improvement Program Assisted Projects.
FAA Order 5100.38, *AIP Handbook*		AIP Handbook provides guidance, policy, and procedures used in the administration of the Airport Improvement Program.

Statues/Regulations	Term	Definition
FAA Order 5190.6 *Airport Compliance Manua*l	Airport Revenue	FAA Order 5190.6, Airport Compliance Manual defines airport revenue as "paid to or due to the airport operator or sponsor or sponsor for use of airport property by the aeronautical and nonaeronautical users of the airport. It also includes revenue from the sale of airport property, and resources and revenue from state/local taxes on aviation fuel."
49 USC § 47102(26)	Airport Sponsor	49 USC § 47102(26) as: a. A public agency that submits to the Secretary under this subchapter an application for financial assistance; and b. A private owner of a public-use airport that submits to the Secretary under this subchapter an application for financial assistance for the airport.
	Allocation	An allocation is the FAA notification to the sponsor of the intent to obligate funds by issuing a grant. It does not involve a transfer of funds. It is an internal administrative re-delegation of the authority to incur obligations and make expenditures.
49 USC § 47110	Allowable Cost	The cost of an item or activity that can be funded with AIP per 49 USC § 47110.
	Amendments	A formal change to the terms or scope of a grant agreement.
49 USC § 50101	"Buy American" Waiver Request	A waiver of 49 USC § 50101 preferences submitted as a request to the FAA ADO before an airport operator or sponsor proceeds with a change order that involves using less than 100% United States steel or manufactured goods. An airport operator or sponsor may have to obtain prior approval from the FAA ADO for contract changes if under the Buy American Review.
	Applicant	Person or entity that makes a formal application.

Statues/Regulations	Term	Definition
	Approving Official	An agency official with approval authority for government actions or documents.
	Avigation Easement	An avigation easement is an easement or right of overflight in the airspace above or near a property. It also includes the right to create such noise or other effects as may result from the lawful operation of aircraft in such airspace, and the right to remove any obstructions to such overflight.
	A-Weighted Sound Level	A quantity, in decibels, read from a standard sound level meter with A-weighting circuitry. The A-weighting scale discriminates against the lower frequencies below 1000 hertz according to a relationship approximating the auditory sensitivity of the human ear. The A-weighted sound level is approximately related to the relative "noisiness" or "annoyance" of many common sounds.
	Block Rounding	Expanding the SIP boundary to incorporate a neighborhood block and preventing the boundary from intercepting or splitting the block. In accordance with FAA policy, an airport operator or sponsor can propose to expand the noise mitigation boundary just beyond the DNL 65 contour to include parcels contiguous to the contour area. Conditions for FAA approval of Block Rounding proposals are contained in the *AIP Handbook*.
	Board	A committee of persons organized under authority of law to exercise certain authorities, have oversight or control of certain matters, or discharge certain functions of a magisterial, representative, or fiduciary character. Typically related to an Airport Authority or governing board.

Statues/Regulations	Term	Definition
14 CFR § 150.7	Compatible Land Use	Per 14 CFR § 150.7, the use of land that is identified as normally compatible with the outdoor noise environment (or an adequately attenuated noise level reduction for indoor activities) because the yearly day-night average sound level is at or below levels identified for that use, or a similar use, under Appendix A (Table 1) of 14 CFR Part 150.
	Consultant	Professional or entity (consulting firm) that gives advice and information to businesses, government, and other organizations on various specialized topics, or prepares analyses for those entities.
	Design Consultant/ Project Architect	Professional with expertise and necessary licenses to prepare design packages for implementation of SIPs, as well as construction cost estimates, bid documents, and construction plans.
	Easement	An interest in land owned by another person, consisting of the right to use or control the land, or an area above or below it, for a specific, limited purpose. (Also, see "Avigation Easement").
	Educational Facilities	A facility used primarily for instruction and learning. For educational facilities, habitable space is defined as classrooms, libraries, fixed seat auditoriums, and educator offices. Non-habitable space in educational facilities is generally defined as areas such as gymnasiums, cafeterias, and hallways, even if these areas are used for incidental instruction and includes restrooms. Facilities that are in leased storefront property are not considered education facilities.
	Electrical Engineer	Licensed professional responsible for designing electrical wiring and electrical panel upgrade, if necessary, during the SIP design process.

Statues/Regulations	Term	Definition
FAA Order 5100.38	Eligibility	Defined by FAA Order 5100.38, *AIP Handbook,* eligibility is determined by modeled noise impact and noise level reduction values determined through testing and refers to qualification for funding under the *AIP Handbook*.
	Equivalent Sound Level (Leq)	Also referred to as Equivalent Continuous Sound Level, a sound metric that quantifies the noise environment, or total noise energy, into a single sound level value over a period of time. Leq is a logarithmic value expressed in decibels (dB).
	FAA Noise Subject Matter Expert	FAA Noise Subject Matter Experts (SME) are the designated noise program specialists in each ADO. Responsibilities include: a. Conducting technical reviews of all aspects of noise programs and noise projects that may be considered under the Airport Improvement Program (AIP), or for Passenger Facility Charge (PFC) funding. b. Reviewing Scopes of Work, coordinating comments, and changes with the ADO Program Manager and airport operator or sponsor. c. Reviewing the SIP Policies and Procedures Manual (PPM); in particular the Acoustical Test Plan, providing comments to the airport operator or sponsor on any elements of the manual that are not in accordance with FAA policy and that would result in certain elements of the program not being considered for FAA funding. Coordinating with FAA noise experts in their RO and FAA Headquarters on an as-needed basis.

