DOT-VNTSC-FAA-10-17
DOT-FAA-AEE-2010-06

Aircraft Source Noise Measurement Studies

Summary of Measurements, Data and Analysis

Cessna 182 Skylane
Cessna 208B Grand Caravan
Dornier 228-202
Dornier 328-100
Piper PA-42 Cheyenne III
Bell 407
Robinson R44 Raven
Schweizer 300C

October 2010
Final Report

Prepared for:
U.S. Department of Transportation
Federal Aviation Administration

Prepared by:
U.S. Department of Transportation
Research and Innovative Technology Administration
John A. Volpe National Transportation Systems Center
Environmental Measurement and Modeling Division, RVT-41

REPORT DOCUMENTATION PAGE		*Form Approved OMB No. 0704-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.		
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE October 2010	3. REPORT TYPE AND DATES COVERED Final Report
4. TITLE AND SUBTITLE Aircraft Source Noise Measurement Studies Summary of Measurements, Data and Analysis for the: Cessna 182 Skylane, Cessna 208B Caravan I, Dornier 228-202, Dornier 328-100, Piper PA-42 Cheyenne III, Bell 407, Robinson R44 Raven, Schweizer 300C		5. FUNDING NUMBERS FP01 – JD7RD
6. AUTHOR(S) Michael C. Lau, Christopher J. Scarpone, Eric R. Boeker, David A. Senzig, Christopher J. Roof, Cynthia S. Y. Lee, Graham A. Burdette		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Department of Transportation Research and Innovative Technology Administration John A. Volpe National Transportation Systems Center Environmental Measurement and Modeling Division, RVT-41 Cambridge, MA 02142-1093		8. PERFORMING ORGANIZATION REPORT NUMBER DOT-VNTSC-FAA-10-17
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) 1) U.S. Department of Transportation Federal Aviation Administration Western-Pacific Region Special Programs Staff, AWP-1SP Lawndale, CA 90261	(2) U.S. Department of Transportation Federal Aviation Administration Office of Environment and Energy, AEE-100 Washington, DC 20591	10.SPONSORING/MONITORING AGENCY REPORT NUMBER DOT-FAA-AEE-2010-06
11. SUPPLEMENTARY NOTES FAA Program Managers: Barry Brayer and Keith Lusk (AWP, Western-Pacific Regional Office, Special Programs Staff); Raquel Girvin, Bill He (AEE, Office of Environment and Energy, Noise Division)		
12a. DISTRIBUTION/AVAILABILITY STATEMENT		12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)
The U.S. Department of Transportation, John A. Volpe National Transportation Systems Center (Volpe Center), Environmental Measurement and Modeling Division, is providing technical support to the Federal Aviation Administration (FAA), with the cooperation of the National Park Service (NPS), toward the development of Air Tour Management Plans (ATMPs) for National Parks with commercial air tours. In October 2006, January 2007 and October 2008, the Volpe Center measured source noise data for eight aircraft that have been identified as participating in commercial air tour operations over National Parks: Cessna 182 Skylane, Cessna 208B Caravan I, Dornier 228, Dornier 328, Piper PA-42 Cheyenne III, Bell 407, Robinson R44 Raven, and Schweizer 300C. This document describes the planning and execution of the noise studies. Additionally, the data reduction procedures and data adjusted to standard conditions are presented.

14. SUBJECT TERMS Aircraft noise, air tours, helicopters, noise measurements, noise, propeller aircraft, Integrated Noise Model, INM, Air Tour Management Plan, Aviation Environmental Design Tool, AEDT			15. NUMBER OF PAGES 236 16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

Tables of Contents

List of Figures

List of Tables

1 INTRODUCTION

The National Parks Air Tour Management Act of 2000 (NPATMA)[1] calls for the regulation of commercial air tour operations over units of the National Park system, and directs the Federal Aviation Administration (FAA), with the cooperation of the National Park Service (NPS), to develop Air Tour Management Plans (ATMPs) for all National Parks with commercial air tours[*]. Currently, approximately 85 parks will need ATMPs. The Volpe National Transportation Systems Center (Volpe Center) is providing technical support to the ATMP program. An important element of this support is the computer modeling of air tour aircraft, which will be used in the assessment potential noise impacts to the National Park resources. In accordance with the results of the Federal Interagency Committee on Aircraft Noise (FICAN) review,[2,3] the FAA's Integrated Noise Model (INM) Version 6.2[4,] is the best-practice modeling methodology currently available for evaluating aircraft noise in the National Parks[†,5,6]. INM Version 6.2 was the latest version at the time of this determination. Since then, INM Versions 6.2a, 7.0, 7.0a, 7.0b which have further algorithmic and database updates, have been released. Further, the FAA has begun developing a new tool that will allow for the evaluation of noise, emissions and fuel burn interdependencies, known as the Aviation Environmental Design Tool (AEDT). AEDT will incorporate and expand upon the capabilities of existing FAA environmental tools, including INM.

INM has a comprehensive aircraft database and is regularly updated with new aircraft source data. The FAA seeks to enhance the INM aircraft database for ATMP-related analyses by collecting noise source data suitable for modeling the many flight configurations flown by air tour aircraft in National Parks. Based on Volpe Center's review of the INM's aircraft source noise database and the known aircraft used to conduct air tours in National Parks, the FAA sponsored noise and performance data collection and development for the following seven aircraft: the Cessna 182 Skylane, Cessna 208B Grand Caravan, Dornier 228, and Piper PA-42 Cheyenne III fixed wing aircraft; the Robinson R44 Raven, Bell 407, and Schweizer 300C helicopters. Per FAA, Office of Environment and Energy, request, the Dornier 328[‡] was also measured for source noise data collection.

The objective of the studies was to collect source noise and performance data that are suitable for modeling various flight configurations flown by air tour aircraft and fulfill the data input requirements for both INM and AEDT.

1.1 Report Organization

This report is organized into nine sections and eight appendices:

- Section 1 presents an introduction, objective, and organization of this document
- Section 2 describes the test aircraft measured during the Aircraft Source Data Measurements

[*] With the exceptions of parks in Alaska and the Grand Canyon

[†] Since 1978, the standard tool for conducting aircraft noise assessments has been the FAA's INM. INM is a computer program used by over 700 organizations in more than 50 countries to assess changes in noise impact due to aircraft operations. Requirements for INM use are defined in FAA Order 1050.1E, Environmental Impacts: Policies and Procedures and Federal Aviation Regulations (FAR) Part 150, Airport Noise Compatibility Planning.

[‡] This is the turboprop version of the Dornier 328. The jet engine version of this aircraft is the 328JET.

- Section 3 discusses the measurement site selection process and an overview of the selected sites
- Section 4 describes the acoustic, aircraft tracking, and meteorological systems used
- Section 5 describes the set up process and equipment locations during measurements
- Section 6 discusses the standard measurement procedure executed during measurements and the quality assurance process
- Section 7 provides descriptions of the events series and a summary of events collected
- Section 8 discusses the data processing procedures and the transformation of the collected data into a form suitable for noise models
- Section 9 provides a summary of which Appendix the processed results can be found Appendix A presents the aircraft performance data necessary to build INM database tables
- Appendix B lists the contacts for the airports used as measurement sites and the charter operators whom provided the test aircraft
- Appendix C provides the test day meteorological data used in processing the noise model data
- Appendix D provides the time-space-position information of the test aircraft during data collection
- Appendix E presents the computed noise-power-distance curves and helicopter directivity data
- Appendix F presents the spectral class assignments and spectral data
- Appendix G provides a list of acronyms and abbreviations used in this report

2 TEST AIRCRAFT

With the exception of the Dornier 328, the aircraft documented in this report have been identified as participating in commercial air tour operations over National Parks. Brief descriptions of all aircraft are provided below. More detailed, INM-specific performance data for the aircraft are provided in Appendix A. A list of contacts for all of the service providers involved in the measurement study, including aircraft charter companies and airports, is provided in Appendix B.

2.1 Cessna 182 Skylane

The Cessna 182 is a single-engine, propeller-driven aircraft designed and manufactured by the Cessna Aircraft Company of Wichita, Kansas (see Table 1 and Figure 1). The aircraft is designed to carry 1 crew member and up to 3 passengers.

Cessna manufactured the 182 in two configurations: the original 2-blade propeller design and the current 3-blade propeller design. The designs utilize different engines. The original 2-blade model was used in this flight test, because it is expected to produce higher sound levels at a lower fundamental frequency than the newer model.

Figure 1. Cessna 182 Skylane

Table 1. Airplane Characteristics of the Cessna 182 Skylane

Aircraft Manufacturer	Cessna Aircraft Company
Aircraft Model	182 Skylane
Aircraft Type	Single Propeller
Maximum Gross Takeoff Weight (lb)	2,800
Number and Type of Engine(s)	1 Continental O-470-L
Blade Manufacturer / Model Number	MCCAULEY 2A36C29/90M-8
Number of Passengers	3

2.2 Cessna 208B Grand Caravan

The Cessna 208B is a single-engine, turbo propeller-driven aircraft designed and manufactured by the Cessna Aircraft Company of Wichita, Kansas (see Table 2 and Figure 2). The airplane is designed to carry 1 crew member and up to 14 passengers.

Figure 2. Cessna 208B Grand Caravan

Table 2. Airplane characteristics of the Cessna 208B Grand Caravan

Aircraft Manufacturer	Cessna Aircraft Company
Aircraft Model	208B Grand Caravan
Aircraft Type	Single Propeller
Maximum Gross Takeoff Weight (lb)	8,750
Number and Type of Engine(s)	1 Pratt & Whitney Canada PT6A-114A
Blade Manufacturer / Model Number	McCauley / C703/106GA-0
Number of Passengers	14

2.3 Dornier 228-202

The Dornier 228 is a twin-engine, turbo propeller-driven aircraft designed and manufactured by Dornier GmbH* (see Table 3 and Figure 3). The aircraft is designed to carry 2 crew members and up to 19 passengers.

Figure 3. Dornier 228-202

Table 3. Airplane Characteristics of the Dornier 228-202

Aircraft Manufacturer	Dornier GmbH
Aircraft Model	228-202
Aircraft Type	Twin Turbo Propeller
Maximum Gross Takeoff Weight (lb)	13,669
Number and Type of Engine(s)	2 Garrett AiResearch TPE331-10P-511D
Blade Manufacturer / Model Number	Hartzell / HC-B4TN-5ML
Number of Passengers	19

* Dornier GmbH was acquired in 1996 by Fairchild Aircraft and became Fairchild Dornier.

2.4 Dornier 328-100

The Dornier 328 is a twin-engine, turbo propeller-driven aircraft designed and manufactured by Fairchild Dornier (see Table 4 and Figure 4). The aircraft is designed to carry 2 crew members and up to 34 passengers.

Figure 4. Dornier 328-100

Table 4. Airplane Characteristics of the Dornier 328-100

Aircraft Manufacturer	Fairchild Dornier
Aircraft Model	328-100
Aircraft Type	Twin Turbo Propeller
Maximum Gross Takeoff Weight (lb)	30,843
Number and Type of Engine(s)	2 Pratt & Whitney Canada PW119B
Blade Manufacturer / Model Number	Hartzell / HD-E6C-3B
Number of Passengers	34

2.5 Piper PA-42 Cheyenne III

The Piper PA-42 is a twin-engine, turbo propeller-driven aircraft designed by Piper Aircraft of Vero Beach, Florida (see Table 5 and Figure 5). The aircraft is designed to carry 2 crew members and up to 9 passengers.

Figure 5. Piper PA-42 Cheyenne III

Table 5. Airplane Characteristics of the Piper PA-42 Cheyenne III

Aircraft Manufacturer	Piper Aircraft
Aircraft Model	PA-42 Cheyenne III
Aircraft Type	Twin Turbo Propeller
Maximum Gross Takeoff Weight (lb)	11,200
Number and Type of Engine(s)	2 Pratt & Whitney Canada PT6A-41
Blade Manufacturer / Model Number	Hartzell / HC-B3TN-3K / T10173AB-6Q
Number of Passengers	9

2.6 Bell 407

The Bell 407 is a civil utility helicopter introduced in 1996. It is frequently used for corporate and offshore transport, as an air ambulance, for law enforcement, as well as gathering news and filming movies. It has a 4 blade main rotor and was designed by Bell Helicopter Textron of Quebec, Canada (see Table 6, Table 7 and Figure 6). It is designed to carry 1 crew member and up to 6 passengers.

Figure 6. Bell 407

Table 6. Helicopter Characteristics of the Bell 407

Helicopter Manufacturer	Bell Helicopter Textron
Aircraft Model	407
Aircraft Type	Single Rotor
Max Gross Takeoff Weight [MGTW] (lb)	6,000
Number and Type of Engine(s)	1 Rolls-Royce Model 250-C47B Turbo-shaft
Shaft Horsepower (hp)	813
Max Continuous Power (hp)	701
Never Exceed Speed [V_{NE}] (kts)	140
Max Speed in Level Flight with Max Continuous Power [V_H] (kts)	127
Speed for Best Rate of Climb [V_Y] (kts)	60
Number of Passengers	6

Table 7. Rotor Specifications of the Bell 407

Characteristic	Main	Tail
Rotor Speed (RPM)	413	2,500
Diameter (in)	420	65
Chord (in)	10.75	6.5
Number of Blades	4	2
Fundamental Blade Passage Frequency (Hz)	27.53	83.33

2.7 Robinson R44 Raven

The Robinson R44 Raven is a helicopter with 2-blade main and tail rotors. It is designed and manufactured by Robinson of Torrance, California (see Table 8, Table 9, and Figure 7). The helicopter is designed to carry 1 crew member and up to 3 passengers.

Figure 7. Robinson R44 Raven

Table 8. Helicopter Characteristics of the Robinson R44 Raven

Helicopter Manufacturer	Robinson Helicopter Company
Aircraft Model	R44 Raven
Aircraft Type	Single Rotor
Max Gross Takeoff Weight [MGTW] (lb)	2,400
Number and Type of Engine(s)	1 Textron Lycoming O-540-F1B5
Shaft Horsepower (hp)	260 @ 2800
Max Continuous Power (hp)	205 @ 2718
Never Exceed Speed [V_{NE}] (kts)	130
Max Speed in Level Flight with Max Continuous Power [V_H] (kts)	108
Speed for Best Rate of Climb [V_Y] (kts)	55
Number of Passengers	3

Table 9. Rotor Specifications of the Robinson R44 Raven

Characteristic	Main	Tail
Rotor Speed (RPM)	400	2426
Diameter (in)	396	58
Chord (in)	10.0	5.1
Number of Blades	2	2
Fundamental Blade Passage Frequency (Hz)	13.6	80.9

2.8 Schweizer 300C

The Schweizer 300C is a light helicopter, originally designed by Hughes Helicopter. It is currently marketed and supported by Schweizer Aircraft, a subsidiary of Sikorsky Aircraft (see Table 10, Table 11 and Figure 8). It has a 3 blade main rotor and is designed to carry 1 crew member and up to 2 passengers.

