A35.3 CONTENT

The contents of the manual must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following sections and information:

(a) *Propeller Maintenance Section.* (1) Introduction information that includes an explanation of the propeller's features and data to the extent necessary for maintenance or preventive maintenance.

(2) A detailed description of the propeller and its systems and installations.

(3) Basic control and operation information describing how the propeller components and systems are controlled and how they operate, including any special procedures that apply.

(4) Instructions for uncrating, acceptance checking, lifting, and installing the propeller.

(5) Instructions for propeller operational checks.

(6) Scheduling information for each part of the propeller that provides the recommended periods at which it should be cleaned, adjusted, and tested, the applicable wear tolerances, and the degree of work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if it shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross-references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the propeller.

(7) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.

(8) Information describing the order and method of removing and replacing propeller parts with any necessary precautions to be taken.

(9) A list of the special tools needed for maintenance other than for overhauls.

(b) *Propeller Overhaul Section.* (1) Disassembly information including the order and method of disassembly for overhaul.

(2) Cleaning and inspection instructions that cover the materials and apparatus to be used and methods and precautions to be taken during overhaul. Methods of overhaul inspection must also be included.

(3) Details of all fits and clearances relevant to overhaul.

(4) Details of repair methods for worn or otherwise substandard parts and components along with information necessary to determine when replacement is necessary.

(5) The order and method of assembly at overhaul.

(6) Instructions for testing after overhaul.

(7) Instructions for storage preparation including any storage limits.

(8) A list of tools needed for overhaul.

A35.4 AIRWORTHINESS LIMITATIONS SECTION

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, inspection interval, and related procedure required for type certification. This section must contain a legible statement in a prominent location that reads: ''The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.''

[Amdt. 35–5, 45 FR 60182, Sept. 11, 1980, as amended by Amdt. 35–6, 54 FR 34330, Aug. 18, 1989]

PART 36—NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

SPECIAL FEDERAL AVIATION REGULATIONS
SFAR NO. 41 [Note]

Subpart A—General

Subpart B—Noise Measurement and Evaluation for Transport Category Large Airplanes and Turbojet Powered Airplanes

Subpart C—Noise Limits for Subsonic Transport Category Large Airplanes and Subsonic Turbojet Powered Airplanes

AUTHORITY: 42 U.S.C. 4321 *et seq.*; 49 U.S.C. 106(g), 40113, 44701–44702, 44704, 44715; sec. 305, Pub. L. 96–193, 94 Stat. 50, 57; E.O. 11514, 35 FR 4247, 3 CFR, 1966–1970 Comp., p. 902.

SOURCE: Docket No. 9337, 34 FR 18364, Nov. 18, 1969, unless otherwise noted.

SPECIAL FEDERAL AVIATION REGULATIONS SFAR No. 41

EDITORIAL NOTE: For the text of SFAR No. 41 see Part 21 of this chapter.

Subpart A—General

§ 36.1 Applicability and definitions.

(a) This part prescribes noise standards for the issue of the following certificates:

(1) Type certificates, and changes to those certificates, and standard airworthiness certificates, for subsonic transport category large airplanes, and for subsonic turbojet powered airplanes regardless of category.

(2) Type certificates and changes to those certificates, standard airworthiness certificates, and restricted category airworthiness certificates, for propeller-driven, small airplanes, and for propeller–driven, commuter category airplanes except those airplanes that are designed for ''agricultural aircraft operations'' (as defined in § 137.3 of this chapter, as effective on January 1, 1966) or for dispersing fire fighting materials to which § 36.1583 of this part does not apply.

(3) A type certificate and changes to that certificate, and standard airworthiness certificates, for Concorde airplanes.

(4) Type certificates, and changes to those certificates, for helicopters except those helicopters that are designated exclusively for ''agricultural aircraft operations'' (as defined in § 137.3 of this chapter, as effective on January 1, 1966), for dispensing fire fighting materials, or for carrying external loads (as defined in § 133.1(b) of this chapter, as effective on December 20, 1976).

(b) Each person who applies under Part 21 of this chapter for a type of airworthiness certificate specified in this part must show compliance with the applicable requirements of this part, in addition to the applicable airworthiness requirements of this chapter.

(c) Each person who applies under Part 21 of this chapter for approval of an acoustical change described in § 21.93(b) of this chapter must show that the aircraft complies with the applicable provisions of §§ 36.7, 36.9, or 36.11 of this part in addition to the applicable airworthiness requirements of this chapter.

(d) Each person who applies for the original issue of a standard airworthiness certificate for a transport category large airplane or for a turbojet powered airplane under §21.183 must, regardless of date of application, show compliance with the following provisions of this part (including appendix C):

(1) The provisions of this part in effect on December 1, 1969, for subsonic airplanes that have not had any flight time before—

(i) December 1, 1973, for airplanes with maximum weights greater than 75,000 pounds, except for airplanes that are powered by Pratt & Whitney Turbo Wasp JT3D series engines;

(ii) December 31, 1974, for airplanes with maximum weights greater than 75,000 pounds and that are powered by Pratt & Whitney Turbo Wasp JT3D series engines; and

(iii) December 31, 1974, for airplanes with maximum weights of 75,000 pounds and less.

(2) The provisions of this part in effect on October 13, 1977, including the stage 2 noise limits, for Concorde airplanes that have not had flight time before January 1, 1980.

(3) December 31, 1974, for airplanes with maximum weights of 75,000 lbs. and less.

(e) Each person who applies for the original issue of a standard airworthiness certificate under §21.183, or for the original issue of a restricted category airworthiness certificate under §21.185, for propeller–driven, commuter category airplanes for a propeller driven small airplane that has not had any flight time before January 1, 1980, must show compliance with the applicable provisions of this part.

(f) For the purpose of showing compliance with this part for transport category large airplanes and turbojet powered airplanes regardless of category, the following terms have the following meanings:

(1) A ''Stage 1 noise level'' means a takeoff, sideline or approach noise level greater than the Stage 2 noise limits prescribed in section C36.5(a)(2) of appendix C of this part.

(2) A ''Stage 1 airplane'' means an airplane that has not been shown under this part to comply with the takeoff, sideline, and approach noise levels required for Stage 2 or Stage 3 airplanes.

(3) A ''Stage 2 noise level'' means a noise level at or below the Stage 2 noise limits prescribed in section C36.5(a)(2) of appendix C of this part but higher than the Stage 3 noise limits prescribed in section C36.5(a)(3) of appendix C of this part.

(4) A ''Stage 2 airplane'' means an airplane that has been shown under this part to comply with Stage 2 noise levels prescribed in section C36.5 of appendix C of this part (including use of the applicable tradeoff provisions) and that does not comply with the requirements for a Stage 3 airplane.

(5) A ''Stage 3 noise level'' means a noise level at or below the Stage 3 noise limits prescribed in section C36.5(a)(3) of appendix C of this part.

(6) A ''Stage 3 airplane'' means an airplane that has been shown under this part to comply with Stage 3 noise levels prescribed in section C36.5 of appendix C of this part (including use of the applicable tradeoff provisions).

(7) A ''subsonic airplane'' means an airplane for which the maximum operating limit speed, M_{mo}, does not exceed a Mach number of 1.

(8) A ''supersonic airplane'' means an airplane for which the maximum operating limit speed, M_{mo}, exceeds a Mach number of 1.

(g) For the purpose of showing compliance with this part for transport category large airplanes and turbojet airplanes regardless of category, each airplane may not be identified as complying with more than one stage or configuration simultaneously.

(h) For the purpose of showing compliance with this part, for helicopters in the primary, normal, transport, and restricted categories, the following terms have the specified meanings:

(1) *Stage 1 noise level* means a takeoff, flyover, or approach noise level greater than the Stage 2 noise limits prescribed in section H36.305 of appendix H of this part, or a flyover noise level greater than the Stage 2 noise limits prescribed in section J36.305 of appendix J of this part.

(2) *Stage 1 helicopter* means a helicopter that has not been shown under this part to comply with the takeoff, flyover, and approach noise levels required for Stage 2 helicopters as prescribed in section H36.305 of appendix H of this part, or a helicopter that has not been shown under this part to comply with the flyover noise level required for Stage 2 helicopters as prescribed in section J36.305 of appendix J of this part.

(3) *Stage 2 noise level* means a takeoff, flyover, or approach noise level at or below the Stage 2 noise limits prescribed in section H36.305 of appendix H of this part, or a flyover noise level at or below the Stage 2 limit prescribed in section J36.305 of appendix J of this part.

(4) *Stage 2 helicopter* means a helicopter that has been shown under this part to comply with Stage 2 noise limits (including applicable tradeoffs) prescribed in section H36.305 of appendix H of this part, or a helicopter that has been shown under this part to comply with the Stage 2 noise limit prescribed in section J36.305 of appendix J of this part.

[Doc. No. 13243, Amdt. 36–4, 40 FR 1034, Jan. 6, 1975 as amended by Amdt. 36–7, 42 FR 12370, Mar. 3, 1977; Amdt. 36–10, 43 FR 28419, June 29, 1978; Amdt. 36–11, 45 FR 67066, Oct. 9, 1980; Amdt. 36–13, 52 FR 1836, Jan. 15, 1987; Amdt. 36–14, 53 FR 3540, Feb. 5, 1988; 53 FR 7728, Mar. 10, 1988; Amdt. 36–15, 53 FR 16366, May 6, 1988; Amdt. 36–20, 57 FR 42854, Sept. 16, 1992]

§ 36.2 Special retroactive requirements.

(a) Notwithstanding § 21.17 of this chapter, each person who applies for a type certificate:

(1) For an airplane covered by this part, irrespective of the date of application for the type certificate, or

(2) For a helicopter covered by this part, on or after March 6, 1986,

must show compliance with the applicable provisions of this part.

(b) Notwithstanding § 21.101(a) of this chapter, each person who applies for an acoustical change to a type design specified in § 21.93(b) of this chapter must show compliance with the applicable provisions of this part.

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–14, 53 FR 3540, Feb. 5, 1988]

§ 36.3 Compatibility with airworthiness requirements.

It must be shown that the aircraft meets the airworthiness regulations constituting the type certification basis of the aircraft under all conditions in which compliance with this part is shown, and that all procedures used in complying with this part, and all procedures and information for the flight crew developed under this part, are consistent with the airworthiness regulations constituting the type certification basis of the aircraft.

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–14, 53 FR 3540, Feb. 5, 1988]

§ 36.5 Limitation of part.

Pursuant to 49 U.S.C. 1431(b)(4), the noise levels in this part have been determined to be as low as is economically reasonable, technologically practicable, and appropriate to the type of aircraft to which they apply. No determination is made, under this part, that these noise levels are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

§ 36.6 Incorporation by reference.

(a) *General.* This part prescribes certain standards and procedures which are not set forth in full text in the rule. Those standards and procedures are contained in published material which is reasonably available to the class of persons affected and has been approved for incorporation by reference by the Director of the Federal Register under 5 U.S.C. 552 (a) and 1 CFR Part 51.

(b) *Incorporated matter.* (1) Each publication, or part of a publication, which is referenced but not set forth in full-text in this part and which is identified in paragraph (c) of this section is hereby incorporated by reference and made a part of Part 36 of this chapter with the approval of the Director of the FEDERAL REGISTER.

(2) Incorporated matter which is subject to subsequent change is incorporated by reference according to the specific reference and to the identification statement. Adoption of any subsequent change in incorporated matter is made under Part 11 of this chapter and 1 CFR Part 51.

(c) *Identification statement.* The complete title or description which identifies each published matter incorporated by reference in this part is as follows:

(1) *International Electrotechnical Commission (IEC) Publications.* (i) IEC Publication No. 179, entitled ''Precision Sound Level Meters,'' dated 1973.

(ii) IEC Publication No. 225, entitled ''Octave, Half-Octave, Third Octave Band Filters Intended for the Analysis of Sounds and Vibrations,'' dated 1966.

(iii) IEC Publication No. 651, entitled ''Sound Level Meters,'' first edition, dated 1979.

(iv) IEC Publication No. 561, entitled ''Electro-acoustical Measuring Equipment for Aircraft Noise Certification,'' first edition, dated 1976.

(v) IEC Publication No. 804, entitled ''Integrating-averaging Sound Level Meters,'' first edition, dated 1985.

(2) *Society of Automotive Engineers (SAE) Publications.* (i) SAE ARP 866A, entitled ''Standard Values at Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise,'' dated March 15, 1975.

(d) *Availability for purchase.* Published material incorporated by reference in this part may be purchased at the price established by the publisher or distributor at the following mailing addresses:

(1) *IEC publications.* (i) The Bureau Central de la Commission Electrotechnique, Internationale, 1, rue de Varembe, Geneva, Switzerland.

(ii) American National Standard Institute, 1430 Broadway, New York City, New York 10018.

(2) *SAE publications.* Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrentown, Pennsylvania 15096.

(e) *Availability for inspection.* A copy of each publication incorporated by reference in this part is available for public inspection at the following locations:

(1) FAA Office of the Chief Counsel, Rules Docket, Room 916, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, DC.

(2) Department of Transportation, Branch Library, Room 930, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, DC.

(3) The respective Region Headquarters of the Federal Aviation Administration as follows:

(i) New England Region Headquarters, 12 New England Executive Park, Burlington, Massachusetts 01803.

(ii) Eastern Region Headquarters, Federal Building, John F. Kennedy (JFK) International Airport, Jamaica, New York 11430.

(iii) Southern Region Headquarters, 3400 Norman Berry Drive, East Point, Georgia 30344.

(iv) Great Lakes Region Headquarters, O'Hare Lake Office Center, 2300 East Devon Avenue, Des Plaines, Illinois 60018.

(v) Central Region Headquarters, Federal Building, 601 East 12th Street, Kanasa City Missouri 64106.

(vi) Southwest Region Headquarters, 4400 Blue Mound Road, Fort Worth, Texas 76193–0000.

(vii) Northwest Mountain Region Headquarters, 17900 Pacific Highway South, Seattle, Washington 98168.

(viii) Western-Pacific Region Headquarters, 15000 Aviation Boulevard, Hawthorne, California 92007.

(ix) Alaskan Region Headquarters, 701 C Street, Anchorage, Alaska 99513.

(x) European Office Headquarters, 15, Rue de la Loi (3rd Floor), B–1040 Brussels, Belgium.

[Amdt. 36–9, 43 FR 8739, Mar. 3, 1978, as amended by Amdt. 36–16, 53 FR 47400, Nov. 22, 1988; Amdt. 36–20, 57 FR 42854, Sept. 16, 1992]

§ 36.7 Acoustical change: Transport category large airplanes and turbojet powered airplanes.

(a) *Applicability.* This section applies to all transport category large airplanes and turbojet powered airplanes for which an acoustical change approval is applied for under § 21.93(b) of this chapter.

(b) *General requirements.* Except as otherwise specifically provided, for each airplane covered by this section, the acoustical change approval requirements are as follows:

(1) In showing compliance, noise levels must be measured and evaluated in

accordance with the applicable procedures and conditions prescribed in Appendices A and B of this part.

(2) Compliance with the noise limits prescribed in section C36.5 of appendix C must be shown in accordance with the applicable provisions of sections C36.7 and C36.9 of appendix C of this part.

(c) *Stage 1 airplanes.* For each Stage 1 airplane prior to the change in type design, in addition to the provisions of paragraph (b) of this section, the following apply:

(1) If an airplane is a Stage 1 airplane prior to the change in type design, it may not, after the change in type design, exceed the noise levels created prior to the change in type design. The tradeoff provisions of section C36.5(b) of appendix C of this part may not be used to increase the Stage 1 noise levels, unless the aircraft qualifies as a Stage 2 airplane.

(2) In addition, for an airplane for which application is made after September 17, 1971—

(i) There may be no reduction in power or thrust below the highest airworthiness approved power or thrust, during the tests conducted before and after the change in type design; and

(ii) During the takeoff and sideline noise tests conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(d) *Stage 2 airplanes.* If an airplane is a Stage 2 airplane prior to the change in type design, the following apply, in addition to the provisions of paragraph (b) of this section:

(1) *Airplanes with high bypass ratio turbojet engines.* For an airplane that has turbojet engines with a bypass ratio of 2 or more before a change in type design—

(i) The airplane, after the change in type design, may not exceed either (A) each Stage 3 noise limit by more than 3 EPNdB, or (B) each Stage 2 noise limit, whichever is lower:

(ii) The tradeoff provisions of section C36.5(b) of appendix C of this part may be used in determining compliance under this paragraph with respect to the Stage 2 noise limit or to the Stage 3 plus 3 EPNdB noise limits, as applicable; and

(iii) During the takeoff and sideline noise test conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(2) *Airplanes that do not have high bypass ratio turbojet engines.* For an airplane that does not have turbojet engines with a bypass ratio of 2 or more before a change in type design—

(i) The airplane may not be a Stage 1 airplane after the change in type design; and

(ii) During the takeoff and sideline noise tests conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(e) *Stage 3 airplanes.* If an airplane is a Stage 3 airplane prior to the change in type design, the following apply, in addition to the provisions of paragraph (b) of this section:

(1) If compliance with Stage 3 noise levels is not required before the change in type design, the airplane must—

(i) Be a Stage 2 airplane after the change in type design and compliance must be shown under the provisions of paragraph (d)(1) or (d)(2) of this section, as appropriate; or

(ii) Remain a Stage 3 airplane after the change in type design. Compliance must be shown under the provisions of paragraph (e)(2) of this section.

(2) If compliance with Stage 3 noise levels is required before the change in type design, the airplane must be a Stage 3 airplane after the change in type design.

(3) Applications on or after [August 14, 1989.] The airplane must remain a Stage 3 airplane after the change in type design.

[Amdt. 36–7, 42 FR 12371, Mar. 3, 1977; Amdt. 36–8, 43 FR 8730, Mar. 2, 1978; Amdt. 36–10, 43 FR 28420, June 29, 1978; Amdt. 36–12, 46 FR 33464, June 29, 1981; Amdt. 36–15, 53 FR 16366, May 6, 1988; 53 FR 18950, May 25, 1988; Amdt. 36–17, 54 FR 21042, May 15, 1989]

§ 36.9 Acoustical change: Propeller-driven small airplanes and propeller-driven commuter category airplanes.

For propeller-driven small airplanes in the primary, normal, utility, acrobatic, transport, and restricted categories and for propeller-driven, commuter category airplanes for which an acoustical change approval is applied for under § 21.93(b) of this chapter after January 1, 1975, the following apply:

(a) If the airplane was type certificated under this part prior to a change in type design, it may not subsequently exceed the noise limits specified in § 36.501 of this part.

(b) If the airplane was not type certificated under this part prior to a change in type design, it may not exceed the higher of the two following values:

(1) The noise limit specified in § 36.501 of this part, or

(2) The noise level created prior to the change in type design, measured and corrected as prescribed in § 36.501 of this part.

[Amdt. 36–16, 53 FR 47400, Nov. 22, 1988; 53 FR 50157, Dec. 13, 1988; Amdt. 36–19, 57 FR 41369, Sept. 9, 1992]

§ 36.11 Acoustical change: Helicopters.

This section applies to all helicopters in the primary, normal, transport, and restricted categories for which an acoustical change approval is applied for under § 21.93(b) of this chapter on or after March 6, 1986. Compliance with the requirements of this section must be demonstrated under appendix H of this part, or, for helicopters having a maximum certificated takeoff weight of not more than 6,000 pounds, compliance with this section may be demonstrated under appendix J of this part.

(a) *General requirements.* Except as otherwise provided, for helicopters covered by this section, the acoustical change approval requirements are as follows:

(1) In showing compliance with the requirements of appendix H of this part, noise levels must be measured, evaluated, and calculated in accordance with the applicable procedures and conditions prescribed in parts B and C of appendix H of this part. For helicopters having a maximum certificated takeoff weight of not more than 6,000 pounds that alternatively demonstrate compliance under appendix J of this part, the flyover noise level prescribed in appendix J of this part must be measured, evaluated, and calculated in accordance with the applicable procedures and conditions prescribed in parts B and C of appendix J of this part.

(2) Compliance with the noise limits prescribed in section H36.305 of appendix H of this part must be shown in accordance with the applicable provisions of part D of appendix H of this part. For those helicopters that demonstrate compliance with the requirements of appendix J of this part, compliance with the noise levels prescribed in section J36.305 of appendix J of this part must be shown in accordance with the applicable provisions of part D of appendix J of this part.

(b) *Stage 1 helicopters.* Except as provided in § 36.805(c), for each Stage 1 helicopter prior to a change in type design, the helicopter noise levels may not, after a change in type design, exceed the noise levels specified in section H36.305(a)(1) of appendix H of this part where the demonstration of compliance is under appendix H of this part. The tradeoff provisions under section H36.305(b) of appendix H of this part may not be used to increase any Stage 1 noise level beyond these limits. If an applicant chooses to demonstrate compliance under appendix J of this part, for each Stage 1 helicopter prior to a change in type design, the helicopter noise levels may not, after a change in type design, exceed the Stage 2 noise levels specified in section J36.305(a) of appendix J of this part.

(c) *Stage 2 helicopters.* For each helicopter that is Stage 2 prior to a change in type design, the helicopter must be a Stage 2 helicopter after a change in type design.

[Doc. No. 26910, 57 FR 42854, Sept. 16, 1992]

Subpart B—Noise Measurement and Evaluation for Transport Category Large Airplanes and Turbojet Powered Airplanes

§ 36.101 Noise measurement.

For transport category large airplanes and turbojet powered airplanes the noise generated by the airplane must be measured under appendix A of this part or under an approved equivalent procedure.

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–10, 43 FR 28420, June 29, 1968]

§ 36.103 Noise evaluation.

For transport category large airplanes and turbojet powered airplanes noise measurement information obtained under § 36.101 must be evaluated under appendix B of this part or under an approved equivalent procedure.

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–10, 43 FR 28420, June 29, 1978]

Subpart C—Noise Limits for Subsonic Transport Category Large Airplanes and Subsonic Turbojet Powered Airplanes

§ 36.201 Noise limits.

(a) For subsonic transport category large airplanes and subsonic turbojet powered airplanes compliance with this section must be shown with noise levels measured and evaluated as prescribed in Subpart B of this part, and demonstrated at the measuring points, and in accordance with the flight test conditions under sections C36.7 and C36.9 (or an approved equivalent procedure), prescribed under appendix C of this part.

(b) Type certification applications for subsonic transport category large airplanes and all subsonic turbojet powered airplanes must show that the noise levels of the airplane are no greater than the Stage 3 noise limits prescribed in section C36.5(a)(3) of appendix C of this part.

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–7, 42 FR 12371, Mar. 3, 1977; Amdt. 36–8, 43 FR 8730, Mar. 2, 1978; Amdt. 36–10, 43 FR 28420, June 29, 1978; Amdt. 36–12, 46 FR 33464, June 29, 1981; Amdt. 36–15, 53 FR 16366, May 6, 1988]

Subpart D—Noise Limits for Supersonic Transport Category Airplanes

§ 36.301 Noise limits: Concorde.

(a) *General.* For the Concorde airplane, compliance with this subpart must be shown with noise levels measured and evaluated as prescribed in Subpart B of this part, and demonstrated at the measuring points prescribed in appendix C of this part.

(b) *Noise limits.* It must be shown, in accordance with the provisions of this part in effect on October 13, 1977, that the noise levels of the airplane are reduced to the lowest levels that are economically reasonable, technologically practicable, and appropriate for the Concorde type design.

[Amdt. 36–10, 43 FR 28420, June 29, 1978]

Subpart E [Reserved]

Subpart F—Propeller Driven Small Airplanes and Propeller-Driven, Commuter Category Airplanes

§ 36.501 Noise limits.

(a) Compliance with this subpart must be shown for—

(1) Propeller driven small airplanes for which application for the issuance of a new, amended, or supplemental type certificate in the normal, utility, acrobatic, transport, or restricted category is made on or after October 10, 1973; and propeller-driven, commuter category airplanes for which application for the issuance of a type certificate in the commuter category is made on or after January 15, 1987.

(2) Propeller driven small airplanes and propeller–driven, commuter category airplanes for which application is made for the original issuance of a standard airworthiness certificate or

restricted category airworthiness certificate, and that have not had any flight time before January 1, 1980 (regardless of date of application).

(3) Airplanes in the primary category:

(i) Except as provided in paragraph (a)(3)(ii) of this section, for an airplane for which application for a type certificate in the primary category is made, and that was not previously certificated under appendix F of this part, compliance with appendix G of this part must be shown.

(ii) For an airplane in the normal, utility or acrobatic category that (A) has a type certificate issued under this chapter, (B) has a standard airworthiness certificate issued under this chapter, (C) has not undergone an acoustical change from its type design, (D) has not previously been certificated under appendix F or G of this part, and (E) for which application for conversion to the primary category is made, no further showing of compliance with this part is required.

(b) For aircraft covered by this subpart for which certification tests are completed before December 22, 1988, compliance must be shown with noise levels as measured and prescribed in Parts B and C of appendix F, or under approved equivalent procedures. It must be shown that the noise level of the airplane is no greater than the applicable limit set in Part D of appendix F.

(c) For aircraft covered by this subpart for which certification tests are not completed before December 22, 1988, compliance must be shown with noise levels as measured and prescribed in Parts B and C of appendix G, or under approved equivalent procedures. It must be shown that the noise level of the airplane is no greater than the applicable limits set in Part D of appendix G.

[Doc. No. 13243, 40 FR 1034, Jan. 6, 1975, as amended by Amdt. 36–13, 52 FR 1836, Jan. 15, 1987; Amdt. 36–16, 53 FR 47400, Nov. 22, 1988; Amdt. 36–19, 57 FR 41369, Sept. 9, 1992]

Subpart G [Reserved]

Subpart H—Helicopters

SOURCE: Amdt. 36–14, 53 FR 3540, Feb. 5, 1988; 53 FR 7728, Mar. 10, 1988, unless otherwise noted.

§36.801 Noise measurement.

For primary, normal, transport, or restricted category helicopters for which certification is sought under appendix H of this part, the noise generated by the helicopter must be measured at the noise measuring points and under the test conditions prescribed in part B of appendix H of this part, or under an FAA-approved equivalent procedure. For those primary, normal, transport, and restricted category helicopters having a maximum certificated takeoff weight of not more than 6,000 pounds for which compliance with appendix J of this part is demonstrated, the noise generated by the helicopter must be measured at the noise measuring point and under the test conditions prescribed in part B of appendix J of this part, or an FAA-approved equivalent procedure.

[Doc. No. 26910, 57 FR 42854, Sept. 16, 1992]

§36.803 Noise evaluation and calculation.

The noise measurement data required under §36.801 and obtained under appendix H of this part must be corrected to the reference conditions contained in part A of appendix H of this part, and evaluated under the procedures of part C of appendix H of this part, or an FAA-approved equivalent procedure. The noise measurement data required under §36.801 and obtained under appendix J of this part must be corrected to the reference conditions contained in part A of appendix J of this part, and evaluated under the procedures of part C of appendix J of this part, or an FAA-approved equivalent procedure.

[Doc. No. 26910, 57 FR 42854, Sept. 16, 1992]

§ 36.805 Noise limits.

(a) Compliance with the noise levels prescribed under part D of appendix H of this part, or under part D of appendix J of this part, must be shown for helicopters for which application for issuance of a type certificate in the primary, normal, transport, or restricted category is made on or after March 6, 1986.

(b) For helicopters covered by this section, except as provided in paragraph (c) or (d)(2) of this section, it must be shown either:

(1) For those helicopters demonstrating compliance under appendix H of this part, the noise levels of the helicopter are no greater than the applicable limits prescribed under section H36.305 of appendix H of this part, or

(2) For helicopters demonstrating compliance under appendix J of this part, the noise level of the helicopter is no greater than the limit prescribed under section J36.305 of appendix J of this part.

(c) For helicopters for which application for issuance of an original type certificate in the primary, normal, transport, or restricted category is made on or after March 6, 1986, and which the FAA finds to be the first civil version of a helicopter that was designed and constructed for, and accepted for operational use by, an Armed Force of the United States or the U.S. Coast Guard on or before March 6, 1986, it must be shown that the noise levels of the helicopter are no greater than the noise limits for a change in type design as specified in section H36.305(a)(1)(ii) of appendix H of this part for compliance demonstrated under appendix H of this part, or as specified in section J36.305 of appendix J of this part for compliance demonstrated under appendix J of this part. Subsequent civil versions of any such helicopter must meet the Stage 2 requirements.

(d) Helicopters in the primary category:

(1) Except as provided in paragraph (d)(2) of this section, for a helicopter for which application for a type certificate in the primary category is made, and that was not previously certificated under appendix H of this part, compliance with appendix H of this part must be shown.

(2) For a helicopter that:

(i) Has a normal or transport type certificate issued under this chapter,

(ii) Has a standard airworthiness certificate issued under this chapter,

(iii) Has not undergone an acoustical change from its type design,

(iv) Has not previously been certificated under appendix H of this part, and

(v) For which application for conversion to the primary category is made, no further showing of compliance with this part is required.

[Doc. No. 26910, 57 FR 42855, Sept. 16, 1992]

Subparts I—N [Reserved]

Subpart O—Operating Limitations and Information

§ 36.1501 Procedures, noise levels and other information.

(a) All procedures, weights, configurations, and other information or data employed for obtaining the certified noise levels prescribed by this part, including equivalent procedures used for flight, testing, and analysis, must be developed and approved. Noise levels achieved during type certification must be included in the approved airplane (rotorcraft) flight manual.

(b) Where supplemental test data are approved for modification or extension of an existing flight data base, such as acoustic data from engine static tests used in the certification of acoustical changes, the test procedures, physical configuration, and other information and procedures that are employed for obtaining the supplemental data must be developed and approved.

[Amdt. 36–15, 53 FR 16366, May 6, 1988]

§ 36.1581 Manuals, markings, and placards.

(a) If an Airplane Flight Manual or Rotorcraft Flight Manual is approved, the approved portion of the Airplane Flight Manual or Rotorcraft Flight Manual must contain the following information, in addition to that specified under § 36.1583 of this part. If an Airplane Flight Manual or Rotorcraft

Flight Manual is not approved, the procedures and information must be furnished in any combination of approved manual material, markings, and placards.

(1) For transport category large airplanes and turbojet powered airplanes, the noise level information must be one value for each takeoff, sideline, and approach as defined and required by appendix C of this part, along with the maximum takeoff weight, maximum landing weight, and configuration.

(2) For propeller driven small airplanes the noise level information must be one value for flyover as defined and required by appendix F of this part, along with the maximum takeoff weight and configuration.

(b) If supplemental operational noise level information is included in the approved portion of the Airplane Flight Manual, it must be segregated, identified as information in addition to the certificated noise levels, and clearly distinguished from the information required under § 36.1581(a).

(c) The following statement must be furnished near the listed noise levels:

No determination has been made by the Federal Aviation Administration that the noise levels of this aircraft are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

(d) For transport category large airplanes and turbojet powered airplanes, for which the weight used in meeting the takeoff or landing noise requirements of this part is less than the maximum weight established under the applicable airworthiness requirements, those lesser weights must be furnished, as operating limitations in the operating limitations section of the Airplane Flight Manual. Further, the maximum takeoff weight must not exceed the takeoff weight that is most critical from a takeoff noise standpoint.

(e) For propeller driven small airplanes and for propeller–driven, commuter category airplanes for which the weight used in meeting the flyover noise requirements of this part is less than the maximum weight by an amount exceeding the amount of fuel needed to conduct the test, that lesser weight must be furnished, as an operating limitation, in the operating limitations section of an approved Airplane Flight Manual, in approved manual material, or on an approved placard.

(f) For primary, normal, transport, and restricted category helicopters, if the weight used in meeting the takeoff, flyover, or approach noise requirements of appendix H of this part, or the weight used in meeting the flyover noise requirement of appendix J of this part, is less than the certificated maximum takeoff weight established under either § 27.25(a) or § 29.25(a) of this chapter, that lesser weight must be furnished as an operating limitation in the operating limitations section of the Rotorcraft Flight Manual, in FAA-approved manual material, or on an FAA-approved placard.

(g) Except as provided in paragraphs (d), (e), and (f) of this section, no operating limitations are furnished under this part.