Statues/Regulations	Term	Definition
	Flush Method	A method where the microphone measures the sound level at a distance less than 1.5 inches from the façade, either by means of a scan over the surface of the façade, or by measurement at a number of fixed points.
	Free-field	A sound field region with no adjacent reflecting surfaces. In practice, a free-field can be said to exist if the direct sound is 6 dB or preferably 10 dB greater than reverberant or reflected sound.
	Grant Assurances	The obligations airport operators or sponsors, planning agencies, or other organizations undertake when they accept funds from FAA-administered airport financial assistance programs. These obligations require the recipients to maintain and operate their facilities safely and efficiently, and in accordance with specified conditions. The assurances appear either in the application for federal assistance and become part of the final grant offer, or in restrictive covenants to property deeds. The duration of these obligations depends on the type of recipient, the useful life of the facility being developed, and other conditions stipulated in the assurances.
	Hazardous Material	Material that contains properties that make it dangerous or capable of having a harmful effect on human health or the environment.
	Hazardous Material Consultant	Licensed professional responsible for conducting tests in impacted structures where hazardous materials may be located and supervising abatement work for impacted structures where hazardous materials are found.

Statues/Regulations	Term	Definition
49 USC § 47102	Hub Airport	49 USC § 47102 defines hub airports as commercial service airports meeting the following criteria. a. *Large hub* airports enplane at least 1% of the national annual passenger boardings per 49 USC § 47102(11). b. *Medium hub* airports enplane at least 0.25% but less than 1% of the national annual passenger boardings per 49 USC § 47102(13). c. *Small hub* airports enplane at least 0.05% but less than 0.25% of the national annual passenger boardings per 49 USC § 47102(25). d. *Non hub* airports enplane less than 0.05% of the national annual passenger boardings per 49 USC § 47102(14).
	Home	A residence or place where one lives permanently.
	Homeowner	A person or entity that owns a residence.
	Impacted Property Owner	Owner of a property with a structure that is impacted by noise from airport operations, as determined from a Part 150 Noise Exposure Map or National Environmental Policy Act of 1969 (NEPA) study.
	Legal Consultant	Professional responsible for preparing all legal documents associated with the SIP, including title certifications, participation agreements, avigation easements, and lender consent documents.
	Mechanical/Ventilation Engineer	Licensed professional responsible for designing necessary heating, cooling, ductwork, and ventilation systems during the SIP design process, and conducting pre- and post-construction ventilation tests. The Mechanical/Ventilation Engineer stamps all plans, specifications, and details used for bidding and construction.

Statues/Regulations	Term	Definition
	Modification to Standards	Any FAA-approved change to FAA standards (other than dimensional standards for runway safety areas) applicable to an airport design, construction, or equipment procurement project.
	Multi-Family Residences	Residential structures with multiple units.
	National Register Bulletin	Technical information on the National Register of Historic Places that provides guidance on evaluating, documenting, and listing different types of historic places.
	Near-Façade Measurement Method	A method where the sound level is measured by means of a scan over the surface of the façade at a distance of 5 feet.
	Near-field	That part of a sound field, usually within about two wavelengths of a noise source, where there is no simple relationship between sound level and distance, and where the sound pressure does not obey the inverse square law and the particle velocity is not in phase with the sound pressure.
	Neighborhood Equity	Case in which an airport operator or sponsor offers "secondary treatment" improvements to a few residences within the eligible noise contour threshold that do not meet the interior noise level requirements, and are scattered among residences that are impacted (meet the interior noise level criteria). Secondary treatments are minimal improvements such as caulking, weather stripping, installation of storm doors, or ventilation packages. If the airport operator or sponsor proposes to use neighborhood equity provisions, the FAA ADO has the option to approve this request if the operator or sponsor meets the requirements for Neighborhood Equity in the AIP Handbook

Statues/Regulations	Term	Definition
14 CFR § 150.7	Noncompatible Land Use	Per 14 CFR § 150.7, the use of land that is not compatible with the outdoor noise environment (or an adequately attenuated noise level reduction for any indoor activities involved) because the yearly day-night average sound level is at or below that identified for that use, or a similar use, under Appendix A (Table 1) of 14 CFR Part 150.
49 USC § 40117 Section 3 of 14 CFR Part 241	Passenger Facility Charge	A charge approved by the FAA that is imposed by a public agency on eligible revenue passengers enplaned at a commercial service airport it controls. Public agencies may use PFC revenue to finance FAA-approved projects that meet the requirements of 49 USC § 40117. Note that revenue passenger is further defined in Section 3 of 14 CFR 241, Uniform System of Accounts and Reports of Large Certificated Air Carriers.
	Post-Construction Acoustical Testing	Acoustical testing conducted after construction as part of the SIP implementation process to determine if the goals of the program were met.
	Pre-Construction Acoustical Testing	Acoustical testing conducted prior to construction, as part of the SIP implementation process, to determine if a structure is impacted.
	Programmatic Agreement	A document that outlines the terms and conditions agreed upon by FAA, State Historic Preservation Officer, Advisory Council on Historic Preservation, project sponsor, and other interested parties to resolve the potential adverse effects for a program of undertakings.

Statues/Regulations	Term	Definition
	Program Manager	In a sound insulation program, both the airport operator or sponsor and the FAA have program managers. a. The airport operator's or sponsor's Program Manager is an airport employee or consultant responsible for providing overall supervision of program development, implementation, and program management. b. The FAA ADO Program Manager works directly with the Airport operator or sponsor to plan and implement the SIP, with assistance from the FAA Noise Subject Matter Experts in their Regional Offices and FAA Headquarters.
	Project Testing Protocol	A formal document prepared by the airport operator or sponsor or its consultants, and approved by FAA, that outlines requirements, activities, resources, and the process to be used for acoustical testing of potentially impacted structures within a SIP boundary.
	Property	Land containing a structure(s) belonging to an individual or entity.
	Property Owner	The individual or entity that owns land with a structure(s) on it.
	Property Owner Liaison	Responsible for interacting with the property owners during the SIP process.
	Secondary Treatment	Refers to improvements such as caulking, weather stripping, installation of storm doors, or ventilation packages that are used as part of "Neighborhood Equity".
	Single-Family Residences	A structure with one habitable unit. The AIP Handbook defines habitable rooms for residences as living, sleeping, eating, or cooking areas, which includes living rooms, family rooms, dining rooms, bedrooms, kitchens, and offices.