Figure 8. Schweizer 300C

Table 10. Helicopter Characteristics of the Schweizer 300C

Helicopter Manufacturer	Schweizer Aircraft
Aircraft Model	300C
Aircraft Type	Single Rotor
Max Gross Takeoff Weight [MGTW] (lb)	2,050
Number and Type of Engine(s)	1 Textron Lycoming HIO-360-D1A
Shaft Horsepower (hp)	190
Max Continuous Power (hp)	190
Never Exceed Speed [V_{NE}] (kts)	95
Max Speed in Level Flight with Max Continuous Power [V_H] (kts)	86
Speed for Best Rate of Climb [V_Y] (kts)	41
Number of Passengers	2

Table 11. Rotor Specifications of the Schweizer 300C

Characteristic	Main	Tail
Rotor Speed (RPM)	471	N/A
Diameter (in)	322	51
Chord (in)	6.75	N/A
Number of Blades	3	2
Fundamental Blade Passage Frequency (Hz)	25.20	N/A

3 MEASUREMENT SITES

Acoustical considerations in selecting measurement site locations include the following:

- To minimize the effect of altitude on aircraft performance, the elevation of the measurement site should be below 2,000 feet above mean sea level (AMSL);
- To lessen the risk of external acoustic contamination, a measurement site should have a relatively quiet ambient environment with minimal aircraft operations; and
- To eliminate the need of acoustic corrections due to terrain undulations, the measurement site should have a long stretch of flat terrain near the test runway, where a microphone array is expected to be placed.

Final selection of measurement locations was made through a screening process of potential sites considering the above factors, and in consideration of the proximity of aircraft charter companies that could provide the test aircraft. This minimized both the fuel and time costs of the chartered aircraft, as well as travel costs of field personnel.

The measurement sites selected were Fitchburg Municipal Airport located in Fitchburg, Massachusetts, Needles Airport located in Needles, California and Crisfield Municipal Airport located in Crisfield, Maryland. Table 12 shows the selected measurement sites, measurement dates, and aircraft measured at each site.

Table 12. Location and Date of Aircraft Source Measurements

Measurement Site	Date (s)	Aircraft Measured
Fitchburg Municipal	October 24 -25, 2006	Cessna 182, Cessna 208B, Robinson R44
Needles	January 20, 2007	Dornier 228, Dornier 328
Crisfield Municipal	October 7 – 11, 2008	Piper PA-42, Bell 407, Schweizer 300C

3.1 Fitchburg Municipal Airport

Located in Massachusetts between the cities of Fitchburg and Leominster, Fitchburg Municipal Airport (FAA identifier: FIT) maintains two runways (14-32 and 02-20). The elevation of FIT is 348 ft AMSL. Runway 02-20 was selected as the test runway. An aerial view of FIT indicating the test runway is provided in Figure 9. A Notice-To-Airmen (NOTAM) informing pilots to use an alternate runway was issued for the days of the tests. Table 13 indicates the dates each aircraft was measured.

Table 13. Fitchburg Municipal Airport Measurement Dates

Aircraft	Date (s) Measured
Cessna 182 Skylane	October 24, 2006
Cessna 208B Grand Caravan	October 25, 2006
Robinson R44 Raven	October 25, 2006

Figure 9. Aerial View of FIT

3.2 Needles Airport

Located in Needles, California, Needles Airport (FAA identifier: EED) maintains two runways (11-29 and 02-20). The elevation of EED is 983 ft AMSL. Runway 02-20 was selected as the test runway. An aerial view of EED indicating the test runway is provided in Figure 10. A NOTAM informing pilots to use an alternate runway was issued for the day of the test. Table 14 indicates the date the aircraft were measured.

Table 14. Needles Airport Measurement Date

Aircraft	Date (s) Measured
Dornier 228	January 20, 2007
Dornier 328	January 20, 2007

Figure 10. Aerial View of EED

3.3 Crisfield Municipal Airport

Located in Crisfield, Maryland, Crisfield Municipal Airport (FAA identifier: W41) maintains two runways, one with an asphalt surface, 14-32, and one with a turf surface, 06-24. The elevation of W41 is 4 ft AMSL. Runway 14-32 was selected as the test runway. An aerial view of Crisfield Municipal Airport indicating the test runway is provided in Figure 11. A NOTAM informing pilots to use an alternate runway was issued for the days of the tests. Table 15 indicates the dates each aircraft was measured.

Table 15. Crisfield Municipal Airport Measurement Dates

Aircraft	Date (s) Measured
Piper PA-42	October 7 & 11, 2008
Bell 407	October 8 & 9, 2008
Schweizer 300C	October 9 & 10, 2008

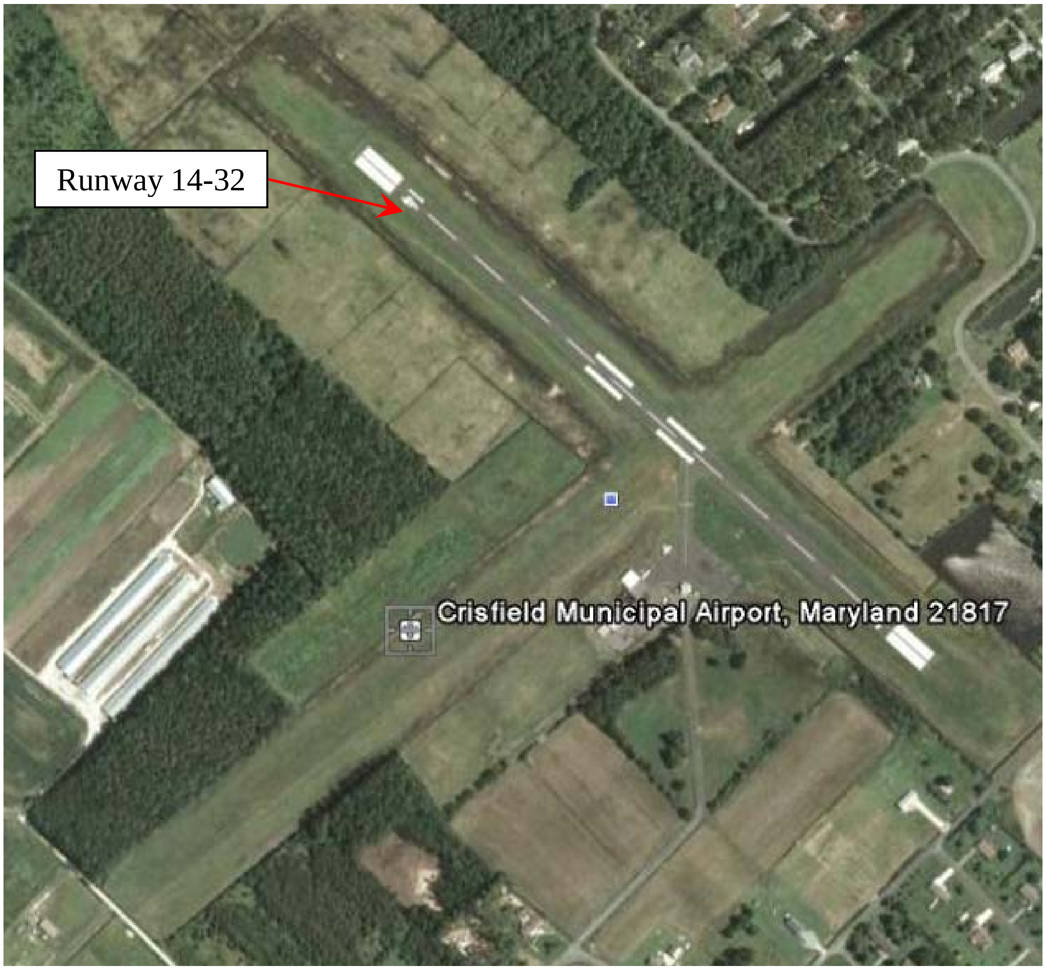

Figure 11. Aerial View of W41

4 INSTRUMENTATION

This section presents a description of the instrumentation used during the measurements at all three measurement locations.

4.1 Acoustic System

Each acoustic system consisted of a Brüel and Kjær (B&K) Model 4189 ½-inch electret microphone covered with a B&K Model UA0207 3.5-inch windscreen. The primary recording device was a Larson Davis Model 824 sound level meter (LD824) and real-time spectral analyzer. Data were also recorded simultaneously with a back-up Sony Model PC208AX Digital Audio Tape (DAT) recorder. A GPS time-code generator, outputting an inter-range instrumentation group (IRIG) B signal, was used to provide a streaming time stamp to the back-up recording device. The primary recording device time was also synched manually to the GPS time-code generator.

The acoustic instrumentation setup is presented in Figure 12. Table 16 shows the settings used for the LD824 during data collection.

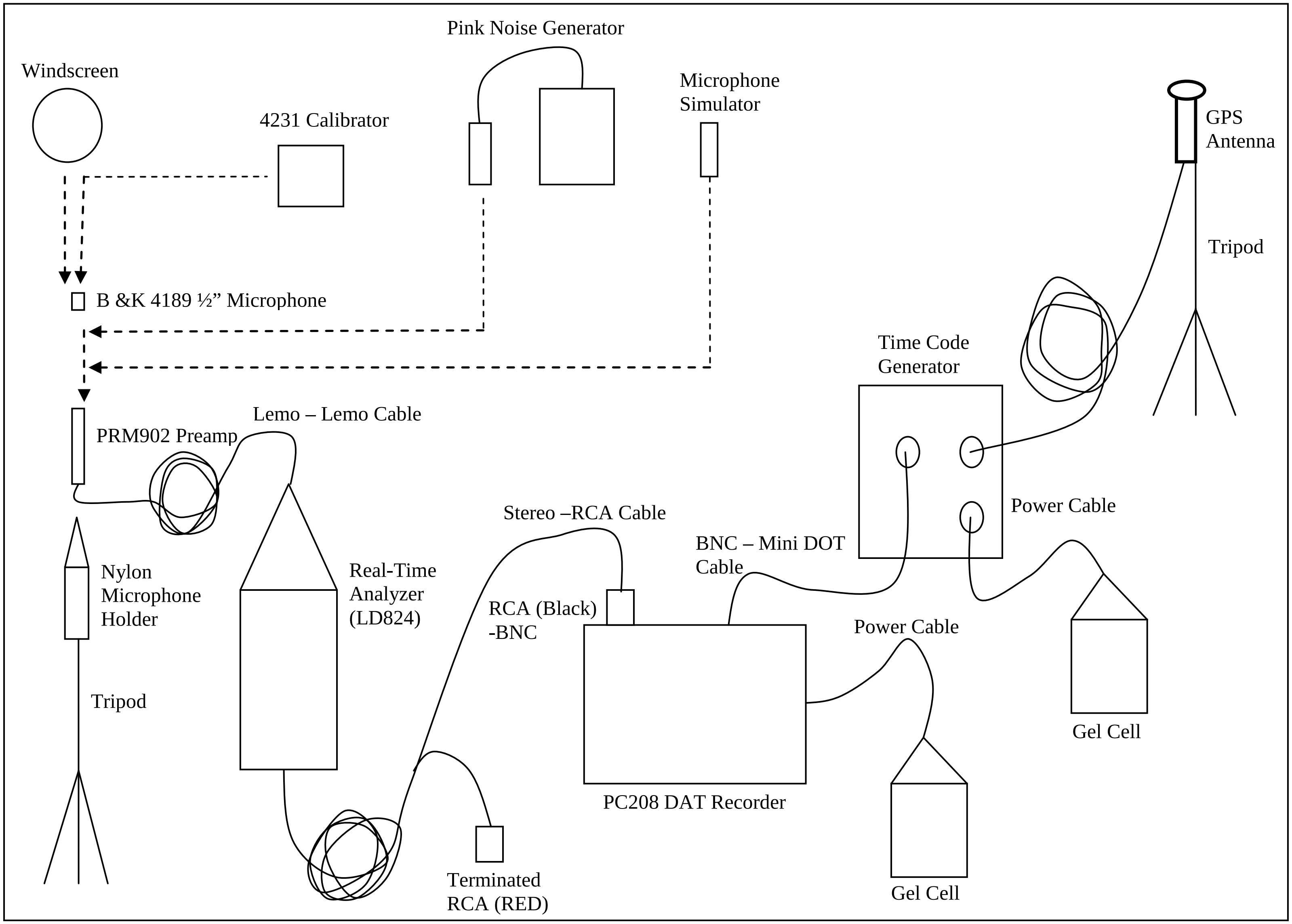

Figure 12. Acoustic Instrumentation Setup

Table 16. LD824 Collection Settings

Parameter	Setting
Detector	Slow
Broadband Frequency Weighting	A
Spectra Bandwidth	$^{1}/_{3}$ Octave Band
Spectra Frequency Weighting	Flat
Time History Interval	½ Second

4.2 Aircraft Tracking Systems

4.2.1 Differential Global Positioning System

A differential Global Positioning System (dGPS) was used as the primary aircraft guidance and tracking system during measurements. The specific system is the Time-Space-Position-Information (TSPI) System Version 5.0, which is a dGPS designed by Volpe Center (refer to Volpe Center Time-Space-Position-Information System User's Guide[7] for more information). The Volpe Center TSPI system can be utilized to track vehicles in motion or at stationary points to within ± 20 centimeter accuracy, while recording time-stamped X-Y-Z-coordinate position data at a rate of twice per second and velocity data once every two seconds. In addition to obtaining time-space information of test aircraft during measurements, the Volpe Center TSPI system served additional purposes:

1. To conduct a site survey of the measurement site to establish a local coordinate system and determine instrumentation locations; and
2. To provide real-time guidance and position information of the aircraft to the pilot and test director.