[Doc. 13243, 40 FR 1035, Jan. 6, 1975 as amended by Amdt. 36–10, 43 FR 28420, June 29, 1978; Amdt. 36–11, 45 FR 67066, Oct. 9, 1980; Amdt. 36–13, 52 FR 1836, Jan. 15, 1987. Redesignated and amended by Amdt. 36–14, 53 FR 3540, Feb. 5, 1988; 53 FR 7728, Mar. 10, 1988; Amdt. 36–15, 53 FR 16366, May 6, 1988; 53 FR 18950, May 25, 1988; Amdt. 36–20, 57 FR 42855, Sept. 16, 1992]

§ 36.1583 Noncomplying agricultural and fire fighting airplanes.

(a) This section applies to propeller-driven, small airplanes that—

(1) Are designed for ''agricultural aircraft operations'' (as defined in § 137.3 of this chapter, effective on January 1, 1966) or for dispensing fire fighting materials; and

(2) Have not been shown to comply with the noise levels prescribed under appendix F of this part—

(i) For which application is made for the original issue of a standard airworthiness certificate and that do not have any flight time before January 1, 1980; or

(ii) For which application is made for an acoustical change approval, for airplanes which have a standard airworthiness certificate after the change in the type design, and that do not have any flight time in the changed configuration before January 1, 1980.

(b) For airplanes covered by this section an operating limitation reading as follows must be furnished in the manner prescribed in § 36.1581:

Noise abatement: This airplane has not been shown to comply with the noise limits in FAR Part 36 and must be operated in accordance with the noise operating limitation prescribed under FAR §91.815.

[Amdt. 36–11, 45 FR 67066, Oct. 9, 1980. Redesignated by Amdt. 36–14, 53 FR 3540, Feb. 5, 1988; Amdt. 36–18, 54 FR 34330, Aug. 18, 1989]

APPENDIX A TO PART 36—AIRCRAFT NOISE MEASUREMENT UNDER §36.101

Sec.

Section A36.1 *Noise certification test and measurement conditions.*

(a) *General.* This section prescribes the conditions under which aircraft noise certification tests must be conducted and the measurement procedures that must be used to measure aircraft noise during each test conducted on or after April 3, 1978.

(b) *Test site requirements.* (1) Tests to show compliance with established aircraft noise certification levels must consist of a series of takeoffs and approaches (or stabilized flight path segments thereof) during which measurements must be taken at noise measuring stations located at the measuring points prescribed in section C36.3 of appendix C of this part. Each recorded segment must include measurements throughout the entire time period in which the recorded signal is within 10 dB of PNLTM.

(2) During each test takeoff, simultaneous measurements should be made at the sideline noise measuring stations on each side of the runway and also at the takeoff noise measuring station. However, if test site conditions make it impractical to simultaneously measure takeoff and sideline noise, and if each of the other sideline measurement requirements is met, independent measurements may be made of the sideline noise under simulated flight path techniques. If the reference flight path includes a power cutback before the maximum possible sideline noise level is developed, the reduced sideline noise level which is the maximum value developed by the simulated flight path technique must be the certificated sideline noise value.

(3) If the height of the ground at a noise measuring station differs from that of the nearest point on the runway by more than 20 feet, corrections must be made as prescribed in section A36.5(d) of this appendix.

(4) The location of each noise measuring station must be surrounded by relatively flat terrain having no excessive sound absorption characteristics, such as might be caused by thick, matted, or tall grass, shrubs, or wooded areas.

(5) An airport tower, or other facility, used to obtain required measurements of meteorological conditions at the test site must be approved in accordance with section A36.9(b)(1) of this appendix.

(6) During the period when the flyover noise/time record indicates the noise measurement is within 10 dB of PNLTM, no obstruction that significantly influences the sound field from the aircraft may exist—

(i) For a takeoff, approach, or sideline measuring station, within a conical space above the measuring position (the point on the ground vertically below the microphone), the cone being defined by an axis normal to the ground and by a half-angle 80 degrees from this axis; and

(ii) For a sideline noise measuring station, above the line of sight between the microphone and the aircraft.

(7) A minimum of two noise measuring stations, symmetrically positioned about the test flight track, must be used to define the maximum sideline noise with respect to location and level as required by section C36.3 of appendix C of this part. For turbojet powered aircraft, when approved by the FAA, the maximum sideline noise at takeoff thrust may be assumed to occur at the point (or its approved equivalent) along the extended centerline of the runway where the aircraft reaches 1000 feet (305 meters) altitude above ground level. A height of 1440 feet (439 meters) may be assumed for Stage 1 or Stage 2 four engine airplanes. The altitude of the aircraft as it passes the microphone stations must be within +500 to −0 feet (+150 to −0 meters) of the target altitude. For aircraft powered by other than turbojet engines, the altitude for maximum sideline noise must be determined experimentally.

(c) *Weather restrictions.* The tests must be conducted under the following atmospheric conditions:

(1) No rain or other precipitation.

(2) Ambient air temperature between 36 degrees F and 95 degrees F (2.2 degrees C and 35 degrees C), inclusively, over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station.

(3) Relative humidity and ambient temperature over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station is such that the sound attenuation in the one-third octave band centered a 8 kHz is not greater than 12 dB/100 meters and the relative humidity is

between 20 and 95 percent, inclusively. However, if the dew point and dry bulb temperature used for obtaining relative humidity are measured with a device which is accurate to within ±0.5 °C, the sound attenuation rate shall not exceed 14 dB/100 meters in the one-third octave band centered at 8kHz.

(4) Average wind velocity 10 meters above ground is not to exceed 12 knots and the crosswind velocity for the airplane is not to exceed 7 knots. The average wind velocity shall be determined using a thirty-second averaging period spanning the 10 dB down time interval. Maximum wind velocity 10 meters above ground is not to exceed 15 knots and the crosswind velocity is not to exceed 10 knots during the 10 dB down time interval.

(5) No anomalous wind conditions (including turbulence) which will significantly affect the noise level of the aircraft when the noise is recorded at each noise measuring station.

(d) *Aircraft testing procedures.*—(1) The aircraft testing procedures and noise measurements must be conducted and processed in an approved manner which yields the noise evaluation measure designated as Effective Perceived Noise Level (EPNL) in units of EPNdB, as prescribed in appendix B of this part.

(2) The aircraft height and lateral position relative to the extended centerline of the runway must be determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(3) The aircraft position along the flight path must be related to the noise recorded at the noise measuring stations by means of synchronizing signals at an approved sampling rate. The position of the aircraft must be recorded relative to the runway during the entire time period in which the recorded signal is within 10 dB of PNLTM. Measuring and sampling equipment must be approved by the FAA.

(4) Each takeoff test must meet the conditions of section C36.7 of appendix C of this part.

(5) If a takeoff test series is conducted at weights other than the maximum takeoff weight for which noise certification is requested, the following additional requirements apply:

(i) At least one takeoff test must be conducted at a weight at, or above, the maximum certification weight.

(ii) Each test weight must be within +5 percent or −10 percent of the maximum certification weight.

(6) Each approach test must be conducted with the aircraft stabilized and following a 3.0 degree ±0.5 degree approach angle and must meet the requirements of section C36.9 of appendix C of this part.

(7) If an approach test series is conducted at weights other than the maximum landing weight for which certification is requested, the following additional requirements apply:

(i) At least one approach test must be conducted at a weight at, or above, the maximum landing weight.

(ii) Each test weight must exceed 90 percent of the maximum landing weight.

(8) Aircraft performance data sufficient to make the correction required under section A36.5 of this appendix must be recorded at an approved sampling rate using FAA approved equipment.

Section A36.3 *Measurement of aircraft noise received on the ground.*

(a) *General.* (1) The measurements prescribed in this section provide the data for determining the one-third octave band noise produced by aircraft during testing at specific noise measuring stations, as a function of time.

(2) Sound pressure level data for aircraft noise certification purposes must be obtained with approved acoustical equipment and measurement practices.

(3) Paragraphs (b), (c), and (d) of this section prescribe the required equipment specifications. Paragraphs (e) and (f) prescribe the calibration and measurement procedures required for each certification test series.

(b) *Measurement system.* The acoustical measurement system must consist of approved equipment equivalent to the following:

(1) A microphone system with frequency response and directivity which are compatible with the measurement and analysis system accuracy prescribed in paragraph (c) of this section.

(2) Tripods or similar microphone mountings that minimize interference with the sound energy being measured.

(3) Recording and reproducing equipment whose characteristics, frequency response, and dynamic range are compatible with the response and accuracy requirements of paragraph (c) of this section.

(4) Calibrators using sine wave, or pink noise, of known levels. When pink noise (defined in paragraph (e)(1) of this section) is used, the signal must be described in terms of its root-mean-square (rms) value.

(5) Analysis equipment with the response and accuracy which meets or exceeds the requirements of paragraph (d) of this section.

(6) Attenuators used for range changing in sensing, recording, reproducing, or analyzing aircraft sound must be capable of being operated in equal-interval decibel steps with no error between any two settings which exceeds 0.2 dB.

(c) *Sensing, recording, and reproducing equipment.* (1) The sound produced by the aircraft must be recorded in such a way that the complete information, including time history, is retained. A magnetic tape recorder is acceptable.

(2) The microphone must be a pressure sensitive capacitive type, or its approved equivalent, such as free field type with incidence corrector.

(i) After an adequate ''warm-up'' period, at least as long as that specified by the equipment manufacturer, the system output for constant acoustical input shall change by not more than 0.3 dB within any one hour nor by more than 0.4 dB within 5 hours.

(ii) The variation of microphone and preamplifier system sensitivity within an angle of ±30 degrees of grazing (60–120 degrees from the normal to the diaphragm) must not exceed the following values:

Frequency (HZ)	Change in sensitivity (dB)
45 to 1,120	1.0
1,120 to 2,240	1.5
2,240 to 4,500	2.5
4,500 to 7,100	4.0
7,100 to 11,200	5.0

With the wind screen in place, the variation in sensitivity in the plane of the diaphragm of the microphone system shall not exceed 1.0 dB over the frequency range 45 to 11,200 Hz.

(iii) The free-field frequency response of the microphone system at the reference incidence direction shall lie within an envelope having the following values:

Frequency (HZ)	Change in Tolerance (dB)
45 to 4,500	±1.0
4,500 to 5,600	±1.5
5,600 to 7,100	+1.5 to −2.0
7,100 to 9,000	+1.5 to −3.0
9,000 to 11,200	+2.0 to −4.0

NOTE: The requirements of this paragraph may be determined by a pressure response calibration (which may be obtained from an electrostatic calibrator in combination with manufacturer provided corrections) or an anechoic free-field facility.

(iv) Specifications concerning sensitivity to environmental factors such as temperature, relative humidity, and vibration must in conformity with the recommendations of International Electrotechnical Commission (IEC) Publication No. 179, entitled ''Precision Sound Level Meters'' (as incorporated by reference under § 36.6 of this part).

(v) If the wind speed exceeds 6 knots, a windscreen must be employed with the microphone during each measurement of aircraft noise. Correction for any insertion loss produced by the windscreen as a function of frequency, must be applied to the measured data and any correction applied must be reported.

(3) If a magnetic tape recorder is used to store data for subsequent analysis, the record/replay system (including tape) must conform to the following:

(i) The electric background noise produced by the system in each one-third octave must be at least 35 dB below the standand recording level, which is defined as that level which is either 10 dB below the 3 pecent harmonic distortion level for direct recording or ±40 percent deviation for frequency modulation (FM) recording.

(ii) At the standard recording level, the corrected frequency response in each selected one-third octave band between 44 Hz and 180 Hz must be flat within ±0.75 dB, and in each band between 180 Hz and 11,200 Hz must be flat within ±0.25 dB.

(iii) If the overall system satisfies the requirements of paragraph (c)(2)(ii) of this section, and if the limitations of the dynamic range of the equipment are insufficient to obtain adequate spectral information, high frequency pre-emphasis may be added to the recording channel with the converse de-emphasis on playback. If pre-emphasis is added, the instantaneously recorded sound pressure level between 800 Hz and 11,200 Hz of the maximum measured noise signal must not vary more than 20 dB between the levels of the maximum and minimum one-third octave bands.

(d) *Analysis equipment.* (1) A frequency analysis of the acoustic signal must be performed using one-third octave filters which conform to the recommendations of International Electrotechnical Commission (IEC) Publication No. 225, entitled ''Octave, Half-Octave, and Third-Octave Band Filters Intended for Analysis of Sounds and Vibrations'' (as incorporated by reference under § 36.6 of this part).

(2) A set of 24 consecutive one-third octave filters must be used. The first filter of the set must be centered at a geometric mean frequency of 50 Hz and the last filter at 10,000 Hz.

(i) The output of each filter must contain less than 0.5 dB ripple.

(ii) The correction for effective bandwidth relative to the response at the center frequency response for each one-third octave band filter must be determined by measuring the filter response to sinusoidal signals at a minimum of 20 frequencies equally spaced between the two adjacent preferred one-third octave frequencies or by using an approved equivalent procedure.

(3) The analyzer indicating device may be either analog or digital, or a combination of both. The preferred sequence of signal processing is:

(i) Squaring the one-third octave filter outputs;

(ii) Averaging or intergrating; and

(iii) Coverting linear formulation to logarithmic.

(4) Each detector must operate over a minimum dynamic range of 60 dB and perform as a true-mean-square device for sinusoidal tone bursts having crest factors of at least 3 over the following dynamic range:

(i) Up to 30 dB below full-scale reading must be accurate within ±0.5 dB;

(ii) Between 30 dB and 40 dB below full-scale reading must be accurate within ±1.0 dB; and

(iii) In excess of 40 dB below full-scale reading must be accurate within ±2.5 dB.

(5) The averaging properties of the integrator must be tested as follows:

(i) White noise must be passed through the 200 Hz one-third octave band filter and the output fed in turn to each detector/integrator. The standard deviation of the measured levels must then be determined from a large number of samples of the filtered white noise taken at intervals of not less than 5 seconds. The value of the standard deviation must be within the interval 0.48±0.06 dB for a probability limit of 95 percent. (An approved equivalent method may be substituted for this test on those analyzers where the test signal cannot readily be fed directly to each detector/integrator.)

(ii) For each detector/integrator, the response to a sudden onset or interruption of a constant amplitude sinusoidal signal at the respective one-third octave band center, frequency must be measured at sampling times 0.5, 1.0, 1.5, and 2.0 seconds after the onset or interruption. The rising responses must be the following amounts before the steady-state level:

0.5 seconds	4.0±1.0 dB
1.0 seconds	1.75±0.75 dB
1.5 seconds	1.0±0.5 dB
2.0 seconds	0.6±0.5 dB

(iii) The falling response must be such that the sum of the decibel readings (below the initial steady-state level) and the corresponding rising response reading are 6.5±1.0 dB, at each sampling time.

(iv) Analyzers using true integration cannot meet the requirements of paragraphs (d)(5)(i), (ii), and (iii) of this section directly, because their overall average time is greater than the sampling interval. For these analyzers, compliance must be demonstrated in terms of the equivalent output of the data processor. Further, in cases where readout and resetting require a dead-time during acquisition, the percentage loss of the total data must not exceed one percent.

(6) The sampling interval between successive readouts shall not exceed 500 milliseconds and its precise value must be known to within ± one (1) percent. The instant in time by which a readout is characterized, shall be the midpoint of the average period. (The averaging period is defined as twice the effective time constant of the analyzer.)

(7) The amplitude resolution of the analyzer must be at least 0.25 dB.

(8) After all systematic errors have been eliminated, each output level from the analyzer must be accurate within ±1.0 dB of the level of the input signal. The total systematic errors for each of the output levels must not exceed ±3.0 dB. For contiguous filter systems, the systematic correction between adjacent one-third octave channels must not exceed 4.0 dB.

(9) The dynamic range capability of the analyzer for display of a single aircraft noise event (in terms of the difference between full-scale output level and the maximum noise level of the analyzer equipment) must be at least 60 dB.

(e) *Calibrations.* (1) Within the five days before the beginning of each test series, the complete electronic system (as installed in the field, including cables) must be electronically calibrated for frequency and amplitude by the use of a pink noise signal of known amplitudes covering the range of signal levels furnished by the microphone. For purposes of this section, a ''pink noise'' means a noise whose noise-power/unit-frequency is inversely proportional to frequency at frequencies within the range of 44 Hz to 11,200 Hz. The signal used must be described in terms of its average root-mean-square (rms) values for a nonoverload signal level. This system calibration must be repeated within five days of the end of each test series, or as required by the FAA.

(2) Immediately before and after each day's testing, a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator to check the system sensitivity and provide an acoustic reference level for the analysis of the sound level data. The performance of equipment in the system will be considered satisfactory if, during each day's testing, the variation does not exceed 0.5 dB.

(3) A normal incidence pressure calibration of the combined microphone/preamplifier must be performed with pure tones at each preferred one-third octave frequency from 50 Hz to 10,000 Hz. This calibration must be completed within the 90 days before the beginning of each test series.

(4) Each reel of magnetic tape must:

(i) Be pistonphone calibrated; and

(ii) At its beginning and end, carry a calibration signal consisting of at least a 15 second burst of pink noise, as defined in paragraph (e)(1) of this section.

(5) Data obtained from tape recorded signals are not considered reliable if the difference between the pink noise signal levels, before and after the tests in each one-third octave band, exceeds 0.75 dB.

(6) The one-third octave filters must have been demonstrated to be in conformity with the recommendations of IEC Publication 225 (as incorporated by reference under §36.6 of

this part) during the six calendar months preceding the beginning of each test series. However, the correction for effective bandwidth relative to the center frequency response may be determined for each filter—

(i) By measuring the filter response to sinusoidal signals at a minimum of twenty frequencies equally spaced between the two adjacent preferred one-third octave frequencies; or

(ii) By using an approved alternative technique.

(7) A performance calibration analysis of each piece of calibration equipment, including piston phones, reference microphones, and voltage insert devices, must have been made during the six calendar months preceding the beginning of each day's test series. Each calibration must be traceable to the National Bureau of Standards.

(f) *Noise measurement procedures.* (1) Each microphone must be oriented so that the diaphragm is substantially in the plane defined by the flight path of the aircraft and the measuring station. The microphone located at each noise measuring station must be placed so that its sensing element is approximately 4 feet above ground.

(2) Immediately before and immediately after each series of test runs and each day's testing, a recorded acoustic calibration of the system prescribed in section A36.3(e)(2) of this appendix must be made in the field to check the acoustic reference level for the analysis of the sound level data. Ambient noise must be recorded for at least 10 seconds and be representative of the acoustical background, including systemic noise, that exists during the flyover test run. During that recorded period, each component of the system must be set at the gain-levels used for aircraft noise measurement.

(3) The mean background noise spectrum must contain the sound pressure levels, which, in each preferred third octave band in the range of 50 Hz to 10,000 Hz, are the averages of the energy of the sound pressure levels in every preferred third octave. When analyzed in PNL, the resulting mean background noise level must be at least 20 PNdB below the maximum PNL of the aircraft.

(4) Corrections for recorded levels of background noise are allowed, within the limits prescribed in § A36.5(d)(3) of this appendix.

Section A36.5 *Reporting and correcting measured data.*

(a) *General.* Data representing physical measurements, or corrections to measured data, including corrections to measurements for equipment response deviations, must be recorded in permanent form and appended to the record. Each correction must be reported and is subject to FAA approval. An estimate must be made of each individual error inherent in each of the operations employed in obtaining the final data.

(b) *Data reporting.* (1) Measured and corrected sound pressure levels must be presented in one-third octave band levels obtained with equipment conforming to the standards prescribed in section A36.3 of this appendix.

(2) The type of equipment used for measurement and analysis of all acoustics, aircraft performance, and meteorological data must be reported.

(3) The atmospheric environmental data required to demonstrate compliance with section A36.1(c) of this appendix, measured throughout the test period under section A36.9(b)(3) of this appendix, must be reported.

(4) Conditions of local topography, ground cover, or events which may interfere with sound recording must be reported.

(5) The following aircraft information must be reported:

(i) Type, model, and serial numbers (if any) of aircraft engines.

(ii) Gross dimensions of aircraft and location of engines.

(iii) Aircraft gross weight for each test run.

(iv) Aircraft configuration, including flap and landing gear positions.

(v) Airspeed in knots.

(vi) Engine performance parameters relevant to noise generation, such as net thrust, engine pressure ratio, exhaust temperatures, and fan or compressor rotational speeds.

(vii) Aircraft flight path (above ground level in feet) determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(6) Aircraft speed and position, and engine performance parameters must be recorded at an approved sampling rate sufficient to correct to the noise certification reference conditions prescribed in paragraph (c) of this section. Lateral position relative to the extended centerline of the runway, configuration, and gross weight must be reported.

(c) *Noise certification reference conditions.* (1) *Meteorological conditions.* Aircraft position and performance data and the noise measurements must be corrected to the following homogeneous noise certification reference atmospheric conditions:

(i) Sea level pressure of 2116 psf (76 cm mercury).

(ii) Ambient temperature of 77 degrees F (25 degrees C).

(iii) Relative humidity of 70 percent.

(iv) Zero wind.

(2) *Aircraft conditions.* The reference condition for takeoff is the maximum weight, except as provided in § 36.1581(b) of this part. The reference conditions for approach tests consist of—

(i) Maximum landing weight, except as provided in §36.1581(d) of this part;

(ii) Approach angle of 3 degrees; and

(iii) Aircraft height of 394 feet above the ground at the noise measuring station.

(d) *Data corrections.* (1) Aircraft position and performance data and the noise measurement must be corrected to the noise certification reference conditions as prescribed in paragraph (c) of this section. The measured atmospheric conditions must be those obtained in accordance with section A36.1(c) of this appendix and paragraph (b)(3) of this section. Atmospheric attenuation sound corrections must be made under section A36.9 of this appendix.

(2) The measured flight path must be corrected by an amount equal to the difference between the applicants predicted flight path for the certification reference conditions and the measured flight path at the test conditions. Necessary corrections relating to aircraft flight path or performance may be derived from approved data other than certification test data. The source noise must be corrected from approved data for the difference between measured and reference engine conditions, together with appropriate allowances for sound attenuation with distance. The Effective Perceived Noise Level (EPNL) correction must be less than 2.0 EPNdB for any combination of the following:

(i) The aircraft's not passing vertically above the measuring station.

(ii) Any difference between 394 feet and the actual minimum distance of the aircraft's ILS antenna from the approach measuring station.

(iii) Any difference between the actual approach angle and the noise certification reference approach flight path.

(iv) Any correction of the measured noise levels which accounts for any difference between the test engine thrust or power and the reference engine thrust or power.

Detailed correction requirements are prescribed in section A36.11 of this appendix.

(3) Aircraft sound pressure levels within the 10 dB-down points (described in section B36.9 of appendix B) must exceed the mean background sound pressure levels determined under section A36.3(f)(3) by at least 3 dB in each one-third octave band (or be corrected under an FAA approved method) to be included in the computation of the overall noise level of the aircraft. An EPNL may not be computed or reported from data from which more than four one-third octave bands in any spectrum within the 10 dB-down points have been excluded under this paragraph.

(4) Where more than seven one-third octaves are within 3 dB of the ambient noise levels, a time/frequency interpolation of the noise data shall be performed using an approved procedure.

(5) If equivalent test procedures, different from the reference procedures, are used, the test procedures and all methods for adjusting the results to the reference procedures must be approved by the FAA. The amounts of adjustments must not exceed 16 EPNdB on takeoff and 8 EPNdB on approach, and if the adjustments are more than 8 EPNdB and 4 EPNdB respectively, the resulting numbers must not be within 2 EPNdB of the appropriate appendix C noise levels including tradeoffs.

(e) *Validity of results.* (1) The test results must produce three mean EPNL values within the 90 percent confidence limits, each value consisting of the arithmetic mean of the corrected noise measurements for all valid test runs at the takeoff, approach, and sideline measuring stations, respectively. If more than one noise measurement system is used at any single measuring station, the resulting data for each test run (after correction) must be averaged as a single measurement. If more than one test site or noise measuring station location is used, each valid test run must be included in the computation of the mean EPNL values and their confidence limits.

(2) The minimum sample size acceptable for each of the three certification measurements (takeoff, approaches, and sideline) is six. The number of samples must be large enough to establish statistically for each of the three mean noise certification levels a 90 percent confidence limit which does not exceed ±1.5 EPNdB. No test result may be omitted from the averaging process, unless otherwise specified by the FAA.

(3) The mean EPNL values and their 90 percent confidence limits obtained by the procedure described in this paragraph must be those by which the noise emission of the aircraft is assessed against the noise certification criteria, and must be reported.

(4) If equivalent procedures are to be used to certificate several airplane configurations of the same type from noise tests of a single airplane, the test procedures and analysis methods must be approved by the FAA. The request for approval must identify the noise measurement test procedures and data base, the airplane configurations, procedures and analysis methods, the method for establishing the 90 percent confidence limit for each noise certification level, and the proposed equivalent procedures.

Section A36.7 *Symbols and units.*

(a) *General.* The symbols used in appendixes A and B of this part have the following meanings.

Symbol	Unit	Meaning
ant	....	*Antilogarithm to the Base 10.*

Symbol	Unit	Meaning
C(k)	dB	*Tone Correction.* The factor to be added to PLN(k) to account for the presence of spectral irregularities such as tones at the k-th increment of time.
d	Sec	*Duration Time.* The length of the significant noise time history being the time interval between the limits of t(1) and t(2) to the nearest second.
D	dB	*Duration Correction.* The factor to be added to PNLM to account for the duration of the noise.
EPNL	EPNdB	*Effective Perceived Noise Level.* The value of PNL adjusted for both the presence or discrete frequencies and the time history. (The unit EPNdB is used instead of the unit dB.)
f(i) or fi	Hz	*Frequency.* The geometrical mean frequency for the i-th one-third octave band.
F(i,k)	dB	*Delta-dB.* The difference between the original and background sound pressure levels in the i-th one-third octave band at the k-th interval of time.
h	dB	*dB-Down.* The level to be subtracted from PNLTM that defines the duration of the noise.
H	%	*Relative Humidity.* The ambient atmospheric relative humidity.
(i) or i	....	*Frequency Band Index.* The numerical indicator that denotes any one of the 24 one-third octave bands with geometrical mean frequencies from 50 to 10,000 Hz.
(k)	....	*Time Increment Index.* The numerical indicator that denotes the number of equal time increments that have elapsed from a reference zero.
log	....	*Logarithm to the Base 10.*
log n (a)	....	*Noy discontinuity Coordinate.* The log n value of the intersection point of the straight lines representing the variation of SPL with log n.
M(b), M(c)	....	*Noy Inverse Slope.* The reciprocals of the slopes of the straight lines representing the variation of SPL with log n.
n	noy	*Perceived Noisiness.* The perceived noisiness at any instant of time that occurs in a specified frequency range.
n(i, k)	noy	*Perceived Noisiness.* The perceived noisiness at the k-th instant of time that occurs in the i-th one-third octave band.
n(k)	noy	*Maximum Perceived Noisiness.* The maximum value of all of the 24 values of n(i) that occurs at the k-th instant of time.
N(k)	noy	*Total Perceived Noisiness.* The total perceived noisiness at the k-th instant of time calculated from the 24-instantaneous values of n(i, k).
p(b), p(c)	....	*Noy Slope.* The slopes of the straight lines representing the variation of SPL with log n.
PNL	PNdB	*Perceived Noise Level.* The perceived noise level at any instant of time (the unit PNdB is used instead of the unit dB).
PNL(k)	PNdB	*Perceived Noise Level.* The perceived noise level calculated from the 24 values of SPL (i, k) at the k-th increment of time. (The unit PNdB is used instead of the unit dB.)
PNLM	PNdB	*Maximum Perceived Noise Level.* The maximum value of PNL(k) that occurs during the aircraft flyover. (The unit PNdB is used instead of the unit dB.)
PNLT	PNdB	*Tone Corrected Perceived Noise Level.* The value of PNL adjusted for the presence of spectral irregularities (discrete frequencies) at any instant of time. (The unit PNdB is used instead of the unit dB.)
PNLT(k)	PNdB	*Tone Corrected Perceived Noise Level.* The value of PNL(k) adjusted for the presence of discrete frequencies that occurs at the k-th increment of time. (The unit PNdB is used instead of the unit dB.)
PNLTM	PNdB	*Maximum tone Corrected Perceived Noise Level.* The maximum value of PNLT(k) that occurs during the aircraft flyover. (The unit PNdB is used instead of the unit dB.)
s(i, k)	dB	*Slope of Sound Pressure Level.* The change in level between adjacent one-third octave band sound pressure levels at the i-th band for the k-th instant of time.
∆ s(i, k)	dB	*Change in Slope of Sound Pressure Level.*
s′(i, k)	dB	*Adjusted Slope of Sound Pressure Level.* The change in level between adjacent adjusted one-third octave band sound pressure levels at the i-th band for the k-th instant of time.
s(i, k)	dB	*Average Slope of Sound Pressure Level.*

Symbol	Unit	Meaning
SPL	dB re 0.0002 microbar.	*Sound Pressure Level.* The sound pressure level at any instant of time that occurs in a specified frequency range.
SPL(a)	dB re 0.002 microbar.	*Noy Discontinuity Coordinate.* The SPL value of the intersection point of the straight lines representing the variation of SPL with log n.
SPL(b) SPL(c)	dB re 0.002 microbar.	*Noy Intercept.* The intercepts on the SPL-axis of the straight lines representing the variation of SPL with log n.
SPL(I, k)	dB re 0.002 microbar.	*Sound Pressure Level.* The sound pressure level at the k-th instant of time that occurs in the i-th one-third octave band.
SPL′(I, k)	dB re 0.002 microbar.	*Adjusted Sound Pressure Level.* The first approximation to background level in the i-th one-third octave band for the k-th instant of time.
SPL″(I, k)	dB re 0.002 microbar.	*Background Sound Pressure Level.* The final approximation to background level in the i-th one-third octave band for the k-th instant of time.
SPLi	dB re 0.002 microbar.	*Maximum Sound Pressure Level.* The sound pressure level that occurs in the i-th one-third octave band of the spectrum for PNL–TM.
SPLic	dB re 0.002 microbar.	*Corrected Maximum Sound Pressure Level.* The sound pressure level that occurs in the i-th one-third octave band of the spectrum for PNLTM corrected for atmospheric sound absorption.
t	Sec	*Elapsed Time.* The length of time measured from a reference zero.
t(1), t(2)	Sec	*Time Limit.* The beginning and end of the significant noise time history defined by h.
Δ t	Sec	*Time Increment.* The equal increments of time for which PNL(k) and PNLT (k) are calculated.
T	Sec	*Normalizing Time Constant.* The length of time used as a reference in the integration method for computing duration corrections.
T	°F	*Temperature.* The ambient atmospheric temperature
α i α i′	dB/ft dB/1000 ft	*Test Atmospheric Absorption.* The atmospheric attenuation of sound that occurs in the i-th one-third octave band for the measured atmospheric temperature and relative humidity.

Symbol	Unit	Meaning
α io α io′	dB/ft dB/1000 ft	*Reference Atmospheric Absorption.* The atmospheric attenuation of sound that occurs in the i-th one-third octave band for the reference atmospheric temperature and relative humidity.
β	Degrees	*First Constant Climb Angle.*
ψ	Degrees	*Second Constant Climb Angle.*
δ	Degrees	*Thrust Cutback Angles.*
ε	Degrees	The angles defining the points on the takeoff flight path at which thrust reduction is started and ended respectively.
η	Degrees	*Approach Angle.*
θ	Degrees	*Takeoff Noise Angle.* The angle between the flight path and noise path for takeoff operation. It is identical for both measured and corrected flight paths.
μ	Degrees	*Approach Noise Angle.* The angle between the flight path and the noise path for approach operation. It is identical for both measured and corrected flight paths.
Δ I	EPNdB	*PNLT Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences in atmospheric absorption and noise path length between reference and test conditions.
Δ2	EPNdB	*Noise Path Duration Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to the noise duration because of differences in flyover altitude between reference and test condition.
Δ3	EPNdB	*Weight Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between maximum and test aircraft weights.
Δ4	EPNdB	*Approach Angle Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between 3° and the test approach angle.
Δ AB	Feet	(1)
Δβ	Degrees	(1)
Δγ.	Degrees	(1)
Δδ	Degrees	(1)
Δα	Degrees	(1)

Symbol	Unit	Meaning
$\Delta\varepsilon$	Degrees	[1]

[1] *Takeoff Profile Changes.* The changes in the basic parameters defining the takeoff profile due to differences between reference and test conditions.

