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AMERICAN NATIONAL STANDARD

Methods for the Measurement of Noise Emissions from High Performance Military Jet Aircraft

Secretariat:

Acoustical Society of America

Approved on September 20, 2012:

American National Standards Institute, Inc.

Abstract

This standard describes noise measurement procedures to characterize the noise emissions from high performance (supersonic jet flow) military aircraft. Specific detailed noise measurement procedures are described for characterizing noise for environmental documents such as environmental impact statements and environmental assessments, and for quantifying aircraft noise emissions. This standard describes test procedures for ground run-up and flyover tests for conventional take-off and landing, short/vertical take-off and landing operations. The standard also describes signal processing, data formatting, and measurement uncertainty.

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Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
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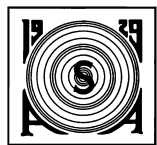
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Foreword

[This Foreword is for information only, and is not a part of the American National Standard ANSI/ASA S12.75-2012 American National Standard Methods for the Measurement of Noise Emissions from High Performance Military Jet Aircraft. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformation to the standard.]

This standard comprises a part of a group of definitions, standards, and specifications for use in noise. It was developed and approved by Accredited Standards Committee S12 Noise, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S12 is as follows:

Standards, specifications, and terminology in the field of acoustical noise pertaining to methods of measurement, evaluation, and control, including biological safety, tolerance, and comfort, and physical acoustics as related to environmental and occupational noise.

This standard is not comparable to any existing ISO Standard.

At the time this Standard was submitted to Accredited Standards Committee S12, Noise for approval, the membership was as follows:

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*When preparation of this standard was ongoing, John (Jack) M. Seiner (now deceased) was part of the working group. His efforts and expertise were carried forward and are acknowledged by the publication of this standard.

Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S12, Noise, in care of the Standards Secretariat of the Acoustical Society of America, 35 Pinelawn Road, Suite 114E, Melville, New York 11747-3177. Telephone: 631-390-0215; FAX: 631-390-0217; E-mail: asastds@aip.org.

Introduction

Noise from high performance military aircraft (supersonic jet flow exhaust) can impact the hearing and performance of personnel working near these aircraft and can be a source of annoyance to people living near airbases, airports, and ranges where these aircraft are operated. Federal agencies operating airfields are required to analyze the noise impacts by proposed new flying operations as part of the environmental analysis that is required by the National Environmental Policy Act of 1969 (NEPA). Additionally, overexposure of flight line/flight deck personnel to high levels/durations of noise can adversely affect hearing and negatively impact voice communication capability.

Accurate, reliable, and repeatable noise measures from standardized noise measurement techniques will help ensure confidence in the data used in the modeling and prediction of noise impacts. Accurate, reliable, and repeatable noise measurements are also required to compute noise exposures and associated hearing damage risk of personnel working near these aircraft. Such data are also essential for evaluation of voice communication capabilities. Finally, these measures are needed to assess noise produced by aircraft systems.

This standard describes several methods for collecting noise data from high performance military aircraft. Each method has a specific application and therefore it would be extremely rare where all the methods were applied simultaneously. The following table outlines the general methods described in this standard. Normally, individual test methods would be cited in regulations or contract specification.

Aircraft performance measurement methods	
Ground run-up	CTOL (Conventional Take-Off and Landing) Personnel near-field
	CTOL Noise reduction studies near-field
	CTOL Far-field community noise
	CTOL Far-field propagation/noise reduction studies
	STO/VL, VTO/VL (Short Take-Off/Vertical Landing), (Vertical Take-Off/Vertical Landing) Personnel near-field
Flyover	CTOL
	STO/SL (Short Take-Off/Short Landing)
	VTO/VL

Collecting noise measurements from high performance military aircraft is an undertaking that involves much preparation and responsible decision making. This standard was developed over a series of working group meetings and a workshop that formed consensus defining measurement methods that would result in accurate, reliable, and repeatable noise data. The standard addresses several important parameters such as microphone height and location, acoustic instrumentation, measurement site specifications, weather measurement and weather limits, data analysis, standard data formatting and organization, and data reporting.

The methods described in this standard are more extensive than measurement techniques previously used for collecting noise measurements from high performance military jet aircraft. Limitations in instrumentation, test location, weather, cost, and schedule may drive decisions for non-compliance with portions of this standard. However, the methods described in this standard are necessary to fully characterize and quantify the noise produced by high performance military aircraft. The methods in this standard use arrays of microphones to characterize both the level and directivity of noise generated by the aircraft. Many aircraft noise emission measurements will typically utilize only one or two of the specific measurement methods/microphone arrays described in this standard.