The Volpe Center TSPI system consists of a base station and a rover unit, each of which receives GPS satellite signals via a receiver and transmits or receives differential corrections via a transceiver.

- **Base Station** - The dGPS base station includes a NovAtel Model TR20E receiver, GLB Model SNTR150 transceiver tuned to a frequency of 136.325 MHz, GPS antenna, and radio antenna. See Figure 13 for a diagram of this setup.

- **Rover Unit** - The dGPS rover unit, which is usually installed aboard the test aircraft, consists of a NovAtel Model TR20E receiver, GLB Model SNTR150 transceiver, and a laptop installed with Volpe Center's TSPI software. Figure 14 depicts a typical Rover Unit setup aboard a test aircraft.

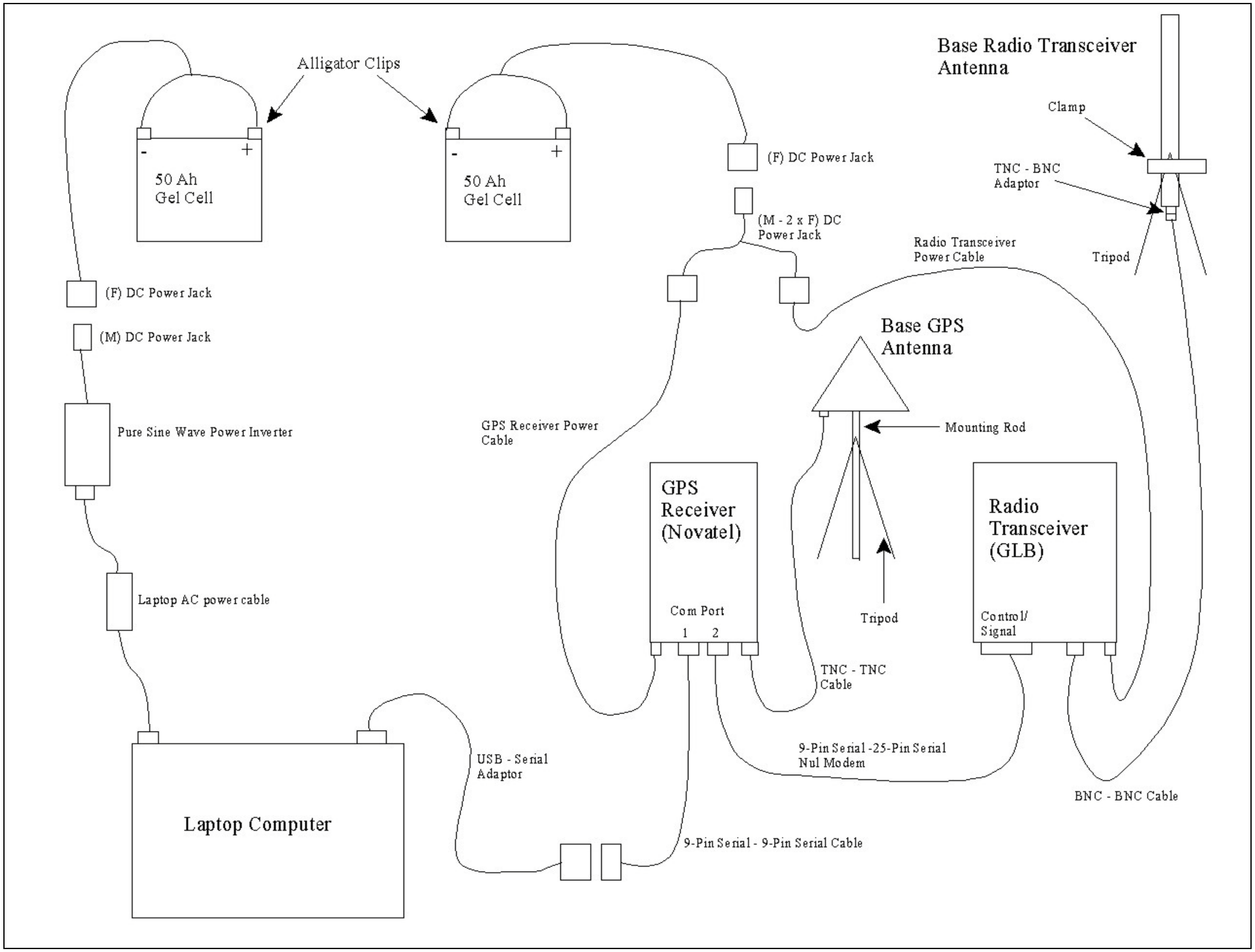

Figure 13. DGPS Base Station Setup

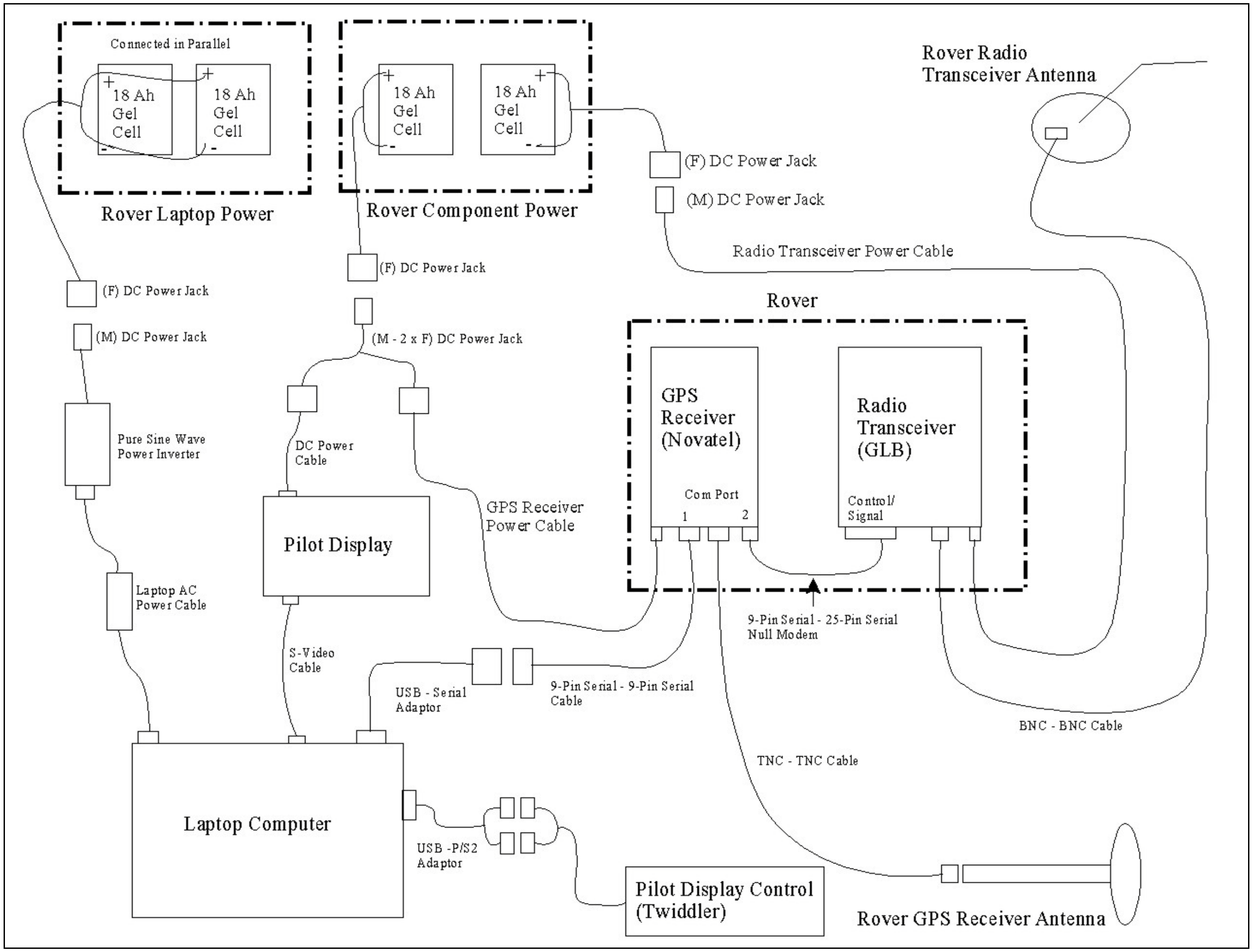

Figure 14. DGPS Rover Unit Setup

4.2.2 Video Camera Systems

Two separate camera systems were used for this study. A multi-camera, digital video tracking system was used as a backup TSPI system in the event of a dGPS malfunction. A single video camera was also used during the hover events for documentation purposes.

<u>Video Tracking for Dynamic Operations</u> - A system consisting of two Canon Optura digital video cameras was used to record aircraft operations. The system utilizes calibrated lenses, field-of-view targets, and triangulation algorithms to determine an aircraft's TSPI data.

<u>Video Recording for Static Operations</u> - A Sony TR818 8 mm camcorder was used to document aircraft orientation during Static Operations.

4.3 Meteorological System

Two Qualimetrics Transportable Automated Meteorological Stations (TAMS) were used to measure wind speed and direction, relative humidity, air temperature, and barometric pressure at one-second intervals throughout all testing periods. The meteorological instrumentation setup is illustrated in Figure 15. Table 17 provides information on the TAMS unit collection parameters and tolerances.

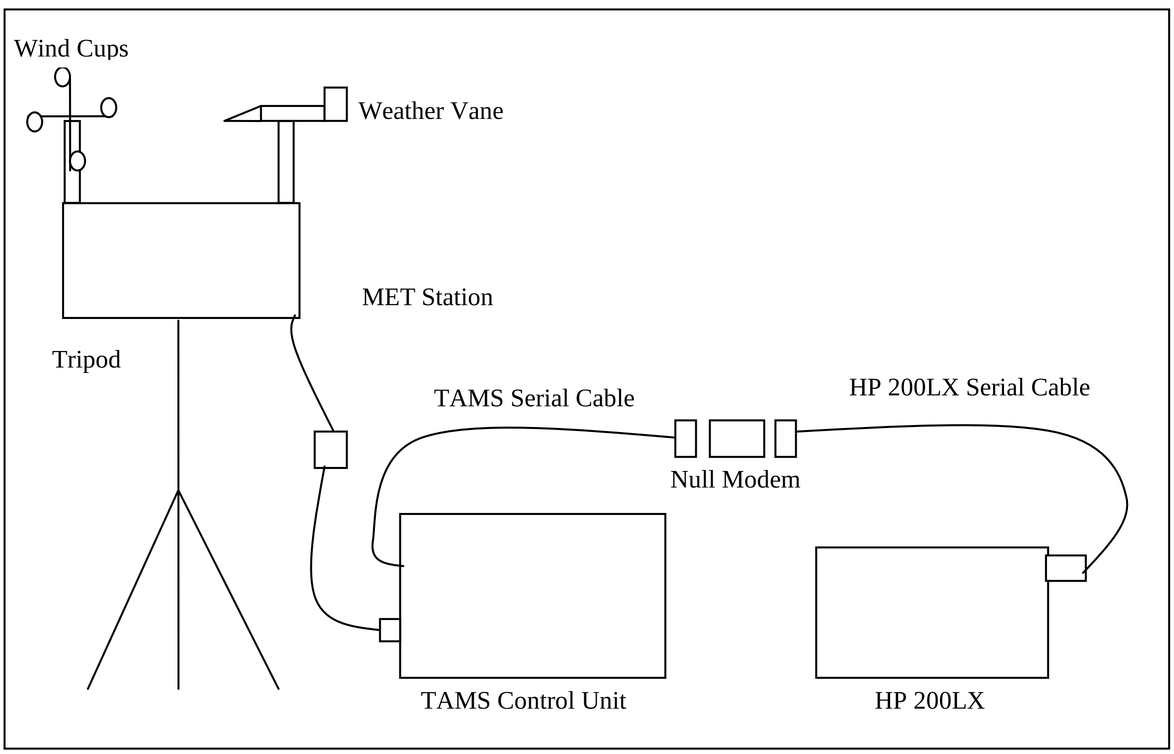

Figure 15. Meteorological Instrumentation Setup

Table 17. TAMS Unit Collection Parameters and Tolerances

Data	Range Capability	Resolution	Accuracy
Wind Speed (mph)	2 – 55	1	1 (or 5 percent of range)
Wind Direction (degrees)	360	10	Root mean standard error of 18
Temperature (degrees Fahrenheit)	-9 to 110	1	1
Relative Humidity (percent)	0 – 100	1	3

This page intentionally left blank.

5 MEASUREMENT SETUP

Two different microphone configurations were used during data collection. The first configuration was used for dynamic operations of both, fixed wing aircraft and helicopters (Section 5.1). Dynamic operations include variations of level fly over (LFO), approach (APP) and departure (DEP) events. The second configuration was used for static helicopter operations (Section 5.2). The static microphone setup is required to develop a 360-degree directivity pattern for all helicopter hover in-ground effect (HIGE), hover out-of-ground effect (HOGE), ground idle, and flight idle operations.

A field technician monitored and operated the acoustic recording instrumentation for each microphone. The field technicians and acoustic recording instrumentation were located at acoustic observer tables, approximately 100 ft from their respective microphones. This distance ensured field personnel would not contaminate the sound-level data. The placement of a field technician at each acoustic location also eliminated the need for long cables, which minimized the potential radio signal interference inherent to their use.

A Test Director was stationed in a central location with a full view of the flight path and instrumentation, but far enough away from the acoustic systems to avoid contamination of the acoustic data. The Test Director was responsible for announcing events, monitoring dGPS and meteorological data, coordinating all site logistics, communicating with the aircraft and field technicians, and ensuring the quality of all measurement events.

5.1 Dynamic Operations

In accordance with Appendix H, Noise Requirements For Helicopters, of the Federal Aviation Regulations Part 36[8] and Chapter 8 of ICAO Annex 16[9] (FAR 36 / Annex 16), dynamic operations were conducted with a three microphone setup; a centerline microphone and two sideline microphones to capture the left, center, and right noise characteristics of the helicopter. The lateral position of the sideline microphones would ideally be 500 feet from the centerline microphone and the vertical height of all the microphones would be set at 4 feet above ground level (AGL). The microphones would also be oriented nominally for grazing incidence i.e., diaphragm at 90 degrees relative to the anticipated direction of the noise source (see Figure 17).