FLIGHT PROFILE IDENTIFICATION POSITIONS

Position	Description
A	Start of takeoff roll.
B	Liftoff.
C	Start of first constant climb.
D	Start of thrust reduction.
E	Start of second constant climb.
Ec	Start of second constant climb on corrected flight path.
F	End of noise certification takeoff flight path.
Fc	End of second constant climb on corrected flight path.
G	Start of noise certification approach flight path.
Gr	Start of noise certification approach on reference flight path.
H	Position on approach path directly above noise measuring station.
I	Start of level off.
Ir	Start of level off on reference approach flight path.
J	Touchdown.
K	Takeoff noise measuring station.
L	Sideline noise measuring station (not on flight track).
M	End of noise type certification takeoff flight track.
N	Approach noise measuring station.
O	Threshold of approach end of runway.
P	Start of noise type certification approach flight track.
Q	Position on measured takeoff flight path corresponding to PNLTM at station K.
Qc	Position on corrected takeoff flight path corresponding to PNLTM at station K.
R	Position on measured takeoff flight path nearest to station K.
Rc	Position on corrected takeoff flight path nearest to station K.
S	Position on measured approach flight path corresponding to PNLTM at station N.
Sr	Position on reference approach flight path corresponding to PNLTM at station N.
T	Position on measured approach flight path nearest to station N.
Tr	Position on reference approach flight path nearest to station N.
X	Position on measured takeoff flight path corresponding to PNLTM at station L.
Xc	Position on corrected takeoff flight path corresponding to PNLTM at station L.

FLIGHT PROFILE DISTANCES

Distance	Unit	Meaning
AB	feet	*Length of Takeoff Roll.* The distance along the runway between the start of takeoff roll and lift off.
AK	feet	*Takeoff Measurement Distance.* The distance from the start of roll to the takeoff noise measurement station along the extended centerline of the runway.
AM	feet	*Takeoff Flight Track Distance.* The distance from the start of roll to the takeoff flight track position along the extended centerline of the runway for which the position of the aircraft need no longer be recorded.
KQ	feet	*Measured Takeoff Noise Path.* The distance from station K to the measured aircraft position Q.
KQc	feet	*Corrected Takeoff Noise Path.* The distance from station K to the corrected aircraft position Qc.
KR	feet	*Measured Takeoff Minimum Distance.* The distance from station K to point R on the measured flight path.
KRc	feet	*Corrected Takeoff Minimum Distance.* The distance from station K to point Rc on the corrected flight path.
LX	feet	*Measured Sideline Noise Path.* The distance from station L to the measured aircraft position X.
LXc	feet	*Corrected Sideline Noise Path.* The distance from station L to the corrected aircraft position Xc.
NH	feet	*Aircraft Approach Height.* The vertical distance between the aircraft and the approach measuring station.
NS	feet	*Measured Approach Noise Path.* The distance from station N to the measured aircraft position S.
NSr	feet	*Reference Approach Noise Path.* The distance from station N to the reference aircraft position Sr.
NT	feet	*Measured Approach Minimum Distance.* The distance from station N to point T on the measured flight path.
NTr	feet	*Reference Approach Minimum Distance.* The distance from station N to point Tr on the corrected flight path; it equals 393 feet.
ON	feet	*Approach Measurement Distance.* The distance from the runway threshold to the approach measurement station along the extended centerline of the runway.
OP	feet	*Approach Flight Track Distance.* The distance from the runway threshold to the approach flight track position along the extended centerline of the runway for which the position of the aircraft need no longer be recorded.

Section A36.9 *Atmospheric attenuation of sound.*

(a) *General.* The measured values of the one-third octave band spectra must conform, or be corrected, to the reference-day conditions listed in section A36.5(c) of this appendix. Each correction must account for any differences in the atmospheric attenuation of sound between the test-day conditions and the reference-day conditions along the sound propagation path between the aircraft and the microphone. Unless the meteorological conditions conform to those prescribed in section A36.1(c) of this appendix, the test data are not acceptable.

(b) *Meteorological measurements.* (1) The wind velocity, temperature and relative humidity measurements required under this part must be measured in the vicinity of the noise measuring stations. The location of the meteorological measurements must be approved by the FAA as representative of those atmospheric conditions existing near the surface over the geographical area in which aircraft noise measurements are made. In some cases, a fixed meteorological station (such as those found at airports or other facilities) may meet this requirement.

(2) The temperature and relative humidity must be measured from a point 10 meters above the surface at the measuring stations to the altitude of the aircraft, using previously approved equipment and methods.

(3) Meteorological measurements must be obtained within 25 minutes of each noise test measurement. Meteorological data must be interpolated to actual times of each noise measurement.

(c) *Attenuation rates.* The atmospheric attenuation rates of sound with distance for each one-third octave band from 50Hz to 10,000 Hz must be determined in accordance with the formulations and tabulations of SAE ARP 866A, entitled ''Standard Values of Atmospheric Absorption as a Function of Temperatures and Humidity for Use in Evaluating Aircraft Flyover Noise'' (as incorporated by reference under §36.6 of this part).

(d) *Correction for atmospheric attenuation.* (1) EPNL values calculated for measured data must be corrected by the methods prescribed in section A36.11(d) of this appendix whenever—

(i) The ambient atmospheric conditions of temperature and relative humidity do not conform to the reference conditions (77 degrees F. and 70 percent, respectively), or

(ii) The measured takeoff and approach flight paths do not conform to the reference flight paths.

(2) If the atmospheric absorption coefficients do not vary over the PNLTM sound propagation path by more than ± 1.6 dB/1000 ft (± 0.5 dB/100 meters) in the 3150 Hz one-third octave band from the value of the absorption coefficient derived from the meteorological measurement obtained at 10 meters above the surface, the mean of the values of the atmospheric absorption coefficients at 10 meters above the surface and at the altitude of the aircraft at PNLTM may be used to determine the atmospheric attenuation rates for each one-third octave band. The resulting atmospheric attenuation rate may be used to compute the PNLTM correction under section A36.11(d) of this appendix.

(3) If the conditions do not conform to those prescribed in paragraph (d)(2) of this section, the corrections for atmospheric attenuation must be determined by the following layered-atmosphere procedure:

(i) The sound propagation path must be divided into increments no greater than 100 feet in altitude, and the average temperature and relative humidity that exists within each increment at the time of the test must be calculated from the meteorological data required under paragraph (b) of this section.

(ii) Atmospheric attenuation rates must be determined under paragraph (c) of this section for each one-third octave band in each altitude increment.

(iii) The mean attenuation rate over the complete sound propagation path from the aircraft to the microphone must be computed for each one-third octave band from 50 Hz to 10,000 Hz. These rates must be used in computing the corrections required in section A36.11(d) of this appendix.

Section A36.11 *Detailed correction procedures.*

(a) *General.* If the test conditions do not conform to those prescribed as noise certification reference conditions under section A36.5 of this appendix, the following correction procedure and requirements apply:

(1) If a positive value results from any difference between reference and test conditions, and appropriate positive correction must be made to the EPNL calculated from the measured data. Conditions which can result in a positive value include:

(i) Atmospheric absorption of sound under test conditions which is greater than the reference;

(ii) Test flight path at an altitude which is higher than the reference; or

(iii) Test weight which is less than maximum certification weight.

(2) If a negative value results from any difference between reference and test conditions, no correction may be made to the EPNL calculated from the measured data, unless the difference results from:

(i) An atmospheric absorption of sound under test conditions which is less than the reference; or

(ii) A test flight path at an altitude which is lower than the reference.

(3) The following correction procedures may produce one or more possible correction values which must be added algebraically to the EPNL calculated as if the tests were conducted completely under the noise certification reference conditions:

(i) The flight profiles must be determined for both takeoff and approach, and for both reference and test conditions. The procedures require noise and flight path recording with a synchronized time signal from which the test profile can be delineated, including the aircraft position for which PNLTM is observed at the noise measuring station. For takeoff, the flight profile corrected to reference conditions may be derived from FAA approved manufacturer's data; however, for approach, the reference profile is prescribed under paragraph (c)(2) of this section.

(ii) The sound propagation paths to the microphone from the aircraft position corresponding to PNLTM are determined for both the test and reference profiles. The SPL values in the spectrum of PNLTM must then be corrected for the effects of—

(A) Change in atmospheric sound absorption;

(B) Atmospheric sound absorption on the change in sound propagation path length; and

(C) Inverse square law on the change in sound propagation path length. The corrected values of SPL are then converted to PNLT from which must be subtracted PNLTM. The resulting difference represents the correction which must be added algebraically to the EPNL calculated from the measured data.

(iii) The minimum distances from both the test and reference profiles to the noise measuring station must be calculated and used to determine a noise duration correction due to any change in the altitude of aircraft flyover. The duration correction must be added algebraically to the EPNL calculated from the measured data.

(iv) From approved data in the form of curves or tables giving the variation of EPNL with engine thrust or test speed, corrections are determined and must be added to the EPNL (which is calculated from the measured data) to account for noise level changes due to differences between test conditions and reference conditions.

(v) From approved data corrections are determined and must be added algebraically to the EPNL (which is calculated from measured data) to account for noise level changes due to differences between 3 degrees and the test approach angle.

(b) *Takeoff profiles.* (1) Figure A1 illustrates a typical takeoff profile.

(i) The aircraft begins the takeoff roll at point A, lifts off at point B, and initiates the first constant climb at point C at an angle β. The noise abatement thrust cutback is started at point D and completed at point E where the second constant climb is defined by the angle γ (usually expressed in terms of the gradient in percent). The end of the noise certification takeoff flight path is represented by aircraft position F whose vertical projection on the flight track (extended centerline of the runway) is point M. The position of the aircraft must be recorded for the entire interval during which the measured aircraft noise level is within 10 dB of PNLTM. Position K is the takeoff noise measuring station whose distance AK is specified as 21,325 feet (6,500 meters). However, if it is necessary to reduce AK to less than 21,325 feet, the procedures prescribed in paragraph (f) of this section must be followed. Position L is the sideline noise measuring station located on a line parallel to, and the prescribed distance from, the runway centerline where the noise level during takeoff is greatest.

(ii) The takeoff profile is defined by five parameters—(A) AB, the length of takeoff roll; (B) β the first constant climb angle; (C) γ, the second constant climb angle; and (D) δ, and *e*, the thrust cutback angles. These five parameters are functions of the aircraft performance and weight, and the atmospheric conditions of temperature, pressure, and wind velocity and direction.

(2) If the test conditions do not conform to those prescribed as reference conditions under section A36.5 of this appendix, the corresponding test and reference profile parameters will be different, as shown in Figure A2. The profile parameter changes, identifies as Δ AB, $\Delta\beta$, $\Delta\gamma$, $\Delta\delta$, and $\Delta\alpha$ may be derived from the manufacturer's data (if approved by the FAA) and may be used to define the fight profile corrected to the reference conditions. The relationships between the measured and corrected takeoff flight profiles may then be used to determine the corrections, which, if positive, must be applied to the EPNL calculated from the measured data.

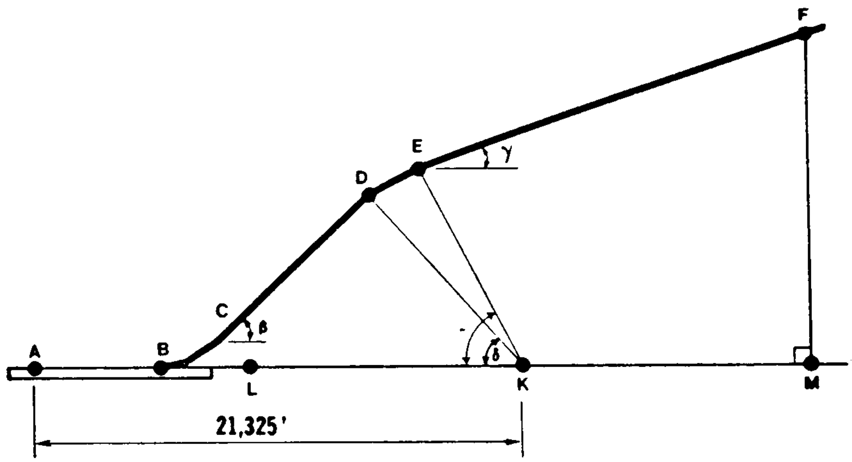


Figure A1. MEASURED TAKEOFF PROFILE

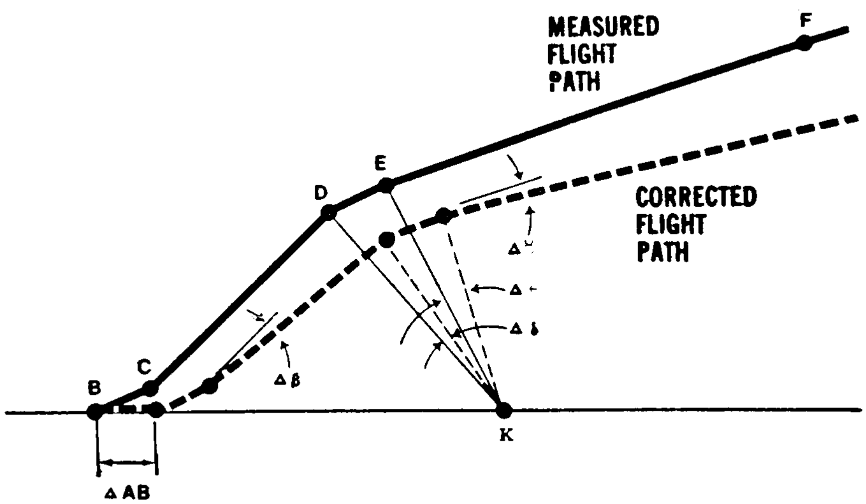


Figure A2. COMPARISON OF MEASURED AND CORRECTED TAKEOFF PROFILES

NOTE: Under reference atmospheric conditions and with maximum takeoff weight, the gradient of the second constant climb angle (γ) may not be less than 4 percent. However, the actual gradient will depend upon the test atmospheric conditions, assuming maximum takeoff weight and the parameters characterizing engine performance are constant (rpm, epr, or any other parameter used by the pilot).

(3) Figure A3 illustrates portions of the measured and corrected takeoff flight paths including the significant geometrical relationships influencing sound propagation. EF represents the measured second constant flight path with climb angle γ, and EcFc represents the corrected second constant flight

path at reduced climb angle $\gamma-\Delta$. Position Q represents the aircraft location on the measured takeoff flight path for which PNLTM is observed at the noise measuring station K, and Qc is the corresponding position on the corrected flight path. The measured and corrected sound propagation paths are KQ and KQc, respectively, which form the same angle α with their flight paths. Position R represents the point on the measured takeoff flight path nearest the noise measuring station K, and Rc is the corresponding position on the corrected flight path. The minimum distance to the measured and corrected flight paths are indicated by the lines KR and KRc, respectively, which are normal to their flight paths.

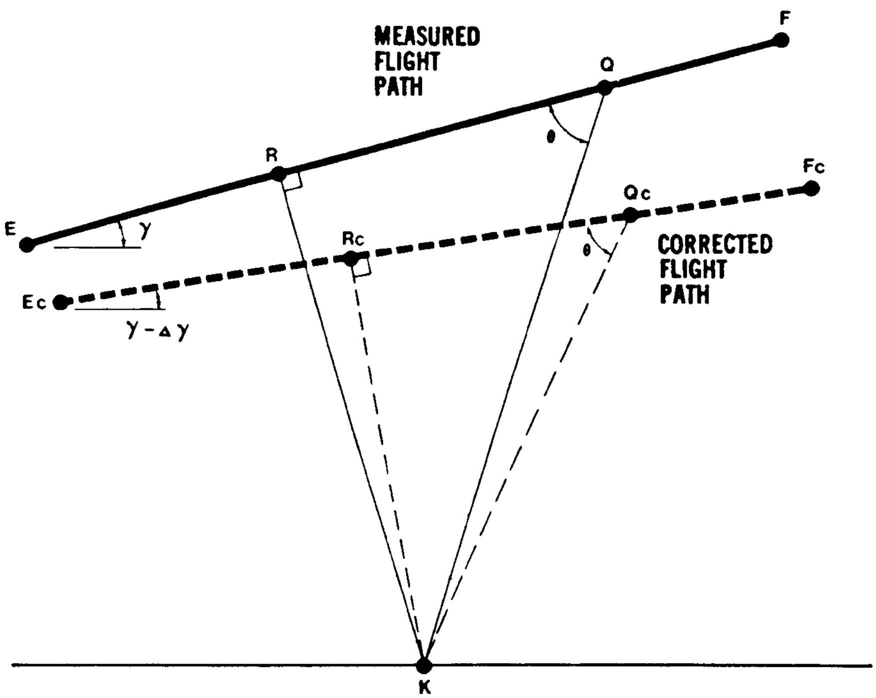


Figure A3. TAKEOFF PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

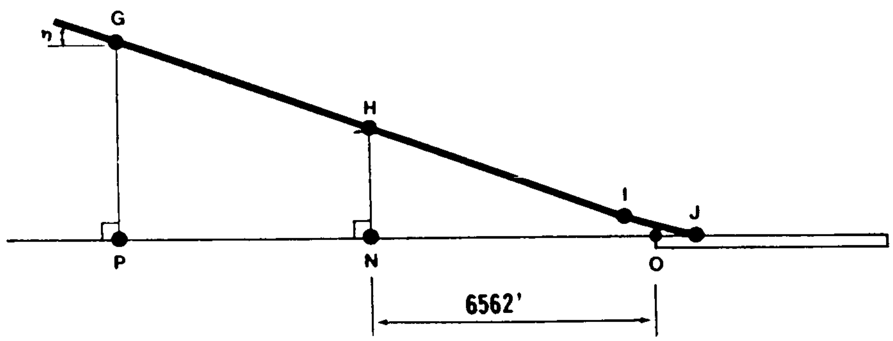


Figure A4. MEASURED APPROACH PROFILE

(c) *Approach profiles.* (1) Figure A4 illustrates a typical approach profile.

(i) The beginning of the noise certification approach profile is represented by aircraft position G whose vertical projection on the flight track (extended centerline of the runway) is point P. The position of the aircraft should be recorded for a distance OP from the runway threshold O to ensure recording of the entire interval during which the measured aircraft noise is within 10 dB of PNLTM.

(ii) The aircraft approaches at an angle passes vertically over the noise measuring station N at a height of NH, begins the level off at position I, and touches down at position J. The distance ON is prescribed as 6,562 feet (2,000 meters).

(iii) The approach profile is defined by the approach angle and the height NH which are functions of the aircraft operating conditions controlled by the pilot. If the measured approach profile parameters do not conform to the corresponding reference approach parameters (3 degrees and 394 feet, respectively, as shown in Figure A5), corrections, if positive, must be applied to the EPNL calculated from the measured data.

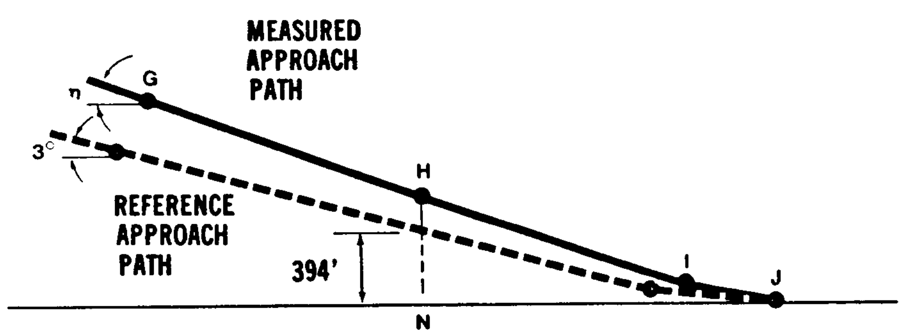


Figure A5. COMPARISON OF MEASURED AND CORRECTED APPROACH PROFILES

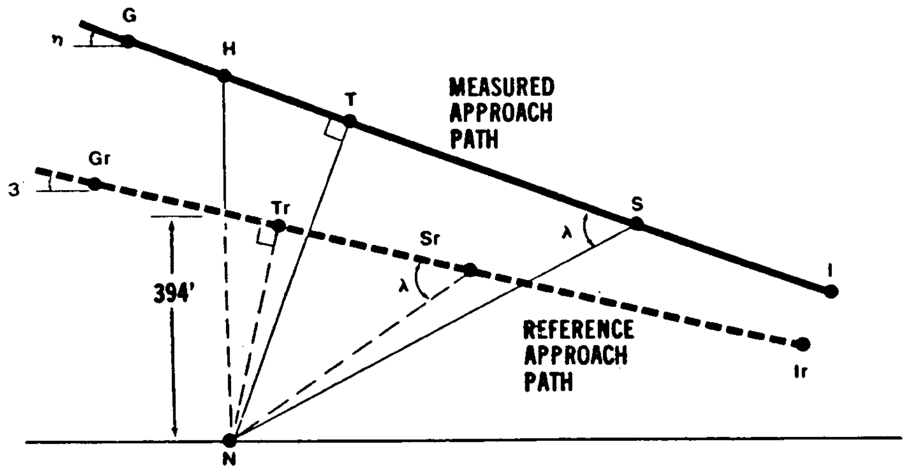


Figure A6. APPROACH PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

(2) Figure A6 illustrates portions of the measured and reference approach flight paths, including the significant geometrical relationships influencing sound propagation. GI represents the measured approach path with approach angle —, and GrIr represents the reference approach flight path at lower altitude and approach angle of 3 degrees. Position S represents the aircraft location on the measured approach flight path for which PNLTM is observed at the noise measuring station N, and Sr is the corresponding position on the reference approach flight path. The measured and corrected sound propagation paths are NS and NSr, respectively, which form the same angle λ with their flight paths. Position T represents the point on the measured approach flight path nearest the noise measuring station N, and Tr is the corresponding point on the reference approach flight path. The minimum distances to the measured and reference flight paths are indicated by the lines NT and NTr, respectively, which are normal to their flight paths. NOTE: The reference approach flight path is defined by —=3 degrees and NH=394 feet. Consequently NTr can also be defined; NTr=393 feet to the nearest foot and is, therefore, considered to be one of the reference parameters.

(d) *PNLT corrections.* If the ambient atmospheric conditions of temperature and relative humidity are not those prescribed as reference conditions under § A36.5(c) of this appendix (77 degrees F and 70 percent, respectively), corrections to the EPNL values must be calculated from the measured data under paragraph (a) of this section as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure A3, the spectrum of PNLTM observed at station K for the aircraft at position Q is decomposed into its individual SPLi values.

(i) *Step 1.* A set of corrected values are then computed as follows:

$$SPLic = SPLi \quad +(\alpha i - \alpha io)\, KQ \quad +\alpha io\, (KQ - KQc) \quad +20 \log (KQ/KQc)$$

where SPLi and SPLic are the measured and corrected sound pressure levels, respectively, in the i-th one-third octave band. The first correction term accounts for the effects of change in atmospheric sound absorption where αi and αio are the sound absorption coefficients for the test (determined under section A36.9(d)) and reference atmospheric conditions, respectively, for the i-th one-third octave band and KQ is the measured takeoff sound propagation path. The second correction term accounts for the effects of atmospheric sound absorption on the change in the sound propagation path length where KQc is the corrected takeoff sound propagation path. The third correction term accounts for the effects of the inverse square law on the change in the sound propagation path length.

(ii) *Step 2.* The corrected values of SPLic are then converted to PNLT and a correction term calculated as follows:

$$\Delta 1 = PNLT - PNLTM$$

which represents the correction to be added algebraically to the EPNL calculated from the measured data.

(2) *Approach flight path.*

(i) The procedure prescribed in paragraph (d)(1) of this section for takeoff flight paths is also used for the approach flight path, except that the value for SPLic relate to the approach sound propagation paths shown in Figure A6 as follows:

$$SPLic = SPLi + (\alpha i - \alpha io)\ NS + \alpha io\ (NS - NSr) + 20 \log (NS/NSr)$$

where NS and NSr are the measured and reference approach sound propagation paths, respectively.

(ii) The remainder of the procedure is the same as that prescribed in paragraph (d)(1)(ii) of this section, regarding takeoff flight path.

(3) *Sideline flight path.* The procedure prescribed in paragraph (d)(1) of this section for takeoff flight paths is also used for the sideline flight path, except that the values of SPLic relate only to the measured sideline sound propagation path as follows:

$$SPLic = SPLi + (\alpha i - \alpha io)\ LX\ \alpha io\ (LX - LXc)\ P + 20 \log (LX/LXc)$$

where LX is the measured sideline sound propagation path from station L (Figure A1) to position X of the aircraft for which PNLTM is observed at station L and LXc is the corrected sideline sound propagation path.

(e) *Duration corrections.* If the measured takeoff and approach flight paths do not conform to those prescribed as the corrected and reference flight paths, under section A36.11 (b) and (c) respectively, it will be necessary to apply duration corrections to the EPNL values calculated from the measured data. Such corrections must be calculated as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure A3, the correction term is calculated using the formula—

$$\Delta 2 = -7.5 \log (KR/KRc)$$

which represents the correction which must be added algebraically to the EPNL calculated from the measured data. The lengths KR and KRc are the measured and corrected takeoff minimum distances from the noise measuring station K to the measured and the corrected flight paths respectively. A negative sign indicates that, for the particular case of a duration correction, the EPNL calculated from the measured data must be reduced if the measured flight path is at a greater altitude than the corrected flight path.

(2) *Approach flight path.* For the approach flight path shown in Figure A6, the correction term is calculated using the formula—

$$\Delta 2 = -7.5 \log (NT/393)$$

where NT is the measured approach minimum distance from the noise measuring station N to the measured flight path and 393 feet is the minimum distance from station N to the reference flight path.

(3) *Sideline flight path.* For the sideline flight path, the correction term is calculated using the formula—

$$\Delta 2 = -7.5 \log (LX/LXc)$$

where LX and LXc are the measured and corrected sideline noise measuring distances, respectively, from the noise measuring station L to the aircraft position X or X_c, respectively on the takeoff flight path.

(f) *Nonstandard location correction.* When takeoff and approach noise measurements are conducted at points other than those prescribed in section C36.1 of appendix C, the EPNL value computed from these measurements must be corrected to the value that would have occurred at the prescribed measuring points under one of the following procedures:

(1) *Simplified procedure.* Unless the amount of adjustment exceeds 8 dB on takeoff or 4 dB on approach, or the correction results in a final EPNL value which is within 1.0 dB of the noise levels prescribed in appendix C of this part, the correction procedures prescribed in paragraphs (d) and (e) of this section may be used. Since this procedure accounts for extrapolation of PNLTM from the close-in measurement station to the prescribed measuring point, the remaining corrections for differences between test and reference conditions, including thrust and airspeed, must be made afterward.

(2) *Integrated procedure.* If the correction factor exceeds 8 dB on takeoff or 4 dB on approach, or the correction results in a final EPNL value which is within 1.0 dB of the noise levels prescribed in appendix C of this part, the following correction procedure must be used:

(i) Each ½ second spectrum measured during a flyover at a noise measuring station which is closer to the flight path than the prescribed reference distance must be adjusted under a procedure similar to that prescribed under paragraph (d)(1) of this section, regarding PNLT corrections. However, the distances which must be used are those values of KQ and KQc for the sound propagation path (and hence value of θ) for PNLTM which represents the actual, measured sound propagation path (and path angle), and the corresponding sound propagation path (and path angle) as if the measurements had been made at the 21,325 foot measuring point under reference acoustic-day conditions.

(ii) After the measured one half (½) second spectra have been corrected to the measuring points prescribed in section C36.1 of appendix C, the remaining noise evaluation must be conducted under the procedures prescribed in appendix B of this part, including the appropriate reference thrust and air speed corrections.

[Amdt. 36–9, 43 FR 8739, Mar. 2, 1978, as amended at 44 FR 3031, Jan. 15, 1979; Amdt. 36–15, 53 FR 16367, May 6, 1988; 53 FR 18835, May 25, 1988; 53 FR 51087, Dec. 19, 1988]

APPENDIX B TO PART 36—AIRCRAFT NOISE EVALUATION UNDER §36.103

Sec.

Section B36.1 *General.* The procedures in this appendix must be used to determine the noise evaluation quantity designated as effective perceived noise level, EPNL, under §§36.103 and 36.803. These procedures, which use the physical properties of noise measured as prescribed by appendix A of this part, consist of the following:

(a) The 24 one-third octave bands of sound pressure level are converted to perceived noisiness by means of a noy table. The noy values are combined and then converted to instantaneous perceived noise levels, PNL(k).

(b) A tone correction factor, C(k), is calculated for each spectrum to account for the subjective response to the presence of the maximum tone.

(c) The tone correction factor is added to the perceived noise level to obtain tone corrected perceived noise levels, PNLT(k), at each one-half second increment of time. The instantaneous values of tone corrected perceived noise level are noted with respect to time and the maximum value, PNLTM, is determined.

$$PNLT(k)=PNL(k)+C(k)$$

(d) A duration correction factor, D, is computed by integration under the curve of tone corrected perceived noise level versus time.

(e) Effective perceived noise level, EPNL, is determined by the algebraic sum of the maximum tone corrected perceived noise level and the duration correction factor.

$$EPNL=PNLTM+D$$

Section B36.3 *Perceived noise level.* Instantaneous perceived noise levels, PNL(k), must be calculated from instantaneous one-third octave band sound pressure levels, SPL(i,k), as follows:

(a) *Step 1.* Convert each one-third octave band SPL(i,k), from 50 to 10,000 Hz, to perceived noisiness, n(i,k), by reference to Table B1, or to the mathematical formulation of the noy table given in §B36.13 of this appendix.

(b) *Step 2.* Combine the perceived noisiness values, n(i,k), found in step 1 by the following formula:

$$N(k)=n(k)+0.15\left[\left[\sum_{i-1}^{24} n(i,k)\right]-n(k)\right]=0.85\,n(K)+0.15\sum_{i-1}^{24} n(i,k)$$

where $n(k)$ is the largest of the 24 values of n(i,k) and N(k) is the total perceived noisiness.

(c) *Step 3.* Convert the total perceived noisiness, N(k), into perceived noise level, PNL(k), by the following formula:

$$PNL(k)=40.0+33.22 \log N(k)$$

which is plotted in Figure B1. PNL(k) may also be obtained by choosing N(k) in the 1,000 Hz column of Table B1 and then reading the corresponding value of SPL(i,k) which, at 1,000 Hz, equals PNL(k).

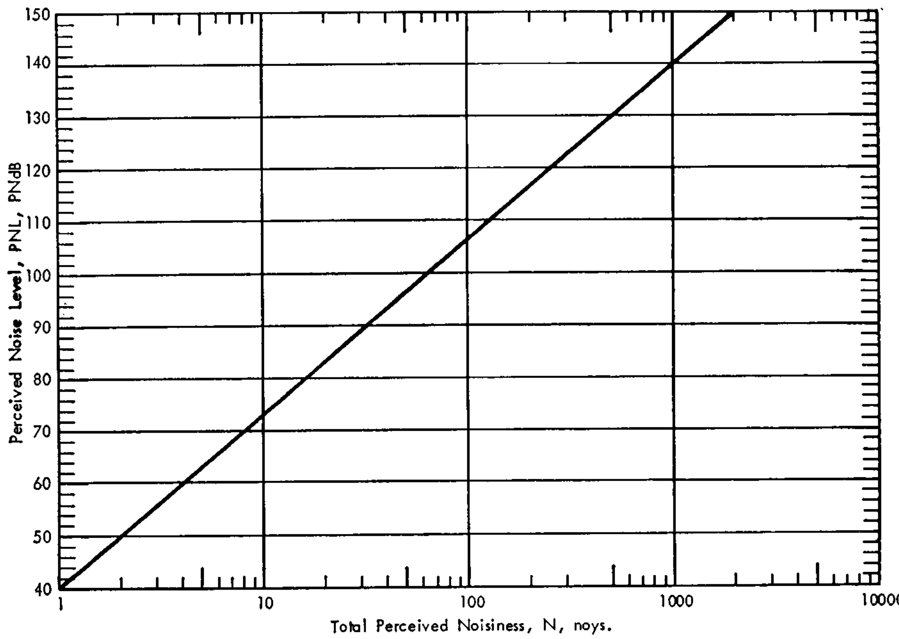


Figure B1. Perceived Noise Level as a Function of Noys.