Statues/Regulations	Term	Definition
	SIP Boundary	Geographical limits of the program based on a Part 150 Noise Exposure Map or mitigation area defined in a NEPA Record of Decision.
	SIP Phase	A component of a SIP that is considered feasible to complete based on financial considerations and constructability. The first SIP phase may be considered a pilot program.
	SIP Phase Boundary	Geographical limits of a SIP phase.
	Structure	A building that may be eligible for sound insulation.
	Windshield Survey	An assessment of potentially impacted structures conducted by traveling around the community to making observations externally about structure design and condition.

B.2 List of Acronyms

Acronym	Expanded Terminology
AC	Advisory Circular
ACRP	Airport Cooperative Research Program
ADO	Airports District Office
AIP	Airport Improvement Program
APP-400	Office of Airport Planning & Programming, Planning and Environmental
APP-500	Office of Airport Planning & Programming, Airports Financial Assistance
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers standards
ASNA	Aviation Safety and Noise Abatement Act of 1979
ATP	Acoustical Test Plan
CIP	Capital Improvement Program
CFR	Code of Federal Regulations
CMS	Case Management Systems
CNEL	Community Noise Equivalent Level

Acronym	Expanded Terminology
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSPP	Construction Safety and Phasing Plan
dB	Decibel, scientific unit of sound
dBA	A-weighted sound level in decibels
DBE	Disadvantaged Business Enterprise
DNL	Yearly Day-Night Average Sound Levels
DMS	Document Management Systems
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
FONSI-ROD	Finding of No Significant Impact-Record of Decision
GIS	Geographic Information System
HVAC	Heating, Ventilation, and Air Conditioning
LEED AP	U.S. Green Building Council (USGBC), Leadership in Environmental and Energy Design (LEED)®
Leq	Sound Equivalent Level
$L_{Ext,Close}$	Loudspeaker
$L_{Ext,Cal}$	Calibration Measurement
L_{max}	Maximum A-weighted noise level
NCP	Noise Compatibility Program
NEM	Noise Exposure Map
NEPA	National Environmental Policy Act of 1969
NLR	Noise Level Reduction
OINR	Outdoor/Indoor Noise Reduction
PFC	Passenger Facility Charge
POC	Point of Contact
PPM	Program Policy Manual
RFI	Request for Information
ROA	Record of Approval
ROD	Record of Decision

Acronym	Expanded Terminology
SEL	Sound Exposure Level
SIP	Sound Insulation Program
SLM	Sound Level Meters
SME	Subject Matter Expert
STA	State Transportation Agency
STC	Sound Transmission Class
TRB	Transportation Research Board
VOC	Volatile Organic Compounds

APPENDIX C. SAMPLE CHECKLISTS

C.1 Program Activities Checklist.

- ☐ Initial planning
  - Identify possible funding sources
  - Estimate total number of eligible homes
  - Validate NEMs (confirm accuracy)
- ☐ Pre-application to FAA
- ☐ Apply to FAA for project approval and funding
- ☐ Determine personnel approach (airport operator or sponsor or sponsor and support personnel or consultant services)
- ☐ Issue RFP for consultant services
- ☐ Hire (or acquire) office personnel and consultant(s)
- ☐ Set up project office
- ☐ Advertise program to the public
  - Hold public meetings
  - Contact media for newspaper and television coverage
- ☐ Conduct housing survey
- ☐ Determine SIP Phase 1 boundary
- ☐ Solicit participants (homeowners/property owners) within the Phase 1 boundary
- ☐ Review applicants for dwelling insulation to identify residents that opt to have their home tested
- ☐ Select dwellings and alternates, and prioritize
- ☐ Conduct site assessments to see if acceptable for implementation within Phase 1 boundary
- ☐ Secure agreement documentation from participants that elect to participate in the pre-construction acoustical testing
- ☐ Perform pre-construction acoustical testing
- ☐ Determine sound insulation improvements required for each house, while conducting structural field measurements
- ☐ Prepare treatment plans and specifications for each house
- ☐ Prepare work requirements and material definitions for procurement
- ☐ Develop overall project schedule
- ☐ Prepare bid package
- ☐ Submit bid package to local building department for review and approval
- ☐ Advertise for construction bids
- ☐ Pre-bid briefings and site visits
- ☐ Review bids and select construction contractor(s)
- ☐ Give project construction seminar to selected contractor
- ☐ Place order for specialized materials, if necessary
- ☐ Inspect delivered materials before installation
- ☐ Construction of SIP phase improvements
- ☐ Inspect work during construction
- ☐ Post-construction final inspection
- ☐ Post-construction acoustical testing
- ☐ Post-construction homeowner opinion survey
- ☐ Assess program/phase
- ☐ Plan for continuing program/phases, if appropriate

C.2 Selection of Consultants.

FAA Form 5100-134 can be downloaded from the FAA website: https://www.faa.gov/forms/.

U.S. Department of Transportation
Federal Aviation Administration

OMB CONTROL NUMBER: 2120-0569
EXPIRATION DATE: 6/30/2023

Selection of Consultants
Airport Improvement Program Sponsor Certification

Sponsor:

Airport:

Project Number:

Description of Work:

Application
49 USC § 47105(d) authorizes the Secretary to require certification from the sponsor that it will comply with the statutory and administrative requirements in carrying out a project under the Airport Improvement Program (AIP). General requirements for selection of consultant services within federal grant programs are described in 2 CFR §§ 200.317-200.326. Sponsors may use other qualifications-based procedures provided they are equivalent to standards of Title 40 chapter 11 and FAA Advisory Circular 150/5100-14, Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects.

Certification Statements
Except for certification statements below marked as not applicable (N/A), this list includes major requirements of the construction project. Selecting "Yes" represents sponsor acknowledgement and confirmation of the certification statement. The term "will" means Sponsor action taken at appropriate time based on the certification statement focus area, but no later than the end of the project period of performance. This list is not comprehensive and does not relieve the sponsor from fully complying with all applicable statutory and administrative standards. The source of the requirement is referenced within parenthesis.