At Crisfield Municipal Airport the sideline microphones were 500 feet from the center line. However, due to space constraints at Fitchburg Municipal Airport and Needles Airport the sideline microphones were 400 feet from the centerline. The microphones at all measurement sites were placed at a height of 4 feet AGL and were oriented for nominal grazing incidence
A primary TAMS unit, with the sensor placed at a height of 4 feet AGL, was located near the centerline microphone to capture meteorological conditions at the microphone array. A secondary TAMS unit, also with the sensor at 4 feet AGL, was used as a monitoring station at the Test Director's location to provide a real-time display of the meteorological data to determine if the meteorological conditions were within tolerances during each measurement run. Table 18, Table 19, and Figure 16 summarizes the setup.

Table 18. Dynamic Operations Microphone Locations at Fitchburg Municipal and Needles Airports

Microphone	X-Coordinate (ft)	Y-Coordinate (ft)	Height (ft)
East Sideline	0	-400	4
Center	0	0	4
West Sideline	0	400	4

Table 19. Dynamic Operations Microphone Locations at Crisfield Municipal Airport

Microphone	X-Coordinate (ft)	Y-Coordinate (ft)	Height (ft)
East Sideline	0	-500	4
Center	0	0	4
West Sideline	0	500	4

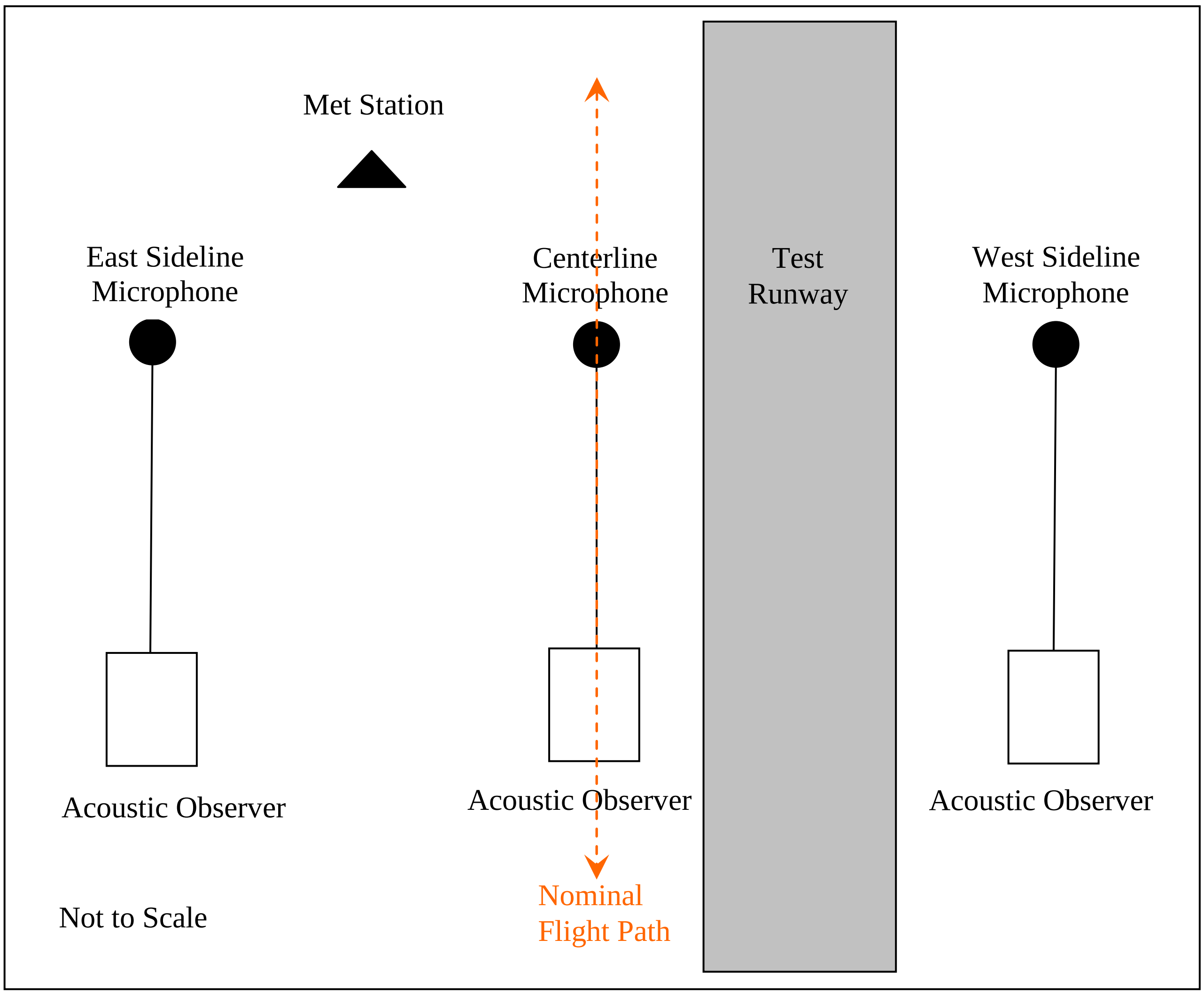

Figure 16. Plan View of a Dynamic Operations Setup

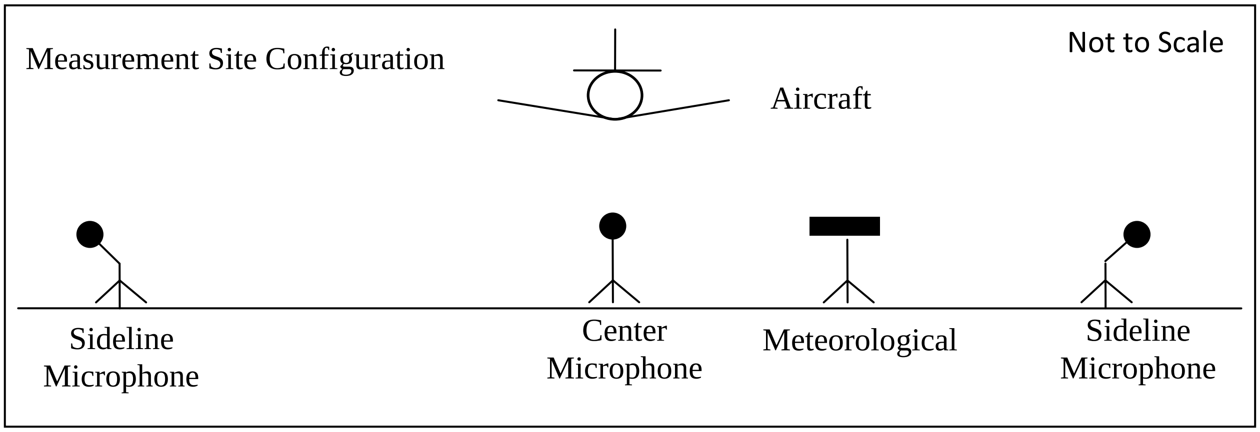

Figure 17. Profile View of a Dynamic Operations Setup

5.2 Static Operations

Static operations were conducted for helicopters and utilized a two microphone setup with the helicopters' hover location in the middle (see Figure 18). At Crisfield Municipal Airport the microphones were 450 feet apart, see Table 20 for X-Y coordinates. Due to space constraints at Fitchburg Municipal Airport the microphones were 400 feet apart, see Table 21 for X-Y coordinates. The microphones were placed at a height of 4 feet AGL and at an angle of 0 degrees (diaphragm parallel with the ground, Figure 19). A primary TAMS unit was located approximately 100 ft from the West Hover microphone, away from the helicopter hover location, to capture meteorological conditions. A secondary TAMS unit was used as a monitoring station at the Test Director's location to provide a real-time display of the meteorological data to determine if the meteorological conditions were within tolerance during each measurement run.

Table 20. Static Operations Locations at Crisfield Municipal Airport

Microphone / Helicopter Location	X-Coordinate (ft)	Y-Coordinate (ft)	Height (ft)	Angle (°)
East Hover Microphone	0	0	4	0
Helicopter Location	0	225	N/A	N/A
West Hover Microphone	0	450	4	0

Table 21. Static Operations Locations at Fitchburg Municipal Airport

Microphone / Helicopter Location	X-Coordinate (ft)	Y-Coordinate (ft)	Height (ft)	Angle (°)
East Hover Microphone	0	-400	4	0
Helicopter Location	-78	-216	N/A	N/A
West Hover Microphone	-156	-32	4	0

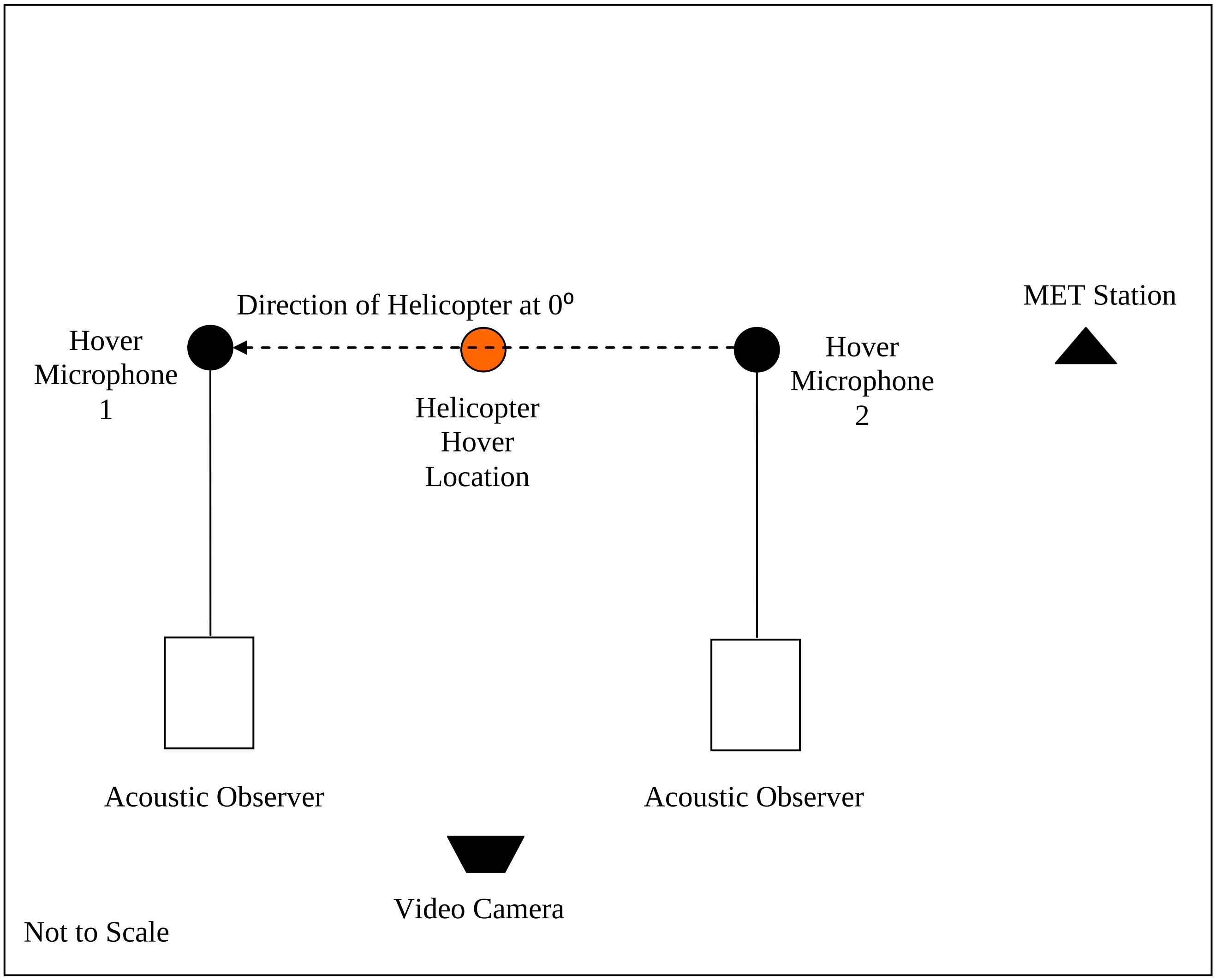

Figure 18. Plan View of a Static Operations Setup

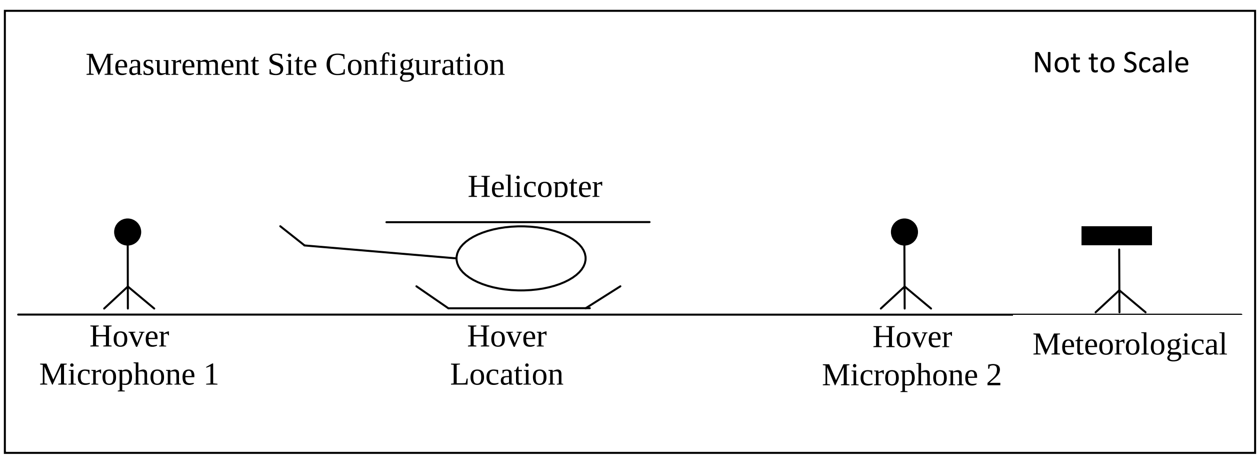

Figure 19. Profile View of a Static Operations Setup

6 MEASUREMENT PROCEDURES

6.1 Acoustic Observers and Technicians

6.1.1 Deployment

The acoustic systems were deployed according to Section 5.1 and Section 5.2 for dynamic and static operations, respectively. The video tracking system and backup meteorological system were deployed according to Sections 4.2.2 and 4.3, respectively. The microphone tripods were anchored to the ground to avoid the risk of the tripod tipping over. A space blanket was secured to the operators table for rain contingency. All microphones were calibrated using the following standard procedure:

1. A calibrator was mounted on the microphone and a sine wave signal of 94 decibels (dB) at 1 kHz was applied to the system. The LD824 was calibrated to this reference signal. One minute of calibration tone was recorded and levels indicated on the LD824 and DAT recorder were noted on log sheets.
2. The microphone was removed and a pink noise generator was applied to check the frequency response of the system. One minute of pink noise was recorded and levels indicated on the LD824 and DAT recorder were noted on log sheets.
3. A microphone simulator was then applied to the system to measure the system noise floor and ensure no outside interference was present. At this point +20 dB gain was added to the LD824 to raise the lower range of the system to help identify any anomalous signals. One minute of the noise floor was recorded and levels indicated on the LD824 and DAT recorder were noted on log sheets. The +20 dB gain was then removed from the LD824.
4. The microphone was replaced, and then the calibrator was reapplied to verify that the LD824 reads the same initial calibration reading performed in Step 1. Another minute of calibration tone was recorded and levels indicated on the LD824 and DAT recorder were noted on log sheets.