TABLE B1 PERCEIVED NOISINESS (NOYS) AS A FUNCTION OF SOUND PRESSURE LEVEL

SPL	⅓ Octave Band Center Frequencies in Hz (c/s)																							
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.10	....	0.10	....	....	....
5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.10	0.11	0.10	....	....	....	....
6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.11	0.12	0.11	....	....	....	....
7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.13	0.14	0.13	0.10	....	....	....
8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.14	0.16	0.14	0.11	....	....	....
9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.10	0.16	0.17	0.16	0.14	....	....	....
10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.11	0.17	0.19	0.18	0.16	0.10	....	....
11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.13	0.19	0.22	0.21	0.18	0.12	....	....
12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.10	0.14	0.22	0.24	0.24	0.21	0.14	....	....
12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.11	0.16	0.24	0.27	0.27	0.24	0.16	....	....
14	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.13	0.18	0.27	0.30	0.30	0.27	0.19	....	....
15	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.10	0.14	0.21	0.30	0.33	0.33	0.30	0.22	....	....
16	....	....	....	....	....	....	....	....	....	0.10	0.10	0.10	0.10	0.10	0.11	0.16	0.24	0.33	0.35	0.35	0.33	0.26	....	....
17	....	....	....	....	....	....	....	....	....	0.11	0.11	0.11	0.11	0.11	0.13	0.18	0.27	0.35	0.38	0.38	0.35	0.30	0.10	....
18	....	....	....	....	....	....	....	....	0.10	0.13	0.13	0.13	0.13	0.13	0.15	0.21	0.30	0.38	0.41	0.41	0.38	0.33	0.12	....
19	....	....	....	....	....	....	....	....	0.11	0.14	0.14	0.14	0.14	0.14	0.17	0.24	0.33	0.41	0.45	0.45	0.41	0.36	0.14	....
20	....	....	....	....	....	....	....	....	0.13	0.16	0.16	0.16	0.16	0.16	0.20	0.27	0.36	0.45	0.49	0.49	0.45	0.39	0.17	....
21	....	....	....	....	....	....	....	0.10	0.14	0.18	0.18	0.18	0.18	0.18	0.23	0.30	0.39	0.49	0.53	0.53	0.46	0.42	0.21	0.10
22	....	....	....	....	....	....	....	0.11	0.16	0.21	0.21	0.21	0.21	0.21	0.26	0.33	0.42	0.53	0.57	0.57	0.53	0.46	0.25	0.11
23	....	....	....	....	....	....	....	0.13	0.18	0.24	0.24	0.24	0.24	0.24	0.30	0.36	0.46	0.57	0.62	0.62	0.57	0.50	0.30	0.13
24	....	....	....	....	....	....	0.10	0.14	0.21	0.27	0.27	0.27	0.27	0.27	0.33	0.40	0.50	0.62	0.67	0.67	0.62	0.55	0.33	0.15
25	....	....	....	....	....	....	0.11	0.16	0.24	0.30	0.30	0.30	0.30	0.30	0.35	0.43	0.55	0.67	0.73	0.73	0.67	0.60	0.36	0.17
26	....	....	....	....	....	....	0.13	0.18	0.27	0.33	0.33	0.33	0.33	0.33	0.38	0.48	0.60	0.73	0.79	0.79	0.73	0.65	0.39	0.20
27	....	....	....	....	....	0.10	0.14	0.21	0.30	0.35	0.35	0.35	0.35	0.35	0.41	0.52	0.65	0.79	0.85	0.85	0.79	0.71	0.42	0.23
28	....	....	....	....	....	0.11	0.16	0.24	0.33	0.38	0.38	0.38	0.38	0.38	0.45	0.57	0.71	0.85	0.92	0.92	0.85	0.77	0.46	0.26
29	....	....	....	....	....	0.13	0.18	0.27	0.35	0.41	0.41	0.41	0.41	0.41	0.49	0.63	0.77	0.92	1.00	1.00	0.92	0.84	0.50	0.30
30	....	....	....	....	0.10	0.14	0.21	0.30	0.38	0.45	0.45	0.45	0.45	0.45	0.53	0.69	0.84	1.00	1.07	1.07	1.00	0.92	0.55	0.33
31	....	....	....	....	0.11	0.16	0.24	0.33	0.41	0.49	0.49	0.49	0.49	0.49	0.57	0.76	0.92	1.07	1.15	1.15	1.07	1.00	0.60	0.37
32	....	....	....	....	0.13	0.18	0.27	0.36	0.45	0.53	0.53	0.53	0.53	0.53	0.62	0.83	1.00	1.15	1.23	1.23	1.15	1.07	0.65	0.41
33	....	....	....	....	0.14	0.21	0.30	0.39	0.49	0.57	0.57	0.57	0.57	0.57	0.67	0.91	1.07	1.23	1.32	1.32	1.23	1.15	0.71	0.45
34	....	....	....	0.10	0.16	0.24	0.33	0.42	0.53	0.62	0.62	0.62	0.62	0.62	0.73	1.00	1.15	1.32	1.41	1.41	1.32	1.23	0.77	0.50
35	....	....	....	0.11	0.18	0.27	0.36	0.46	0.57	0.67	0.67	0.67	0.67	0.67	0.79	1.07	1.23	1.41	1.51	1.51	1.41	1.32	0.84	0.55
36	....	....	....	0.13	0.21	0.30	0.40	0.50	0.62	0.73	0.73	0.73	0.73	0.73	0.85	1.15	1.32	1.51	1.62	1.62	1.51	1.41	0.92	0.61
37	....	....	....	0.15	0.24	0.33	0.43	0.55	0.67	0.79	0.79	0.79	0.79	0.79	0.92	1.23	1.41	1.62	1.74	1.74	1.62	1.51	1.00	0.67
38	....	....	....	0.17	0.27	0.37	0.48	0.60	0.73	0.85	0.85	0.85	0.85	0.85	1.00	1.32	1.51	1.74	1.86	1.86	1.74	1.62	1.10	0.74
39	....	....	0.10	0.20	0.30	0.41	0.52	0.65	0.79	0.92	0.92	0.92	0.92	0.92	1.07	1.41	1.62	1.86	1.99	1.99	1.86	1.74	1.21	0.82
40	....	....	0.12	0.23	0.33	0.45	0.57	0.71	0.85	1.00	1.00	1.00	1.00	1.00	1.15	1.51	1.74	1.99	2.14	2.14	1.99	1.86	1.34	0.90
41	....	....	0.14	0.26	0.37	0.50	0.63	0.77	0.92	1.07	1.07	1.07	1.07	1.07	1.23	1.62	1.86	2.14	2.29	2.29	2.14	1.99	1.48	1.00
42	....	....	0.16	0.30	0.41	0.55	0.69	0.84	1.00	1.15	1.15	1.15	1.15	1.15	1.32	1.74	1.99	2.29	2.45	2.45	2.29	2.14	1.63	1.10
43	....	....	0.19	0.33	0.45	0.61	0.76	0.92	1.07	1.23	1.23	1.23	1.23	1.23	1.41	1.86	2.14	2.45	2.63	2.63	2.45	2.29	1.79	1.21
44	....	0.10	0.22	0.37	0.50	0.67	0.83	1.00	1.15	1.32	1.32	1.32	1.32	1.32	1.52	1.99	2.29	2.63	2.81	2.81	2.63	2.45	1.99	1.34

45	....	0.12	0.26	0.42	0.55	0.74	0.91	1.08	1.24	1.41	1.41	1.41	1.41	1.41	1.62	2.14	2.45	2.81	3.02	3.02	2.81	2.63	2.14	1.48
46	....	0.14	0.30	0.46	0.61	0.82	1.00	1.16	1.33	1.52	1.52	1.52	1.52	1.52	1.74	2.29	2.63	3.02	3.23	3.23	3.02	2.81	2.29	1.63
47	....	0.16	0.34	0.52	0.67	0.90	1.08	1.25	1.42	1.62	1.62	1.62	1.62	1.62	1.87	2.45	2.81	3.23	3.46	3.46	3.23	3.02	2.45	1.79
48	....	0.19	0.38	0.58	0.74	1.00	1.17	1.34	1.53	1.74	1.74	1.74	1.74	1.74	2.00	2.63	3.02	3.46	3.71	3.71	3.46	3.23	2.63	1.98
49	0.10	0.22	0.43	0.65	0.82	1.08	1.26	1.45	1.64	1.87	1.87	1.87	1.87	1.87	2.14	2.81	3.23	3.71	3.97	3.97	3.71	3.46	2.81	2.18
50	0.12	0.26	0.49	0.72	0.90	1.17	1.36	1.56	1.76	2.00	2.00	2.00	2.00	2.00	2.30	3.02	3.46	3.97	4.26	4.26	3.97	3.71	3.02	2.40
51	0.14	0.30	0.55	0.80	1.00	1.26	1.47	1.68	1.89	2.14	2.14	2.14	2.14	2.14	2.46	3.23	3.71	4.26	4.56	4.56	4.26	3.97	3.23	2.63
52	0.17	0.34	0.62	0.90	1.08	1.36	1.58	1.80	2.03	2.30	2.30	2.30	2.30	2.30	2.64	3.46	3.97	4.56	4.89	4.89	4.56	4.26	3.46	2.81
53	0.21	0.39	0.70	1.00	1.18	1.47	1.71	1.94	2.17	2.46	2.46	2.46	2.46	2.46	2.83	3.71	4.26	4.69	5.24	5.24	4.89	4.56	3.71	3.02
54	0.25	0.45	0.79	1.09	1.28	1.50	1.85	2.09	2.33	2.64	2.64	2.64	2.64	2.64	3.03	3.97	4.56	5.24	5.61	5.61	5.24	4.89	3.97	3.23
55	0.30	0.51	0.89	1.18	1.39	1.71	2.00	2.25	2.50	2.83	2.83	2.83	2.83	2.83	3.25	4.26	4.89	5.61	6.01	6.01	5.61	5.24	4.26	3.46
56	0.34	0.59	1.00	1.29	1.50	1.85	2.15	2.42	2.69	3.03	3.03	3.03	3.03	3.03	3.48	4.56	5.24	6.01	6.44	6.44	6.01	5.61	4.56	3.71
57	0.39	0.67	1.09	1.40	1.63	2.00	2.33	2.61	2.88	3.25	3.25	3.25	3.25	3.25	3.73	4.89	5.61	6.44	6.90	6.90	6.44	6.01	4.89	3.97
58	0.45	0.77	1.18	1.53	1.77	2.15	2.51	2.81	3.10	3.48	3.48	3.48	3.48	3.48	4.00	5.24	6.01	6.90	7.39	7.39	6.90	6.44	5.24	4.26
59	0.51	0.87	1.29	1.66	1.92	2.33	2.71	3.03	3.32	3.73	3.73	3.73	3.73	3.73	4.29	5.61	6.44	7.39	7.92	7.92	7.39	6.90	5.61	4.56
60	0.59	1.00	1.40	1.81	2.08	2.51	2.93	3.26	3.57	4.00	4.00	4.00	4.00	4.00	4.59	6.01	6.90	7.92	8.49	8.49	7.92	7.39	6.01	4.89
61	0.67	1.10	1.53	1.97	2.26	2.71	3.16	3.51	3.83	4.29	4.29	4.29	4.29	4.29	4.92	6.44	7.39	8.49	9.09	9.09	8.49	7.92	6.44	5.24
62	0.77	1.21	1.66	2.15	2.45	2.93	3.41	3.79	4.11	4.59	4.59	4.59	4.59	4.59	5.28	6.90	7.92	9.09	9.74	9.74	9.09	8.49	6.90	5.61
63	0.87	1.32	1.81	2.34	2.65	3.16	3.69	4.06	4.41	4.92	4.92	4.92	4.92	4.92	5.66	7.39	8.49	9.74	10.4	10.4	9.74	9.09	7.39	6.01
64	1.00	1.45	1.97	2.54	2.88	3.41	3.98	4.39	4.73	5.28	5.28	5.28	5.28	5.28	6.06	7.52	9.09	10.4	11.2	11.2	10.4	9.74	7.92	6.44
65	1.11	1.60	2.15	2.77	3.12	3.69	4.30	4.71	5.08	5.66	5.66	5.66	5.66	5.66	6.50	8.49	9.74	11.2	12.0	12.0	11.2	10.4	8.49	6.90
66	1.22	1.75	2.34	3.01	3.39	3.99	4.64	5.07	5.45	6.06	6.06	6.06	6.06	6.06	6.96	9.09	10.4	12.0	12.8	12.8	12.0	11.2	9.09	7.39
67	1.35	1.92	2.54	3.28	3.68	4.30	5.01	5.46	5.85	6.50	6.50	6.50	6.50	6.50	7.46	9.74	11.2	12.8	13.8	13.8	12.8	12.0	9.74	7.92
68	1.49	2.11	2.77	3.57	3.99	4.64	5.41	5.88	6.27	6.96	6.96	6.96	6.96	6.96	8.00	10.4	12.0	13.8	14.7	14.7	13.8	12.8	10.4	8.49
69	1.65	2.32	3.01	3.80	4.33	5.01	5.84	6.33	6.73	7.46	7.46	7.46	7.46	7.46	8.57	11.2	12.8	14.7	15.8	15.8	14.7	13.8	11.2	9.09
70	1.82	2.59	3.28	4.23	4.69	5.41	6.31	6.81	7.23	8.00	8.00	8.00	8.00	8.00	9.19	12.0	13.8	15.8	16.9	16.9	15.8	14.7	12.0	9.74
71	2.02	2.79	3.57	4.60	5.09	5.84	6.81	7.33	7.75	8.57	8.57	8.57	8.57	8.57	9.85	12.8	14.7	16.9	18.1	18.1	16.9	15.8	12.8	10.4
72	2.23	3.07	3.88	5.01	5.52	6.31	7.36	7.90	8.32	9.19	9.19	9.19	9.19	9.19	10.6	13.8	15.8	18.1	19.4	19.4	18.1	16.9	13.8	11.2
73	2.46	3.37	4.23	5.45	5.99	6.81	7.94	8.50	8.93	9.85	9.85	9.85	9.85	9.85	11.3	14.7	16.9	19.4	20.8	20.8	19.4	18.1	14.7	12.0
74	2.72	3.70	4.60	5.94	6.50	7.36	8.57	9.15	9.59	10.6	10.6	10.6	10.6	10.6	12.1	15.8	18.1	20.8	22.3	22.3	20.8	19.4	15.8	12.8
75	3.01	4.06	5.01	6.46	7.05	7.94	9.19	9.85	10.3	11.3	11.3	11.3	11.3	11.3	13.0	16.9	19.4	22.3	23.9	23.9	22.3	20.8	16.9	13.8
76	3.32	4.46	5.45	7.03	7.65	8.57	9.85	10.6	11.0	12.1	12.1	12.1	12.1	12.1	13.9	18.1	20.8	23.9	25.6	25.6	23.9	22.3	18.1	14.7
77	3.67	4.89	5.94	7.66	8.29	9.19	10.6	11.3	11.8	13.0	13.0	13.0	13.0	13.0	14.9	19.4	22.3	25.6	27.4	27.4	25.6	23.9	19.4	15.8
78	4.06	5.37	6.46	8.33	9.00	9.85	11.3	12.1	12.7	13.9	13.9	13.9	13.9	13.9	16.0	20.8	23.9	27.4	29.4	29.4	27.4	25.6	20.8	16.9
79	4.49	5.90	7.03	9.07	9.76	10.6	12.1	13.0	13.6	14.9	14.9	14.9	14.9	14.9	17.1	22.3	25.6	29L4	31.5	31.5	29.4	27.4	22.3	18.1
80	4.96	6.48	7.66	9.85	10.6	11.3	13.0	13.9	14.6	16.0	16.0	16.0	16.0	16.0	18.4	23.9	27.4	31.5	33.7	33.7	31.5	29.4	23.9	19.4
81	5.48	7.11	8.33	10.6	11.3	12.1	13.9	14.9	15.7	17.1	17.1	17.1	17.1	17.1	19.7	25.6	29.4	33.7	36.1	36.1	33.7	31.5	25.6	20.8
82	6.06	7.81	9.07	11.3	12.1	13.0	14.9	16.0	16.9	18.4	18.4	18.4	18.4	18.4	21.1	27.4	31.5	36.1	38.7	38.7	36.1	33.7	27.4	22.3
83	6.70	8.57	9.87	12.1	13.0	13.9	16.0	17.1	18.1	19.7	19.7	19.7	19.7	19.7	22.6	29.4	33.7	38.7	41.5	41.5	38.7	36.1	29.4	23.9
84	7.41	9.41	10.7	13.0	13.9	14.9	17.1	18.4	19.4	21.1	21.1	21.1	21.1	21.1	24.3	31.5	36.1	41.5	44.4	44.4	41.5	38.7	31.5	25.6
85	8.19	10.3	11.7	13.9	14.9	16.0	18.4	19.7	20.8	22.6	22.6	22.6	22.6	22.6	26.0	33.7	38.7	44.4	47.6	47.6	44.4	41.5	33.7	27.4
86	9.05	11.3	12.7	14.9	16.0	17.1	19.7	21.1	22.4	24.3	24.3	24.3	24.3	24.3	27.9	36.1	41.5	47.6	51.0	51.0	47.6	44.4	36.1	29.4
87	10.0	12.1	13.9	16.0	17.1	18.4	21.1	22.6	24.0	26.0	26.0	26.0	26.0	26.0	29.9	38.7	44.4	51.0	54.7	54.7	51.0	47.6	38.7	31.5
88	11.1	13.0	14.9	17.1	18.4	19.7	22.6	24.3	25.8	27.9	27.9	27.9	27.9	27.9	32.0	41.5	47.6	54.7	58.6	58.6	54.7	51.0	41.5	33.7
89	12.2	13.9	16 .0	18.4	19.7	21.1	24.3	26.0	27.7	29.9	29.9	29.9	29.9	29.9	34.3	44.4	51.0	58.6	62.7	62.7	58.6	54.7	44.4	36.1
90	13.5	14.9	17.1	19.7	21.1	22.6	26.0	27.9	29.7	32.0	32.0	32.0	32.0	32.0	36.8	47.6	54.7	62.7	67.2	67.2	62.7	58.6	47.6	38.7

TABLE B1 PERCEIVED NOISINESS (NOYS) AS A FUNCTION OF SOUND PRESSURE LEVEL—Continued

SPL	⅓ Octave Band Center Frequencies in Hz (c/s)																							
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
91	14.9	16.0	18.4	21.1	22.6	24.3	27.9	29.9	31.8	34.3	34.3	34.3	34.3	34.3	39.4	51.0	58.6	67.2	72.6	72.0	67.2	62.7	51.0	41.5
92	16.0	17.1	19.7	22.6	24.3	26.0	29.9	32.0	34.2	36.8	36.8	36.8	36.8	36.8	42.2	54.7	62.7	72.0	77.2	77.2	72.0	67.2	54.7	44.4
93	17.1	18.4	21.1	24.3	26.0	27.9	32.0	34.3	36.7	39.4	39.4	39.4	39.4	39.4	45.3	58.6	67.2	77.2	82.7	82.7	77.2	72.0	58.6	47.6
94	18.4	19.7	22.6	26.0	27.9	29.9	34.3	36.8	39.4	42.2	42.2	42.2	42.2	42.2	48.5	62.7	72.0	82.7	88.6	88.6	82.7	77.2	62.7	51.0
95	19.7	21.1	24.3	27.9	29.9	32.0	36.8	39.4	42.2	45.3	45.3	45.3	45.3	45.3	52.0	67.2	77.2	88.6	94.9	94.9	88.6	82.7	67.2	54.7
96	21.1	22.6	26.0	29.9	32.0	34.3	39.4	42.2	45.3	48.5	48.5	48.5	48.5	48.5	55.7	72.0	82.7	94.9	102	102	94.9	88.6	72.0	58.6
97	22.6	24.3	27.9	32.0	34.3	36.8	42.2	45.3	48.5	52.0	52.0	52.0	52.0	52.0	59.7	77.2	88.6	102	109	109	102	94.9	77.2	62.7
98	24.3	26.0	29.9	34.3	36.8	39.4	45.3	48.5	52.0	55.7	55.7	55.7	55.7	55.7	64.0	82.7	94.9	109	117	117	105	102	82.7	67.2
99	26.0	27.9	32.0	36.8	39.4	42.2	48.5	52.0	55.7	59.7	59.7	59.7	59.7	59.7	68.6	88.6	102	117	125	125	117	109	88.6	72.0
100	27.9	29.9	34.3	39.4	42.2	45.3	52.0	55.7	59.7	64.0	64.0	64.0	64.0	64.0	73.5	94.9	109	125	134	134	125	117	94.9	77.2
101	29.9	32.0	36.8	42.2	45.3	48.5	55.7	59.7	64.0	68.6	68.6	68.6	68.6	68.6	78.8	102	117	134	144	144	134	125	102	82.7
102	32.0	34.3	39.4	45.3	48.5	52.0	59.7	64.0	68.6	73.5	73.5	73.5	73.5	73.5	84.4	109	125	144	154	154	144	134	109	88.6
103	34.3	36.8	42.2	48.5	52.0	55.7	64.0	68.6	73.5	78.8	78.8	78.8	78.8	78.8	90.5	117	134	154	165	165	154	144	117	94.9
104	36.8	39.4	45.3	52.0	55.7	59.7	68.6	73.5	78.8	84.4	84.4	84.4	84.4	84.4	97.0	125	144	165	177	177	165	154	125	102
105	39.4	42.2	48.5	55.7	59.7	64.0	73.5	78.8	84.4	90.5	90.5	90.5	90.5	90.5	104	134	154	177	189	189	177	165	134	109
106	42.2	45.3	52.0	59.7	64.0	68.6	78.8	84.4	90.5	97.0	97.0	97.0	97.0	97.0	111	144	165	189	203	203	189	177	144	117
107	45.3	48.5	55.7	64.0	68.6	73.5	84.4	90.5	97.0	104	104	104	104	104	119	154	177	203	217	217	203	109	154	125
108	48.5	52.0	59.7	68.6	73.5	78.8	90.5	97.0	104	111	111	111	111	111	128	165	189	217	233	233	217	203	165	134
109	52.0	55.7	64.0	73.5	78.8	84.4	97.0	104	111	119	119	119	119	119	137	177	203	233	249	249	233	217	177	144
110	55.7	59.7	68.6	78.8	84.4	90.5	104	111	119	128	128	128	128	128	137	189	217	249	267	267	249	233	189	154
111	59.7	64.0	73.5	84.4	90.5	97.0	111	119	128	137	137	137	137	137	158	203	233	267	286	286	267	249	203	165
112	64.0	68.6	78.8	90.4	97.0	104	119	128	137	147	147	147	147	147	169	217	249	286	307	307	286	267	217	177
113	64.6	73.5	84.4	97.0	104	111	128	137	147	158	158	158	158	158	181	233	267	307	329	329	307	286	233	189
114	73.5	78.8	50.5	104	111	119	137	147	158	169	169	169	169	169	194	249	286	329	352	352	329	307	249	203
115	78.8	84.4	97.0	111	119	128	147	158	169	181	181	181	181	181	208	267	307	352	377	377	352	329	267	217
116	84.4	90.5	104	119	128	137	158	169	181	194	194	194	194	194	223	286	329	377	404	404	377	352	286	233
117	90.5	97.6	111	128	137	147	169	181	194	208	208	208	208	208	239	307	352	404	433	433	404	377	307	249
118	97.0	104	119	137	147	158	181	194	208	223	223	223	223	223	256	329	377	433	464	464	433	404	329	267
119	104	111	128	147	158	169	194	208	223	239	239	239	239	239	274	352	404	464	497	497	464	433	352	286
120	111	119	137	158	169	181	208	223	239	256	256	256	256	256	294	377	433	497	533	533	497	464	377	307
121	119	128	147	169	181	194	223	239	256	274	274	274	274	274	315	404	464	533	571	571	533	497	404	329
122	128	137	158	181	194	208	239	256	274	294	294	294	294	294	338	433	497	571	611	611	571	533	433	352
123	137	147	169	194	208	223	256	274	294	315	315	315	315	315	362	464	533	611	655	655	611	571	464	377
124	147	158	181	208	223	239	274	294	315	338	338	338	338	338	388	497	571	655	702	702	655	611	497	404
125	158	169	194	223	239	256	294	315	338	362	362	362	362	362	416	533	611	702	752	752	702	655	533	433
126	169	181	208	239	256	274	315	338	362	388	388	388	388	388	446	571	655	752	806	806	752	702	571	464
127	181	194	223	256	274	294	338	362	388	416	416	416	416	416	479	611	702	806	863	863	606	732	611	497
128	194	208	239	274	294	315	362	388	416	446	446	446	446	446	512	655	752	863	925	925	863	806	655	533
129	208	223	256	294	315	338	388	416	446	478	478	478	478	478	549	702	806	925	991	991	925	863	702	571
130	223	239	274	315	338	362	416	446	478	512	512	512	512	512	588	752	863	991	1062	1062	991	925	752	611
131	239	256	294	338	362	388	446	478	512	549	549	549	549	549	630	806	925	1062	1137	1137	1062	991	606	655

132	256	274	315	362	388	416	478	512	549	588	588	588	588	588	676	863	991	1137	1219	1219	1137	1062	863	702
133	274	294	338	388	416	446	512	549	588	630	630	630	630	630	724	925	1062	1219	1306	1306	1219	1137	925	752
134	294	315	362	416	446	478	549	588	630	676	676	676	676	676	776	991	1137	1306	1399	1399	1306	1219	991	606
135	315	338	388	446	478	512	588	630	676	724	724	724	724	724	832	1062	1219	1399	1499	1499	1399	1306	1062	863
136	338	362	416	478	512	549	630	676	724	776	776	776	776	776	891	1137	1306	1499	1606	1606	1499	1399	1197	925
137	362	388	446	512	549	588	676	724	776	832	832	832	832	832	955	1219	1399	1606	1721	1721	1606	1499	1219	991
138	398	416	478	549	588	630	724	776	832	891	891	891	891	891	1024	1306	1499	1721	1844	1844	1721	1606	1306	1062
139	416	446	512	588	630	676	776	832	891	955	955	955	955	955	1098	1399	1606	1844	1975	1975	1844	1721	1399	1137
140	446	478	549	630	676	724	832	891	955	1024	1024	1024	1024	1024	1176	1499	1721	1975	....	....	1975	1844	1499	1219
141	478	512	588	676	724	776	891	955	1024	1098	1098	1098	1098	1098	1261	1606	1844	....	....	....	....	1975	1606	1306
142	512	549	630	724	776	832	955	1024	1098	1176	1176	1176	1176	1176	1351	1721	1975	....	....	....	....	....	1721	1399
143	549	588	676	776	832	891	1024	1098	1176	1261	1261	1261	1261	1261	1448	1844	....	....	....	....	....	....	1844	1499
144	588	630	724	832	891	955	1098	1176	1261	1351	1351	1351	1351	1351	1552	1975	....	....	....	....	....	....	1975	1606
145	630	676	776	891	955	1024	1176	1261	1351	1448	1448	1448	1448	1448	1664	....	....	....	....	....	....	....	....	1721
146	676	724	832	955	1024	1098	1261	1351	1448	1552	1552	1552	1552	1552	1783	....	....	....	....	....	....	....	....	1844
147	724	776	891	1024	1098	1176	1351	1448	1552	1664	1664	1664	1664	1664	1911	....	....	....	....	....	....	....	....	1975
148	776	832	955	1098	1176	1261	1448	1552	1664	1783	1783	1783	1783	1783	2048	....	....	....	....	....	....	....	....	....
149	832	891	1024	1176	1261	1351	1552	1664	1783	1911	1911	1911	1911	1911	....	....	....	....	....	....	....	....	....	....
150	891	955	1098	1261	1351	1448	1664	1783	1911	2048	2048	2048	2048	2048	....	....	....	....	....	....	....	....	....	....

Section B36.5 *Correction for spectral irregularities.* Noise having pronounced irregularities in the spectrum (for example, discrete frequency components or tones), must be adjusted by the correction factor C(k) calculated as follows:

(a) *Step 1.* Starting with the corrected sound pressure level in the 80 Hz one-third octave band (band number 3), calculate the changes in sound pressure level (or ''slopes'') in the remainder of the one-third octave bands as follows:

s(3,k)=no value
s(4,k)=SPL(4,k) − SPL(3,k)
.
.
.
s(i,k)=SPL(i,k) − SPL[(i − l),k]
.
.
.
s(24,k)=SPL(24,k) − SPL(23,k)

(b) *Step 2.* Encircle the value of the slope, s(i,k), where the absolute value of the change in slope is greater than 5; that is, where

$$\| \Delta s(i,k) \| = \| s(i,k) - s[(i-1),k] \| > 5$$

(c) *Step 3.* (1) If the encircled value of the slope s(i,k) is positive and algebraically greater than the slope s[(i − 1),k], encircle SPL(I,K).

(2) If the encircled value of the slope s(1,k) is zero or negative and the slope s[i − 1),k] is positive, encircle (SPL[(i − 1),k])

(3) For all other cases, no sound pressure level value is to be encircled.

(d) *Step 4.* Omit all SPL(i,k) encircled in Step 3 and compute new sound pressure levels SPL'prime;(i,k) as follows:

(1) For nonencircled sound pressure levels, let the new sound pressure levels equal the original sound pressure levels,

$$SPL'(i,k)=SPL(i,k)$$

(2) For encircled sound pressure levels in bands 1–23, let the new sound pressure level equal the arithmetic average of the preceding and following sound pressure levels.

$$SPL'(i,k)=(1/2)[SPL[(i-1),k]+SPL[(i+1),k]]$$

(3) If the sound pressure level in the highest frequency band (i=24) is encircled, let the new sound pressure level in that band equal

$$SPL'(24,k)=SPL(23,k+s(23,k).$$

(e) *Step 5.* Recompute new slopes s′ (i,k), including one for an imaginary 25–th band, as follows:

s′(3,k)=s′(4,k)
s′(4,k)=SPL′(4,k) − SPL′(3,k)
.
.
.
s′(i,k)=SPL′(i,k) − SPL′[(i − 1),k]
s′(24,k)=SPL′(24,k) − SPL′(23,k)
s′(25,k)=s′(24,k)

(f) *Step 6.* For i from 3 to 23, compute the arithmetic average of the three adjacent slopes as follows:

$$S(I,K)=(1/3)[S'(I,K)+S'[(I+1),K] + S'[(I+2),K]]$$

(g) *Step 7.* Compute final adjusted one-third octave-band sound pressure levels, SPL″(i,k), by beginning with band number 3 and proceeding to band number 24 as follows:

SPL″(3,k)=SPL(3,k)
SPL″(4,k)=SPL″(3.k)+s(3.k)
.
.
.
SPL″(i,k)=SPL″[(i − 1),k]+s[(i − 1),k]
.
.
.
SPL″(24,k)=SPL″(23,k)+s(23,k)

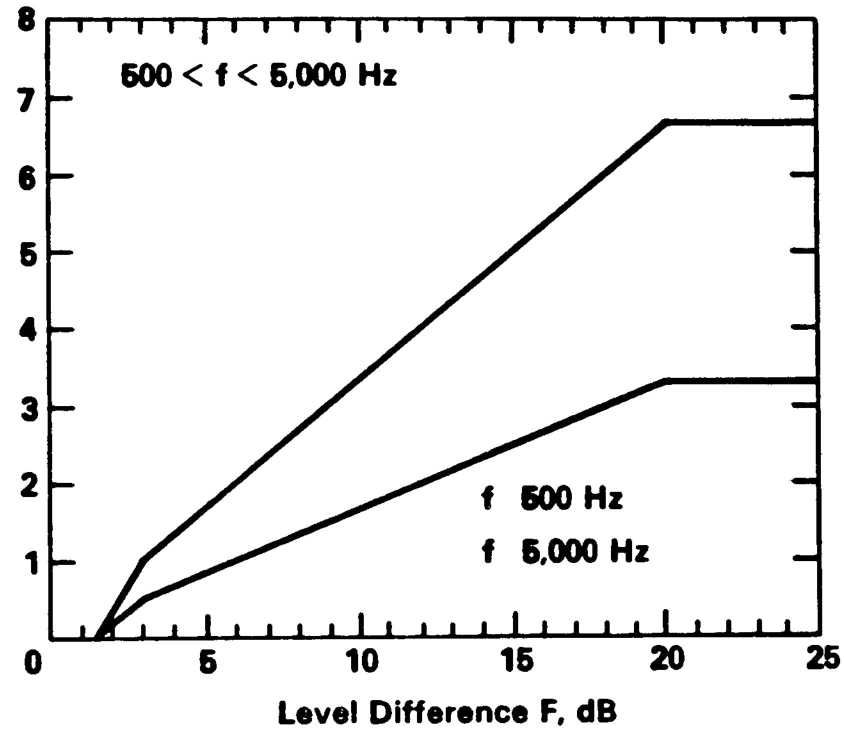
(h) *Step 8.* Calculate the differences, F(i,k), between the original and the adjusted sound pressure levels as follows:

$$F(i,k)=SPL(i,k) - SPL''(i,k)$$

and note only value greater than one and a half.