1. Sponsor acknowledges their responsibility for the settlement of all contractual and administrative issues arising out of their procurement actions (2 CFR § 200.318(k)).
   ☐ Yes ☐ No ☐ N/A
2. Sponsor procurement actions ensure or will ensure full and open competition that does not unduly limit competition (2 CFR § 200.319).
   ☐ Yes ☐ No ☐ N/A
3. Sponsor has excluded or will exclude any entity that develops or drafts specifications, requirements, or statements of work associated with the development of a request-for-qualifications (RFQ) from competing for the advertised services (2 CFR § 200.319).
   ☐ Yes ☐ No ☐ N/A

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4. The advertisement describes or will describe specific project statements-of-work that provide clear detail of required services without unduly restricting competition (2 CFR § 200.319).

   ☐ Yes ☐ No ☐ N/A

5. Sponsor has publicized or will publicize a RFQ that:

   a. Solicits an adequate number of qualified sources (2 CFR § 200.320(d)); and

   b. Identifies all evaluation criteria and relative importance (2 CFR § 200.320(d)).

   ☐ Yes ☐ No ☐ N/A

6. Sponsor has based or will base selection on qualifications, experience, and disadvantaged business enterprise participation with price not being a selection factor (2 CFR § 200.320(d)).

   ☐ Yes ☐ No ☐ N/A

7. Sponsor has verified or will verify that agreements exceeding $25,000 are not awarded to individuals or firms suspended, debarred or otherwise excluded from participating in federally assisted projects (2 CFR §180.300).

   ☐ Yes ☐ No ☐ N/A

8. A/E services covering multiple projects: Sponsor has agreed to or will agree to:

   a. Refrain from initiating work covered by this procurement beyond five years from the date of selection (AC 150/5100-14); and

   b. Retain the right to conduct new procurement actions for projects identified or not identified in the RFQ (AC 150/5100-14).

   ☐ Yes ☐ No ☐ N/A

9. Sponsor has negotiated or will negotiate a fair and reasonable fee with the firm they select as most qualified for the services identified in the RFQ (2 CFR § 200.323).

   ☐ Yes ☐ No ☐ N/A

10. The Sponsor's contract identifies or will identify costs associated with ineligible work separately from costs associated with eligible work (2 CFR § 200.302).

    ☐ Yes ☐ No ☐ N/A

11. Sponsor has prepared or will prepare a record of negotiations detailing the history of the procurement action, rationale for contract type and basis for contract fees (2 CFR §200.318(i)).

    ☐ Yes ☐ No ☐ N/A

12. Sponsor has incorporated or will incorporate mandatory contact provisions in the consultant contract for AIP-assisted work (49 U.S.C. Chapter 471 and 2 CFR part 200 Appendix II)

    ☐ Yes ☐ No ☐ N/A

13. For contracts that apply a time-and-material payment provision (also known as hourly rates, specific rates of compensation, and labor rates), the Sponsor has established or will establish:
    a. Justification that there is no other suitable contract method for the services (2 CFR §200.318(j));
    b. A ceiling price that the consultant exceeds at their risk (2 CFR §200.318(j)); and
    c. A high degree of oversight that assures consultant is performing work in an efficient manner with effective cost controls in place 2 CFR §200.318(j)).

    ☐ Yes ☐ No ☐ N/A

14. Sponsor is not using or will not use the prohibited cost-plus-percentage-of-cost (CPPC) contract method. (2 CFR § 200.323(d)).

    ☐ Yes ☐ No ☐ N/A

Attach documentation clarifying any above item marked with "no" response.

Sponsor's Certification

I certify, for the project identified herein, responses to the forgoing items are accurate as marked and additional documentation for any item marked "no" is correct and complete.

I declare under penalty of perjury that the foregoing is true and correct. I understand that knowingly and willfully providing false information to the federal government is a violation of 18 USC § 1001 (False Statements) and could subject me to fines, imprisonment, or both.

Executed on this day of , .

Name of Sponsor:

Name of Sponsor's Authorized Official:

Title of Sponsor's Authorized Official:

Signature of Sponsor's Authorized Official: _____

I declare under penalty of perjury that the foregoing is true and correct. I understand that knowingly and willfully providing false information to the federal government is a violation of 18 USC § 1001 (False Statements) and could subject me to fines, imprisonment, or both.

Submit by Email

C.3 Construction Project Final Acceptance.

FAA Form 5100-129 can be downloaded from the FAA website: https://www.faa.gov/forms/.

U.S. Department of Transportation
Federal Aviation Administration

OMB CONTROL NUMBER: 2120-0569
EXPIRATION DATE: 6/30/2023

Construction Project Final Acceptance
Airport Improvement Program Sponsor Certification

Sponsor:

Airport:

Project Number:

Description of Work:

Application
49 USC § 47105(d), authorizes the Secretary to require me certification from the sponsor that it will comply with the statutory and administrative requirements in carrying out a project under the Airport Improvement Program. General standards for final acceptance and close out of federally funded construction projects are in 2 CFR § 200.343 – Closeout and supplemented by FAA Order 5100.38. The sponsor must determine that project costs are accurate and proper in accordance with specific requirements of the grant agreement and contract documents.

Certification Statements
Except for certification statements below marked not applicable (N/A), this list includes major requirements of the construction project. Selecting "Yes" represents sponsor acknowledgment and confirmation of the certification statement. The term "will" means Sponsor action taken at appropriate time based on the certification statement focus area, but no later than the end of the project period of performance. This list is not comprehensive and does not relieve the sponsor from fully complying with all applicable statutory and administrative standards. The source of the requirement is referenced within parenthesis.

1. The personnel engaged in project administration, engineering supervision, project inspection, and acceptance testing were or will be determined to be qualified and competent to perform the work (Grant Assurance).
   ☐ Yes ☐ No ☐ N/A
2. Construction records, including daily logs, were or will be kept by the resident engineer/construction inspector that fully document contractor's performance in complying with:
   a. Technical standards (Advisory Circular (AC) 150/5370-12);
   b. Contract requirements (2 CFR part 200 and FAA Order 5100.38); and
   c. Construction safety and phasing plan measures (AC 150/5370-2).
   ☐ Yes ☐ No ☐ N/A
3. All acceptance tests specified in the project specifications were or will be performed and documented. (AC 150/5370-12).
   ☐ Yes ☐ No ☐ N/A

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4. Sponsor has taken or will take appropriate corrective action for any test result outside of allowable tolerances (AC 150/5370-12).