6.1.2 During an Event

During an event, each acoustic observer performed the following:

- Recorded the maximum sound level (L_{ASmx}) observed on the LD824 on the log sheet. The observer also checked the L_{ASmx} for consistency and repeatability, i.e., the L_{ASmx} values for events in the same series should generally be similar in sound level.
- Confirmed and noted that the recording instrumentation indicated a minimum 20-dBA rise and fall during an event.
- Noted any audible external contamination.
- If possible, observed that the aircraft route was straight, at a constant speed, and over the centerline or hover point, as appropriate.
- Collect ambient measurements periodically throughout the measurement day.

At the end of each pass-by event, personnel at the sideline microphones signaled to the center position whether 20-dBA rise and fall has been observed on their respective LD824. The center position then radioed to the test director if a 20-dBA rise and fall was attained at all microphone locations.

6.1.3 End of Measurement Day

At the end of the day a calibrator was reapplied to check for any drift that may have occurred during the day. Similar to during deployment, a minute of calibration tone was recorded and levels indicated on the LD824 and DAT recorder were noted on log sheets.

6.2 Test Director

6.2.1 Deployment

The TSPI tracking system base station and the primary meteorological system were deployed according to Sections 4.2.1 and 4.3, respectively. While the field team deployed the acoustic, TAMS, and TSPI systems; the Test Director, TSPI System Operator (see Section 6.3), and Pilot discussed the test flight series to be flown.

6.2.2 During an Event

During an event, the Test Director performed the following:

- Announced, via 2-way radio, the start of an event along with the event number.
- Monitored the tracking data to verify the aircraft was within tolerances.
- Listened for external contamination.
- Monitored wind speed in real time via the TAMS meteorological system.
- Recorded the following in the log sheet:
    - Wind speed and direction;
    - Tracking information; and
    - Any external contamination.
- Announced, via 2-way radio, the end of event.

After the end of an event, the Test Director received an update from the acoustic observers as to the event quality at their microphone locations. Based on their input, monitored wind speed[*] and aircraft tracking data, and input from the pilot, a determination was made on the overall quality of the event; this was done to ensure that an adequate number of events were collected for each series.

6.2.3 End of Measurement Day

At the end of the day the Test Director, TSPI System Operator, and Pilot conducted a second briefing. This briefing discussed the measurements and any improvements that could be implemented in the future.

[*] Absolute- and cross-wind speed tolerances are discussed in Section **Error! Reference source not found.**

6.3 TSPI System Operator

6.3.1 Deployment

The TSPI tracking system rover unit was deployed according to Section 4.2.1. While the field team deployed the acoustic, TAMS, and TSPI systems; the Test Director, TSPI System Operator, and Pilot discussed the test flight series to be flown.

6.3.2 During an Event

During an event, the TSPI System Operator performed the following:

- Selected tolerances for the pilot guidance display.
- Verified the Test Director was receiving data from the rover station.
- Monitored the TSPI system to verify that the pilot flew within the assigned tolerances.
- Recorded actual flight parameters (Power, flaps, speed, and inlet turbine temperature) during the event.

6.3.3 End of Measurement Day

At the end of the day the Test Director, TSPI System Operator, and Pilot conducted a second briefing. This briefing discussed the measurements and any improvements that could be implemented in the future.

6.4 Quality Assurance

The quality of the measured and processed data is crucial since they will be used to develop noise model input data for the AEDT/INM database and ultimately used in modeling exercises, including environmental analyses in support of ATMPs. Special care was given to inspecting the data in the field during data collection and in the lab during data processing.

6.4.1 Calibration

At the beginning of each measurement day, the acoustic systems were calibrated as described in Section 6.1.1 and integrity of the noise floor checked. A calibration was also done at the end of each measurement day to determine if a calibration drift existed during the measurement period. During the source data measurements documented herein no calibration drifts occurred. If a calibration drift of up to 0.5 dB had occurred, then it would have been corrected for during data processing. The MiniFAR software (Section 8.2.1.1) is capable of correcting for calibration drifts during its calculation of noise metrics. In accordance with FAR 36 / Annex 16, if a calibration drift exceeded 0.5 dB, then the data would have been deemed invalid and not included in the data processing.

6.4.2 Time of Day

To ensure a uniform time source across all data acquisition systems, a TrueTime Model 705 GPS time code generator was used as the “gold standard” time base during data collection. LD824s, which were the primary recording devices, were set to the time displayed on the time code generator. The Sony Model PC208Ax (DAT) recorders, which were the secondary recording devices, recorded the IRIG B signal from the time code generator directly to one of its channels. Field personnel also used the time code generator when transcribing notes onto field logs. Meteorological stations had their system time synched with the GPS time code. The Volpe

Center TSPI system, deployed as described in Section 4.2.1, was set to use the identical time base as the TrueTime Model 705, therefore synchronizing the aircraft tracking and acoustic data. During processing, MiniFAR links the acoustic, field log, TSPI, and meteorological data together using this uniform time base.

6.4.3 External Contamination

During field measurements three acoustic observers, stationed approximately 100 feet from each microphone, noted in field logs the effects of any potentially contaminating noise sources. These field notes were displayed in the MiniFAR software. Accordingly, the user was able to view these notes in conjunction with a visual display of the event's sound level time history to determine if the external noise contaminated the event. Events where contamination was seen in the time history by this initial screening process were discarded. During post-process inspection of the generated NPD curves and one-third octave spectral data, the field logs were referred to once again to help identify any external contamination to the data.

6.4.4 Test Aircraft TSPI

The TSPI System operator on board the test aircraft monitored the TSPI in real time to ensure the position of the aircraft remained within tolerance during the event. Any events where the aircraft was out of tolerance were discarded and repeated. In addition, the Test Director monitored the test aircraft position with a real-time feed from the TSPI System.

7 SUMMARY OF MEASURED DATA

7.1 Test Series Descriptions

The modeling methodology in INM relies strongly on the source noise and performance characteristics defined in its aircraft noise and performance database. Procedures for using and developing these databases are described in SAE-AIR-1845[10], the INM Technical Manual, and Doc 29[11] / Doc 9911[12]. The aircraft noise and performance database defines the noise source for an aircraft state and is structured in a way that allows the model to reflect how aircraft noise sources change with aircraft state.

The test series described in this section were designed to capture the noise source as a function of aircraft state. Typically the state of the aircraft includes the aircraft operational mode (e.g. departure) and its power state, although flap state and speed are also important factors. Changes in source noise due to aircraft speed are accounted for with modeling adjustments, which are discussed in later sections.

SAE-AIR-1845 is primarily used in jet and propeller-driven aircraft noise modeling and has been adapted to handle helicopters. The SAE Technical Committee is examining the refinement of these methods to support more advanced modeling related to helicopters. This data collection effort includes test series that support additional helicopter source data for noise models, including: 1) accounting for directivity through left, right and center noise-power-distance (NPD) curves, 2) 360-degree directivity patterns for hover and idle static operations, and 3) effects of speed on noise beyond simple duration corrections, referred to as the source noise adjustment due to advancing tip Mach number.

7.1.1 Dynamic Operations

Dynamic operations events included LFO, APP, and DEP flight configurations for both fixed wing aircraft and helicopters. The different test series were varied by:

- Flight configuration
    - Operational mode
    - Descent angle
    - Flap setting (fixed wing aircraft only)
- Reference altitude
- Reference speed
- Power settings

Individual events for each test series were flown to have reasonable confidence in the collected data. This typically translated into three passes that were free from observable external contamination, pilot error, and meteorological conditions that exceed tolerance, for each series. Descriptions of the specific test series for each aircraft measured at Fitchburg, Needles, and Crisfield airports are provided in Table 22, Table 23, and Table 24, respectively. Power settings, meteorological, and TSPI data for each of these test series are presented in Appendices A, C and D, respectively.

Table 22. Fitchburg Test Series Definitions

Test Series	Aircraft		
	Cessna 182	**Cessna 208B**	**Robinson R44**
100	LFO: Tour Cruise @ 500 ft	LFO: Tour Cruise @ 500 ft	LFO: Tour Cruise @ 500 ft
200	LFO: Normal Cruise* @ 500 ft	LFO: Normal Cruise @ 500 ft	LFO: High Cruise @ 500 ft
300	DEP (standard)	DEP (standard)	DEP (standard)
400	DEP: Cruise Climb	DEP: Cruise Climb	N/A
500	APP: Flaps 10	APP: Flaps 20 (fast speed)	APP: -12 degrees
600	APP: Flaps 30	APP: Flaps 20 (slow speed)	APP: -9 degrees
700	N/A	N/A	APP: -6 degrees
800	N/A	N/A	APP: -3 degrees

Table 23. Needles Test Series Definitions

Test Series	Aircraft	
	Dornier 228	**Dornier 328**
100	LFO: Normal Cruise @ 500 ft	LFO: Normal Cruise @ 500 ft
200	LFO: Tour Cruise @ 500 ft	N/A
300	DEP (standard)	DEP (standard)
400	DEP: Cruise Climb	DEP: Cruise Climb
500	APP: Flaps 1, gear up	APP: Flaps 12, gear up
600	APP: Flaps 2, gear down	APP: Flaps 20, gear down

* The difference between tour and normal cruises are the reference speeds. Reference speeds were chosen to be representative of fast, normal cruise and slow, tour cruise speeds.

Table 24. Crisfield Test Series Definitions

Test Series	Aircraft		
	Piper PA-42	**Bell 407**	**Schweizer 300C**
100	LFO: Tour Cruise @ 500 ft	LFO: Tour Cruise (0.6*Vne)	LFO: Tour Cruise @ 500 ft (0.6*Vne)
200	LFO: Normal Cruise @ 500 ft	LFO: High Cruise (0.9*Vne)	LFO: High Cruise @ 500 ft (0.9*Vne)
300	DEP (standard)	DEP (standard)	DEP (standard)
400	DEP: Cruise Climb	DEP: Cruise Climb (acceleration)	DEP: Cruise Climb (acceleration)
500	APP: Flap up	APP: -6 degrees	APP: -6 degrees
600	APP: Flaps 10	APP: -6 degrees (deceleration)	APP: -6 degrees (deceleration)
700	APP: Flaps 30, gear down	APP: -3 degrees	APP: -3 degrees
800	N/A	APP: -9 degrees	APP: -9 degrees
900	N/A	APP: -12 degrees	APP: -12 degrees
1000	N/A	LFO: Cruise (0.8*V_H)	LFO: Cruise (0.8*V_H)
1100	N/A	LFO: Cruise (0.7*V_H)	LFO: Cruise (0.7*V_H)
1800[*]	N/A	Taxi	Taxi

7.1.2 Static Operations

Static operations were performed for helicopters only. Tables 25 through 27 present definitions of the static operations test events. The test series for these conditions are used to develop a single NPD and a full 360-degree directivity pattern. These data may be used to model hover in-ground effect (HIGE), hover out-of-ground effect (HOGE), ground idle, and flight idle operations. These events were performed directly over the hover point illustrated in Figure 18 and Figure 19. The HIGE reference altitude is 5 feet and the HOGE reference altitude is approximately 2.5 times the main rotor diameter[13]. Helicopter power is expressed in revolutions per minute (RPM), manifold pressure (MP), engine speed, or torque.

Table 25. Robinson R44 Static Operation Test Series Descriptions

Series	Configuration	Operational Mode	Ref. Speed (kts)	Ref. Altitude (ft)	Power Settings	
					RPM (%)	**MP (in-Hg)**
HIGE	HIGE	Hover	0	5	102	22
HOGE	HOGE	Hover	0	83	102	23
Flight Idle	Flight Idle	Idle	0	0	102	19
Ground Idle	Ground Idle	Idle	0	0	103	13

[*] Taxi events were measured as supplemental data and will be processed and analyzed at a later date.

Table 26. Bell 407 Static Operation Test Series Descriptions

Series	Configuration	Operational Mode	Ref. Speed (kts)	Ref. Altitude (ft)	Power Settings	
					Torque (%)	NG (%)
2100	HIGE	Hover	0	5	70	95
2200	HOGE	Hover	0	88	68	95
2300	Flight Idle	Idle	0	0	29	84
2400	Ground Idle	Idle	0	0	10	63

Table 27. Schweizer 300C Static Operation Test Series Descriptions

Series	Configuration	Operational Mode	Ref. Speed (kts)	300C Ref. Altitude (ft)	Power Settings	
					RPM	MP (in-Hg)
2100	HIGE	Hover	0	5	3150	25
2200	HOGE	Hover	0	67	3170	26
2300	Flight Idle	Idle	0	0	3190	15
2400	Ground Idle	Idle	0	0	2000	11.5

Test helicopters began static operations with the nose facing the East Hover Microphone and the tail facing the West Hover Microphone, as seen in Figure 18. The pilots then rotated the helicopters clockwise in 45-degree increments approximately every 30 seconds between 0 and 180 degrees, maintaining their reference altitudes. Figure 20 presents a diagram of the helicopter sweep pattern.