(i) *Step 9.* For each of the 24 one-third octave bands, determine tone correction factors from the sound pressure level differences F(i,k) and Table B2.

Table B2 — Tone Correction Factors



Frequency f, Hz	Level difference F, dB	Tone correction C, dB
50≤ f<500	1½*≤ F<3	F/3 − ½
	3≤ F<20	F/6
	20≤ F	3½
500≤ f≤5,000	1½*≤ F<3	2 F/3 − 1
	3≤ F<20	F/3
	20≤ F	6⅔
5,000< f≤10,000	1½*≤ F<3	F/3 − ½
	3≤ F<20	F/6
	20≤ F	3⅓

*See Step 8.

(j) *Step 10.* Designate the largest of the tone correction factors, determined in Step 9, as C(k). An example of the tone correction procedure is given in Table B3.

(k) Tone corrected perceived noise levels PNLT(k) are determined by adding the C(k) values to corresponding PNL(k) values, that is,

$$PNLT(k)=PNL(k)+C(k)$$

(l) For any i-th one-third octave band, at any k-th increment of time, for which the tone correction factor is suspected to result from something other than (or in addition to) an actual tone (or any special irregularity other than aircraft noise), an additional analysis may be made using a filter with a bandwidth narrower than one-third of an octave. If the narrow band analysis corroborates that suspicion, then a revised value for the background sound pressure level, SPL″(i,k) may be determined from the analysis and used to compute a revised tone correction factor, F(i,k), for that particular one-third octave band.

(m) Tones resulting from ground-plane reflections in the 800 Hz and lower one-third octave bands may be excluded from the calculation of corrections for spectral irregularities. To qualify for this exclusion, the pseudotones must be clearly identified as not being related to the engine noise. This identification may be made either by comparing measured data with data from a flush mounted microphone, or by observing the Doppler shift characteristics of the tone during the flyover-noise/time history. Since pseudotones are related to ground reflections, a microphone mounted flush to the ground will yield a spectral shape which can be distinguished from that produced by the 4-foot high microphone at those frequencies which can be related to ground reflection's geometrical relationships. Identification through Doppler shifting (the symmetric variation of frequency with time) can be made because the Doppler frequency variation yields a frequency increase for an approaching signal and a frequency decrease for a receding signal. Pseudotones at frequencies above 800 Hz generally should not yield significant tone corrections. However, for consistency, each tone correction value must be included in the computation for spectral irregularities. While the tone corrections below 800 Hz may be ignored for the spectral irregularity correction, the SPL values must be included in the noy calculation prescribed in section B36.13 of this appendix.

(n) After the value of PNLTM for each flyover-noise/time history, is identified, the frequency for the largest tone correction factor (C(k)) must be identified for the two preceding and the two succeeding, 500-milli-second time intervals, to identify possible tone suppression at PNLTM as a result of band sharing of the tone. If the value of C(k) for PNLTM is less than the average value of C(k) for those five consecutive time intervals, that average value of C(k) must be used to compute a new value for PNLTM.

Section B36.7 *Maximum tone corrected perceived noise level.* (a) The maximum tone corrected perceived noise level, PNLTM, is the maximum calculated value of the tone corrected perceived noise level, PNLT(k), calculated in accordance with the procedure of section B36.5 of this appendix. Figure B2 is an example of a flyover noise time history where the maximum value is clearly indicated. Half-second time intervals, Δt, are small enough to obtain a satisfactory noise time history.

① Band (i)	② f HZ	③ SPL dB	④ S dB Step 1	⑤ |ΔS| dB Step 2	⑥ SPL' dB Step 4	⑦ S' dB Step 5	⑧ S̄ dB Step 6	⑨ SPL" dB Step 7	⑩ F dB Step 8	⑪ C. dB Step 9
1	50	-	-	-	-	-	-	-	-	-
2	63	-	-	-	-	-	-	-	-	-
3	80	70	-	-	70	-8	-2 1/3	70	-	
4	100	62	- 8	-	62	-8	+3 1/3	67 2/3	-	
5	125	(70)	+(8)	16	71	+9	+6 2/3	71	-	
6	160	80	+10	2	80	+9	+2 2/3	77 2/3	2 1/3	
7	200	82	+(2)	8	82	+2	-1 1/3	80 1/3	1 2/3	
8	250	(83)	+ 1	1	79	-3	-1 1/3	79	4	2/3
9	315	76	-(7)	8	76	-3	+ 1/3	77 2/3	-	
10	400	(80)	+(4)	11	78	+2	+1	78	2	
11	500	80	0	4	80	+2	0	79	1	
12	630	79	- 1	1	79	-1	0	79	-	
13	800	78	- 1	0	78	-1	- 1/3	79	-	
14	1000	80	+ 2	3	80	+2	- 2/3	78 2/3	1 1/3	
15	1250	78	- 2	4	78	-2	- 1/3	78	-	
16	1600	76	- 2	0	76	-2	+ 1/3	77 2/3	-	
17	2000	79	+ 3	5	79	+3	+1	78	1	
18	2500	(85)	+ 6	3	79	0	- 1/3	79	6	[2]
19	3150	79	-(6)	12	79	0	-2 2/3	78 2/3	1/3	
20	4000	78	- 1	5	78	-1	-6 1/3	76	2	
21	5000	71	-(7)	6	71	-7	-8	69 2/3	1 1/3	
22	6300	60	-11	4	60	-11	-8 2/3	61 2/3	-	
23	8000	54	- 6	5	54	-6	-8	53	1	0
24	10000	45	- 9	3	45	-9	-	45	-	
						-9				

Step 1	③(i) - ③(i-1)
Step 2	|④(i) - ④(i-1)|
Step 3	see instructions
Step 4	see instructions
Step 5	⑥(i) - ⑥(i-1)

Step 6	[⑦(i) +⑦(i+1) +⑦(i+2)] ÷ 3
Step 7	⑨(i-1) +⑧(i-1)
Step 8	③(i) - ⑨(i)
Step 9	see Table B2

Table B3. Example of Tone Correction Calculation for a Turbofan Engine

(b) If there are no pronounced irregularities in the spectrum, then the procedure of §B36.5 of this appendix would be redundant since PNLT(k) would be identically equal to PNL(k). For this case, PNLTM would be the maximum value of PNL(k) and would equal PNLM.

Section B36.9 *Duration correction*. The duration correction factor D is determined by the integration technique defined by the expression:

$$D = 10\ \log\left[\left(\frac{1}{T}\right)\int_{t(1)}^{t(2)} \text{ant}\left[\frac{\text{PNLT}}{10}\right]dt\right] - \text{PNLTM}$$

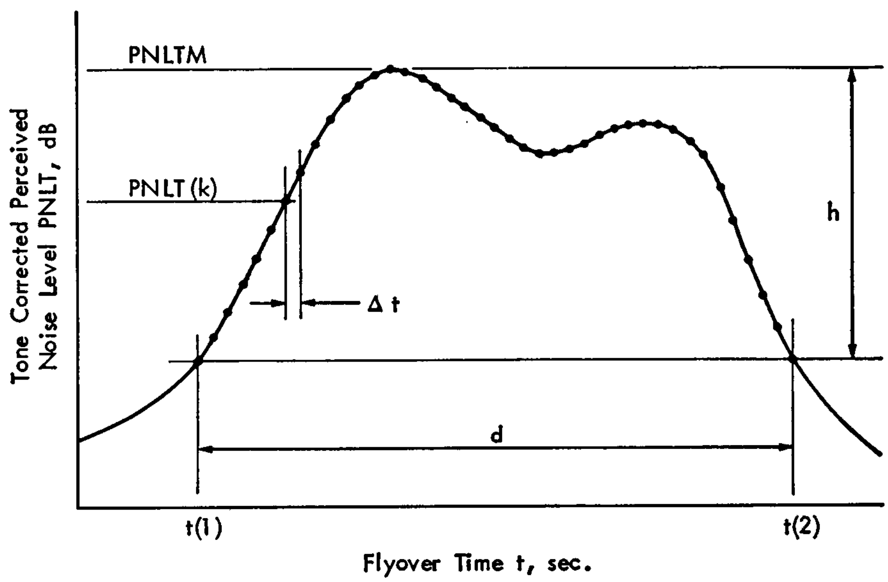


Figure B2. Example of Perceived Noise Level Corrected for Tones as a Function of Aircraft Flyover Time

Where T is a normalizing time constant, PNLTM is the maximum value of PNLT, and t(1) and t(2) are the limits of the significant noise time history.

(a) Since PNLT is calculated from measured values of SPL, there will, in general, be no obvious equation for PNLT as a function of time. Consequently, the equation can be rewritten with a summation sign instead of an integral sign as follows:

$$D = 10\ \log\left[\left(\frac{1}{T}\right)\sum_{k=0}^{d/\Delta t}\Delta t\ \text{ant}\left[\frac{\text{PNLT(k)}}{10}\right]\right] - \text{PNLTM}$$

where Δ t is the length of the equal increments of time for which PNLT(k) is calculated and d is the time interval to the nearest 1.0 second during which PNLT(k) is within a specified value, h, of PNLTM.

(b) Half-second time intervals for Δ t are small enough to obtain a satisfactory history of the perceived noise level. A shorter time interval may be selected by the applicant provided approved limits and constants are used.

(c) The following values for T, Δ t,and h, must be used in calculating D:

T=10 sec,
Δ t=0.5 sec. (or the approved sampling time interval), and
h=10 dB.

Using the above values, the equation for D becomes

$$D = 10 \log \left[\sum_{k=0}^{2d} \text{ant} \left[\frac{PNLT(k)}{10} \right] \right] - PNLTM - 13$$

Where the integer d is the duration time defined by the points that are 10 dB less than PNLTM.

(d) If the 10 dB-down points fall between calculated PNLT(k) values (the usual case), the applicable limits for the duration time must be chosen from the PNLT(k) values closest to PNLTM−10. For those cases with more than one peak value of PNLT(k), the applicable limits must be chosen to yield the largest possible value for the duration time.

(e) If the value of PNLT(k) at the 10 dB-down points is 90 PNdB or less, the value of d may be taken as the time interval between the initial and the final times for which PNLT(k) equals 90 PNdB.

(f) The aircraft testing procedures must include the 10 dB-down points in the flyover noise/time record.

Section B36.11 *Effective perceived noise level.* (a) The total subjective effect of an aircraft flyover is designated ''effective perceived noise level,'' EPNL, and is equal to the algebraic sum of the maximum value of the tone corrected perceived noise level, PNLTM, and the duration correction, D. That is,

EPNL=PNLTM+D

where PNLTM and D are calculated under sections B36.7 and B36.9 of this appendix.

(b) The above equation can be rewritten by substituting the equation for D from § B36.9 of this appendix, that is,

$$EPNL = 10 \log \left[\sum_{k=0}^{2d} \text{ant} \left[\frac{PNLT(k)}{10} \right] \right] - 13$$

(c) If, during a test flight, one or more peak values of PNLT are observed which are within 2 dB of PNLTM, the value of EPNL shall be calculated for each, as well as for PNLTM. If any EPNL value exceeds the value at the moment of PNLTM, the maximum value of such exceedance must be added as a further adjustment to the EPNL calculated from the measured data.

Section B36.13 *Mathematical formulation of noy tables.*

(a) The relationship between sound pressure level and perceived noisiness given in Table B1 is illustrated in Figure B3. The variation of log (n) with SPL for a given one-third octave band can be expressed by straight lines as shown in Figure B3.

(1) The slopes of the straight lines M(b), M(c), and M(d) and M(e);

(2) The intercepts of the lines on the SPL axis, SPL (b) and SPL (c); and

(3) The coordinates of the discontinuities, SPL (a) and log n(a); SPL (d) and log n = −1.0; and SPL (e) and log n = log (0.3).

(b) The important aspects of the mathematical formulation are:

(1) SPL ≥ SPL (a)

n = antilog [M(c)*(SPL−SPL(c))]

(2) SPL (b) ≤ SPL < SPL (a)

n = antilog [M(b)*(SPL−SPL(b))]

(3) SPL (e) ≤ SPL < SPL (b)

n = antilog [M(e)*(SPL−SPL(b))]

(4) SPL (d) ≤ SPL < SPL (e)

n = 0.1 antilog [M(d)*(SPL−SPL(d))]

(c) Table B4 lists the values of the important constants necessary to calculate sound pressure level as a function of perceived noisiness.

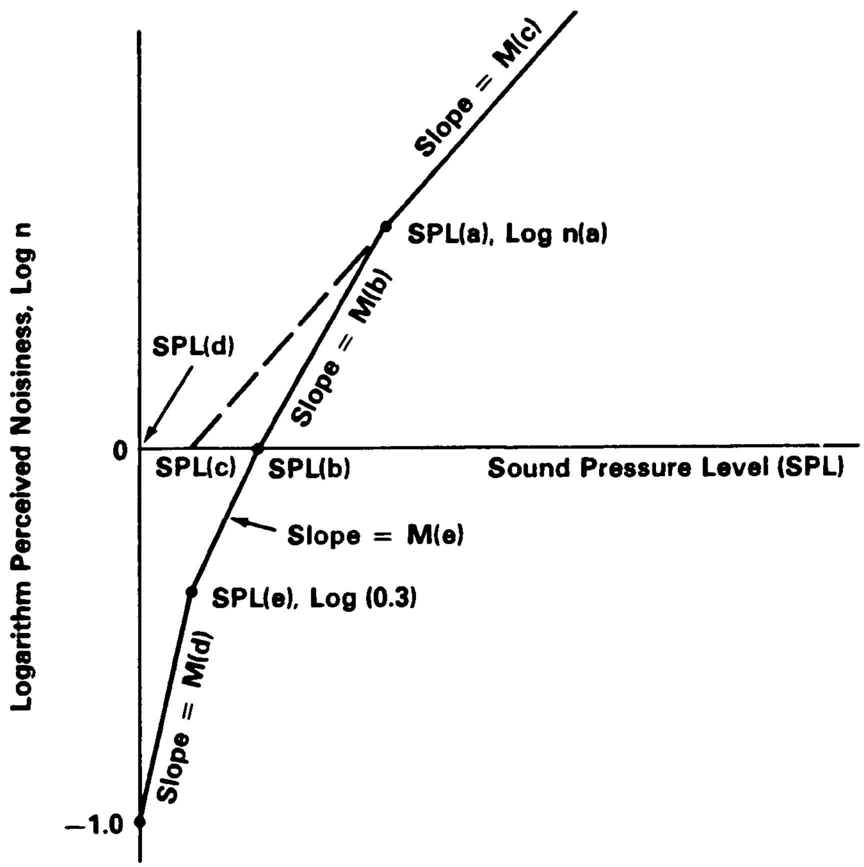


Fig. B3. Perceived Noisiness As a Function of Sound Pressure Level.

Table B4 Constants for Mathematically Formulated NOY Values

Band (i)	f Hz	SPL (a)	SPL (b)	SPL (c)	SPL (d)	SPL (e)	M(b)	M(c)	M(d)	M(e)
1	50	91.0	64	52	49	55	0.043478	0.030103	0.079520	0.058098
2	63	85.9	60	51	44	51	0.040570	↕	0.068160	"
3	80	87.3	56	49	39	46	0.036831	↕	"	0.052288
4	100	79.9	53	47	34	42	"	↕	0.059640	0.047534
5	125	79.8	51	46	30	39	0.035336	↕	0.053013	0.043573
6	160	76.0	48	45	27	36	0.033333	↕	↕	"
7	200	74.0	46	43	24	33	"	↕	↕	0.040221
8	250	74.9	44	42	21	30	0.032051	↕	↕	0.037349
9	315	94.6	42	41	18	27	0.030675	0.030103	↕	0.034859
10	400	∞	40	40	16	25	0.030103	Not Applicable	↕	↕
11	500	↕	40	40	16	25	↕		↕	↕
12	630	↕	40	40	16	25	↕		↕	↕
13	800	↕	40	40	16	25	↕		↕	↕
14	1000	↕	40	40	16	25	↕		0.053013	↕
15	1250	↕	38	38	15	23	0.030103		0.059640	0.034859
16	1600	↕	34	34	12	21	0.029960		0.053013	0.040221
17	2000	↕	32	32	9	18	↕		"	0.037349
18	2500	↕	30	30	5	15	↕		0.047712	0.034859
19	3150	↕	29	29	4	14	↕		"	↕
20	4000	↕	29	29	5	14	↕		0.053013	↕
21	5000	↕	30	30	6	15	↕		"	0.034859
22	6300	∞	31	31	10	17	0.029960		0.068160	0.037349
23	8000	44.3	37	34	17	23	0.042285	0.029960	0.079520	"
24	10000	50.7	41	37	21	29	"	"	0.059640	0.043573

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–5, 41 FR 35058, Aug. 19, 1976; Amdt. 36–9, 43 FR 8748, Mar. 2, 1978; Amdt. 36–14, 53 FR 3541, Feb. 5, 1988; Amdt. 36–15, 53 FR 16368, May 6, 1988]

APPENDIX C TO PART 36—NOISE LEVELS FOR TRANSPORT CATEGORY AND TURBOJET POWERED AIRPLANES UNDER §36.201

Section C36.1 *Noise measurement and evaluation.* Compliance with this appendix must be shown with noise levels measured and evaluated as prescribed, respectively, by appendix A and appendix B of this part, or under approved equivalent procedures.

Section C36.3 *Noise measuring points.* Compliance with the noise level standards of section C36.5 must be shown—

(a) For takeoff, at a point 21, 325 feet (6,500 meters) from the start of the takeoff roll on the extended centerline of the runway;

(b) For approach, at a point 6,562 feet (2,000 meters) from the threshold on the extended centerline of the runway; and

(c) For the sideline, at the point, on a line parallel to and 1,476 feet (450 meters) from the extended centerline of the runway, where the noise level after liftoff is greatest, except that, for an airplane powered by more than three turbojet engines, this distance must be 0.35 nautical miles for the purpose of showing compliance with Stage 1 or Stage 2 noise limits (as applicable).

Sec. C36.5 *Noise levels.*

(a) *Limits.* Except as provided in paragraphs (b) and (c) of this section, it must be shown by flight test that the noise levels of the airplane, at the measuring points described in section C36.3, do not exceed the following (with appropriate interpolation between weights);

(1) Stage 1 noise limits for acoustical changes for airplanes regardless of the number of engines are those noise levels prescribed under §36.7(c) of this part.

(2) Stage 2 noise limits for airplanes regardless of the number of engines are as follows:

(i) *For takeoff.* 108 EPNdB for maximum weights of 600,000 pounds or more, reduced by 5 EPNdB per halving of the 600,000 pounds maximum weight down to 93 EPNdB for maximum weights of 75,000 pounds and less.

(ii) *For sideline and approach.*—108 EPNdB for maximum weights of 600,000 pounds or more, reduced by 2 EPNdB per halving of the 600,000 pounds maximum weight down to 102 EPNdB for maximum weights of 75,000 pounds and less.

(3) Stage 3 noise limits are as follows:

(i) *For takeoff.*

(A) *For airplanes with more than 3 engines.* 106 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 44,673 pounds or less;

(B) *For airplanes with 3 engines*—104 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 63,177 pounds and less; and

(C) *For airplanes with fewer than 3 engines*—101 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 106,250 pounds and less.

(ii) *For sideline,* regardless of the number of engines. 103 EPNdB for maximum weights of 882,000 pounds or more, reduced by 2.56 EPNdB per halving of the 882,000 pounds maximum weight down to 94 EPNdB for maximum weights of 77,200 pounds or less.

(iii) *For approach,* regardless of the number of engines—105 EPNdB for maximum weights of 617,300 pounds or more, reduced by 2.33 EPNdB per halving of the 617,300 pounds weight down to 98 EPNdB for maximum weights of 77,200 pounds or less.

(b) *Tradeoffs.* Except to the extent limited under §§36.7(c)(1) and 36.7(d)(3)(i)(B) of this part, the noise level limits prescribed in paragraph (a) of this section may be exceeded at one or two of the measuring points specified in section C36.3 of this appendix, if—

(1) The sum of the exceedances is not greater than 3 EPNdB;

(2) No exceedance is greater than 2 EPNdB; and

(3) The exceedances are completely offset by reductions at other required measuring points.

Sec. C36.7 *Takeoff Reference and Test Limitations.*

(a) This section applies to all takeoff noise tests conducted under this appendix in showing compliance with this part.

(b) Takeoff power or thrust must be used from the start of takeoff roll to at least the following altitude above the runway:

(1) *For Stage 1 airplanes and for Stage 2 airplanes that do not have turbojet engines with a bypass ratio of 2 or more,* the following apply:

(i) For airplanes with more than three turbojet engines—700 feet (214 meters).

(ii) For all other airplanes—1,000 feet (305 meters).

(2) *For Stage 2 airplanes that have turbojet engines with a bypass ratio of 2 or more and for Stage 3 airplane,* the following apply:

(i) For airplanes with more than three turbojet engines—689 feet (210 meters).

(ii) For airplanes with three turbojet engines—853 feet (260 meters).

(iii) For airplanes with fewer than three turbojet engines—984 feet (300 meters).

(iv) For airplanes not powered by turbojet engines—1,000 feet (305 meters).

(c) Upon reaching the altitude specified in paragraph (b) of this section, the power or thrust may not be reduced below that needed to maintain level flight with one engine inoperative, or to maintain a four percent climb gradient, whichever power or thrust is greater.

(d) A constant takeoff configuration, selected by the applicant, must be maintained throughout the takeoff noise test, except that the landing gear may be retracted.

(e) For applications made for subsonic airplanes after September 17, 1971, and for Concorde airplanes, the following apply:

(1) For subsonic airplanes the test day speeds and the acoustic day reference speed must be the minimum approved value of V_2+10 knots, or the all-engines-operating speed at 35 feet (for turbine engine powered airplanes) or 50 feet (for reciprocating engine powered airplanes), whichever speed is greater as determined under the regulations constituting the type certification basis of the airplane. These tests must be conducted at the test day speeds±3 knots. Noise values measured at the test day speeds must be corrected to the acoustic day reference speed.

(2) For Concorde airplanes, the test day speeds and the acoustic day reference speed must be the minimum approved value of V_2 +35 knots, or the all-engines-operating speed at 35 feet, whichever speed is greater as determined under the regulations constituting the type certification basis of the airplane, except that the reference speed may not exceed 250 knot. These tests must be conducted at the test day speeds ±3 knots. Noise values measured at the test day speeds must be corrected to the acoustic day reference speed.

(3) If a negative runway gradient exists in the direction of takeoff, performance and acoustic data must be corrected to the zero slope condition.

Sec. C36.9 *Approach reference and test limitations.*

(a) This section applies to all approaches conducted in showing compliance with this part.

(b) The airplane's configuration must be that used in showing compliance with the landing requirements in the airworthiness regulations constituting the type certification basis of the airplane. If more than one configuration is used in showing compliance with the landing requirements in the airworthiness regulations constituting the type certification basis of the airplane, the configuration that is most critical from a noise standpoint must be used.

(c) The approaches must be conducted with a steady glide angle of 3°±0.5° and must be continued to a normal touchdown with no airframe configuration change.

(d) All engines must be operating at approximately the same power or thrust.

(e) For applications made for subsonic airplanes after September 17, 1971, and for Concorde airplanes, the following apply:

(1) For subsonic airplanes a steady approach speed, that is either 1.30 *Vs* +10 knots or the speed used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane, whichever speed is greatest, must be established and maintained over the approach measuring point.

(2) For Concorde airplanes a steady approach speed, that is either the landing reference speed + 10 knots or the speed used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane, whichever speed is greater, must be established and maintained over the approach measuring point.

(3) A tolerance of ±3 knots may be used throughout the approach noise testing.

[Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36–1, 34 FR 18815, Nov. 25, 1969; 34 FR 19025, Nov. 29, 1969; Amdt. 36–5, 41 FR 35058, Aug. 19, 1976, Amdt. 36–7, 42 FR 12371, Mar. 3, 1977; Amdt. 36–8, 43 FR 8730, Mar. 2, 1978; Amdt. 36–10, 43 FR 28420, June 29, 1978; 43 FR 44475, Sept. 28, 1978; 43 FR 47489, Oct. 16, 1978; Amdt. 36–12, 46 FR 33465, June 29, 1981; Amdt. 36–15, 53 FR 16372, May 6, 1988]

APPENDICES D–E TO PART 36 [RESERVED]

APPENDIX F TO PART 36—FLYOVER NOISE REQUIREMENTS FOR PROPELLER-DRIVEN SMALL AIRPLANE AND PROPELLER-DRIVEN, COMMUTER CATEGORY AIRPLANE CERTIFICATION TESTS PRIOR TO DECEMBER 22, 1988

PART A—GENERAL

Section F36.1 *Scope.* This appendix prescribes noise level limits and procedures for measuring and correcting noise data for the propeller driven small airplanes specified in §§36.1 and 36.501(b).

PART B—NOISE MEASUREMENT

Sec. F36.101 *General test conditions.*

(a) The test area must be relatively flat terrain having no excessive sound absorption characteristics such as those caused by thick, matted, or tall grass, by shrubs, or by wooded areas. No obstructions which significantly influence the sound field from the airplane may exist within a conical space above the measurement position, the cone being defined by an axis normal to the ground and by a half-angle 75 degrees from this axis.

(b) The tests must be carried out under the following conditions:

(1) There may be no precipitation.

(2) Relative humidity may not be higher than 90 percent or lower than 30 percent.

(3) Ambient temperature may not be above 86 degrees F. or below 41 degrees F. at 33′ above ground. If the measurement site is within 1 n.m. of an airport thermometer the airport reported temperature may be used.

(4) Reported wind may not be above 10 knots at 33′ above ground. If wind velocities of more than 4 knots are reported, the flight direction must be aligned to within ±15 degrees of wind direction and flights with tail wind and head wind must be made in equal numbers. If the measurement site is within 1 n.m. of an airport anemometer, the airport reported wind may be used.

(5) There may be no temperature inversion or anomalous wind conditions that would significantly alter the noise level of the airplane when the noise is recorded at the required measuring point.

(6) The flight test procedures, measuring equipment, and noise measurement procedures must be approved by the FAA.

(7) Sound pressure level data for noise evaluation purposes must be obtained with acoustical equipment that complies with section F36.103 of this appendix.

Sec. F36.103 *Acoustical measurement system.* The acoustical measurement system must consist of approved equipment equivalent to the following:

(a) A microphone system with frequency response compatible with measurement and analysis system accuracy as prescribed in section F36.105 of this appendix.

(b) Tripods or similar microphone mountings that minimize interference with the sound being measured.

(c) Recording and reproducing equipment characteristics, frequency response, and dynamic range compatible with the response and accuracy requirements of section F36.105 of this appendix.

(d) Acoustic calibrators using sine wave or broadband noise of known sound pressure level. If broadband noise is used, the signal must be described in terms of its average and maximum root-mean-square (rms) value for nonoverload signal level.

Sec. F36.105 *Sensing, recording, and reproducing equipment.*

(a) The noise produced by the airplane must be recorded. A magnetic tape recorder is acceptable.

(b) The characteristics of the system must comply with the recommendations in International Electrotechnical Commission (IEC) Publication No. 179, entitled ''Precision Sound Level Meters'' as incorporated by reference in Part 36 under §36.6 of this part.

(c) The response of the complete system to a sensibly plane progressive sinusoidal wave of constant amplitude must lie within the tolerance limits specified in IEC Publication No. 179, dated 1973, over the frequency range 45 to 11,200 Hz.

(d) If limitations of the dynamic range of the equipment make it necessary, high frequency pre-emphasis must be added to the recording channel with the converse de-emphasis on playback. The pre-emphasis must be applied such that the instantaneous recorded sound pressure level of the noise signal between 800 and 11,200 Hz does not vary more than 20 dB between the maximum and minimum one-third octave bands.

(e) If requested by the Administrator, the recorded noise signal must be read through an ''A'' filter with dynamic characteristics designated ''slow,'' as defined in IEC Publication No. 179, dated 1973. The output signal from the filter must be fed to a rectifying circuit with square law rectification, integrated with time constants for charge and discharge of about 1 second or 800 milliseconds.

(f) The equipment must be acoustically calibrated using facilities for acoustic freefield calibration and if analysis of the tape recording is requested by the Administrator, the analysis equipment shall be electronically calibrated by a method approved by the FAA.

(g) A windscreen must be employed with microphone during all measurements of aircraft noise when the wind speed is in excess of 6 knots.

Sec. F36.107 *Noise measurement procedures.*

(a) The microphones must be oriented in a known direction so that the maximum sound received arrives as nearly as possible in the direction for which the microphones are calibrated. The microphone sensing elements must be approximately 4′ above ground.

(b) Immediately prior to and after each test; a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator for the two purposes of checking system sensitivity and providing an acoustic reference level for the analysis of the sound level data.

(c) The ambient noise, including both acoustical background and electrical noise of the measurement systems, must be recorded and determined in the test area with the system gain set at levels that will be used for aircraft noise measurements. If aircraft sound pressure levels do not exceed the background sound pressure levels by at least 10 dB(A), approved corrections for the contribution of background sound pressure level to the observed sound pressure level must be applied.

Sec. F36.109 *Data recording, reporting, and approval.*

(a) Data representing physical measurements or corrections to measured data must be recorded in permanent form and appended to the record except that corrections to measurements for normal equipment response deviations need not be reported. All other corrections must be approved. Estimates must be made of the individual errors inherent in each of the operations employed in obtaining the final data.

(b) Measured and corrected sound pressure levels obtained with equipment conforming to the specifications described in section F36.105 of this appendix must be reported.

(c) The type of equipment used for measurement and analysis of all acoustic, airplane performance, and meteorological data must be reported.

(d) The following atmospheric data, measured immediately before, after, or during each test at the observation points prescribed in section F36.101 of this appendix must be reported:

(1) Air temperature and relative humidity.

(2) Maximum, minimum, and average wind velocities.

(e) Comments on local topography, ground cover, and events that might interfere with sound recordings must be reported.

(f) The following airplane information must be reported:

(1) Type, model and serial numbers (if any) of airplanes, engines, and propellers.

(2) Any modifications or nonstandard equipment likely to affect the noise characteristics of the airplane.

(3) Maximum certificated takeoff weights.

(4) Airspeed in knots for each overflight of the measuring point.

(5) Engine performance in terms of revolutions per minute and other relevant parameters for each overflight.

(6) Aircraft height in feet determined by a calibrated altimeter in the aircraft, approved photographic techniques, or approved tracking facilities.

(g) Aircraft speed and position and engine performance parameters must be recorded at an approved sampling rate sufficient to ensure compliance with the test procedures and conditions of this appendix.

Sec. F36.111 *Flight procedures.*

(a) Tests to demonstrate compliance with the noise level requirements of this appendix must include at least six level flights over the measuring station at a height of 1,000′ ±30′ and ±10 degrees from the zenith when passing overhead.

(b) Each test over flight must be conducted:

(1) At not less than the highest power in the normal operating range provided in an Airplane Flight Manual, or in any combination of approved manual material, approved placard, or approved instrument markings; and

(2) At stabilized speed with propellers synchronized and with the airplane in cruise configuration, except that if the speed at the power setting prescribed in this paragraph would exceed the maximum speed authorized in level flight, accelerated flight is acceptable.