   ☐ Yes ☐ No ☐ N/A

5. Pay reduction factors required by the specifications were applied or will be applied in computing final payments with a summary made available to the FAA (AC 150/5370-10).

   ☐ Yes ☐ No ☐ N/A

6. Sponsor has notified, or will promptly notify the Federal Aviation Administration (FAA) of the following occurrences:

   a. Violations of any federal requirements set forth or included by reference in the contract documents (2 CFR part 200);

   b. Disputes or complaints concerning federal labor standards (29 CFR part 5); and

   c. Violations of or complaints addressing conformance with Equal Employment Opportunity or Disadvantaged Business Enterprise requirements (41 CFR Chapter 60 and 49 CFR part 26).

   ☐ Yes ☐ No ☐ N/A

7. Weekly payroll records and statements of compliance were or will be submitted by the prime contractor and reviewed by the sponsor for conformance with federal labor and civil rights requirements as required by FAA and U.S. Department of Labor (29 CFR Part 5).

   ☐ Yes ☐ No ☐ N/A

8. Payments to the contractor were or will be made in conformance with federal requirements and contract provisions using sponsor internal controls that include:

   a. Retaining source documentation of payments and verifying contractor billing statements against actual performance (2 CFR § 200.302 and FAA Order 5100.38);

   b. Prompt payment of subcontractors for satisfactory performance of work (49 CFR § 26.29);

   c. Release of applicable retainage upon satisfactory performance of work (49 CFR § 26.29); and

   d. Verification that payments to DBEs represent work the DBE performed by carrying out a commercially useful function (49 CFR §26.55).

   ☐ Yes ☐ No ☐ N/A

9. A final project inspection was or will be conducted with representatives of the sponsor and the contractor present that ensure:

   a. Physical completion of project work in conformance with approved plans and specifications (Order 5100.38);

   b. Necessary actions to correct punch list items identified during final inspection are complete (Order 5100.38); and

   c. Preparation of a record of final inspection and distribution to parties to the contract (Order 5100.38);

   ☐ Yes ☐ No ☐ N/A

10. The project was or will be accomplished without material deviations, changes, or modifications from approved plans and specifications, except as approved by the FAA (Order 5100.38).

    ☐ Yes ☐ No ☐ N/A

11. The construction of all buildings have complied or will comply with the seismic construction requirements of 49 CFR § 41.120.
    ☐ Yes ☐ No ☐ N/A
12. For development projects, sponsor has taken or will take the following close-out actions:
    a. Submit to the FAA a final test and quality assurance report summarizing acceptance test results, as applicable (Grant Condition);
    b. Complete all environmental requirements as established within the project environmental determination (Oder 5100.38); and
    c. Prepare and retain as-built plans (Order 5100.38).
    ☐ Yes ☐ No ☐ N/A
13. Sponsor has revised or will revise their airport layout plan (ALP) that reflects improvements made and has submitted or will submit an updated ALP to the FAA no later than 90 days from the period of performance end date. (49 USC § 47107 and Order 5100.38).
    ☐ Yes ☐ No ☐ N/A

Attach documentation clarifying any above item marked with "No" response.

Sponsor's Certification

I certify, for the project identified herein, responses to the forgoing items are accurate as marked and additional documentation for any item marked "no" is correct and complete.

Executed on this day of , .

Name of Sponsor:

Name of Sponsor's Authorized Official:

Title of Sponsor's Authorized Official:

Signature of Sponsor's Authorized Official: _____

I declare under penalty of perjury that the foregoing is true and correct. I understand that knowingly and willfully providing false information to the federal government is a violation of 18 USC § 1001 (False Statements) and could subject me to fines, imprisonment, or both.

Submit by Email

FAA Form 5100-129 (8/20) SUPERSEDES PREVIOUS EDITION page 3 of 3

C.4 Project Plans and Specifications.

FAA Form 5100-132 can be downloaded from the FAA website: https://www.faa.gov/forms/

U.S. Department of Transportation
Federal Aviation Administration

OMB CONTROL NUMBER: 2120-0569
EXPIRATION DATE: 6/30/2023

Project Plans and Specifications
Airport Improvement Program Sponsor Certification

Sponsor:

Airport:

Project Number:

Description of Work:

Application

49 USC § 47105(d) authorizes the Secretary to require certification from the sponsor that it will comply with the statutory and administrative requirements in carrying out a project under the Airport Improvement Program (AIP). Labor and civil rights standards applicable to AIP are established by the Department of Labor (www.dol.gov/). AIP Grant Assurance C.1—General Federal Requirements identifies applicable federal laws, regulations, executive orders, policies, guidelines and requirements for assistance under AIP. A list of current advisory circulars with specific standards for procurement, design or construction of airports, and installation of equipment and facilities is referenced in standard airport sponsor Grant Assurance 34 contained in the grant agreement.

Certification Statements

Except for certification statements below marked as not applicable (N/A), this list includes major requirements of the construction project. Selecting "Yes" represents sponsor acknowledgement and confirmation of the certification statement. The term "will" means Sponsor action taken at appropriate time based on the certification statement focus area, but no later than the end of the project period of performance. This list is not comprehensive and does not relieve the sponsor from fully complying with all applicable statutory and administrative standards. The source of the requirement is referenced within parenthesis.

1. The plans and specifications were or will be prepared in accordance with applicable federal standards and requirements, so that no deviation or modification to standards set forth in the advisory circulars, or FAA-accepted state standard, is necessary other than those explicitly approved by the Federal Aviation Administration (FAA) (14 USC § 47105).

   ☐ Yes ☐ No ☐ N/A

2. Specifications incorporate or will incorporate a clear and accurate description of the technical requirement for the material or product that does not contain limiting or proprietary features that unduly restrict competition (2 CFR §200.319).