Microphone height and location are two of the parameters which vary based on the objectives for the measurement and the selected measurement method. For example, in the method for measuring near-field noise for the assessment of personnel noise exposure, microphone heights of 3 and 5 feet above ground level are selected to represent a human kneeling or standing around the aircraft while for near-field noise reduction measurements ground microphones are selected to give spectral information without the interference from ground reflections. Similarly, microphone locations and number vary with the different methods. For example, in the method for measuring near-field noise for defining personnel noise, microphone locations are defined at 30 feet and 42 feet lines parallel with the center of the aircraft (based on "final checker" locations and aircraft carrier "foul line" locations) and two arcs at 50 feet and 125 feet to bound the rest of the near-field locations.

Microphone height and locations for flyover noise measurements were defined to give accurate level information with minimal interference from ground reflections and micro-climate effects very near the ground. Methods define microphone heights ranging from ground level to 30 feet above ground on tripods from 300 to 1200 feet above ground suspended from towers or cranes. The microphone locations for flyover measurements are arranged to collect data for source modeling, source model validation, source linear and non-linear propagation, and propagation model validation.

Measurement site requirements are defined to reduce as much as possible the confounding of measured data by irregularities of the measurement site including acoustic reflections from buildings and other structures. Weather requirements are defined to reduce the adverse effects of wind, turbulence, and other atmospheric conditions which make accurate, repeatable, and reliable measurements difficult.

Regardless of the method chosen to collect noise measurements from high performance military aircraft, this document importantly standardizes the analysis, organization, and reporting of the data. A format has been created to ease the organization and exchange of data which has proved to be difficult in the past.

American National Standard

Methods for the Measurement of Noise Emissions from High Performance Military Jet Aircraft

1 Scope

This standard describes noise measurement procedures to characterize the noise emissions, including directivity and non-linearity, from high performance military (supersonic jet flow) aircraft during ground and airborne operations. The data resulting from the procedures described in clauses 6.3 through 6.7 of this standard are appropriate as input for community noise propagation models such as NOISEMAP[12] and the Advanced Acoustic Model (AAM)[16]. NOISEMAP data have been converted and applied for use in the Federal Aviation Administration's Integrated Noise Model (INM)[7] to supplement community noise assessments.[24] These models will use the noise measurements collected in accordance with this standard for preparation of official documents such as community environmental impact statements and environmental assessments. Noise measurements collected in accordance with this standard will also be used to define aircraft support personnel noise exposures, aircraft noise reduction and propagation studies, and evaluation of aircraft and propulsion system compliance with noise requirements and regulations.

This standard describes methods for the measurement of noise from high performance military aircraft covering the following operation modes: ground run-up, flyover, conventional take-off and landing and short/vertical take-off and landing. This standard serves as a toolbox of recommended measurement locations and acquisition methods for specific types of test and non-test applications. There are separate methods for measuring personnel noise exposure (e.g., Figure 2), ground run-up (e.g., Figure 4), and flyover noise (e.g., Figure 7) for use in National Environmental Policy Act (NEPA) documents such as environmental impact statements, and for development uses such as measuring/validating the propagation of sound from a source or the effect of a noise reduction technology (e.g., Figures 3, 5, 8). These measurement methods can be conducted independently, or, in some instances, combined, to satisfy multiple goals and thus potentially minimize cost and test time. It is not required that all methods in this standard are employed to characterize the noise emitted from an aircraft. In some circumstances both ground run-up and flyover measurements will have to be used in combination to predict far-field noise levels from aircraft operations; however, they cannot be used interchangeably if accurate noise level exposure predictions are desired.

The data recording and reporting requirements are given in order to ensure compatibility with common noise exposure mapping tools. Noise measurement and signal processing procedures are defined in order to achieve accuracy within the defined measurement uncertainty.

This standard does not address the application of noise propagation models such as NOISEMAP, INM, or AAM in the NEPA-defined environmental processes. The results of the noise measurements conducted in accordance with this standard are limited to the characterization of noise emissions of high performance military aircraft. Additionally, this standard applies only to future measurements conducted after approval by ANSI. It is not intended to require the retest or re-measurement of aircraft noise measured prior to the publishing date of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.