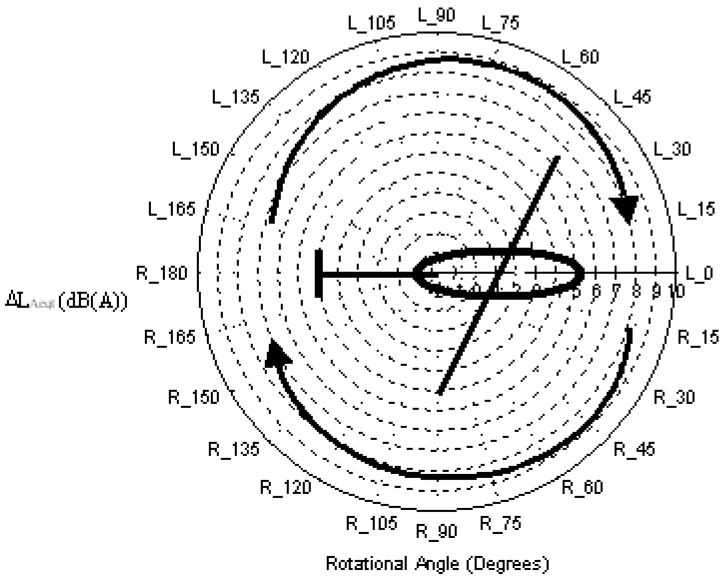

Figure 20. Helicopter Static Operations Sweep Pattern

7.2 Summary of Events Collected

A total of 306 events, varying in flight configuration, reference altitude, power and speed as described in the previous section, were recorded for the eight test aircraft. Of those 306 measured events, 236 events passed quality assurance (QA, see Section 6.4). Only data from events that passed QA were included in INM database development. Events were omitted on the following basis:

- *Contamination*, including an audible noise source from anything other than the test aircraft was detected during data recording by field personnel and also identified later on in the data analysis process (See Section 6.4.3);
- *Incorrect aircraft settings*, including wrong power or flap setting, aircraft speed, or altitude and/or out-of-tolerance position; and
- *Out-of-tolerance winds*, i.e., wind speeds that exceeded the FAR 36 / Annex 16 absolute limit of 10 knots and/or the cross wind speed limit of 5 knots.

8 DATA PROCESSING AND NOISE MODEL DATA DEVELOPMENT

This section describes the data reduction and analysis methodology undertaken to process the as-measured data and the procedures used to transform these data into a form suitable for the INM/AEDT*. Noise model data development included the production of: 1) NPD curves (Section 8.3) with results presented in Appendix E; 2) helicopter static operation directivity patterns (Section 8.4) with results also presented in Appendix E; 3) spectral classes (Section 8.5) with results presented in Appendix F; and 4) blade tip Mach number corrections (Section 8.6).

8.1 Noise Metrics

NPD data for dynamic operations were generated for four different noise metrics: sound exposure level (SEL), denoted by the ANSI[14] symbol L_{AE}; maximum, slow time- and A-weighted sound level (MXSA), denoted by the ANSI symbol L_{ASmx}; effective perceived noise level (EPNL), denoted by the ANSI symbol L_{EPN}; and tone-adjusted, maximum, slow time-weighted, perceived noise level (MXSPNT), denoted by the ANSI symbol L_{PNTSmx}. Appendix E provides these data in tabular format for fixed wing and helicopter dynamic operations. Graphical representations of the NPD data are also presented in Appendix E for L_{AE} only.

NPD data and directivity patterns for helicopter static operations were generated as time-period, equivalent, continuous, A-weighted sound pressure levels (TAEQ), denoted by the ANSI symbol L_{Aeq30s}, and time-period, equivalent, continuous, perceived noise levels (TPEQ), denoted by the symbol $L_{PNT30s,}$ where the "30s" refers to an averaging time-period of 30 seconds. Helicopter static operations NPD and directivity data are presented in Appendix E in tabular format. Graphical representations of the directivity data are also presented in Appendix E.

8.2 Data Development Methodology

The as-measured sound pressure level (SPL), meteorological, and tracking data were processed in accordance with the FAR 36 / Annex 16 methodology to generate a set of sound level metrics. Specifically, the sound level metrics were derived using the FAR 36 / Annex 16 simplified procedure). The differences between the integrated and simplified procedures are as follows:

> **<u>Integrated Process (Type 1)</u>** – In the integrated process L_{AE}, LASmx, L_{EPN}, and LPNTSmx metrics are generated using the full spectral, meteorological and tracking time-history data representative of aircraft sound levels within ten decibels of the maximum sound level. NPD curves generated using the integrated method are Type 1 NPDs.

* As noted earlier, the FAA has begun developing a new tool called the Aviation Environmental Design Tool (AEDT) that will allow for the evaluation of noise and emissions interdependencies. AEDT will incorporate and expand upon the capabilities of existing FAA tools, including INM.

Simplified Process (Type 2) In the simplified process LAE, L_{ASmx}, LEPN, and L_{PNTSmx} metrics are generated using as-measured spectral and tracking data taken at time of L_{ASmx}. NPD curves generated in the simplified method are Type 2 NPDs. This method was used to derive the NPDs presented in Appendix E of this report.

L_{AE}, L_{ASmx}, L_{EPN}, and L_{PNTSmx} metrics were generated using as-measured spectral and tracking data taken at time of L_{ASmx}. These metrics were derived for the three 4-foot microphones for each aircraft event, representing the left, center, and right noise characteristics of the aircraft.

8.2.1 Volpe Center Data Processing Software

To expedite the processing of large amounts of data using a modified version of the FAR 36 / Annex 16 simplified method, the Volpe Center developed two data processing software programs. The first software, MiniFAR Version 2.0, combines all field data and outputs a text file with calculated test day noise metrics. MiniFAR also contains a quick method for visually screening events for obvious contamination and missing data parameters. The other software, LCorrect Version 2.2, takes test day noise metrics from MiniFAR and adjusts them to INM reference day conditions. LCorrect also generates the distance-based data needed to create NPD curves and helicopter directivity patterns.

8.2.1.1 MiniFAR Version 2.0

MiniFAR requires the following as-measured data input parameters:

- Time-history of sound levels;
- Time-history of aircraft TSPI data;
- Microphone locations (X, Y Z in local coordinates);
- Meteorological data;
- Corrections to be applied to the as-measured data, including microphone frequency response, windscreen insertion loss, and calibration drifts; and
- Observer logs that include event start and stop times, as well as notes on contamination, were converted into comma delimited files (.csv).

MiniFAR uses the above data and outputs a single file containing event-based $L_{AE,}$ L_{ASmx}, L_{EPN}, L_{PNTSmx} data, along with the unweighted, one-third octave spectra at the time of L_{ASmx}. MiniFAR also appends to this file supplemental data that may be easily referenced to at a later time; these include slant dance, wind speed and direction, aircraft speed at time of max, etc. Figure 21 presents an overview of the MiniFAR process.

MiniFAR also allows the user to visually examine events as an initial screening for external contamination. This feature also allows the user to detect any missing input parameters that would affect the computation of the noise metrics. Figure 22 shows a screenshot of MiniFAR's user interface. In addition, MiniFAR generates additional files that are used by another software developed by the Volpe Center, LCorrect.

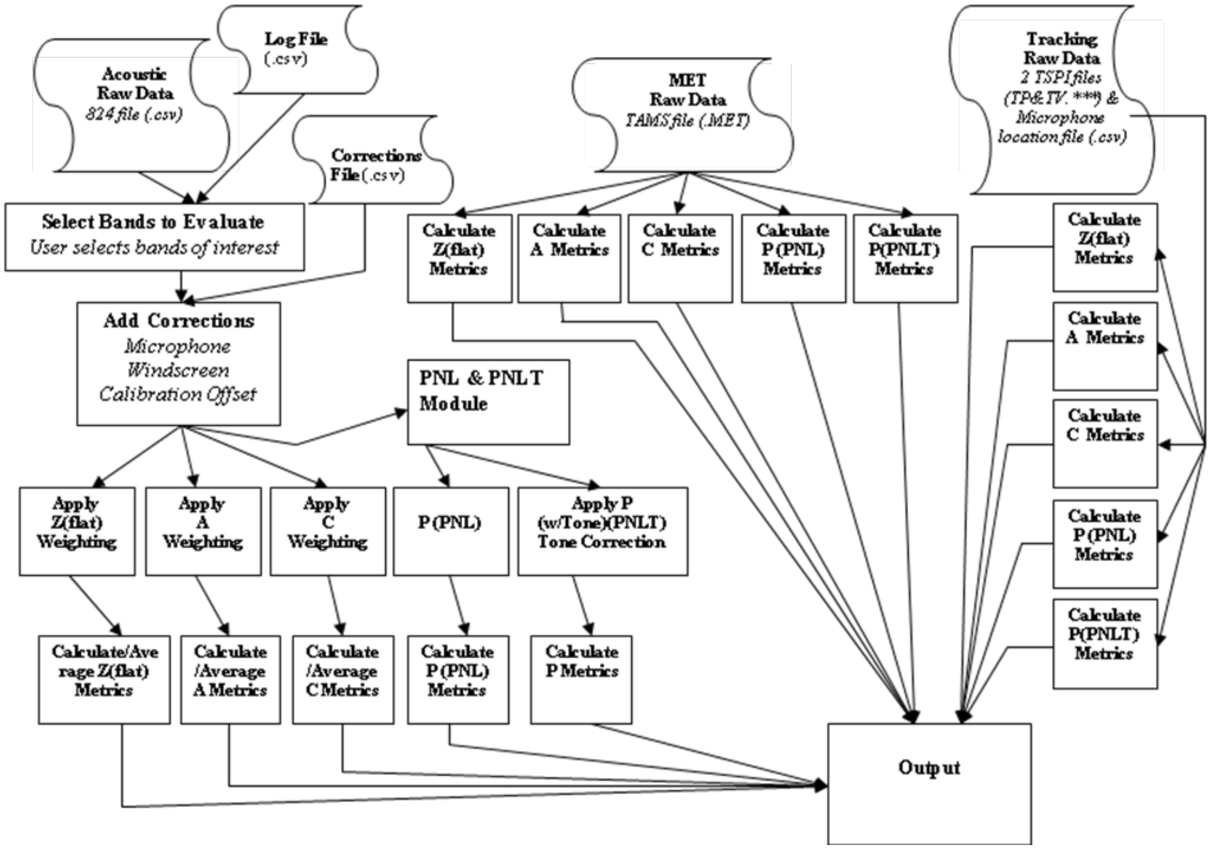

Figure 21. Overview of the MiniFAR Process

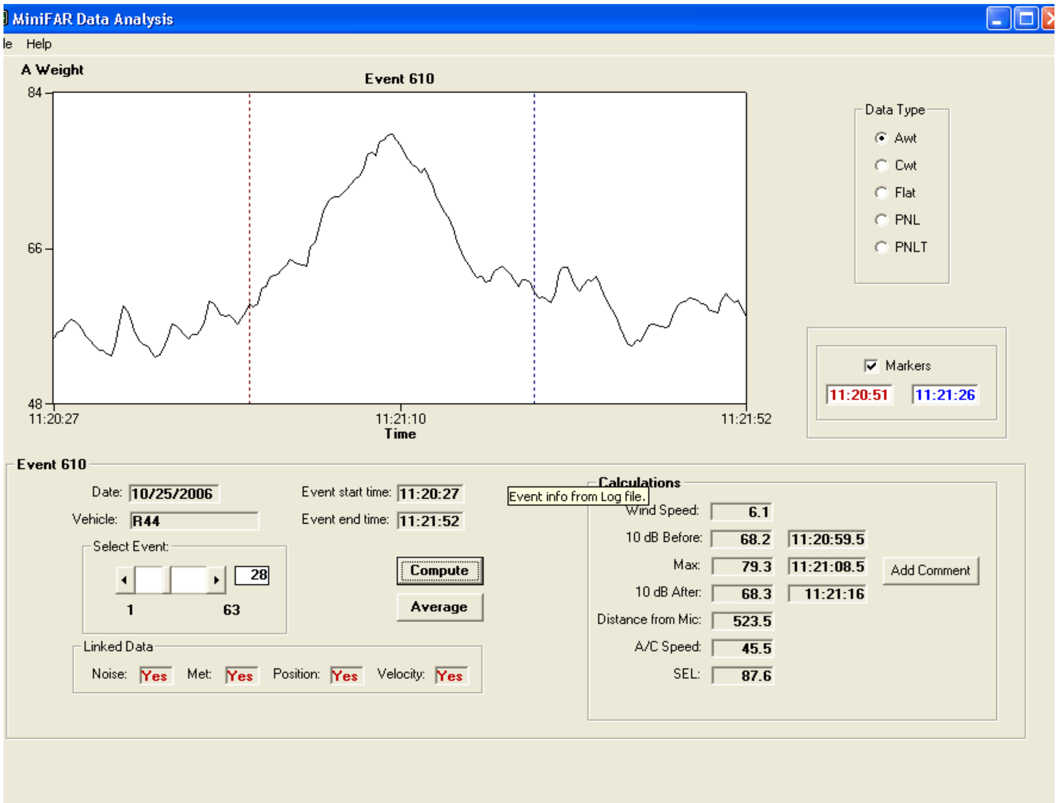

Figure 22. MiniFAR User's Display

MiniFAR averages the absolute- and cross-wind speeds for an event during data processing. These wind speeds were reviewed during processing and any events where the absolute- or cross-wind speeds exceeded the FAR 36 / Annex 16 absolute limit of 10 knots and/or the cross wind speed limit of 5 knots were discarded. Exceptions were made during measurements of the Cessna 208B and Robinson R44 at Fitchburg Municipal Airport due to time constraints and availability of the charter aircraft. Data for these events were especially scrutinized during processing.

8.2.1.2 LCorrect Version 2.2

LCorrect Version 2.2 takes the test day noise metrics, meteorological, aircraft speed, and slant distance results generated by MiniFAR as inputs to calculate noise metrics at the 10 standard INM NPD distances, with reference day atmospheric conditions[*]. LCorrect also takes the unweighted spectrum at time of maximum sound level produced by MiniFAR and adjusts it to the 10 distances. For the purpose of INM database development, the spectrum adjusted to 1,000 feet was used. Figure 23 shows an overview of the LCorrect process.

[*] Noise data outputted from LCorrect are corrected to the SAE-AIR-1845 reference conditions.