   ☐ Yes ☐ No ☐ N/A

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Page 1 of 3

3. The development that is included or will be included in the plans is depicted on the current airport layout plan as approved by the FAA (14 USC § 47107).

   ☐ Yes ☐ No ☐ N/A

4. Development and features that are ineligible or unallowable for AIP funding have been or will be omitted from the plans and specifications (FAA Order 5100.38, par. 3-43).

   ☐ Yes ☐ No ☐ N/A

5. The specification does not use or will not use "brand name" or equal to convey requirements unless sponsor requests and receives approval from the FAA to use brand name (FAA Order 5100.38, Table U-5).

   ☐ Yes ☐ No ☐ N/A

6. The specification does not impose or will not impose geographical preference in their procurement requirements (2 CFR §200.319(b) and FAA Order 5100.38, Table U-5).

   ☐ Yes ☐ No ☐ N/A

7. The use of prequalified lists of individuals, firms or products include or will include sufficient qualified sources that ensure open and free competition and that does not preclude potential entities from qualifying during the solicitation period (2 CFR §319(d)).

   ☐ Yes ☐ No ☐ N/A

8. Solicitations with bid alternates include or will include explicit information that establish a basis for award of contract that is free of arbitrary decisions by the sponsor (2 CFR § 200.319(a)(7)).

   ☐ Yes ☐ No ☐ N/A

9. Concurrence was or will be obtained from the FAA if Sponsor incorporates a value engineering clause into the contract (FAA Order 5100.38, par. 3-57).

   ☐ Yes ☐ No ☐ N/A

10. The plans and specifications incorporate or will incorporate applicable requirements and recommendations set forth in the federally approved environmental finding (49 USC §47106(c)).

    ☐ Yes ☐ No ☐ N/A

11. The design of all buildings comply or will comply with the seismic design requirements of 49 CFR § 41.120. (FAA Order 5100.38d, par. 3-92)

    ☐ Yes ☐ No ☐ N/A

12. The project specification include or will include process control and acceptance tests required for the project by as per the applicable standard:

    a. Construction and installation as contained in Advisory Circular (AC) 150/5370-10.

       ☐ Yes ☐ No ☐ N/A

b. Snow Removal Equipment as contained in AC 150/5220-20.

☐ Yes ☐ No ☐ N/A

c. Aircraft Rescue and Fire Fighting (ARFF) vehicles as contained in AC 150/5220-10.

☐ Yes ☐ No ☐ N/A

13. For construction activities within or near aircraft operational areas(AOA):

a. The Sponsor has or will prepare a construction safety and phasing plan (CSPP) conforming to Advisory Circular 150/5370-2.

b. Compliance with CSPP safety provisions has been or will be incorporated into the plans and specifications as a contractor requirement.

c. Sponsor will not initiate work until receiving FAA's concurrence with the CSPP (FAA Order 5100.38, Par. 5-29).

☐ Yes ☐ No ☐ N/A

14. The project was or will be physically completed without federal participation in costs due to errors and omissions in the plans and specifications that were foreseeable at the time of project design (49 USC §47110(b)(1) and FAA Order 5100.38d, par. 3-100).

☐ Yes ☐ No ☐ N/A

Attach documentation clarifying any above item marked with "No" response.

Sponsor's Certification

I certify, for the project identified herein, responses to the forgoing items are accurate as marked and additional documentation for any item marked "no" is correct and complete.

Executed on this day of , .

Name of Sponsor:

Name of Sponsor's Authorized Official:

Title of Sponsor's Authorized Official:

Signature of Sponsor's Authorized Official: _____

I declare under penalty of perjury that the foregoing is true and correct. I understand that knowingly and willfully providing false information to the federal government is a violation of 18 USC § 1001 (False Statements) and could subject me to fines, imprisonment, or both.

Submit by Email

FAA Form 5100-132 (8/20) SUPERSEDES PREVIOUS EDITION Page 3 of 3

C.5 Equipment Construction Contracts.

FAA Form 5100-131 can be downloaded from the FAA website: https://www.faa.gov/forms/.

U.S. Department of Transportation
Federal Aviation Administration

OMB CONTROL NUMBER: 2120-0569
EXPIRATION DATE: 6/30/2023

Equipment and Construction Contracts
Airport Improvement Sponsor Certification

Sponsor:

Airport:

Project Number:

Description of Work:

Application

49 USC § 47105(d) authorizes the Secretary to require certification from the sponsor that it will comply with the statutory and administrative requirements in carrying out a project under the Airport Improvement Program (AIP). General procurement standards for equipment and construction contracts within Federal grant programs are described in 2 CFR §§ 200.317-200.326. Labor and Civil Rights Standards applicable to the AIP are established by the Department of Labor (www.dol.gov) AIP Grant Assurance C.1—General Federal Requirements identifies all applicable Federal Laws, regulations, executive orders, policies, guidelines and requirements for assistance under the AIP. Sponsors may use state and local procedures provided the procurement conforms to these federal standards.

This certification applies to all equipment and construction projects. Equipment projects may or may not employ laborers and mechanics that qualify the project as a "covered contract" under requirements established by the Department of Labor requirements. Sponsor shall provide appropriate responses to the certification statements that reflect the character of the project regardless of whether the contract is for a construction project or an equipment project.

Certification Statements

Except for certification statements below marked as not applicable (N/A), this list includes major requirements of the construction project. Selecting "Yes" represents sponsor acknowledgement and confirmation of the certification statement. The term "will" means Sponsor action taken at appropriate time based on the certification statement focus area, but no later than the end of the project period of performance. This list is not comprehensive and does not relieve the sponsor from fully complying with all applicable statutory and administrative standards. The source of the requirement is referenced within parenthesis.

1. A written code or standard of conduct is or will be in effect prior to commencement of the project that governs the performance of the sponsor's officers, employees, or agents in soliciting, awarding and administering procurement contracts (2 CFR § 200.318).