PART C—DATA CORRECTION

Sec. F36.201 *Correction of data.*

(a) Noise data obtained when the temperature is outside the range of 68 degrees F. ±9 degrees F., or the relative humidity is below 40 percent, must be corrected to 77 degrees F. and 70 percent relative humidity by a method approved by the FAA.

(b) The performance correction prescribed in paragraph (c) of this section must be used. It must be determined by the method described in this appendix, and must be added algebraically to the measured value. It is limited to 5dB(A).

(c) The performance correction must be computed by using the following formula:

$$\Delta dB = 60 - 20\ \log_{10}\left\{(11{,}430 - D_{50}\ \frac{R/C}{V_y} + 50\right\}$$

Where:

D_{50}=Takeoff distance to 50 feet at maximum certificated takeoff weight.

R/C=Certificated best rate of climb (fpm).

V*y*=Speed for best rate of climb in the same units as rate of climb.

(d) When takeoff distance to 50′ is not listed as approved performance information, the figures of 2000 for single-engine airplanes and 1600′ for multi-engine airplanes must be used.

Sec. F36.203 *Validity of results.*

(a) The test results must produce an average dB(A) and its 90 percent confidence limits, the noise level being the arithmetic average of the corrected acoustical measurements for all valid test runs over the measuring point.

(b) The samples must be large enough to establish statistically a 90 pecent confidence limit not to exceed ±1.5 dB(A). No test result may be omitted from the averaging process, unless omission is approved by the FAA.

PART D—NOISE LIMITS

Sec. F36.301 *Aircraft noise limits.*

(a) Compliance with this section must be shown with noise data measured and corrected as prescribed in Parts B and C of this appendix.

(b) For airplanes for which application for a type certificate is made on or after October 10, 1973, the noise level must not exceed 68 dB(A) up to and including aircraft weights of 1,320 pounds (600 kg.). For weights greater than 1,320 pounds up to and including 3,630 pounds (1.650 kg.) the limit increases at the rate of 1 dB/165 pounds (1 dB/75 kg.) to 82 dB(A) at 3,630 pounds, after which it is constant at 82 dB(A). However, airplanes produced under type certificates covered by this paragraph must also meet paragraph (d) of this section for the original issuance of standard airworthiness certificates or restricted category airworthiness certificates if those airplanes have not had flight time before the date specified in that paragraph.

(c) For airplanes for which application for a type certificate is made on or after January 1, 1975, the noise levels may not exceed the noise limit curve prescribed in paragraph (b) of this section, except that 80 dB(A) may not be exceeded.

(d) For airplanes for which application is made for a standard airworthiness certificate or for a restricted category airworthiness certificate, and that have not had any flight time before January 1, 1980, the requirements of paragraph (c) of this section apply, regardless of date of application, to the original issuance of the certificate for that airplane.

[Doc. No. 13243, 40 FR 1035, Jan. 6, 1975; 40 FR 6347, Feb. 11, 1975, as amended by Amdt. 36–6, 41 FR 56064, Dec. 23, 1976; Amdt. 36-6, 42 FR 4113, Jan. 24, 1977; Amdt. 36–9, 43 FR 8754, Mar. 2, 1978; Amdt. 36–13, 52 FR 1836, Jan. 15, 1987; Amdt. 36–16, 53 FR 47400, Nov. 22, 1988]

APPENDIX G TO PART 36—TAKEOFF NOISE REQUIREMENTS FOR PROPELLER-DRIVEN SMALL AIRPLANE AND PROPELLER-DRIVEN, COMMUTER CATEGORY AIRPLANE CERTIFICATION TESTS ON OR AFTER DECEMBER 22, 1988

PART A—GENERAL

Section G36.1 *Scope.* This appendix prescribes limiting noise levels and procedures for measuring noise and adjusting these data to standard conditions, for propeller driven small airplanes and propeller-driven, commuter category airplanes specified in §§36.1 and 36.501(c).

PART B—NOISE MEASUREMENT

Sec. G36.101 *General Test Conditions.*

(a) The test area must be relatively flat terrain having no excessive sound absorption characteristics such as those caused by thick, matted, or tall grass, by shrubs, or by wooded areas. No obstructions which significantly influence the sound field from the airplane may exist within a conical space above the measurement position, the cone being defined by an axis normal to the ground and by a half-angle 75 degrees from the normal ground axis.

(b) The tests must be carried out under the following conditions:

(1) No precipitation;

(2) Ambient air temperature between 36 and 95 degrees F (2.2 and 35 degrees C);

(3) Relative humidity between 20 percent and 95 percent, inclusively;

(4) Wind speed may not exceed 10 knots (19 km/h) and cross wind may not exceed 5 knots (9 km/h), using a 30-second average;

(5) No temperature inversion or anomalous wind condition that would significantly alter the noise level of the airplane when the nose is recorded at the required measuring point, and

(6) The meteorological measurements must be made between 4 ft. (1.2 m) and 33 ft. (10 m) above ground level. If the measurement site is within 1 n.m. of an airport meteorological station, measurements from that station may be used.

(c) The flight test procedures, measuring equipment, and noise measurement procedures must be approved by the FAA.

(d) Sound pressure level data for noise evaluation purposes must be obtained with acoustical equipment that complies with section G36.103 of this appendix.

Sec. G36.103 *Acoustical Measurement System.*

The acoustical measurement system must consist of approved equipment with the following characteristics: (a) A microphone system with frequency response compatible with measurement and analysis system accuracy as prescribed in section G36.105 of this appendix.

(b) Tripods or similar microphone mountings that minimize interference with the sound being measured.

(c) Recording and reproducing equipment characteristics, frequency response, and dynamic range compatible with the response and accuracy requirements of section G36.105 of this appendix.

(d) Acoustic calibrators using sine wave or broadband noise of known sound pressure level. If broadband noise is used, the signal must be described in terms of its average and maximum root-mean-square (rms) value for non-overload signal level.

Sec. G36.105 *Sensing, Recording, and Reproducing Equipment.*

(a) The noise produced by the airplane must be recorded. A magnetic tape recorder, graphic level recorder, or sound level meter is acceptable when approved by the regional certificating authority.

(b) The characteristics of the complete system must comply with the requirements in International Electrotechnical Commission (IEC) Publications No. 651, entitled ''Sound Level Meters'' and No. 561, entitled ''Electro-acoustical Measuring Equipment for Aircraft Noise Certification'' as incorporated by reference under §36.6 of this part. Sound level meters must comply with the requirements for Type 1 sound level meters as specified in IEC Publication No. 651.

(c) The response of the complete system to a sensibly plane progressive sinusoidal wave of constant amplitude must be within the tolerance limits specified in IEC Publication No. 651, over the frequency range 45 to 11,200 Hz.

(d) If equipment dynamic range limitations make it necessary, high frequency pre-emphasis must be added to the recording channel with the converse de-emphasis on playback. The pre-emphasis must be applied such that the instantaneous recorded sound pressure level of the noise signal between 800 and 11,200 Hz does not vary more than 20 dB between the maximum and minimum one-third octave bands.

(e) The output noise signal must be read through an ''A'' filter with dynamic characteristics designated ''slow'' as defined in IEC Publication No. 651. A graphic level recorder, sound level meter, or digital equivalent may be used.

(f) The equipment must be acoustically calibrated using facilities for acoustic free-field calibration and if analysis of the tape recording is requested by the Administrator, the analysis equipment shall be electronically calibrated by a method approved by the FAA. Calibrations shall be performed, as appropriate, in accordance with paragraph A36.3(e) of appendix A of this part.

(g) A windscreen must be employed with the microphone during all measurements of aircraft noise when the wind speed is in excess of 5 knots (9 km/hr).

Sec. G36.107 *Noise Measurement Procedures.*

(a) The microphones must be oriented in a known direction so that the maximum sound received arrives as nearly as possible in the direction for which the microphones are calibrated. The microphone sensing elements must be 4 ft. (1.2m) above ground level.

(b) Immediately prior to and after each test, a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator for the purposes of checking system sensitivity and providing an acoustic reference level for the analysis of the sound level data. If a tape recorder or graphic level recorder is used, the frequency response of the electrical system must be determined at a level within 10 dB of the full-scale reading used during the test, utilizing pink or pseudorandom noise.

(c) The ambient noise, including both acoustic background and electrical systems noise, must be recorded and determined in the test area with the system gain set at levels which will be used for aircraft noise measurements. If aircraft sound pressure levels do not exceed the background sound pressure levels by at least 10 dB(A), a takeoff measurement point nearer to the start of the takeoff roll must be used and the results must be adjusted to the reference measurement point by an approved method.

Sec. G36.109 *Data Recording, Reporting, and Approval.*

(a) Data representing physical measurements and adjustments to measured data must be recorded in permanent form and appended to the record, except that corrections to measurements for normal equipment response deviations need not be reported. All other adjustments must be approved. Estimates must be made of the individual errors inherent in each of the operations employed in obtaining the final data.

(b) Measured and corrected sound pressure levels obtained with equipment conforming to the specifications in section G36.105 of this appendix must be reported.

(c) The type of equipment used for measurement and analysis of all acoustical, airplane performance, and meteorological data must be reported.

(d) The following atmospheric data, measured immediately before, after, or during each test at the observation points prescribed in section G36.101 of this appendix must be reported:

(1) Ambient temperature and relative humidity.

(2) Maximum and average wind speeds and directions for each run.

(e) Comments on local topography, ground cover, and events that might interfere with sound recordings must be reported.

(f) The aircraft position relative to the takeoff reference flight path must be determined by an approved method independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, or photographic scaling techniques.

(g) The following airplane information must be reported:

(1) Type, model, and serial numbers (if any) of airplanes, engines, and propellers;

(2) Any modifications or nonstandard equipment likely to affect the noise characteristics of the airplane;

(3) Maximum certificated takeoff weight;

(4) For each test flight, airspeed and ambient temperature at the flyover altitude over the measuring site determined by properly calibrated instruments;

(5) For each test flight, engine performance parameters, such as manifold pressure or power, propeller speed (rpm) and other relevant parameters. Each parameter must be determined by properly calibrated instruments. For instance, propeller RPM must be validated by an independent device accurate to within ±1 percent, when the airplane is equipped with a mechanical tachometer.

(6) Airspeed, position, and performance data necessary to make the corrections required in section G36.201 of this appendix must be recorded by an approved method when the airplane is directly over the measuring site.

Sec. G36.111 *Flight Procedures.*

(a) The noise measurement point is on the extended centerline of the runway at a distance of 8200 ft (2500 m) from the start of takeoff roll. The aircraft must pass over the measurement point within ±10 degrees from the vertical and within 20% of the reference altitude. The flight test program shall be initiated at the maximum approved takeoff weight and the weight shall be adjusted back to this maximum weight after each hour of flight time. Each flight test must be conducted at the speed for the best rate of climb (V_y) ±5 knots (±9 km/hour) indicated airspeed. All test, measurement, and data correction procedures must be approved by the FAA.

(b) The takeoff reference flight path must be calculated for the following atmospheric conditions:

(1) Sea level atmospheric pressure of 1013.25 mb (013.25 hPa);

(2) Ambient air temperature of 59° F (15° C);

(3) Relative humidity of 70 percent; and

(4) Zero wind.

(c) The takeoff reference flight path must be calculated assuming the following two segments:

(1) First segment.

(i) Takeoff power must be used from the brake release point to the point at which the height of 50 ft (15m) above the runway is reached.

(ii) A constant takeoff configuration selected by the applicant must be maintained through this segment.

(iii) The maximum weight of the airplane at brake-release must be the maximum for which noise certification is requested.

(iv) The length of this first segment must correspond to the airworthiness approved value for a takeoff on a level paved runway (or the corresponding value for seaplanes).

(2) Second segment.

(i) The beginning of the second segment corresponds to the end of the first segment.

(ii) The airplane must be in the climb configuration with landing gear up, if retractable, and flap setting corresponding to normal climb position throughout this second segment.

(iii) The airplane speed must be the speed for the best rate of climb (V_y).

(iv) Maximum continuous installed power and rpm for variable pitch propeller(s) shall be used. For fixed pitch propeller(s), the maximum power and rpm that can be delivered by the engine(s) must be maintained throughout the second segment.

PART C—DATA CORRECTIONS

Sec. G36.201 *Corrections to Test Results.*

(a) These corrections account for the effects of:

(1) Differences in atmospheric absorption of sound between meteorological test conditions and reference conditions.

(2) Differences in the noise path length between the actual airplane flight path and the reference flight path.

(3) The change in the helical tip Mach number between test and reference conditions.

(4) The change in the engine power between test and reference conditions.

(b) Atmospheric absorption correction is required for noise data obtained when the test conditions are outside those specified in Figure G1. Noise data outside the applicable range must be corrected to 77 F and 70 percent relative humidity by a FAA approved method.

(c) Helical tip Mach number and power corrections must be made if:

(1) The propeller is a variable pitch type, or

(2) The propeller is a fixed pitch type and the test power is not within 5 percent of the reference power.

(d) When the test conditions are outside those specified, corrections must be applied by an approved procedure or by the following simplified procedure:

(1) Measured sound levels must be corrected from test day meteorological conditions to reference conditions by adding an increment equal to

$$\text{Delta (M)} = (\alpha - 0.7)\ H_T/1000$$

where H_T is the height in feet of the test aircraft when directly over the noise measurement point and α is the rate of absorption for the test day conditions at 500 Hz as specified in SAE ARP 866A, entitled ''Standard Values of Atmospheric Absorption as a function of Temperature and Humidity for use in Evaluating Aircraft Flyover Noise'' as incorporated by reference under § 36.6 of this part.

(2) Measured sound levels in decibels must be corrected for height by algebraically adding an increment equal to Delta (1). When test day conditions are within those specified in figure G1:

$$\text{Delta (1)} = 22 \log (H_T/H_R)$$

where H_T is the height of the test aircraft when directly over the noise measurement point and H_R is the reference height.

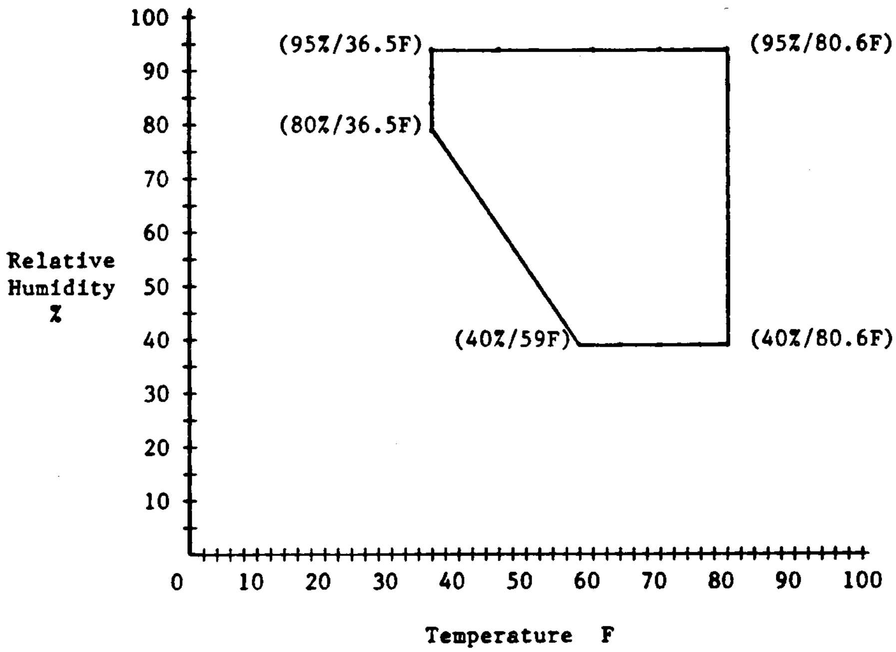
When test day conditions are outside those specified in figure G1:

$$\text{Delta (1)} = 20 \log (H_T/H_R)$$

(3) Measured sound levels in decibels must be corrected for helical tip Mach number by algebraically adding an increment equal to:

$$\text{Delta (2)} = k \log (M_R/M_T)$$

where M_T and M_R are the test and reference helical tip Mach numbers, respectively. The constant ''k'' is equal to the slope of the line obtained for measured values of the sound level in dB(A) versus helical tip Mach number. The value of k may be determined from approved data. A nominal value of k = 150 may be used when M_T is smaller than



MEASUREMENT WINDOW FOR NO ABSORPTION CORRECTION

Figure G1

M_R. No correction may be made using the nominal value of k when M_T is larger than M_R. The reference helical tip Mach number M_R is the Mach number corresponding to the reference conditions (RPM, airspeed, temperature) above the measurement point.

(4) Measured sound levels in decibels must be corrected for engine power by algebraically adding an increment equal to:

Delta (3) = 17 log (P_R/P_T)

where P_T and P_R are the test and reference engine powers respectively.

Sec. G36.203 *Validity of Results.*

(a) The measuring point must be overflown at least six times. The test results must produce an average noise level (L_{Amax}) value within a 90 percent confidence limit. The average noise level is the arithmetic average of the corrected acoustical measurements for all valid test runs over the measuring point.

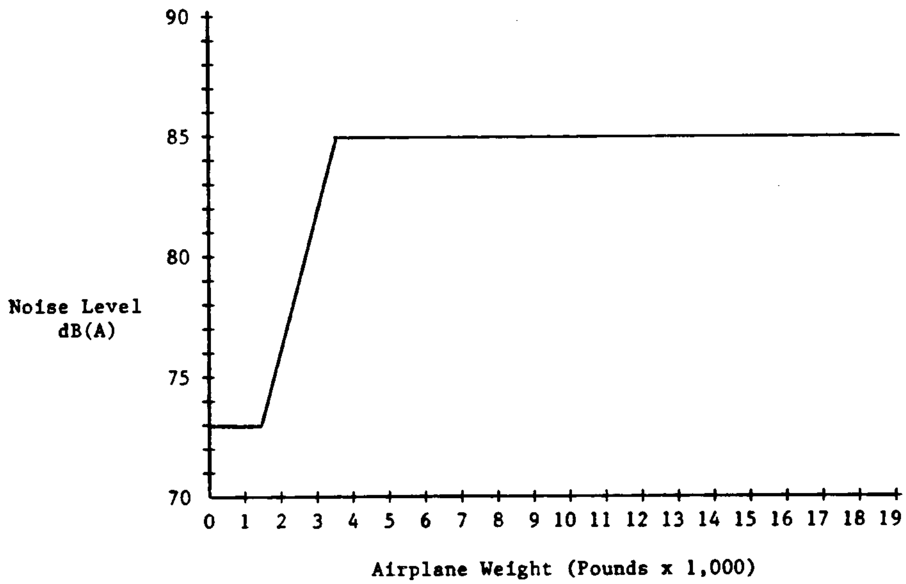
(b) The samples must be large enough to establish statistically a 90 percent confidence limit not exceeding ±1.5 dB(A). No test results may be omitted from the averaging process unless omission is approved by the FAA.

PART D—NOISE LIMITS

Sec. G36.301 *Aircraft noise limits.*

(a) Compliance with this section must be shown with noise data measured and corrected as prescribed in Parts B and C of this appendix.

(b) The noise level must not exceed 73 dB(A) up to and including aircraft weights of 1,320 pounds (600 kg). For weights greater than 1,320 pounds the limit increases at the rate of 1 dB/165



NOISE LEVEL vs AIRPLANE WEIGHT

FIGURE G2

pounds (1 dB/75 kg) up to 85 dB(A) at 3,300 pounds (1,500 kg), after which it is constant at 85 dB(A) up to and including 19,000 pounds (8,640). Figure G2 shows noise level limits vs airplane weight.

(Secs. 313(a), 603, and 611(b), Federal Aviation Act of 1958 as amended (49 U.S.C. 1354(a), 1423, and 1431(b)); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655 (c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*); E. O. 11514, March 5, 1970 and 14 CFR 11.45).

[Amdt. 36–16, 53 FR 47400, Nov. 22, 1988; 53 FR 50157, Dec. 13, 1988]

APPENDIX H TO PART 36—NOISE REQUIREMENTS FOR HELICOPTERS UNDER SUBPART H

PART A—REFERENCE CONDITIONS

Section H36.1 *General.* This appendix prescribes noise requirements for helicopters specified under §36.1, including:

(a) The conditions under which helicopter noise certification tests under Part H must be conducted and the measurement procedures that must be used under §36.801 to measure helicopter noise during each test;

(b) The procedures which must be used under §36.803 to correct the measured data to the reference conditions and to calculate the noise evaluation quantity designated as Effective Perceived Noise Level (EPNL); and

(c) The noise limits for which compliance must be shown under § 36.805.

Section H36.3 *Reference Test Conditions.*

(a) *Meteorological conditions.* Aircraft position, performance data and noise measurements must be corrected to the following noise certification reference atmospheric conditions which shall be assumed to exist from the surface to the aircraft altitude:

(1) Sea level pressure of 2116 psf (76 cm mercury).

(2) Ambient temperature of 77 degrees F (25 degrees C).

(3) Relative humidity of 70 percent.

(4) Zero wind.

(b) *Reference test site.* The reference test site is flat and without line-of-sight obstructions across the flight path that encompasses the 10 dB down points.

(c) *Takeoff reference profile.* (1) Figure H1 illustrates a typical takeoff profile, including reference conditions.

(2) The reference flight path is defined as a straight line segment inclined from the starting point (1640 feet prior to the center microphone location at 65 feet above ground level) at an angle β defined by the certificated best rate of climb and V_y for minimum engine performance. The constant climb angle β is derived from the manufacturer's data (FAA-approved by the FAA) to define the flight profile for the reference conditions. The constant climb angle β is drawn through C_r and continues, crossing over station A, to the position corresponding to the end of the type certification takeoff path represented by position I_r.

(d) *Level flyover reference profile.* The beginning of the level flyover reference profile is represented by helicopter position D (Figure H2). The helicopter approaches position D in level flight 492 feet above ground level as measured at station A. Airspeed is stabilized at either 0.9 V_H or 0.45 V_H + 65 knots (0.45 V_H + 120 km/hr), whichever speed is less. Rotor speed is stabilized at the maximum continuous RPM throughout the 10 dB down time period. The helicopter crosses station A in level flight and proceeds to position J.

(e) For noise certification purposes, V_H is defined as the airspeed in level flight obtained using the minimum specification engine torque corresponding to maximum continuous power available for sea level, 25° C ambient conditions at the relevant maximum certificated weight. The value of V_H thus defined must be listed in the Rotorcraft Flight Manual.

(f) *Approach reference profile.* (1) Figure H3 illustrates approach profile, including reference conditions.

(i) The beginning of the approach profile is represented by helicopter position E. The position of the helicopter is recorded for a sufficient distance (EK) to ensure recording of the entire interval during which the measured helicopter noise level is within 10 dB of Maximum Tone Corrected Perceived Noise Level (PNLTM), as required. EK represents a stable flight condition in terms of torque, rpm, indicated airspeed, and rate of descent resulting in a 6° ± 0.5° approach angle.

(ii) The approach profile is defined by the approach angle β passing directly over the station A at a height of AH, to position K, which terminates the approach noise certification profile.

(2) The helicopter approaches position H along a constant 6° approach slope throughout the 10 dB down time period. The helicopter crosses position E and proceeds along the approach slope crossing over station A until it reaches position K.

Section H36.5 *Symbols and units.* The following symbols and units as used in this appendix for helicopter noise certification have the following meanings.

FLIGHT PROFILE IDENTIFICATION—POSITIONS

Position	Description
A	Location of the noise measuring point at the flight-track noise measuring station vertically below the reference (takeoff, flyover, or approach) flight path.
C	Start of noise certification takeoff flight path.
C_r	Start of noise certification reference takeoff flight path.
D	Start of noise certification flyover flight path.
D_r	Start of noise certification reference flyover path.
E	Start of noise certification approach flight path.
E_r	Start of noise certification reference approach flight path.
F	Position on takeoff flight path directly above noise measuring station A.
G	Position on flyover flight path directly above noise measuring station A.
H	Position on approach flight path directly above noise measuring station A.
I	End of noise type certification takeoff flight path.
I_r	End of noise type certification reference takeoff flight path.
J	End of noise type certification flyover flight path.
J_r	End of noise type certification reference flyover flight path.
K	End of noise certification approach type flight path.
K_r	End of noise type certification reference approach flight path.
L	Position on measured takeoff flight path corresponding to PNLTM at station A.

FLIGHT PROFILE IDENTIFICATION—POSITIONS—Continued

Position	Description
L_r	Position on reference takeoff flight path corresponding to PNLTM of station A.
M	Position on measured flyover flight path corresponding to PNLTM of station A.
M_r	Position on reference flyover flight path corresponding to PNLTM of station A.
N	Position on measured approach flight path corresponding to PNLTM at station A.
N_r	Position on reference approach flight path corresponding to PNLTM at station A.
S	Position on measured approach path nearest to station A.
S_r	Position on reference approach path nearest to station A.
T	Position on measured takeoff path nearest to station A.
T_r	Position on reference takeoff path nearest to station A.

FLIGHT PROFILE DISTANCES

Distance	Unit	Meaning
AF	Feet	*Takeoff Height.* The vertical distance between helicopter and station A.
AG	Feet	*Flyover Height.* The vertical distance between the helicopter and station A.
AH	Feet	*Approach Height.* The vertical distance between the helicopter and station A.
AL	Feet	*Measured Takeoff Noise Path.* The distance from station A to the measured helicopter position L.
AL_r	Feet	*Reference Takeoff Noise Path.* The distance from station A to the reference helicopter position L_r.
AM	Feet	*Measured Flyover Noise Path.* The distance from station A to the measured helicopter position M.
AM_r	Feet	*Reference Flyover Noise Path.* The distance from station A to helicopter position M_r on the reference flyover flight path.
AN	Feet	*Measured Approach Noise Path.* The distance from station A to the measured helicopter noise position N.
AN_r	Feet	*Reference Approach Noise Path.* The distance from station A to the reference helicopter position N_r.
AS	Feet	*Measured Approach Minimum Distance.* The distance from station A to the position S on the measured approach flight path.
AS_r	Feet	*Reference Approach Minimum Distance.* The distance from station A to the position S_r on the reference approach flight path.
AT	Feet	*Measured Takeoff Minimum Distance.* The distance from station A to the position T on the measured takeoff flight path.
AT_r	Feet	*Reference Takeoff Minimum Distance.* The distance from station A to the position T_r on the reference takeoff flight path.
CI	Feet	*Takeoff Flight Path Distance.* The distance from position C at which the helicopter establishes a constant climb angle on the takeoff flight path passing over station A and continuing to position I at which the position of the helicopter need no longer be recorded.
DJ	Feet	*Flyover Flight Path Distance.* The distance from position D at which the helicopter is established on the flyover flight path passing over station A and continuing to position J at which the position of the helicopter need no longer be recorded.
EK	Feet	*Approach Flight Path Distance.* The distance from position E at which the helicopter establishes a constant angle on the approach flight path passing over station A and continuing to position K at which the position of the helicopter need no longer be recorded.

PART B—NOISE MEASUREMENT UNDER § 36.801

Section H36.101 *Noise certification test and measurement conditions.*

(a) *General.* This section prescribes the conditions under which aircraft noise certification tests must be conducted and the measurement procedures that must be used to measure helicopter noise during each test.

(b) *Test site requirements.* (1) Tests to show compliance with established helicopter noise certification levels must consist of a series of takeoffs, level flyovers, and approaches during which measurement must be taken at noise measuring stations located at the measuring points prescribed in this section.

(2) Each takeoff test, flyover test, and approach test includes simultaneous measurements at the flight-track noise measuring station vertically below the reference flight path and at two sideline noise measuring stations, one on each side of the reference flight track 492 feet (150m) from, and on a line perpendicular to, the flight track of the noise measuring station.

(3) The difference between the elevation of either sideline noise measuring station may not differ from the flight-track noise measuring station by more than 20 feet.

(4) Each noise measuring station must be surrounded by terrain having no excessive sound absorption characteristics, such as might be caused by thick, matted, or tall grass, shrubs, or wooded areas.

(5) During the period when the takeoff, flyover, or approach noise/time record indicates the noise measurement is within 10 dB of PNLTM, no obstruction that significantly influences the sound field from the aircraft may exist—

(i) For any flight-track or sideline noise measuring station, within a conical space above the measuring position (the point on the ground vertically below the microphone), the cone being defined by an axis normal to the ground and by half-angle 80° from this axis; and

(ii) For any sideline noise measuring station, above the line of sight between the microphone and the helicopter.

(6) If a takeoff or flyover test series is conducted at weights other than the maximum takeoff weight for which noise certification is requested, the following additional requirements apply:

(i) At least one takeoff test must be conducted at a weight at, or above, the maximum certification weight.

(ii) Each test weight must be within +5 percent or −10 percent of the maximum certification weight.

(iii) FAA-approved data must be used to determine the variation of EPNL with weight for takeoff test conditions.

(7) Each approach test must be conducted with the aircraft stabilized and following a 6.0 degree ±0.5 degree approach angle and must meet the requirements of section H36.107 of this part.

(8) If an approach test series is conducted at weights other than the maximum landing weight for which certification is requested, the following additional requirements apply:

(i) At least one approach test must be conducted at a weight at, or above, the maximum landing weight.

(ii) Each test weight must exceed 90 percent of the maximum landing weight.

(iii) FAA-approved data must be used to determine the variation of EPNL with weight for approach test conditions.

(9) Aircraft performance data sufficient to make the corrections required under section H36.205 of this appendix must be recorded at an FAA-approved sampling rate using FAA approved equipment.

(c) *Weather restrictions.* The tests must be conducted under the following atmospheric conditions:

(1) No rain or other precipitation.

(2) Ambient air temperature between 36° F and 95° F (2.2 C° and 35° C), inclusively, over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station. The temperature and relative humidity measured at aircraft altitude and at 10 meters above ground shall be averaged and used to adjust for propagation path absorption.

(3) Relative humidity and ambient temperature over the portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station is such that the sound attenuation in the one-third octave band centered at 8 kHz is not greater than 12 dB/100 meters and the relative humidity is between 20 percent and 95 percent, inclusively.

(4) Wind velocity as measured at 10 meters above ground does not exceed 10 knots (19 km/h) and the crosswind component does not exceed 5 knots (9 km/h). The wind shall be determined using a continuous thirty-second averaging period spanning the 10dB down time interval.

(5) No anomalous wind conditions (including turbulence) which will significantly affect the noise level of the aircraft when the noise is recorded at each noise measuring station.

(6) The wind velocity, temperature, and relative humidity measurements required under the appendix must be measured in the vicinity of noise measuring stations 10 meters above the ground. The location of the meteorological measurements must be approved by the FAA as representative of those atmospheric conditions existing near the surface over the geographical area which aircraft noise measurements are made. In some cases, a fixed meteorological station (such as those found at airports or other facilities) may meet this requirement.

(7) Temperature and relative humidity measurements must be obtained within 25 minutes of each noise test measurement. Meteorological data must be interpolated to actual times of each noise measurement.

(d) *Aircraft testing procedures.* (1) The aircraft testing procedures and noise measurements must be conducted and processed in a manner which yields the noise evaluation measure designated as Effective Perceived Noise Level (EPNL) in units of EPNdB, as prescribed in appendix B of this part.

(2) The aircraft height and lateral position relative to the centerline of the reference flight-track (which passes through the noise measuring point) must be determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(3) The aircraft position along the flight path must be related to the noise recorded at the noise measuring stations by means of synchronizing signals at an approved sampling rate. The position of the aircraft must be recorded relative to the runway during the entire time period in which the recorded signal is within 10 dB of PNLTM. Measuring and sampling equipment must be approved by the FAA.

Section H36.103 *Takeoff test conditions.*

(a) This section, in addition to the applicable requirements of sections H36.101 and H36.205(b) of this appendix, applies to all takeoff noise tests conducted under this appendix to show compliance with Part 36.

(b) A test series must consist of at least six flights over the flight-track noise measuring station (with simultaneous measurements at all three noise measuring stations) as follows:

(1) An airspeed of either $V_y \pm 5$ knots or the lowest approved speed ±5 knots for the climb after takeoff, whichever speed is greater, must be established during the horizontal portion of each test flight and maintained during the remainder of the test flight.