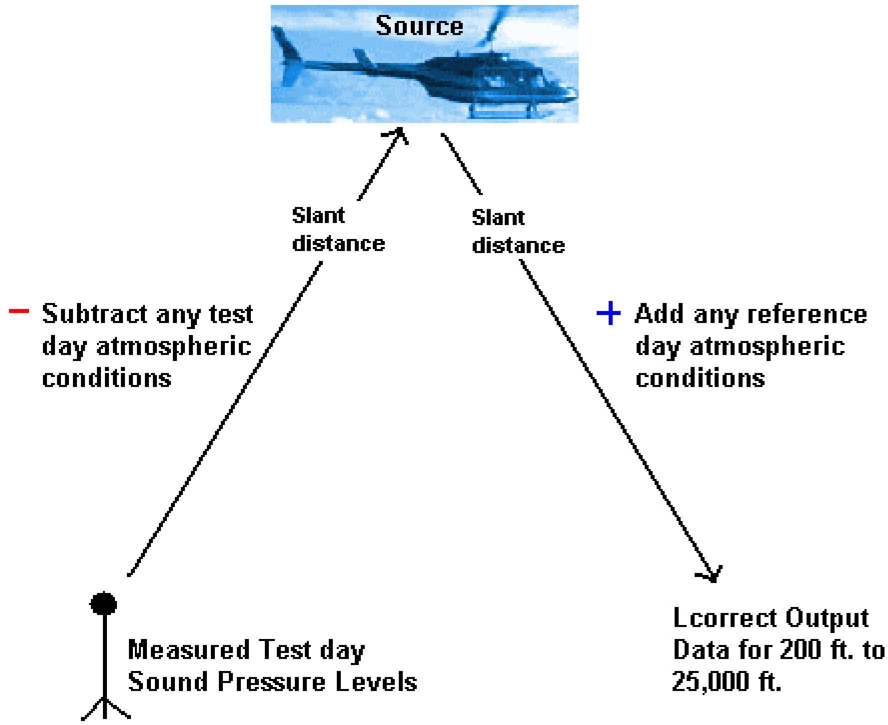

Figure 23. LCorrect Process

Consistent with SAE-AIR-1845 which, along with FAR 36 / Annex 16, is the foundation for processing data for inclusion in the INM/AEDT, NPD curves for exposure-based, fixed-wing aircraft noise metrics were adjusted in LCorrect to a reference speed of 160 knots. LCorrect computes the reference speed adjustment by applying a duration adjustment to the propeller-driven aircraft NPD curves in order to account for the effect of time-varying aircraft speed. This duration adjustment is made using the following equation from Section 3.7 of the INM Technical Manual:

$$DUR_{ADJ} = 10 \log_{10}[160/AS_{seg}] \quad \text{[Eq. 1]}$$

where:

AS_{seg} is the aircraft reference speed at the closest point of approach between the flight segment and the receiver.

The L_{AE} and L_{EPN} values in Appendix E of this report are adjusted to the reference speed using the above methodology. Since the L_{ASmx} and L_{PNTSmx} metrics are assumed to be independent of speed, no duration adjustment is applied to these metrics.

The same methodology was applied to exposure-based helicopter noise with the exception of the reference speed being equal to the arithmetic average of the test day speeds for a test series. Test day and reference speeds for all aircraft are found in the TSPI data tables in Appendix D.

8.3 Noise-Power-Distance Curves

NPD curves for the left side, center, and right side of the aircraft (relative to the direction of flight) for each event were generated with the software and method described in Section 8.2.1. The curves for each event were then grouped by configuration and power settings, and arithmetically averaged together. The resulting NPD curves are presented in Appendix E for the L_{AE}, L_{ASmx}, L_{EPN}, and L_{PNTSmx} metrics.

8.4 Helicopter Static Operation Directivity Patterns

The method for processing static operations is similar to dynamic operations with the exception of the need to process a time-period equivalent continuous A-weighted sound pressure level (TEQ) difference, denoted by the symbol ΔL_{Aeqt} for each measured degree of the helicopters rotation. Instead of generating an L_{AE} as with dynamic events, MiniFAR outputs an arithmetically averaged value over a period of t=30 seconds. LCorrect then corrects these data to the reference slant distance of 200 feet. Graphical representations of the helicopter directivity noise data, as well as data in tabular format, are presented in Appendix E.

8.5 Spectral Classes

Spectral classes are the INM/AEDT database of operation-mode-specific spectral data that represent groups of aircraft. Spectral class assignments, which are determined by the FAA Office of Environment and Energy's (AEE) INM/AEDT development team, are computed in accordance to Appendix D of the INM Technical Manual.

The processed spectral data consist of two sets of unweighted, one-third octave-band sound levels measured at the time of maximum sound level, L_{ASmx} or $L_{PNLTSmx}$, and corrected to a reference distance of 1,000 feet. From these sets of data, a spectral class is assigned for each condition. Since the processed data are representative of a range of thrust parameter values, spectral class assignments are based on the maximum departure and minimum approach thrust values*.

There are three propagation phenomena in INM/AEDT which are spectrally dependant: atmospheric absorption, excess ground attenuation, and shielding caused by barriers or terrain. As a result, spectral class assignments are based on both, the "shape" of the spectral data and the behavior of these three effects. The assignment process consisted of 5 steps:

1. Normalization and computation of free-field effect.
2. Comparison of aircraft spectral shape to spectral class shapes.
3. Comparison of atmospheric absorption effects calculated using aircraft spectra and those of the spectral classes.
4. Comparison of ground effects calculated using aircraft spectra and those of the spectral classes.

* Spectral data representative of other submitted thrust values are examined to verify that no large errors result from this assumption.

5. Comparison of barrier effects calculated using aircraft spectra and those of the spectral classes.

Ideally, the spectral class assignments resulting from steps 2 through 5 were identical and a final assignment was made without further analysis. If they were not consistent, the data were examined and either 1) a spectral class assignment was made based on a "majority rule", or, if no clear majority existed, 2) the possibility of the creation of a new spectral class was considered.

8.6 Blade Tip Mach Corrections for Helicopters

The fundamental SAE-AIR-1845 modeling methodology does not directly account for speed effects on source noise; there are only duration corrections that are applied to exposure-based metrics, such as L_{AE} and L_{EPN}. However, it is recognized that these speed effects do exist, particularly in helicopter measurement programs where speed effects have been quantified[15]. Across test series of level flight conditions, power and aircraft state may be constant with aircraft speed varying about the reference speed. Aircraft noise can be seen to vary with speed and this effect may be captured through a regression of noise on speed. Previous noise model measurement programs[15] have identified the dominant source of this effect as the blade tip Mach number.

The source noise correction accounts for changes in sound level associated with deviations in the in-flight advancing blade tip Mach number (ABTMN). Procedures for calculating ABTMN are described in Appendix H and Chapter 8 in FAR 36 and Annex 16, respectively. Changes in ABTMN can be associated with changes in any single or combination of the following parameters: (1) rotor RPM, (2) airspeed, and (3) ambient temperature; these are all dominant components of the ABTMN. The source noise correction was applied only for level flyovers.

ABTMN was calculated by arithmetically summing the helicopter's rotor rotational Mach number and its translational Mach number from the aircraft's forward airspeed.

ABTMN = Rotational Blade Tip Mach Number (RBTMN) + Translational Mach Number (TMN) [Eq. 2]

where:

$$\text{RBTMN} = \frac{\pi * \text{Blade Diameter (ft)} * \text{Tip Speed (rpm)}}{\text{Speed of Sound, C (ft/m)}}$$

$$\text{TMN} = \frac{V_H \text{ (usually reported in kt)}}{\text{C (kt)}}$$

$$\text{Speed of sound, C (ft/m)} = 3944.88\,(\text{Temp(EC)} + 273.15)^{0.5}$$
$$\text{C (kt)} = 38.96\,(\text{Temp(EC)} + 273.15)^{0.5}$$

The ABTMN was calculated for both test and reference conditions.

The test ABTMN was computed at:

- The ambient air temperature during the test run;
- The actual forward or horizontal air speed; and
- The actual rotor RPM during the test run, noted by the Rover operator (see Section 6.3).

The reference ABTMN was computed at:

- 20°C;
- The helicopters' reference air speed; and
- Reference rotor RPM.

For the implementation of ABTMN in INM/AEDT, the relationship between the $PNLT_{max}$ and delta **[**test ABTMN – INM reference ABTMN] was determined. This relationship takes the form of a second order regression equation. The data required for AEDT were the B1 and B2 coefficients of the 2nd order regression (The B0 coefficient is set to zero). To determine the coefficients of the second order regression, the as-measured $PNLT_{max}$ versus delta ABTMN were plotted and the trend line option was exercised to determine the regression coefficients (B0, the constant, B1, the first-order term, and B2, the second-order term). A separate regression was computed for each microphone position: centerline, left side, and right side.

9 RESULTS

Results from the aircraft source data measurements are presented in the appendices. Specifically:

- Appendix E contains the NPD data for dynamic and static operations, developed as described in Section 8.2 and 8.3, are displayed in tabular and graphical format for each test aircraft. Graphical representations of the helicopter directivity are also presented in this Appendix E.
- Appendix F provides the spectral class assignments, developed as described in Section 8.5, and un-weighted spectral data at time of L_{ASmx} for each aircraft and test series.

This page intentionally left blank.

APPENDIX A: INM DATA

Appendix A presents the aircraft performance data necessary to build the INM database tables for the five fixed wing aircraft, the Cessna 182 Skylane, Cessna 208B Grand Caravan, Dornier 228-202, Dornier 328-100, and Piper PA-42 Cheyenne III. The three helicopters, the Bell 407, Robinson R44 Raven, and Schweizer 300C are modeled with profile points, not procedure steps. Therefore, no performance coefficients are used in the development of helicopter profiles. The profile points data for the three helicopters are contained in their respective INM submittal forms.

The calculation of INM input data, performance and aerodynamic parameters for both departures and approaches are explained in the following sections. The general method is outlined in A.1. Section A.2 presents the data for the Cessna 182 Skylane, a piston engine aircraft which requires a unique set of steps. For the Dornier 328, a complete flight manual was not readily available and its approach profile varies from the standard approach; the calculation of this aircraft's performance data is outlined in Section A.3.

Information on the aircraft was taken from their respective flight manuals[16,17] unless otherwise stated.

A.1 General Calculations for INM Aircraft Data Submittal Forms

A.1.1 Calculation of Performance Parameters

INM performance coefficients are based on the equations found in SAE-AIR-1845[18]. A primary parameter in the calculation of aircraft noise and performance in INM is thrust. The INM uses Equation 3 below to calculate thrust for propeller-driven aircraft from horsepower and flight speed. The equation is equivalent to SAE-AIR-1845 equation A4:

$$F / \delta = K\eta HP / V\delta \qquad \text{[Eq. 3]}$$

where:

F is the net thrust in pounds
δ is the non-dimensional pressure ratio
K is a constant to convert to dimensionally consistent units
η is the non-dimensional propeller efficiency
HP is horsepower
V is true airspeed in knots

Horsepower data for turboprop aircraft were calculated using the following formula:

$$HP = (RPM * \tau) / 5252 \qquad \text{[Eq .4]}$$

where:

RPM is the Revolutions Per Minute of the propeller
τ is the torque in foot-lb
5252 is a constant to convert rotational foot-pounds per minute to Horsepower

True airspeed in knots (KTAS) is derived from the calibrated airspeed in knots (KCAS) and the density ratio σ at study conditions using the following equation:

$$KTAS = KCAS / \sqrt{\sigma} \qquad \text{[Eq. 5]}$$

A.1.2 Aerodynamic Parameters

INM uses the coefficient of drag divided by lift (R) in the calculation of aircraft departure and approach performance. The equation used to derive the value of R for various flight conditions is based on equation A12 in SAE-AIR-1845:

$$R = [(F / \delta) / (W / \delta)] - [\sin(\gamma) / 1.01] \qquad \text{[Eq. 6]}$$

where:

R is the non-dimensional coefficient of drag divided by lift
F is the net thrust in pounds
W is the aircraft weight in pounds
δ is the non-dimensional pressure ratio
γ is the climb angle in degrees
1.01 is a factor used to adjust the climb angle for flight into an assumed headwind

To calculate R for the first segment of the climb, a modified version of the above equation was used. The modified version found on page 42 of the INM Technical Manual accounts for the acceleration during a climb segment. The equation is:

$$S_a = 0.95k(\nu^2_{T2} - \nu^2_{T1}) / (G_m - G) \qquad \text{[Eq. 7]}$$

where:

S_a is the horizontal distance in feet
k is a constant to convert to dimensionally consistent units
ν_{T1} is the initial true airspeed in kts
ν_{T2} is the final true airspeed in kts
G_m is an acceleration factor; $G_m = [N (F / \delta)] / (W / \delta) - R$ (non-dimensional)
N is the number of engines
G is the climb gradient (non-dimensional)

The equation is re-ordered to solve for the R parameter. Take off distance S_a can be found from the flight manuals. R_{zero} and other values of R can be found from enroute climb charts in the flight manuals.

A.1.3 Departure and Approach Parameters

For each of the aircraft, standard departure and approach parameters are derived using their respective flight manuals. Details of the methods for determining INM parameters from information in aircraft flight manuals are given below for the Cessna 182. The other aircraft were found by similar methods. More details on previous aircraft can be found in the 2005 Fitchburg flight test measurement report[19].

A.2 Cessna 182 Skylane

Data in this section were gathered from the Cessna Model 182 and Skylane Owner's Manual, Cessna Model 182P and Skylane Pilot's Operating Handbook and Airplane Flight Manual[20], the Continental Aircraft Engine Series IO-470 Operator's Manual[21], and propeller performance software provided by Hartzell[22].

The purpose of this analysis was to appropriately characterize a Cessna 182 for inclusion in the INM. The genesis of this study was to accurately depict a particular aircraft flying commercial tours. This aircraft was an early-model Cessna 182, with a Continental O-470-L, 6 cylinder, 230 horsepower engine. A Cessna 182 was chartered for a flight test to record the noise characteristics at various flight phases; note however that a different model than that flown in the Grand Canyon aircraft was tested. The C182H, a newer, higher takeoff weight model with a newer model engine was used for the tests. An owner's manual for the C182H was used for pertinent information like field lengths, but since information necessary for calculating the INM coefficients was still lacking, a more detailed Pilot's Operating Handbook (POH) was obtained. This more recent handbook provided all necessary information, but was applicable to the C182P, a still-newer model aircraft. The differences between these three aircraft models are highlighted below in Table 28. Since the differences were not large, it was determined that the analysis should be conducted with information pertinent to the flight test aircraft (C182H) wherever possible, and supplemented by POH information (C182P) where more detailed information was necessary. Terminal area performance was one such area where POH information was necessary for the calculation of INM coefficients. The differences between the three aircraft models, while not great, should still be noted while considering the overall accuracy of the performance and noise characterization of the Cessna 182.