   ☐ Yes ☐ No ☐ N/A

FAA Form 5100-131 (8/20) SUPERSEDES PREVIOUS EDITION Page 1 of 4

2. For all contracts, qualified and competent personnel are or will be engaged to perform contract administration, engineering supervision, construction inspection, and testing (Grant Assurance C.17).

   ☐ Yes ☐ No ☐ N/A

3. Sponsors that are required to have a Disadvantage Business Enterprise (DBE) program on file with the FAA have included or will include clauses required by Title VI of the Civil Rights Act and 49 CFR Part 26 for Disadvantaged Business Enterprises in all contracts and subcontracts.

   ☐ Yes ☐ No ☐ N/A

4. Sponsors required to have a DBE program on file with the FAA have implemented or will implement monitoring and enforcement measures that:

   a. Ensure work committed to Disadvantaged Business Enterprises at contract award is actually performed by the named DBEs (49 CFR § 26.37(b));

   b. Include written certification that the sponsor has reviewed contract records and has monitored work sites for performance by DBE firms (49 CFR § 26.37(b)); and

   c. Provides for a running tally of payments made to DBE firms and a means for comparing actual attainments (i.e. payments) to original commitments (49 CFR § 26.37(c)).

   ☐ Yes ☐ No ☐ N/A

5. Sponsor procurement actions using the competitive sealed bid method (2 CFR § 200.320(c)). was or will be:

   a. Publicly advertised, allowing a sufficient response time to solicit an adequate number of interested contractors or vendors;

   b. Prepared to include a complete, adequate and realistic specification that defines the items or services in sufficient detail to allow prospective bidders to respond;

   c. Publicly opened at a time and place prescribed in the invitation for bids; and

   d. Prepared in a manner that result in a firm fixed price contract award to the lowest responsive and responsible bidder.

   ☐ Yes ☐ No ☐ N/A

6. For projects the Sponsor proposes to use the competitive proposal procurement method (2 CFR § 200.320(d)), Sponsor has requested or will request FAA approval prior to proceeding with a competitive proposal procurement by submitting to the FAA the following:

   a. Written justification that supports use of competitive proposal method in lieu of the preferred sealed bid procurement method;

   b. Plan for publicizing and soliciting an adequate number of qualified sources; and

   c. Listing of evaluation factors along with relative importance of the factors.

   ☐ Yes ☐ No ☐ N/A

7. For construction and equipment installation projects, the bid solicitation includes or will include the current federal wage rate schedule(s) for the appropriate type of work classifications (2 CFR Part 200, Appendix II).

   ☐ Yes ☐ No ☐ N/A

8. Concurrence was or will be obtained from the Federal Aviation Administration (FAA) prior to contract award under any of the following circumstances (Order 5100.38D):
    a. Only one qualified person/firm submits a responsive bid;
    b. Award is to be made to other than the lowest responsible bidder; and
    c. Life cycle costing is a factor in selecting the lowest responsive bidder.

    ☐ Yes ☐ No ☐ N/A

9. All construction and equipment installation contracts contain or will contain provisions for:
    a. Access to Records (§ 200.336)
    b. Buy American Preferences (Title 49 U.S.C. § 50101)
    c. Civil Rights - General Provisions and Title VI Assurances(41 CFR part 60)
    d. Federal Fair Labor Standards (29 U.S.C. § 201, et seq)
    e. Occupational Safety and Health Act requirements (20 CFR part 1920)
    f. Seismic Safety – building construction (49 CFR part 41)
    g. State Energy Conservation Requirements - as applicable(2 CFR part 200, Appendix II)
    h. U.S. Trade Restriction (49 CFR part 30)
    i. Veterans Preference (49 USC § 47112(c))

    ☐ Yes ☐ No ☐ N/A

10. All construction and equipment installation contracts exceeding $2,000 contain or will contain the provisions established by:
    a. Davis-Bacon and Related Acts (29 CFR part 5)
    b. Copeland "Anti-Kickback" Act (29 CFR parts 3 and 5)

    ☐ Yes ☐ No ☐ N/A

11. All construction and equipment installation contracts exceeding $3,000 contain or will contain a contract provision that discourages distracted driving (E.O. 13513).

    ☐ Yes ☐ No ☐ N/A

12. All contracts exceeding $10,000 contain or will contain the following provisions as applicable:
    a. Construction and equipment installation projects - Applicable clauses from 41 CFR Part 60 for compliance with Executive Orders 11246 and 11375 on Equal Employment Opportunity;
    b. Construction and equipment installation - Contract Clause prohibiting segregated facilities in accordance with 41 CFR part 60-1.8;
    c. Requirement to maximize use of products containing recovered materials in accordance with 2 CFR § 200.322 and 40 CFR part 247; and
    d. Provisions that address termination for cause and termination for convenience (2 CFR Part 200, Appendix II).

    ☐ Yes ☐ No ☐ N/A

13. All contracts and subcontracts exceeding $25,000: Measures are in place or will be in place (e.g. checking the System for Award Management) that ensure contracts and subcontracts are not awarded to individuals or firms suspended, debarred, or excluded from participating in federally assisted projects (2 CFR parts 180 and 1200).

    ☐ Yes ☐ No ☐ N/A

14. Contracts exceeding the simplified acquisition threshold (currently $250,000) include or will include provisions, as applicable, that address the following:

    a. Construction and equipment installation contracts - a bid guarantee of 5%, a performance bond of 100%, and a payment bond of 100% (2 CFR § 200.325);

    b. Construction and equipment installation contracts - requirements of the Contract Work Hours and Safety Standards Act (40 USC 3701-3708, Sections 103 and 107);

    c. Restrictions on Lobbying and Influencing (2 CFR part 200, Appendix II);

    d. Conditions specifying administrative, contractual and legal remedies for instances where contractor of vendor violate or breach the terms and conditions of the contract (2 CFR §200, Appendix II); and

    e. All Contracts - Applicable standards and requirements issued under Section 306 of the Clean Air Act (42 USC 7401-7671q), Section 508 of the Clean Water Act (33 USC 1251-1387, and Executive Order 11738.