(2) The horizontal portion of each test flight must be conducted at an altitude of 65 feet (20 meters) above the ground level at the flight-track noise measuring station.

(3) Upon reaching a point 1,640 feet (500 meters) from the noise measuring station, the helicopter shall be stabilized at:

(i) The torque used to establish the takeoff distance for an ambient temperature at sea level of 25° C for helicopters for which the determination of takeoff performance is required by airworthiness regulations; or

(ii) The torque corresponding to minimum installed power available for an ambient temperature at sea level of 25° C for all other helicopters.

(4) The helicopter shall be maintained throughout the takeoff reference procedure at:

(i) The speed used ±5 knots to establish takeoff distance for an ambient temperature at sea level of 25° C for helicopters for which the determination of takeoff performance is required by airworthiness regulations; or

(ii) The best rate of climb speed $V_y \pm 5$ knots, or the lowest approved speed for climb after takeoff, whichever is greater, for an ambient temperature at sea level of 25° C for all other helicopters.

(5) The rotor speed must be stabilized at the normal operating RPM (±1%) during the entire period of the test flight when the measured helicopter noise level is within 10 dB of PNLTM.

(6) The helicopter must pass over the flight-track noise measuring station within ±10° from the zenith.

Section H36.105 *Flyover test conditions.*

(a) This section, in addition to the applicable requirements of sections H36.101 and H36.205(c) of this appendix, applies to all flyover noise tests conducted under this appendix to show compliance with Part 36.

(b) A test series must consist of at least six flights (three in each direction) over the flight-track noise measuring station (with simultaneous measurements at all three noise measuring stations)—

(1) In level flight;

(2) At a height of 492 feet ±30 feet (150±9 meters) above the ground level at the flight-track noise measuring station; and

(3) Within ±5° from the zenith.

(c) Each flyover noise test must be conducted—

(1) At a speed of 0.9 V_H or 0.45 V_H+120 km/hr (0.45 V_H+65 kt), whichever is less, maintained throughout the measured portion of the flyover;

(2) At rotor speed stabilized at the normal operating rotor RPM (±1 percent); and

(3) With the power stabilized during the period when the measured helicopter noise level is within 10 dB of PNLTM.

(d) The airspeed shall not vary from the reference airspeed by more than ±5 knots (9 km/hr).

Section H36.107 *Approach test conditions.*

(a) This section, in addition to the requirements of sections H36.101 and H36.205(d) of this appendix, applies to all approach tests conducted under this appendix to show compliance with Part 36.

(b) A test series must consist of at least six flights over the flight-track noise measuring station (with simultaneous measurements at the three noise measuring stations)—

(1) On an approach slope of 6°±0.5°;

(2) At a height of 394±30 feet (120±9 meters) above the ground level at the flight-track noise measuring station;

(3) Within ±10° of the zenith;

(4) At stabilized airspeed equal to the certificated best rate of climb V_y, or the lowest approved speed for approach, whichever is greater, with power stabilized during the approach and over the flight path reference point, and continued to a normal touchdown; and

(5) At rotor speed stabilized at the maximum normal operating rotor RPM (±1 percent).

(c) The airspeed shall not vary from the reference airspeed by more than ±5 knots (±9 km/hr).

Section H36.109 *Measurement of helicopter noise received on the ground.*

(a) *General.* (1) The measurements prescribed in this section provide the data needed to determine the one-third octave band noise produced by an aircraft during testing, at specific noise measuring stations, as a function of time.

(2) Sound pressure level data for aircraft noise certification purposes must be obtained with FAA-approved acoustical equipment and measurement practices.

(3) Paragraphs (b), (c), and (d) of this section prescribe the required equipment specifications. Paragraphs (e) and (f) prescribe the calibration and measurement procedures required for each certification test series.

(b) *Measurement system.* The acoustical measurement system must consist of FAA-approved equipment equivalent to the following:

(1) A microphone system with frequency response and directivity which are compatible with the measurement and analysis system accuracy prescribed in paragraph (c) of this section.

(2) Tripods or similar microphone mountings that minimize interference with the sound energy being measured.

(3) Recording and reproducing equipment, the characteristics, frequency response, and dynamic range of which are compatible with the response and accuracy requirements of paragraph (c) of this section.

(4) Calibrators using sine wave, or pink noise, of known levels. When pink noise (defined in paragraph (e)(1) of this section) is used, the signal must be described in terms of its root-mean-square (rms) value.

(5) Analysis equipment with the response and accuracy which meets or exceeds the requirements of paragraph (d) of this section.

(6) Attenuators used for range changing in sensing, recording, reproducing, or analyzing aircraft sound must be capable of being operated in equal-interval decibel steps with no error between any two settings which exceeds 0.2 dB.

(c) *Sensing, recording, and reproducing equipment.* (1) The sound produced by the aircraft must be recorded in such a way that the complete information, including time history, is retained. A magnetic tape recorder is acceptable.

(2) The microphone must be a pressure-sensitive capacitive type, or its FAA-approved equivalent, such as a free-field type with incidence corrector.

(i) The variation of microphone and preamplifier system sensitivity within an angle of ±30 degrees of grazing (60–120 degrees from the normal to the diaphragm) must not exceed the following values:

Frequency (Hz)	Change in sensitivity (dB)
45 to 1,120	1
1,120 to 2,240	1.5
2,240 to 4,500	2.5
4,500 to 7,100	4
7,100 to 11,200	5

With the windscreen in place, the sensitivity variation in the plane of the microphone diaphragm shall not exceed 1.0 dB over the frequency range 45 to 11,200 Hz.

(ii) The overall free-field frequency response at 90 degrees (grazing incidence) of the combined microphone (including incidence corrector, if applicable) preamplifier, and windscreen must be determined by using either (A) an electrostatic calibrator in combination with manufacturer-provided corrections, or (B) an anechoic free-field facility. The calibration unit must include pure tones at each preferred one-third octave frequency from 50 Hz to 10,000 Hz. The frequency response (after corrections based on that determination) must be flat and within the following tolerances:

44–3,549 Hz	±0.25 dB
3,550–7,099 Hz	±0.5 dB
7,100–11,200 Hz	±1.0 dB

(iii) Specifications concerning sensitivity to environmental factors such as temperature, relative humidity, and vibration must be in conformity with the recommendations of International Electrotechnical Commission (IEC) Publication No. 179, entitled ''Precision Sound Level Meters'', as incorporated by reference under §36.6 of this part.

(iv) If the wind speed exceeds 6 knots, a windscreen must be employed with the microphone during each measurement of aircraft noise. Correction for any insertion loss produced by the windscreen, as a function of frequency, must be applied to the measured data and any correction applied must be reported.

(3) If a magnetic tape recorder is used to store data for subsequent analysis, the record/replay system (including tape) must conform to the following:

(i) The electric background noise produced by the system in each one-third octave must be at least 35 dB below the standard recording level, which is defined as the level that is either 10 dB below the 3 percent harmonic distortion level for direct recording or ±40 percent deviation for frequency modulation (FM) recording.

(ii) At the standard recording level, the corrected frequency response in each selected one-third octave band between 44 Hz and 180 Hz must be flat and within ±0.75 dB, and in each band between 180 Hz and 11,200 Hz must be flat and within ±0.25 dB.

(iii) If the overall system satisfies the requirements of paragraph (c)(2)(ii) of this section, and if the limitations of the dynamic range of the equipment are insufficient to obtain adequate spectral information, high frequency pre-emphasis may be added to the recording channel with the converse de-emphasis on playback. If pre-emphasis is added, the instantaneously recorded sound-pressure level between 800 Hz and 11,200 Hz of the maximum measured noise signal must not vary more than 20 dB between the levels of the maximum and minimum one-third octave bands.

(d) *Analysis equipment.* (1) A frequency analysis of the acoustic signal must be performed using one-third octave filters which conform to the recommendations of International Electrotechnical Commission (IEC) Publication No. 225, entitled ''Octave, Half-Octave, and Third-Octave Band Filters Intended for Analysis of Sound and Vibrations,'' as incorporated by reference under §36.6 of this part.

(2) A set of 24 consecutive one-third octave filters must be used. The first filter of the set must be centered at a geometric mean frequency of 50 Hz and the last filter at 10,000 Hz. The output of each filter must contain less than 0.5 dB ripple.

(3) The analyzer indicating device may be either analog or digital, or a combination of both. The preferred sequence of signal processing is:

(i) Squaring the one-third octave filter outputs;

(ii) Averaging or integrating; and

(iii) Converting linear formulation to logarithmic.

(4) Each detector must operate over a minimum dynamic range of 60 dB and perform as a root-mean-square device for sinusoidal tone bursts having crest factors of at least 3 over the following dynamic range:

(i) Up to 30 dB below full-scale reading must be accurate within ±0.5 dB;

(ii) Between 30 dB and 40 dB below full-scale reading must be accurate within ±1.0 dB; and

(iii) In excess of 40 dB below full-scale reading must be accurate within ±2.5 dB.

(5) The averaging properties of the integrator must be tested as follows:

(i) White noise must be passed through the 200 Hz one-third octave band filter and the output fed in turn to each detector/integrator. The standard deviation of the measured levels must then be determined from a statistically significant number of samples of the filtered white noise taken at intervals of not less than 5 seconds. The value of the standard deviation must be within the interval 0.48±0.06 dB for a probability limit of 95 percent. An approved equivalent method may be substituted for this test on those analyzers where the test signal cannot readily be fed directly to each detector/integrator.

(ii) For each detector/integrator, the response to a sudden onset or interruption of a constant amplitude sinusoidal signal at the respective one-third octave band center frequency must be measured at sampling times 0.5, 1.0, 1.5, and 2.0 seconds after the onset or interruption. The rising responses must be in the following amounts before the steady-state level:

0.5 seconds, 4.0±1.0 dB
1.0 seconds, 1.75±0.5 dB
1.5 seconds, 1.0±0.5 dB
2.0 seconds, 0.6±0.25 dB

(iii) The falling response must be such that the sum of the decibel readings below the initial steady-state level, and the corresponding rising response reading is 6.5±1.0 dB, at both 0.5 and 1.0 seconds and, on subsequent records, the sum of the onset plus decay must be greater than 7.5 decibels.

≤NOTE 1: For analyzers with linear detection, an approximation of this response would be given by:

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$$SPL\ (i, k)-10 \log \left[0.17\ (10^{0.1(Li,k-3)}) + 10.21\ (0^{0.1(Li,k-2)}) + 0.24\ (10^{0.1(Li,k-1)}) + 0.33\ (10^{0.1(Li,k)})\right]$$

When this approximation is used, the calibration signal should be established without this weighting.

NOTE 2: Some analyzers have been shown to have signal sampling rates that are insufficiently accurate to detect signals with crest factor ratios greater than three which is common to helicopter noise. Preferably, such analyzers should not be used for helicopter certification. Use of analysis systems with high signal sampling rates (greater than 40KHz) or those with analog detectors prior to digitization at the output of each one-third octave filter is encouraged.

(iv) Analyzers using true integration cannot meet the requirements of (i), (ii), and (iii) directly, because their overall average time is greater than the sampling interval. For these analyzers, compliance must be demonstrated in terms of the equivalent output of the data processor. Further, in cases where readout and resetting require a dead-time during acquisition, the percentage loss of the total data must not exceed one percent.

(6) The sampling interval between successive readouts shall not exceed 500 milliseconds and its precise value must be known to within ±1 one percent. The instant in time by which a readout is characterized shall be

the midpoint of the average period where the averaging period is defined as twice the effective time constant of the analyzer.

(7) The amplitude resolution of the analyzer must be at least 0.25 dB.

(8) After all systematic errors have been eliminated, each output level from the analyzer must be accurate within ±1.0 dB of the level of the input signal. The total systematic errors for each of the output levels must not exceed ±3.0 dB. For contiguous filter systems, the systematic corrections between adjacent one-third octave channels must not exceed 4.0 dB.

(9) The dynamic range capability of the analyzer to display a single aircraft noise event, in terms of the difference between full-scale output level and the maximum noise level of the analyzer equipment, must be at least 60 dB.

(e) *Calibrations.* (1) Within five days prior to beginning each test series, the complete electronic system, as installed in field including cables, must be electronically calibrated for frequency and amplitude by the use of a pink noise signal of known amplitudes covering the range of signal levels furnished by the microphone. For purposes of this section, ''pink noise'' means a noise whose noise-power/unit-frequency is inversely proportional to frequency at frequencies within the range of 44 Hz to 11,200 Hz. The signal used must be described in terms of its average root-mean-square (rms) values for a nonoverload signal level. This system calibration must be repeated within five days of the end of each test series, or as required by the FAA.

(2) Immediately before and after each day's testing, a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator to check the system sensitivity and provide an acoustic reference level for the sound level data analysis. The performance of equipment in the system will be considered satisfactory if, during each day's testing, the variation in the calibration value does not exceed 0.5 dB.

(3) A normal incidence pressure calibration of the combined microphone/preamplifier must be performed with pure tones at each preferred one-third octave frequency from 50 Hz to 10,000 Hz. This calibration must be completed within 90 days prior to the beginning of each test series.

(4) Each reel of magnetic tape must:

(i) Be pistonphone calibrated; and

(ii) At its beginning and end, carry a calibration signal consisting of at least a 15 second burst of pink noise, as defined in paragraph (e)(1) of this section.

(5) Data obtained from tape recorded signals are not considered reliable if the difference between the pink noise signal levels, before and after the tests in each one-third octave band, exceeds 0.75 dB.

(6) The one-third octave filters must have been demonstrated to be in conformity with the recommendations of IEC Publication 225 as incorporated by reference under §36.6 of this part, during the six calendar months preceding the beginning of each test series. However, the correction for effective bandwidth relative to the center frequency response may be determined for each filter by:

(i) Measuring the filter response to sinusoidal signals at a minimum of twenty frequencies equally spaced between the two adjacent preferred one-third octave frequencies; or

(ii) Using an FAA approved equivalent technique.

(7) A performance calibration analysis of each piece of calibration equipment, including pistonphones, reference microphones, and voltage insert devices, must have been made during the six calendar months preceding the beginning of each day's test series. Each calibration must be traceable to the National Bureau of Standards.

(f) *Noise measurement procedures.* (1) Each microphone must be oriented so that the diaphragm is substantially in the plane defined by the flight path of the aircraft and the measuring station. The microphone located at each noise measuring station must be placed so that its sensing element is approximately 4 feet above ground.

(2) Immediately before and immediately after each series of test runs and each day's testing, acoustic calibrations of the system prescribed in this section of this appendix must be recorded in the field to check the acoustic reference level for the analysis of the sound level data. Ambient noise must be recorded for at least 10 seconds and be representative of the acoustical background, including system noise, that exists during the flyover test run. During that recorded period, each component of the system must be set at the gain-levels used for aircraft noise measurement.

(3) The mean background noise spectrum must contain the sound pressure levels, which, in each preferred third octave band in the range of 50 Hz to 10,000 Hz, are the averages of the energy of the sound pressure levels in every preferred third octave. When analyzed in PNL, the resulting mean background noise level must be at least 20 PNdB below the maximum PNL of the helicopter.

(4) Corrections for recorded levels of background noise are allowed, within the limits prescribed in section H36.111(c)(3) of this appendix.

Section H36.111 Reporting and correcting measured data

(a) *General.* Data representing physical measurements, and corrections to measured data, including corrections to measurements for equipment response deviations, must be recorded in permanent form and appended to the record. Each correction must be reported and is subject to FAA approval. An estimate must be made of each individual error inherent in each of the operations employed in obtaining the final data.

(b) *Data reporting.* (1) Measured and corrected sound pressure levels must be presented in one-third octave band levels obtained with equipment conforming to the standards prescribed in section H36.109 of this appendix.

(2) The type of equipment used for measurement and analysis of all acoustic, aircraft performance, and meteorological data must be reported.

(3) The atmospheric environmental data required to demonstrate compliance with this appendix, measured throughout the test period, must be reported.

(4) Conditions of local topography, ground cover, or events which may interfere with sound recording must be reported.

(5) The following aircraft information must be reported:

(i) Type, model, and serial numbers, if any, of aircraft engines and rotors.

(ii) Gross dimensions of aircraft and location of engines.

(iii) Aircraft gross weight for each test run.

(iv) Aircraft configuration, including landing gear positions.

(v) Airspeed in knots.

(vi) Helicopter engine performance as determined from aircraft instruments and manufacturer's data.

(vii) Aircraft flight path, above ground level in feet, determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(6) Aircraft speed, and position, and engine performance parameters must be recorded at an approved sampling rate sufficient to correct to the noise certification reference test conditions prescribed in section H36.3 of this appendix. Lateral position relative to the reference flight-track must be reported.

(c) *Data corrections.* (1) Aircraft position, performance data and noise measurement must be corrected to the noise certification reference conditions as prescribed in sections H36.3 and H36.205 of this appendix.

(2) The measured flight path must be corrected by an amount equal to the difference between the applicant's predicted flight path for the certification reference conditions and the measured flight path at the test conditions. Necessary corrections relating to aircraft flight path or performance may be derived from FAA-approved data for the difference between measured and reference engine conditions, together with appropriate allowances for sound attenuation with distance. The Effective Perceived Noise Level (EPNL) correction must be less than 2.0 EPNdB for any combination of the following:

(i) The aircraft's not passing vertically above the measuring station.

(ii) Any difference between the reference flight-track and the actual minimum distance of the aircraft's ILS antenna from the approach measuring station.

(iii) Any difference between the actual approach angle and the noise certification reference approach flight path.

(iv) Any correction of the measured level flyover noise levels which accounts for any difference between the test engine thrust or power and the reference engine thrust or power.

Detailed correction requirements are prescribed in section H36.205 of this appendix.

(3) Aircraft sound pressure levels within the 10 dB-down points must exceed the mean background sound pressure levels determined under section A36.3(f)(3) by at least 5 dB in each one-third octave band or be corrected under an FAA approved method to be included in the computation of the overall noise level of the aircraft. An EPNL may not be computed or reported from data from which more than four one-third octave bands in any spectrum within the 10 dB-down points have been excluded under this paragraph.

(d) *Validity of results.* (1) The test results must produce three average EPNL values within the 90 percent confidence limits, each value consisting of the arithmetic average of the corrected noise measurements for all valid test runs at the takeoff, level flyovers, and approach conditions. The 90 percent confidence limit applies separately to takeoff, flyover, and approach.

(2) The minimum sample size acceptable for each takeoff, approach, and flyover certification measurements is six. The number of samples must be large enough to establish statistically for each of the three average noise certification levels a 90 percent confidence limit which does not exceed ±1.5 EPNdB. No test result may be omitted from the averaging process, unless otherwise specified by the FAA.

(3) To comply with this appendix, a minimum of six takeoffs, six approaches, and six level flyovers is required. To be counted toward this requirement, each flight event must be validly recorded at all three noise measuring stations.

(4) The approved values of V_H and V_y used in calculating test and reference conditions and flight profiles must be reported along with measured and corrected sound pressure levels.

Section H36.113 Atmospheric attenuation of sound.

(a) The values of the one-third octave band spectra measured during helicopter noise certification tests under this appendix must conform, or be corrected, to the reference conditions prescribed in section H36.3(a). Each correction must account for any differences in the atmospheric attenuation of sound between the test-day conditions and the reference-day conditions along the sound propagation path between the aircraft and the microphone. Unless the meteorological conditions are within the test window prescribed in this appendix, the test data are not acceptable.

(b) *Attenuation rates.* The atmospheric attenuation rates of sound with distance for each one-third octave band from 50 Hz to 10,000 Hz must be determined in accordance with the formulations and tabulations of SAE ARP 866A, entitled ''Standard Values of Atmospheric Absorption as a Function of Temperatures and Humidity for Use in Evaluating Aircraft Flyover Noise'', as incorporated by reference under §36.6 of this part.

(c) *Correction for atmospheric attenuation.* (1) EPNL values calculated for measured data must be corrected whenever—

(i) The ambient atmospheric conditions of temperature and relative humidity do not conform to the reference conditions, 77 ° F and 70%, respectively, or

(ii) The measured flight paths do not conform to the reference flight paths.

(iii) The temperature and relative humidity measured at aircraft altitude and at 10 meters above the ground shall be averaged and used to adjust for propagation path absorption.

(2) The mean attenuation rate over the complete sound propagation path from the aircraft to the microphone must be computed for each one-third octave band from 50 Hz to 10,000 Hz. These rates must be used in computing the corrections required in section H36.111(d) of this appendix.

PART C—NOISE EVALUATION AND CALCULATION UNDER §36.803

Section H36.201 Noise Evaluation in EPNdB.

(a) Effective Perceived Noise Level (EPNL), in units of effective perceived noise decibels (EPNdB), shall be used for evaluating noise level values under §36.803 of this part. Except as provided in paragraph (b) of this section, the procedures in appendix B of Part 36 must be used for computing EPNL. appendix B includes requirements governing determination of noise values, including calculations of:

(1) Instantaneous perceived noise levels;

(2) Corrections for spectral irregularities;

(3) Tone corrections;

(4) Duration corrections;

(5) Effective perceived noise levels; and

(6) Mathematical formulation of noy tables.

(b) Notwithstanding the provisions of section B36.5(a), for helicopter noise certification, corrections for spectral irregularities shall start with the corrected sound pressure level in the 50 Hz one-third octave band.

Section H36.203 Calculation of noise levels.

(a) To demonstrate compliance with the noise level limits of section H36.305, the noise values measured simultaneously at the three noise measuring points must be arithmetically averaged to obtain a single EPNdB value for each flight.

(b) The calculated noise level for each noise test series, i.e., takeoff, flyover, or approach must be the numerical average of at least six separate flight EPNdB values. The 90 percent confidence limit for all valid test runs under section H36.111(d) of this appendix applies separately to the EPNdB values for each noise test series.

Section H36.205 Detailed data correction procedures

(a) *General.* If the test conditions do not conform to those prescribed as noise certification reference conditions under section H36.305 of this appendix, the following correction procedure shall apply:

(1) If a positive value results from any difference between reference and test conditions, an appropriate positive correction must be made to the EPNL calculated from the measured data. Conditions which can result in a positive value include:

(i) Atmospheric absorption of sound under test conditions which is greater than the reference;

(ii) Test flight path at an altitude which is higher than the reference; or

(iii) Test weight which is less than maximum certification weight.

(2) If a negative value results from any difference between reference and test conditions, no correction may be made to the EPNL calculated from the measured data, unless the difference results from:

(i) An atmospheric absorption of sound under test conditions which is less than the reference; or

(ii) A test flight path at an altitude which is lower than the reference.

(3) The following correction procedures may produce one or more possible correction values which must be added algebraically to the calculated EPNL to bring it to reference conditions:

(i) The flight profiles must be determined for both reference and test conditions. The procedures require noise and flight path recording with a synchronized time signal from which the test profile can be delineated, including the aircraft position for which PNLTM is observed at the noise measuring station. For takeoff, the flight profile corrected to reference conditions may be derived from FAA approved manufacturer's data.

(ii) The sound propagation paths to the microphone from the aircraft position corresponding to PNLTM are determined for both the test and reference profiles. The SPL values in the spectrum of PNLTM must then be corrected for the effects of—

(A) Change in atmospheric sound absorption;

(B) Atmospheric sound absorption on the linear difference between the two sound path lengths; and

(C) Inverse square law on the difference in sound propagation path length. The corrected values of SPL are then converted to PNLTM from which PNLTM must be subtracted. The resulting difference represents the correction which must be added algebraically to the EPNL calculated from the measured data.

(iii) The minimum distances from both the test and reference profiles to the noise measuring station must be calculated and used to determine a noise duration correction due to any change in the altitude of aircraft flyover. The duration correction must be added algebraically to the EPNL calculated from the measured data.

(iv) From FAA approved data in the form of curves or tables giving the variation of EPNL with rotor rpm and test speed, corrections are determined and must be added to the EPNL, which is calculated from the measured data to account for noise level changes due to differences between test conditions and reference conditions.

(v) From FAA approved data in the form of curves or tables giving the variation of EPNL with approach angle, corrections are determined and must be added algebraically to the EPNL, which is calculated from measured data, to account for noise level changes due to differences between the 6 degree and the test approach angle.

(b) *Takeoff profiles.* (1) Figure H1 illustrates a typical takeoff profile, including reference conditions.

(i) The reference takeoff flight path is described in section H36.3(c).

(ii) The test parameters are functions of the helicopter's performance and weight and the atmospheric conditions of temperature, pressure, wind velocity and direction.

(2) For the actual takeoff, the helicopter approaches position C in level flight at 65 feet (20 meters) above ground level at the flight track noise measuring station and at either V_y±5 knots (±9 km/hr) or the maximum speed of the curve tangential at the ordinate of the height-speed envelope plus 3.0 knots (±5 knots), whichever speed is greater. Rotor speed is stabilized at the normal operating RPM (±1 percent), specified in the flight manual. The helicopter is stabilized in level flight at the speed for best rate of climb using minimum engine specifications (power or torque and rpm) along a path starting from a point located 1640 feet (500 meters) forward of the flight-track noise measuring station and 65 feet (20 meters) above the ground. Starting at point B, the helicopter climbs through point C to the end of the noise certification takeoff flight path represented by position I. The position of point C may vary within limits allowed by the FAA. The position of the helicopter shall be recorded for a distance (CI) sufficient to ensure recording of the entire interval during which the measured helicopter noise level is within 10 dB of PNLTM, as required by this rule. Station A is the flight-track noise measuring station. The relationships between the measured and corrected takeoff flight profiles can be used to determine the corrections which must be applied to the EPNL calculated from the measured data.

(3) Figure H1 also illustrates the significant geometrical relationships influencing sound propagation. Position L represents the helicopter location on the measured takeoff flight path from which PNLTM is observed at station A, and L_r is the A and Nρ corresponding position on the reference sound propagation path. AL and AL_r both form the angle Φ with their respective flight paths. Position T represents the point on the measured takeoff flight path nearest station A, and T_r is the corresponding position on the reference flight path. The minimum distance to the measured and reference flight paths are indicated by the lines AT and AT_r, respectively, which are normal to their flight paths.

(c) *Level flyover profiles.* (1) The noise type certification level flyover profile is shown in Figure H2. Airspeed must be stabilized within ±5 knots of the reference airspeed given in section H36.3(d). For each run, the difference between airspeed and ground speed shall not exceed 10 knots between the 10 dB down points. Rotor speed must be stabilized at the maximum continuous RPM within one percent, throughout the 10 dB down time period. If the test requirements are otherwise met, flight direction may be reversed for each subsequent flyover, to obtain three test runs in each direction.

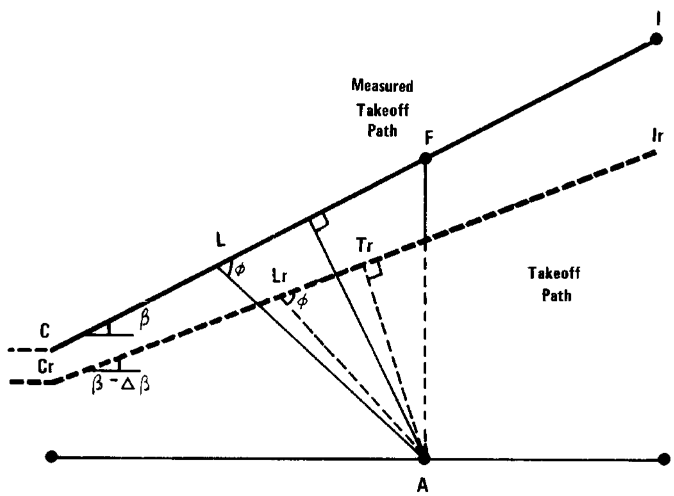

Figure H1. COMPARISON OF MEASURED AND CORRECTED TAKEOFF PROFILES

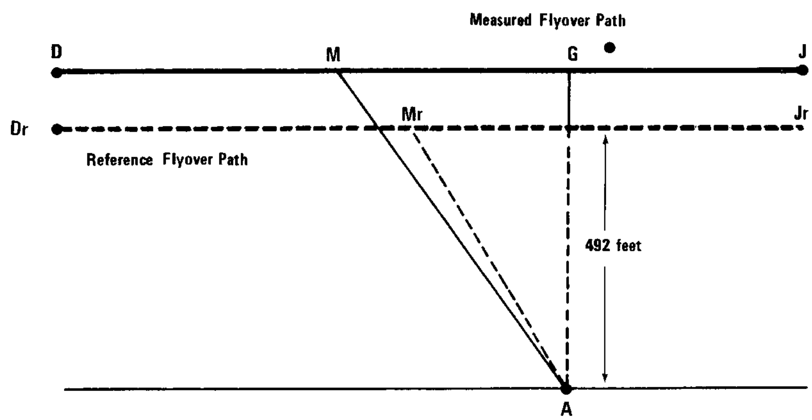

Figure H2. COMPARISON OF MEASURED AND CORRECTED FLYOVER PROFILES

(2) Figure H2 illustrates comparative flyover profiles when test conditions do not conform to prescribed reference conditions. The position of the helicopter shall be recorded for a distance (DJ) sufficient to ensure recording of the entire interval during which the measured helicopter noise level is

within 10 dB of PNLTM, as required. The flyover profile is defined by the height AG which is a function of the operating conditions controlled by the pilot. Position M represents the helicopter location on the measured flyover flight path for which PNLTM is observed at station A, and M_r is the corresponding position on the reference flight path.

(d) *Approach profiles.* (1) Figure H3 illustrates a typical approach profile, including reference conditions.

(2) The helicopter approaches position H along a 6° (±0.5°) average approach slope throughout the 10 dB down period. The approach procedure shall be acceptable to the FAA and shall be included in the Flight Manual.

(3) Figure H3 illustrates portions of the measured and reference approach flight paths including the significant geometrical relationships influencing sound propagation. EK represents the measured approach path with approach angle η, and E_r and K_r represent the reference approach angle of 6°. Position N represents the helicopter location on the measured approach flight path for which PNLTM is observed at station A, and N_r is the corresponding position on the reference approach flight path. The measured and corrected noise propagation paths are AN and AN_r, respectively, both of which form the same angle with their flight paths. Position S represents the point on the measured approach flight path nearest station A, and S_r is the corresponding point on the reference approach flight path. The minimum distance to the measured and reference flight paths are indicated by the lines AS and AS_r, respectively, which are normal to their flight paths.

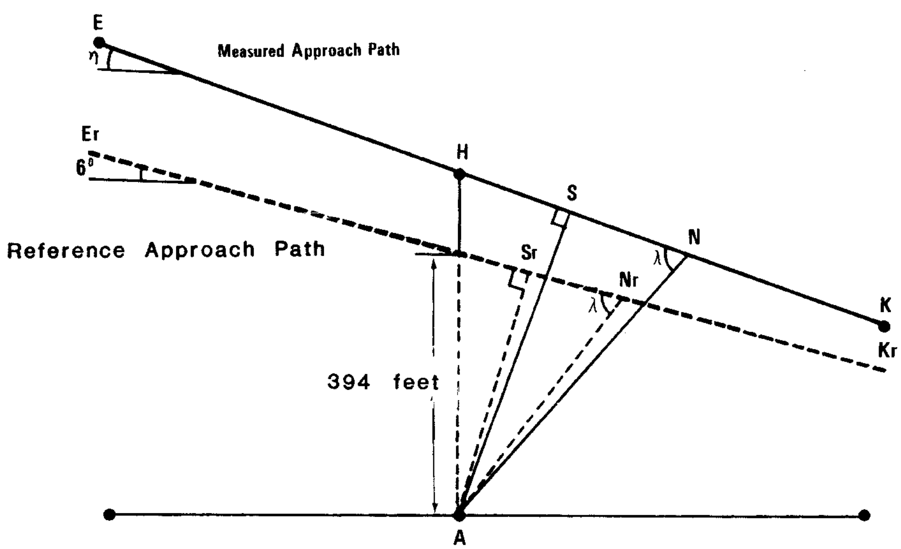

Figure H3. COMPARISON OF MEASURED AND CORRECTED APPROACH PROFILES

(e) *Correction of noise at source during level flyover.* (1) For level overflight, if any combination of the following three factors, 1) airspeed deviation from reference, 2) rotor speed deviation from reference, and 3) temperature deviation from reference, results in an advancing blade tip Mach number which deviates from the reference Mach value, then source noise adjustments shall be determined. This adjustment shall be determined from the manufacturer supplied data approved by the FAA.

