



AEROSPACE INFORMATION REPORT

AIR6297™

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Method to Calculate Behind Start of Takeoff Roll Noise Level Adjustments

RATIONALE

This AIR describes a method to calculate noise level adjustments at locations behind an airplane at the start of takeoff roll (SOTR) for the purposes of aircraft noise prediction modeling.

This method replaces the methods found in paragraph 3.3.1 (Sound Exposure Level Behind the Start-of-Takeoff Roll) of AIR1845A "Procedure for the Calculation of Airplane Noise in the Vicinity of Airports". Specifically, the calculations presented in 3.1 and 3.2 of this document replace the calculations in Step 3 of paragraph 3.3.1 of AIR1845A. It adheres to the basic approach described in AIR1845A and is based on measurements from modern jet and turboprop aircraft (circa 2004). The behind start of takeoff roll noise directivity method found in AIR1845A is based on measurements of older-generation (circa 1980), low by-pass ratio aircraft, primarily configured with fuselage-mounted engines. The new method described herein for modeling the noise directivity behind start of takeoff roll is derived from empirical data from modern jet aircraft, most of which are configured with wing-mounted engines that tend to have higher by-pass ratios as well as operate at higher thrust levels. Additionally, this AIR version includes a separate directivity adjustment for propeller-driven aircraft. Comparison of directivity adjustments computed from the method described herein and the AIR1845A method are presented in Appendix A.

AIR6297 has been reaffirmed to comply with the SAE Five-Year Review policy.

FOREWORD

The SAE Aircraft Noise Committee (A-21) initiated an activity to update the behind start of takeoff roll algorithm in AIR1845A. This update was preceded by a study conducted at Dulles International Airport (IAD) in October 2004 by the National Aeronautics and Space Administration (NASA), Langley Research Center, with support provided by the Volpe National Transportation Systems Center (Volpe). Analysis of the data collected at IAD showed that the directivity patterns of modern aircraft have only marginal similarities with the AIR1845A directivity pattern.

The updated algorithms will benefit current aircraft noise prediction models, as the adjustments better represent the current aircraft fleet and allow for the directivity associated with jet and turboprop aircraft to be represented separately in the models.

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1. SCOPE

This document describes a method to calculate noise level adjustments at locations behind an airplane (described by an angular offset or directivity) at the start of takeoff roll (SOTR). This method is derived from empirical data from jet aircraft (circa 2004), most of which are configured with wing-mounted engines with high by-pass ratios (Lau, et al., 2012). Methods are also described which apply to modern turboprop aircraft.

Calculations of other propagation-related adjustments required for aircraft noise prediction models are described in AIR1845A, ARP5534, ARP866A, and AIR5662.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR1845A Procedure for the Calculation of Airplane Noise in the Vicinity of Airports

2.1.2 ANSI Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI/S1.1-1994 Acoustical Terminology, American National Standard

2.1.3 NASA Publications

NASA Technical Services, NASA STI Program STI Support Services, Mail Stop 148, NASA Langley Research Center, Hampton, VA 23681-2199, 757-864-9658, Fax: 757-864-6500, <http://ntrs.nasa.gov/>.

Lau, Michael C., Roof, C.J., Fleming, G.G., Rapoza, A.S., Boeker, E.B., McCurdy, D.A., and Shepherd, K.P., "Behind Start of Take-off Roll Aircraft Sound Level Directivity Study – Revision 1," NASA Technical Memorandum 217783, NASA Report No. NASA/TM-2012-217783, Volpe Report No. DOT-VNTSC-NASA-12-01, 2015.

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Aerospace Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Telephone: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR5662 Method for Predicting Lateral Attenuation of Airplane Noise

ARP5534 Application of Pure-Tone Atmospheric Absorption Losses to One-Third Octave-Band Data

ARP866A Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity

2.2.2 ECAC Publications

Available from the European Civil Aviation Conference website at <https://www.ecac-ceac.org/>.

ECAC Doc 29 Standard Method of Computing Noise Contours Around Civil Airports

2.2.3 ICAO Publications

Available from International Civil Aviation Organization, 999 University Street, Montreal, Quebec H3C 5H7, Canada, Tel: +1 514-954-8219, <http://www.icao.int/>.

ICAO Doc9911 Recommended Method for Computing Noise Contours around Airports

2.2.4 Volpe Publications

Available from the U.S. Department of Commerce, Technology Administration, National Technical Information Service (NTIS), Alexandria, VA, <http://www.ntis.gov>.

Koopman, et al., Aviation Environmental Design Tool (AEDT) 2A Technical Manual, Report No. DOT-VNTSC-FAA-12-09, Cambridge, MA, John A Volpe National Transportation Systems Center, April 2014.

2.3 Definitions

2.3.1 AZIMUTH ANGLE (θ)

The angle, with vertex at the nominal location of airplane engines, measured between a line along the center of an airplane from nose to tail and the radial line to the sound receiver. A 0° angle represents positions directly in front of the airplane, and a 180° angle represents positions directly behind the airplane. Also, may be referred to as directivity angle.

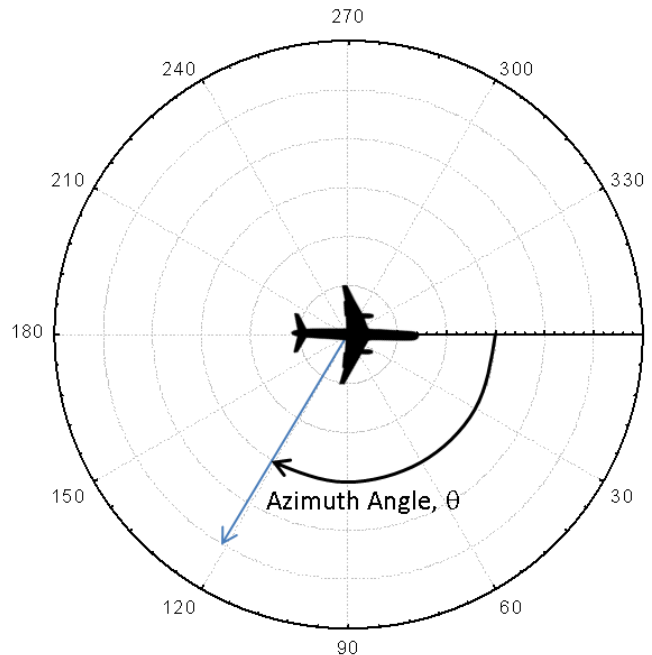


Figure 1 - Illustration of azimuth angle