    ☐ Yes ☐ No ☐ N/A

Attach documentation clarifying any above item marked with "No" response.

Sponsor's Certification

I certify, for the project identified herein, responses to the forgoing items are accurate as marked and additional documentation for any item marked "no" is correct and complete.

Executed on this day of , .

Name of Sponsor:

Name of Sponsor's Authorized Official:

Title of Sponsor's Authorized Official:

Signature of Sponsor's Authorized Official: _____

I declare under penalty of perjury that the foregoing is true and correct. I understand that knowingly and willfully providing false information to the federal government is a violation of 18 USC § 1001 (False Statements) and could subject me to fines, imprisonment, or both.

Submit by Email

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C.6 Real Property Acquisition.

FAA Form 5100-133 can be downloaded from the FAA website: https://www.faa.gov/forms/.

U.S. Department of Transportation
Federal Aviation Administration

OMB CONTROL NUMBER: 2120-0569
EXPIRATION DATE: 6/30/2023

Real Property Acquisition
Airport Improvement Program Sponsor Certification

Sponsor:

Airport:

Project Number:

Description of Work:

Application
49 USC § 47105(d) authorizes the Secretary to require certification from the sponsor that it will comply with the statutory and administrative requirements in carrying out a project under the Airport Improvement Program (AIP). General requirements on real property acquisition and relocation assistance are in 49 CFR Part 24. The AIP project grant agreement contains specific requirements and assurances on the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act), as amended.

Certification Statements
Except for certification statements below marked not applicable (N/A), this list includes major requirements of the real property acquisition project. Selecting "Yes" represents sponsor acknowledgement and confirmation of the certification statement. The term "will" means Sponsor action taken at appropriate time based on the certification statement focus area, but no later than the end of the project period of performance. This list is not comprehensive and does not relieve the sponsor from fully complying with all applicable statutory and administrative standards.

1. The sponsor's attorney or other official has or will have good and sufficient title as well as title evidence on property in the project.
   ☐ Yes ☐ No ☐ N/A
2. If defects and/or encumbrances exist in the title that adversely impact the sponsor's intended use of property in the project, they have been or will be extinguished, modified, or subordinated.
   ☐ Yes ☐ No ☐ N/A
3. If property for airport development is or will be leased, the following conditions have been met:
   a. The term is for 20 years or the useful life of the project;
   b. The lessor is a public agency; and
   c. The lease contains no provisions that prevent full compliance with the grant agreement.
   ☐ Yes ☐ No ☐ N/A

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4. Property in the project is or will be in conformance with the current Exhibit A property map, which is based on deeds, title opinions, land surveys, the approved airport layout plan, and project documentation.

   ☐ Yes ☐ No ☐ N/A

5. For any acquisition of property interest in noise sensitive approach zones and related areas, property interest was or will be obtained to ensure land is used for purposes compatible with noise levels associated with operation of the airport.

   ☐ Yes ☐ No ☐ N/A

6. For any acquisition of property interest in runway protection zones and areas related to 14 CFR 77 surfaces or to clear other airport surfaces, property interest was or will be obtained for the following:

   a. The right of flight;

   b. The right of ingress and egress to remove obstructions; and

   c. The right to restrict the establishment of future obstructions.

   ☐ Yes ☐ No ☐ N/A

7. Appraisals prepared by qualified real estate appraisers hired by the sponsor include or will include the following:

   a. Valuation data to estimate the current market value for the property interest acquired on each parcel; and

   b. Verification that an opportunity has been provided to the property owner or representative to accompany appraisers during inspections.

   ☐ Yes ☐ No ☐ N/A

8. Each appraisal has been or will be reviewed by a qualified review appraiser to recommend an amount for the offer of just compensation, and the written appraisals as well as review appraisal are available to Federal Aviation Administration (FAA) for review.

   ☐ Yes ☐ No ☐ N/A

9. A written offer to acquire each parcel was or will be presented to the property owner for not less than the approved amount of just compensation.

   ☐ Yes ☐ No ☐ N/A

10. Effort was or will be made to acquire each property through the following negotiation procedures:

    a. No coercive action to induce agreement; and

    b. Supporting documents for settlements included in the project files.

    ☐ Yes ☐ No ☐ N/A

11. If a negotiated settlement is not reached, the following procedures were or will be used:
    a. Condemnation initiated and a court deposit not less than the just compensation made prior to possession of the property; and
    b. Supporting documents for awards included in the project files.

    ☐ Yes ☐ No ☐ N/A

12. If displacement of persons, businesses, farm operations, or non-profit organizations is involved, a relocation assistance program was or will be established, with displaced parties receiving general information on the program in writing, including relocation eligibility, and a 90-day notice to vacate.

    ☐ Yes ☐ No ☐ N/A

13. Relocation assistance services, comparable replacement housing, and payment of necessary relocation expenses were or will be provided within a reasonable time period for each displaced occupant in accordance with the Uniform Act.

    ☐ Yes ☐ No ☐ N/A

Attach documentation clarifying any above item marked with "No" response.

Sponsor's Certification

I certify, for the project identified herein, responses to the forgoing items are accurate as marked and additional documentation for any item marked "no" is correct and complete.

Executed on this day of , .

Name of Sponsor:

Name of Sponsor's Authorized Official:

Title of Sponsor's Authorized Official:

Signature of Sponsor's Designated Official Representative: _____

I declare under penalty of perjury that the foregoing is true and correct. I understand that knowingly and willfully providing false information to the federal government is a violation of 18 USC § 1001 (False Statements) and could subject me to fines, imprisonment, or both.

Submit by Email

ADVISORY CIRCULAR FEEDBACK

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by emailing content on this form to the attention of the Manager of the Airport Planning and Environmental Division (APP-400) via the APP-400 webpage.

Subject: AC 150/5000-9B Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

_____
_____

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

_____
_____
_____

☐ Other comments:

_____
_____
_____

☐ I would like to discuss the above. Please contact me at (phone number, email address).

_____
_____
_____

Submitted by: _____ Date: _____