(2) Off-reference tip Mach number adjustments shall be based upon a sensitivity curve of PNLTM versus advancing blade tip Mach number, deduced from overflights carried out at different airspeeds around the reference airspeed. If the test aircraft is unable

to attain the reference value, then an extrapolation of the sensitivity curve is permitted if data cover at least a range of 0.3 Mach units. The advancing blade tip Mach number shall be computed using true airspeed, onboard outside air temperature, and rotor speed. A separate PNLTM versus advancing blade tip Mach number function shall be derived for each of the three certification microphone locations, i.e., centerline, sideline left, and sideline right. Sideline left and right are defined relative to the direction of the flight on each run. PNLTM adjustments are to be applied to each microphone datum using the appropriate PNLTM function.

(f) *PNLT corrections.* If the ambient atmospheric conditions of temperature and relative humidity are not those prescribed as reference conditions under this appendix (77 degrees F and 70 percent, respectively), corrections to the EPNL values must be calculated from the measured data under paragraph (a) of this section as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure H1, the spectrum of PNLTM observed at station A for the aircraft at position L_r is decomposed into its individual SPLi values.

(i) Step 1. A set of corrected values are then computed as follows:

$$SPLic = SPLi + (\alpha\ i - \alpha\ io)AL + (\alpha\ io)AL - ALr) + 20\ \log(AL/ALr)$$

Where SPLi and SPLic are the measured and corrected sound pressure levels, respectively, in the i-th one-third octave band. The first correction term accounts for the effects of change in atmospheric sound absorption where ai and aio are the sound absorption coefficients for the test and reference atmospheric conditions, respectively, for the -ith one-third octave band and L_r A is the measured takeoff sound propagation path. The second correction term accounts for the effects of atmospheric sound absorption on the change in the sound propagation path length where L_r A is the corrected takeoff sound propagation path. The third correction term accounts for the effects of the inverse square law on the change in the sound propagation path length.

(ii) Step 2. The corrected values of the SPLic are then converted to PNLT and a correction term calculated as follows:

$$\Delta_1 = PNLT - PNLTM$$

Which represents the correction to be added algebraically to the EPNL calculated from the measured data.

(2) *Approach flight path.* (i) The procedure described in paragraph (f)(1) of this section for takeoff flight paths is also used for the approach flight path, except that the value for SPLic relate to the approach sound propagation paths shown in Figure H3 as follows:

$$SPLic = SPLi + (\alpha - \alpha\ io)\ AM + \alpha(AM - AMr) + 20\ \log(AM/AMr)$$

Where the lines NS and N_r S_r are the measured and referenced approach sound propagation paths, respectively.

(ii) The remainder of the procedure is the same as that prescribed in paragraph (d)(1)(ii) of this section, regarding takeoff flight path.

(3) *Sideline microphones.* The procedure prescribed in paragraph (f)(1) of this section for takeoff flight paths is also used for the propagation to the sideline microphones, except that the values of SPLic relate only in the measured sideline sound propagation path as follows:

$$SPLic - SPLi + (\alpha\ io - \alpha + io)KX + \alpha\ io\ (KX - KXr) + 20\ \log(KX/KXr)$$

K is the sideline measuring station where

X=L and Xr=Ln for takeoff

X=M and Xr=Mn for approach

X=N and Xr=Nr for flyover

(4) *Level flyover flight path.* The procedure prescribed in paragraph (f)(1) of this section for takeoff flight paths is also used for the level flyover flight path, except that the values of SPLic relate only to the flyover sound propagation paths as follows:

$$SPLic = SPLi + (\alpha - \alpha\ io)\ AN + \alpha\ io\ (AN - ANr) + 20\ \log(AN/ANr)$$

(g) *Duration corrections.* (1) If the measured takeoff and approach flight paths do not conform to those prescribed as the corrected and reference flight paths, respectively, under section A36.5(d)(2) it will be necessary to apply duration corrections to the EPNL values calculated from the measured data. Such corrections must be calculated as follows:

(i) *Takeoff flight path.* For the takeoff flight path shown in Figure H1, the correction term is calculated using the formula—

$$\Delta_2 = -10\ \log(AT/ATr) + 10\ \log(V/Vr)$$

which represents the correction which must be added algebraically to the EPNL calculated from the measured data. The lengths AT and ATr are the measured and corrected takeoff minimum distances from the noise measuring station A to the measured and the corrected flight paths, respectively. A negative sign indicates that, for the particular case of a duration correction, the EPNL calculated from the measured data must be reduced if the measured flight path is at greater altitude than the corrected flight path.

(ii) *Approach flight path.* For the approach flight path shown in Figure H3, the correction term is calculated using the formula—

$$\Delta_2 = -10\ \log(AS/ASr) + 10\ \log(V/Vr)$$

where AS is the measured approach minimum distance from the noise measuring station A to the measured flight path and 394 feet is the minimum distance from station A to the reference flight path.

(iii) *Sideline microphones.* For the sideline flight path, the correction term is calculated using the formula—

$\Delta_2 = -10 \log (KX/KXr) + 10 \log (V/Vr)$

K is the sideline measuring station

where X=T and Xr=Tr for takeoff
where X=S and Xr=Sr for approach
where X=G and Xr=Gr for flyover

(iv) *Level flyover flight paths.* For the level flyover flight path, the correction term is calculated using the formula—

$\Delta_2 = -10 \log (AG/AGr) + 10 \log (V/Vr)$
where AG is the measured flyover altitude over the noise measuring station A.

(2) The adjustment procedure described in this section shall apply to the sideline microphones in the take-off, overflight, and approach cases. Although the noise emission is strongly dependent on the directivity pattern, variable from one helicopter type to another, the propagation angle θ shall be the same for test and reference flight paths. The elevation angle ψ shall not be constrained but must be determined and reported. The certification authority shall specify the acceptable limitations on ψ. Corrections to data obtained when these limits are exceeded shall be applied using FAA approved procedures.

PART D—NOISE LIMITS UNDER § 36.805

Section H36.301 Noise measurement, evaluation, and calculation

Compliance with this part of this appendix must be shown with noise levels measured, evaluated, and calculated as prescribed under Parts B and C of this appendix.

Section H36.303 [Reserved]

Section H36.305 Noise levels

(a) *Limits.* For compliance with this appendix, it must be shown by flight test that the calculated noise levels of the helicopter, at the measuring points described in section H36.305(a) of this appendix, do not exceed the following, with appropriate interpolation between weights:

(1) *Stage 1* noise limits for acoustical changes for helicopters are as follows:

(i) For takeoff, flyover, and approach calculated noise levels, the noise levels of each Stage 1 helicopter that exceed the Stage 2 noise limits plus 2 EPNdB may not, after a change in type design, exceed the noise levels created prior to the change in type design.

(ii) For takeoff, flyover, and approach calculated noise levels, the noise levels of each Stage 1 helicopter that do not exceed the Stage 2 noise limits plus 2 EPNdB may not, after the change in type design, exceed the Stage 2 noise limits plus 2 EPNdB.

(2) *Stage 2* noise limits are as follows:

(i) *For takeoff calculated noise levels*—109 EPNdB for maximum takeoff weights of 176,370 pounds or more, reduced by 3.01 EPNdB per halving of the weight down to 89 EPNdB for maximum weights of 1,764 pounds or less.

(ii) *For flyover calculated noise levels*—108 EPNdB for maximum weights of 176,370 pounds or more, reduced by 3.01 EPNdB per halving of the weight down to 88 EPNdB for maximum weights of 1,764 pounds or less.

(iii) *For approach calculated noise levels*—110 EPNdB for maximum weights of 176,370 pounds or more, reduced by 3.01 EPNdB per halving of the weight down 90 EPNdB for maximum weight of 1,764 pounds or less.

(b) *Tradeoffs.* Except to the extent limited under § 36.11(b) of this part, the noise limits prescribed in paragraph (a) of this section may be exceeded by one or two of the takeoff, flyover, or approach calculated noise levels determined under section H36.203 of this appendix if

(1) The sum of the exceedances is not greater than 4 EPNdB;

(2) No exceedance is greater than 3 EPNdB; and

(3) The exceedances are completely offset by reduction in the other required calculated noise levels.

[Amdt. 36–14, 53 FR 3541, Feb. 5, 1988; 53 FR 4099, Feb. 11, 1988; 53 FR 7728, Mar. 10, 1988]

APPENDIX I TO PART 36 [RESERVED]

APPENDIX J TO PART 36—ALTERNATIVE NOISE CERTIFICATION PROCEDURE FOR HELICOPTERS UNDER SUBPART H HAVING A MAXIMUM CERTIFICATED TAKEOFF WEIGHT OF NOT MORE THAN 6,000 POUNDS

PART A—REFERENCE CONDITIONS

PART B—NOISE MEASUREMENT PROCEDURE UNDER § 36.801

PART C—NOISE EVALUATION AND CALCULATION UNDER § 36.803

PART D—NOISE LIMITS PROCEDURE UNDER §36.805

PART A—REFERENCE CONDITIONS

Section J36.1 General

This appendix prescribes the alternative noise certification requirements identified under §36.1 of this part and subpart H of this part for helicopters in the primary, normal, transport, and restricted categories having maximum certificated takeoff weight of not more than 6,000 pounds including:

(a) The conditions under which an alternative noise certification test under subpart H of this part must be conducted and the alternative measurement procedure that must be used under §36.801 of this part to measure the helicopter noise during the test;

(b) The alternative procedures which must be used under §36.803 of this part to correct the measured data to the reference conditions and to calculate the noise evaluation quantity designated as Sound Exposure Level (SEL); and

(c) The noise limits for which compliance must be shown under §36.805 of this part.

Section J36.3 Reference Test Conditions

(a) *Meteorological conditions.* The following are the noise certification reference atmospheric conditions which shall be assumed to exist from the surface to the helicopter altitude:

(1) Sea level pressure of 2116 pounds per square foot (76 centimeters mercury);

(2) Ambient temperature of 77 degrees Fahrenheit (25 degrees Celsius);

(3) Relative humidity of 70 percent; and

(4) Zero wind.

(b) *Reference test site.* The reference test site is flat and without line-of-sight obstructions across the flight path that encompasses the 10 dB down points of the A-weighted time history.

(c) *Level flyover reference profile.* The reference flyover profile is a level flight 492 feet (150 meters) above ground level as measured at the noise measuring station. The reference flyover profile has a linear flight track and passes directly over the noise monitoring station. Airspeed is stabilized at $0.9V_H$; $0.9V_{NE}$; $0.45V_H + 65$ kts ($0.45V_H + 120$ km/h); or $0.45V_{NE} + 65$ kts ($0.45V_{NE} + 120$ km/h), whichever of the four speeds is least. Rotor speed is stabilized at the power on maximum normal operating RPM throughout the 10 dB down time period.

(1) For noise certification purposes, V_H is defined as the airspeed in level flight obtained using the minimum specification engine power corresponding to maximum continuous power available for sea level, 77 degree Fahrenheit (25 degrees Celsius) ambient conditions at the relevant maximum certificated weight. The value of V_H thus defined must be listed in the Rotorcraft Flight Manual.

(2) V_{NE} is the never-exceed airspeed.

(d) The weight of the helicopter shall be the maximum takeoff weight at which noise certification is requested.

Section J36.5 [Reserved]

PART B—NOISE MEASUREMENT PROCEDURE UNDER §36.801

Section J36.101 Noise certification test and measurement conditions

(a) *General.* This section prescribes the conditions under which helicopter noise certification tests must be conducted and the measurement procedures that must be used to measure helicopter noise during each test.

(b) *Test site requirements.* (1) The noise measuring station must be surrounded by terrain having no excessive sound absorption characteristics, such as might be caused by thick, matted, or tall grass, shrubs, or wooded areas.

(2) During the period when the flyover noise measurement is within 10 dB of the maximum A-weighted sound level, no obstruction that significantly influences the sound field from the helicopter may exist within a conical space above the noise measuring position (the point on the ground vertically below the microphone), the cone is defined by an axis normal to the ground and by half-angle 80 degrees from this axis.

(c) *Weather restrictions.* The test must be conducted under the following atmospheric conditions:

(1) No rain or other precipitation;

(2) Ambient air temperature between 36 degrees and 95 degrees Fahrenheit (2 degrees and 35 degrees Celsius), inclusively, and relative humidity between 20 percent and 95 percent inclusively, except that testing may not take place where combinations of temperature and relative humidity result in a rate of atmospheric attenuation greater than 10 dB per 100 meters (30.5 dB per 1000 ft) in the one-third octave band centered at 8 kilo-Hertz.

(3) Wind velocity that does not exceed 10 knots (19 km/h) and a crosswind component that does not exceed 5 knots (9 km/h). The wind shall be determined using a continuous averaging process of no greater than 30 seconds;

(4) Measurements of ambient temperature, relative humidity, wind speed, and wind direction must be made between 4 feet (1.2 meters) and 33 feet (10 meters) at the noise monitoring station. Unless otherwise approved by the FAA, ambient temperature and relative humidity must be measured at

the noise measuring station at the same height above the ground.

(5) No anomalous wind conditions (including turbulence) or other anomalous meteorological conditions that will significantly affect the noise level of the helicopter when the noise is recorded at the noise measuring station; and

(6) The location of the meteorological instruments must be approved by the FAA as representative of those atmospheric conditions existing near the surface over the geographical area where the helicopter noise measurements are made. In some cases, a fixed meteorological station (such as those found at airports or other facilities) may meet this requirement.

(d) *Helicopter testing procedures.* (1) The helicopter testing procedures and noise measurements must be conducted and processed in a manner which yields the noise evaluation measure designated Sound Exposure Level (SEL) as defined in section J36.109(b) of this appendix.

(2) The helicopter height relative to the noise measurement point sufficient to make corrections required under section J36.205 of this appendix must be determined by an FAA-approved method that is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(3) If an applicant demonstrates that the design characteristics of the helicopter would prevent flight from being conducted in accordance with the reference test conditions prescribed under section J36.3 of this appendix, then with FAA approval, the reference test conditions used under this appendix may vary from the standard reference test conditions, but only to the extent demanded by those design characteristics which make compliance with the reference test conditions impossible.

Section J36.103 [Reserved]

Section J36.105 Flyover test conditions

(a) This section prescribes the flight test conditions and allowable random deviations for flyover noise tests conducted under this appendix.

(b) A test series must consist of at least six flights with equal numbers of flights in opposite directions over the noise measuring station:

(1) In level flight and in cruise configuration;

(2) At a height of 492 feet ±50 feet (150 ±15 meters) above the ground level at the noise measuring station; and

(3) Within ±10 degrees from the zenith.

(c) Each flyover noise test must be conducted:

(1) At the reference airspeed specified in section J36.3(c) of this appendix, with such airspeed adjusted as necessary to produce the same advancing blade tip Mach number as associated with the reference conditions;

(i) Advancing blade tip Mach number (M_{AT}) is defined as the ratio of the arithmetic sum of blade tip rotational speed (V_R) and the helicopter true air speed (V_T) over the speed of sound (c) at 77 degrees Fahrenheit (1135.6 ft/sec or 346.13 m/sec) such that $M_{AT} = (V_R + V_T)/c$; and

(ii) The airspeed shall not vary from the adjusted reference airspeed by more than ±3 knots (±5 km/hr) or an equivalent FAA-approved variation from the reference advancing blade tip Mach number. The adjusted reference airspeed shall be maintained throughout the measured portion of the flyover.

(2) At rotor speed stabilized at the power on maximum normal operating rotor RPM (±1 percent); and

(3) With the power stabilized during the period when the measured helicopter noise level is within 10 dB of the maximum A-weighted sound level (L_{AMAX}).

(d) The helicopter test weight for each flyover test must be within plus 5 percent or minus 10 percent of the maximum takeoff weight for which certification under this part is requested.

(e) The requirements of paragraph (b)(2) of this section notwithstanding, flyovers at an FAA-approved lower height may be used and the results adjusted to the reference measurement point by an FAA-approved method if the ambient noise in the test area, measured in accordance with the requirements prescribed in section J36.109 of this appendix, is found to be within 15 dB(A) of the maximum A-weighted helicopter noise level (L_{AMAX}) measured at the noise measurement station in accordance with section J36.109 of this appendix.

Section J36.107 [Reserved]

Section J36.109 Measurement of helicopter noise received on the ground

(a) *General.* (1) The helicopter noise measured under this appendix for noise certification purposes must be obtained with FAA-approved acoustical equipment and measurement practices.

(2) Paragraph (b) of this section identifies and prescribes the specifications for the noise evaluation measurements required under this appendix. Paragraphs (c) and (d) of this section prescribe the required acoustical equipment specifications. Paragraphs (e) and (f) of this section prescribe the calibration and measurement procedures required under this appendix.

(b) *Noise unit definition.* (1) The value of sound exposure level (SEL, or as denoted by symbol, L_{AE}), is defined as the level, in decibels, of the time integral of squared 'A'-weighted sound pressure (P_A) over a given time period or event, with reference to the square of the standard reference sound pressure (P_O) of 20 micropascals and a reference duration of one second.

(2) This unit is defined by the expression:

$$L_{AE} = 10\ Log_{10} \frac{1}{T_0} \int_{t_1}^{t_2} \left(\frac{P_A(t)}{P_0} \right)^2 dt\ dB$$

Where T_O is the reference integration time of one second and (t_2-t_1) is the integration time interval.

(3) The integral equation of paragraph (b)(2) of this section can also be expressed as:

$$L_{AE} = 10\ Log_{10} \frac{1}{T_0} \int_{t_1}^{t_2} 10^{0.1 L_A(t)} dt\ dB$$

Where $L_A(t)$ is the time varying A-weighted sound level.

(4) The integration time (t_2-t_1) in practice shall not be less than the time interval during which $L_A(t)$ first rises to within 10 dB(A) of its maximum value (L_{AMAX}) and last falls below 10 dB(A) of its maximum value.

(5) The SEL may be approximated by the following expression:

L_{AE} = L_{AMAX} + <delta> A

where <delta> A is the duration allowance given by:

<delta> A = 10 $\log_{10}$ (T)

where T = (t_2-t_1)/2 and L_{AMAX} is defined as the maximum level, in decibels, of the A-weighted sound pressure (slow response) with reference to the square of the standard reference sound pressure (P_0).

(c) *Measurement system.* The acoustical measurement system must consist of FAA-approved equipment equivalent to the following:

(1) A microphone system with frequency response that is compatible with the measurement and analysis system accuracy prescribed in paragraph (d) of this section;

(2) Tripods or similar microphone mountings that minimize interference with the sound energy being measured;

(3) Recording and reproducing equipment with characteristics, frequency response, and dynamic range that are compatible with the response and accuracy requirements of paragraph (d) of this section; and

(4) Acoustic calibrators using sine wave noise and, if a tape recording system is used, pink noise, of known levels. When pink noise (defined in section H36.109(e)(1) of appendix H of this part) is used, the signal must be described in terms of its root-mean-square (rms) value.

(d) *Sensing, recording, and reproducing equipment.* (1) The noise levels measured from helicopter flyovers under this appendix may be determined directly by an integrating sound level meter, or the A-weighted sound level time history may be written onto a graphic level recorder set at ''slow'' response from which the SEL value may be determined. With the approval of the FAA, the noise signal may be tape recorded for subsequent analysis.

(i) The SEL values from each flyover test may be directly determined from an integrating sound level meter complying with the Standards of the International Electrotechnical Commission (IEC) Publication No. 804, ''Integrating-averaging Sound Level Meters,'' as incorporated by reference under §36.6 of this part, for a Type 1 instrument set at ''slow'' response.

(ii) The acoustic signal from the helicopter, along with the calibration signals specified under paragraph (e) of this section and the background noise signal required under paragraph (f) of this section may be recorded on a magnetic tape recorder for subsequent analysis by an integrating sound level meter identified in paragraph (d)(1)(i) of this section. The record/playback system (including the audio tape) of the tape recorder must conform to the requirements prescribed in section H36.109(c)(3) of appendix H of this part. The tape recorder shall comply with specifications of IEC Publication No. 561, ''Electro-acoustical Measuring Equipment for Aircraft Noise Certification,'' as incorporated by reference under §36.6 of this part.

(iii) The characteristics of the complete system shall comply with the recommendations given in IEC Publication No. 651, ''Sound Level Meters,'' as incorporated by reference under §36.6 of this part, with regard to the specifications concerning microphone, amplifier, and indicating instrument characteristics.

(iv) The response of the complete system to a sensibly plane progressive wave of constant amplitude shall lie within the tolerance limits specified in Table IV and Table V for Type 1 instruments in IEC Publication No. 651, ''Sound Level Meters,'' as incorporated by reference under §36.6 of this part, for weighting curve ''A'' over the frequency range of 45 Hz to 11500 Hz.

(v) A windscreen must be used with the microphone during each measurement of the helicopter flyover noise. Correction for any insertion loss produced by the windscreen, as a function of the frequency of the acoustic calibration required under paragraph (e) of this section, must be applied to the measured data and any correction applied must be reported.

(e) *Calibrations.* (1) If the helicopter acoustic signal is tape recorded for subsequent analysis, the measuring system and components of the recording system must be calibrated as prescribed under section H36.109(e) of appendix H of this part.

(2) If the helicopter acoustic signal is directly measured by an integrating sound level meter:

(i) The overall sensitivity of the measuring system shall be checked before and after the series of flyover tests and at intervals (not exceeding one-hour duration) during the flyover tests using an acoustic calibrator using sine wave noise generating a known sound pressure level at a known frequency.

(ii) The performance of equipment in the system will be considered satisfactory if, during each day's testing, the variation in the calibration value does not exceed 0.5 dB. The SEL data collected during the flyover tests shall be adjusted to account for any variation in the calibration value.

(iii) A performance calibration analysis of each piece of calibration equipment, including acoustic calibrators, reference microphones, and voltage insertion devices, must have been made during the six calendar months proceeding the beginning of the helicopter flyover series. Each calibration shall be traceable to the National Institute of Standards and Technology.

(f) *Noise measurement procedures.* (1) The microphone shall be of the pressure-sensitive capacitive type designed for nearly uniform grazing incidence response. The microphone shall be mounted with the center of the sensing element 4 feet (1.2 meters) above the local ground surface and shall be oriented for grazing incidence such that the sensing element, the diaphragm, is substantially in the plane defined by the nominal flight path of the helicopter and the noise measurement station.

(2) If a tape recorder is used, the frequency response of the electrical system must be determined at a level within 10 dB of the full-scale reading used during the test, utilizing pink or pseudorandom noise.

(3) The ambient noise, including both acoustical background and electrical noise of the measurement systems shall be determined in the test area and the system gain set at levels which will be used for helicopter noise measurements. If helicopter sound levels do not exceed the background sound levels by at least 15 dB(A), flyovers at an FAA-approved lower height may be used and the results adjusted to the reference measurement point by an FAA-approved method.

(4) If an integrating sound level meter is used to measure the helicopter noise, the instrument operator shall monitor the continuous A-weighted (slow response) noise levels throughout each flyover to ensure that the SEL integration process includes, at minimum, all of the noise signal between the maximum A-weighted sound level (L_{AMAX}) and the 10 dB down points in the flyover time history. The instrument operator shall note the actual db(A) levels at the start and stop of the SEL integration interval and document these levels along with the value of L_{AMAX} and the integration interval (in seconds) for inclusion in the noise data submitted as part of the reporting requirements under section J36.111(b) of this appendix.

Section J36.111 Reporting Requirements

(a) *General.* Data representing physical measurements, and corrections to measured data, including corrections to measurements for equipment response deviations, must be recorded in permanent form and appended to the record. Each correction is subject to FAA approval.

(b) *Data reporting.* After the completion of the test the following data must be included in the test report furnished to the FAA:

(1) Measured and corrected sound levels obtained with equipment conforming to the standards prescribed in section J36.109 of this appendix;

(2) The type of equipment used for measurement and analysis of all acoustic, aircraft performance and flight path, and meteorological data;

(3) The atmospheric environmental data required to demonstrate compliance with this appendix, measured throughout the test period;

(4) Conditions of local topography, ground cover, or events which may interfere with the sound recording;

(5) The following helicopter information:

(i) Type, model, and serial numbers, if any, of helicopter, engine(s) and rotor(s);

(ii) Gross dimensions of helicopter, location of engines, rotors, type of antitorque system, number of blades for each rotor, and reference operating conditions for each engine and rotor;

(iii) Any modifications of non-standard equipment likely to affect the noise characteristics of the helicopter;

(iv) Maximum takeoff weight for which certification under this appendix is requested;

(v) Aircraft configuration, including landing gear positions;

(vi) V_H or V_{NE} (whichever is less) and the adjusted reference airspeed;

(vii) Aircraft gross weight for each test run;

(viii) Indicated and true airspeed for each test run;

(ix) Ground speed, if measured, for each run;

(x) Helicopter engine performance as determined from aircraft instruments and manufacturer's data; and

(xi) Aircraft flight path above ground level, referenced to the elevation of the noise measurement station, in feet, determined by an FAA-approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photoscaling techniques; and

(6) Helicopter position and performance data required to make the adjustments prescribed under section J36.205 of this appendix and to demonstrate compliance with the performance and position restrictions prescribed under section J36.105 of this appendix must be recorded at an FAA-approved sampling rate.

Section J36.113 [Reserved]

PART C—NOISE EVALUATION AND CALCULATIONS UNDER § 36.803

Section J36.201 Noise Evaluation in SEL

The noise evaluation measure shall be the sound exposure level (SEL) in units of dB(A) as prescribed under section J36.109(b) of this appendix. The SEL value for each flyover may be directly determined by use of an integrating sound level meter. Specifications for the integrating sound level meter and requirements governing the use of such instrumentation are prescribed under section J36.109 of this appendix.

Section J36.203 Calculation of Noise Levels

(a) To demonstrate compliance with the noise level limits specified under section J36.305 of this appendix, the SEL noise levels from each valid flyover, corrected as necessary to reference conditions under section J36.205 of this appendix, must be arithmetically averaged to obtain a single SEL dB(A) mean value for the flyover series. No individual flyover run may be omitted from the averaging process, unless otherwise specified or approved by the FAA.

(b) The minimum sample size acceptable for the helicopter flyover certification measurements is six. The number of samples must be large enough to establish statistically a 90 percent confidence limit that does not exceed ±1.5 dB(A).

(c) All data used and calculations performed under this section, including the calculated 90 percent confidence limits, must be documented and provided under the reporting requirements of section J36.111 of this appendix.

Section J36.205 Detailed Data Correction Procedures

(a) When certification test conditions measured under part B of this appendix differ from the reference test conditions prescribed under section J36.3 of this appendix, appropriate adjustments shall be made to the measured noise data in accordance with the methods set out in paragraphs (b) and (c) of this section. At minimum, appropriate adjustments shall be made for off-reference altitude and for the difference between reference airspeed and adjusted reference airspeed.

(b) The adjustment for off-reference altitude may be approximated from:

<delta>J_1=12.5 $\log_{10}(H_T/492)$ dB;

where <delta>J_1 is the quantity in decibels that must be algebraically added to the measured SEL noise level to correct for an off-reference flight path, H_T is the height, in feet, of the test helicopter when directly over the noise measurement point, and the constant (12.5) accounts for the effects on spherical spreading and duration from the off-reference altitude.

(c) The adjustment for the difference between reference airspeed and adjusted reference airspeed is calculated from:

<delta>J_3=10 $\log_{10}(V_{RA}/V_R)$ dB;

Where <delta>J_3 is the quantity in decibels that must be algebraically added to the measured SEL noise level to correct for the influence of the adjustment of the reference airspeed on the duration of the measured flyover event as perceived at the noise measurement station, V_R is the reference airspeed as prescribed under section J36.3.(c) of this appendix, and V_{RA} is the adjusted reference airspeed as prescribed under section J36.105(c) of this appendix.

(d) No correction for source noise during the flyover other than the variation of source noise accounted for by the adjustment of the reference airspeed prescribed for under section J36.105(c) of this appendix need be applied.

(e) No correction for the difference between the reference ground speed and the actual ground speed need be applied.

(f) No correction for off-reference atmospheric attenuation need be applied.

(g) The SEL adjustments must be less than 2.0 dB(A) for differences between test and reference flight procedures prescribed under section J36.105 of this appendix unless a larger adjustment value is approved by the FAA.

(h) All data used and calculations performed under this section must be documented and provided under the reporting requirements specified under section J36.111 of this appendix.

PART D—NOISE LIMITS PROCEDURE UNDER § 36.805

Section J36.301 Noise Measurement, Evaluation, and Calculation

Compliance with this part of this appendix must be shown with noise levels measured, evaluated, and calculated as prescribed under parts B and C of this appendix.

Section J36.303 [Reserved]

Section J36.305 Noise Limits

For compliance with this appendix, the calculated noise levels of the helicopter, at the measuring point described in section J36.101 of this appendix, must be shown to not exceed the following (with appropriate interpolation between weights):

(a) For primary, normal, transport, and restricted category helicopters having a maximum certificated takeoff weight of not more than 6,000 pounds and noise tested under this appendix, the Stage 2 noise limit is 82 decibels SEL for helicopters with maximum certificated takeoff weight at which the noise certification is requested, of up to 1,764 pounds and increasing at a rate of 3.01 decibels per doubling of weight thereafter. The limit may be calculated by the equation:

$L_{AE(limit)}=82+3.01[\log_{10}(MTOW/1764)/\log_{10}(2)]$ dB;

where MTOW is the maximum takeoff weight, in pounds, for which certification under this appendix is requested.

(b) The procedures required in this amendment shall be done in accordance with the International Electrotechnical Commission IEC Publication No. 804, entitled ''Integrating-averaging Sound Level Meters,'' First Edition, dated 1985. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from the Bureau Central de la Commission Electrotechnique Internationale, 1, rue de Varembe, Geneva, Switzerland or the American National Standard Institute, 1430 Broadway, New York City, New York 10018, and can be inspected at the Office of the Federal Register, 800 North Capitol Street NW., suite 700, Washington, DC.

[Doc. No. 26910, 57 FR 42855, Sept. 16, 1992, as amended by Amdt. 36–20, 57 FR 46243, Oct. 7, 1992]

PART 39—AIRWORTHINESS DIRECTIVES

Subpart A—General

Subpart B—Airworthiness Directives

AUTHORITY: 49 U.S.C. 106(g), 40113, 44701.

SOURCE: Docket No. 5061, 29 FR 14403, Oct. 20, 1964, unless otherwise noted.

Subpart A—General

§ 39.1 Applicability.

This part prescribes airworthiness directives that apply to aircraft, aircraft engines, propellers, or appliances (hereinafter referred to in this part as ''products'') when—

(a) An unsafe condition exists in a product; and

(b) That condition is likely to exist or develop in other products of the same type design.

[Doc. No. 5061, 29 FR 14403, Oct. 20, 1964, as amended by Amdt. 39–106, 30 FR 8826, July 14, 1965]

§ 39.3 General.

No person may operate a product to which an airworthiness directive applies except in accordance with the requirements of that airworthiness directive.

Subpart B—Airworthiness Directives

§ 39.11 Applicability.

This subpart identifies those products in which the Administrator has found an unsafe condition as described in § 39.1 and, as appropriate, prescribes inspections and the conditions and limitations, if any, under which those products may continue to be operated.

§ 39.13 Airworthiness directives.

All airworthiness directives contained in § 507.10 of the regulations of the Administrator are hereby transferred to this section of the Federal Aviation Regulations.

EDITORIAL NOTE: Airworthiness directives prescribed under this subpart were published in full in the FEDERAL REGISTER at 21 FR 9449, Dec. 4, 1956. For FEDERAL REGISTER citations to amendments in 1957 and subsequent years, see former § 507.10 of this title, in a separate volume entitled ''List of Sections Affected 1949–1963.'' See also § 39.13 in a separate volume entitled ''List of CFR Sections Affected, 1964–1972 and 1973–1985,'' and the List of CFR Sections Affected at the end of this volume.

PART 43—MAINTENANCE, PREVENTIVE MAINTENANCE, REBUILDING, AND ALTERATION