Table 28. C182 Models Used in INM Characterization

Aircraft	Attribute	MTOW	Engine	Hp	Max. RPM
C182	Grand Canyon Aircraft	2550	O-470-L	230	2600
C182H	Fitchburg Flight Test Aircraft	2800	O-470-R	250	2600
C182P	(Pilot's Operating Handbook)	2950	O-470-S	260	2625

Although the maximum takeoff weight for the C182H was 2800 lbs, a 2550 lb weight was used in the flight-test aircraft calculations since that was the actual flying weight of the test aircraft, including passengers and equipment, but neglecting fuel burn. Proprietary propeller information was used to provide thrust data for the C182H. Information provided by Hartzell specific to an F8468, 2-bladed propeller (which was considered appropriate for this aircraft because it is very similar to those used on the 182 models and was used on slightly newer models and many similar aircraft) even though it was not used on any of the three specific aircraft above. A summary of the flight tests conducted, and the associated aircraft performance characteristics, is shown below in Table 29.

Table 29. Fitchburg Flight Test C182H Performance Characteristics

Series	RPM	MP	BHP	KTAS	Thrust	Efficiency
Tour Cruise	2130	19	109.0	114.8	262.1	0.85
Normal Cruise	2300	22	161.4	139.2	321.9	0.85
Departure	2557	25	222.4	85.2	639.7	0.75
Cruise Climb	2400	24	189.8	90.6	533.3	0.78
Approach Flaps 10	2100	14	59.2	90.4	168.9	0.79
Approach Flaps 30	1943	15	66.4	71.1	244.3	0.80

A.2.1 Aerodynamic Coefficients (B, C, D)

A.2.1.1 Departure

Coefficient C

The takeoff speed coefficient was calculated with information from the C182P POH, with takeoff speeds for maximum performance, 20^o flap deflection. The maximum takeoff weight was used in this analysis.

$$C_{F20} = \frac{V_{C\,F20}}{\sqrt{W}} = \frac{56.4\,KCAS}{\sqrt{2950\ lbs}} = 1.038\frac{kts}{lb^{0.5}} \qquad \text{[Eq.8]}$$

Coefficient B

This coefficient was calculated using C182H flight test data for maximum takeoff. Takeoff distance was taken from the C182H owner's manual, and was interpolated to be 720 feet, and then reduced by 10% to 648 feet for SAE-assumed 8-knot headwind as per instructions in the owner's manual. Takeoff thrust, δ, and θ were taken from Fitchburg flight test data.

$$B_{F-20} = \frac{s_g\left(N\, {F_N}/{\delta_{am}}\right)}{\theta_{am}\left({W}/{\delta_{am}}\right)^2} = \frac{(648\,ft)\left({640 lbs}/{0.875}\right)}{0.975\left({2950}/{0.875}\right)^2} = 0.058 \qquad \text{[Eq. 9]}$$

A.2.1.2 Approach

Coefficient D

Approach speeds were taken from C182P POH. Cessna suggested using approach flaps between 0-40^o and speeds between 60-70 KIAS. The POH specifically referenced 60 KIAS approach speed with 40^o flaps at 50 feet, so the 65 KIAS speed was assumed to be associated with 20^o flaps, and the 70 KIAS with 0^o flaps.

$$D_{F-0} = \frac{V_{CA\,F0}}{\sqrt{W}} = \frac{70\,KIAS}{\sqrt{2950}\,lbs} = \frac{72\,KCAS}{\sqrt{2950}\,lbs} = 1.325\frac{kts}{lb^{0.5}} \quad \text{[Eq. 10]}$$

$$D_{F20} = \frac{V_{CA\,F20}}{\sqrt{W}} = \frac{65\,KIAS}{\sqrt{2950}\,lbs} = \frac{67.74\,KCAS}{\sqrt{2950}\,lbs} = 1.247\frac{kts}{lb^{0.5}} \quad \text{[Eq. 11]}$$

$$D_{F40} = \frac{V_{CA\,F40}}{\sqrt{W}} = \frac{60\,KIAS}{\sqrt{2950}\,lbs} = \frac{64\,KCAS}{\sqrt{2950}\,lbs} = 1.178\frac{kts}{lb^{0.5}} \quad \text{[Eq. 12]}$$

A.2.2 Aerodynamic Coefficients (R)

A.2.2.1 Departure

For initial climb, a constant climb angle from liftoff to 50 feet obstacle was assumed, and thrust information from the Fitchburg departure series flight tests was used. The flight test weight was used with the C182H takeoff field length, adjusted for an assumed 8 knot headwind.

$$R_{F-20} = \frac{F_n/\delta_{am}}{W/\delta_{am}} - \frac{\sin\gamma}{1.01} = \frac{640lbs/0.875}{2550/0.875} - \frac{\sin(4.75^o)}{1.01} = 0.170 \quad \text{[Eq. 13]}$$

A.2.2.2 Approach

Two main approach settings were suggested by Cessna, at 10^o and 30^o flaps. A -3^o flight path angle was assumed, and averaged Fitchburg approach thrusts were used in the calculation of the approach R parameter.

$$R_{F-10} = \frac{F_n/\delta_{am}}{W/\delta_{am}} - \frac{\sin\gamma}{0.95} = \frac{169/0.875}{2550/0.875} - \frac{\sin(-3^o)}{0.95} = 0.122 \quad \text{[Eq .14]}$$

$$R_{F-30} = \frac{F_n/\delta_{am}}{W/\delta_{am}} - \frac{\sin\gamma}{0.95} = \frac{244/0.875}{2550/0.875} - \frac{\sin(-3^o)}{0.95} = 0.151 \quad \text{[Eq .15]}$$

As a result of inputting information into INM, it was discovered that including a third approach coefficient, that for higher altitude, zero flap descent, was desired for the initial phases of an approach. Based on information that was already included in the INM, the coefficient for this approach phase should represent higher speed, lower power settings, with the same -3^{o} flight path as approach segments. These settings for the C182 resulted in a low thrust of 180 lbf, which corresponded to an R of 0.127.

A.2.2.3 Normal Cruise

An ideal cruise characterization of the C182 would include cruise at about 9,000 feet MSL, which would represent flight near the Grand Canyon. Estimations for this higher altitude performance may introduce some error, however, since the flight tests at Fitchburg were completed at 850 feet MSL. Because of this concern, two methods were employed for calculating cruise R values, the results of which were compared for similarity.

Method 1: Averaged Manufacturer's Suggested Cruise Settings - This method involved consulting the owner's manual for suggested engine settings at high altitude cruise. Propeller thrusts were then calculated using these engine settings with Hartzell information. Since no suggestions were given for 9,000 feet cruise, results were interpolated between 7,500 and 10,000 feet normal cruise. An example calculation is shown below.

$$R_{Cruise} = \frac{F/\delta}{W/\delta} - \frac{\sin(\gamma)}{0.95} = \frac{(275.1\,lbs)/0.7571}{2800\,lbs/0.7571} - \frac{\sin(0)}{0.95} = 0.0983 \qquad \text{[Eq. 16]}$$

Table 30 shows the calculated R values for all manufacture-suggested cruise settings. The estimated average for 9,000 feet cruise R value was 0.097.

Table 30. C182H normal cruise performance

Altitude	δam ISA	KTAS	% BHP	RPM	MP	Thrust	$R_{Norm. Cruise}$
10000	0.6877	136	63	2450	19	293.6	0.1049
10000	0.6877	132	60	2450	18	287.6	0.1027
10000	0.6877	127	55	2450	17	273.2	0.0976
10000	0.6877	123	51	2450	16	260.3	0.0930
10000	0.6877	132	60	2300	19	288.5	0.1030
10000	0.6877	128	56	2300	18	278.0	0.0993
10000	0.6877	123	51	2300	17	263.9	0.0943
10000	0.6877	116	47	2300	16	255.2	0.0911
10000	0.6877	129	56	2200	19	276.8	0.0989
10000	0.6877	123	52	2200	18	267.8	0.0956
10000	0.6877	118	49	2200	17	263.0	0.0939
10000	0.6877	112	45	2200	16	253.5	0.0905
10000	0.6877	111	44	2000	18	250.0	0.0893
10000	0.6877	104	40	2000	17	241.5	0.0863
10000	0.6877	99	38	2000	16	240.4	0.0859
10000	0.6877	91	35	2000	15	237.8	0.0849
7500	0.7571	140	71	2450	21	320.7	0.1145
7500	0.7571	136	67	2450	20	310.2	0.1108
7500	0.7571	132	62	2450	19	297.6	0.1063
7500	0.7571	128	58	2450	18	285.5	0.1020
7500	0.7571	136	66	2300	21	309.8	0.1106
7500	0.7571	131	62	2300	20	300.2	0.1072
7500	0.7571	128	58	2300	19	287.9	0.1028
7500	0.7571	123	54	2300	18	277.9	0.0993
7500	0.7571	132	62	2200	21	299.1	0.1068
7500	0.7571	129	58	2200	20	287.3	0.1026
7500	0.7571	124	54	2200	19	276.5	0.0988
7500	0.7571	120	51	2200	18	270.3	0.0965
7500	0.7571	114	47	2000	19	261.8	0.0935
7500	0.7571	107	43	2000	18	254.5	0.0909
7500	0.7571	101	39	2000	17	243.7	0.0870
7500	0.7571	93	36	2000	16	241.9	0.0864
Approximate average R for 9,000 feet normal cruise							0.0977

Similar information was calculated for C182P suggested cruise performance, resulting in a very similar R value of 0.095.

Method 2: Averaged Fitchburg flight test data - The manufacturer-suggested information was then compared to the Fitchburg flight test data. Using the same calculation as above, with averaged flight test data, a normal cruise R was found to be **0.127**, significantly higher than manufacturer-suggested information. The averaged engine settings corresponding to the flight test are shown below in Table 31.

Table 31. C182H Normal Cruise Flight Test Performance

Altitude	δam ISA	KTAS	% BHP	RPM	Thrust	$R_{Norm. Cruise}$
850	0.858	138	0.70	2300	321.9	0.127

Because of the concern regarding the low-altitude Fitchburg flight test, and the desire for higher altitude cruise performance to accurately represent the Grand Canyon area, this flight test value for normal cruise was rejected in favor of the result corresponding to manufacturer-suggested information.

A.2.2.4 Tour Cruise

Lacking any information from Cessna regarding suggested settings for lower power tour cruise, the Fitchburg flight test information was used in the calculation of R values for this segment. At an RPM of 2130, with 18.5" of manifold pressure, the C182H produced about 260 lbs of thrust, resulting in a tour cruise R value of 0.103. The associated engine settings are shown below in Table 32.

Table 32. C182H Tour Cruise Flight Test Performance

Altitude	δam ISA	KTAS	% BHP	RPM	MP	Thrust	$R_{Norm. Cruise}$
850	0.850	115	0.47	2130	18.5	262.1	0.103

The final values for the R parameter for cruise, and the associated calculations, are shown below.

$$R_{Cruise-OM} = \frac{F/\delta}{W/\delta} - \frac{\sin(\gamma)}{0.95} = \frac{(273\,lbs)/0.9129}{2800\,lbs/0.9129} - \frac{\sin(0)}{0.95} = 0.097 \qquad \text{[Eq. 17]}$$

$$R_{Cruise-FT} = \frac{F/\delta}{W/\delta} - \frac{\sin(\gamma)}{0.95} = \frac{(260\,lbs)/0.858}{2550\,lbs/0.858} - \frac{\sin(0)}{0.95} = 0.103 \qquad \text{[Eq. 18]}$$

A summary of all INM parameters associated with the C182 are shown below in Table 33.

Table 33. Summary of C182 INM Parameters

Parameter	Value	Units
MTOGW	2800	lbs
MLW	2800	lbs
C F-20	1.204	kt/(lb^1/2)
D F-0	1.326	kt/(lb^1/2)
D F-20	1.247	kt/(lb^1/2)
D F-40	1.285	kt/(lb^1/2)
B F-20	0.058	ft/lb
R Takeoff, F-20	0.170	-
R Approach, F-10	0.122	-
R Approach, F-30	0.151	-
R Tour Cruise - Flight Test	0.103	-
R Normal Cruise - Manual	0.097	-

A.3 Dornier 328-100

Data for this section were gathered from the World Encyclopedia of Aero Engines[23], the Dornier 328 Airplane Flight Manual[24], the aircraft's Type Certificate Data Sheet (TCDS), and Hartzell.

The purpose of this analysis was to determine appropriate coefficients for the Dornier 328 for inclusion in INM. Normally, aerodynamic coefficients required by INM are determined with the help of an aircraft owner's manual or similar reference, but the manual for the Dornier 328 was not useful for this purpose, because it mainly contained information for one-engine inoperative performance, rather than normal two-engine operations. Thus, in order to calculate aerodynamic coefficients, it was necessary to use detailed flight test information to determine climb rates, flight path angles, and other similar information. This was accomplished by utilizing the data gathered from the TSPI system (see Section 4.2.1), which recorded 4-dimesional X, Y, Z and time) data, as well as aircraft velocity during the flight tests. The flight test aircraft was flown with a payload less than the maximum allowable takeoff weight, and included 3 people weighing approximately 200 lbs each, 100 lbs additional payload, and full fuel tanks. The actual takeoff weight was calculated using the "Typical" operating empty weight which, as quoted in the Dornier 328 fact sheet, includes 3 crew members weighing 225 lbs each, and an additional 7557 lbs representing the maximum fuel load as quoted by Dornier 328 Support Services. When possible, the reduced takeoff weight value of 27720 lbs was used in conjunction with the associated flight test information. A summary of the performance of the test flights accomplished in Needles, CA, is shown below in Table 34.

Table 34. Summary of Fitchburg II Flight Test Information with Hartzell Thrust

	Altitude (MSL)	KTAS	BHP	RPM	Propeller Thrust	Prop η
Normal Cruise	1340.8	252	1421.4	1071	1534.7	0.84
Departure	1355.7	131	2012.4	1315	3972.2	0.79
Cruise Climb	1399.6	172	1925.4	1285	3091.2	0.85
Approach, Flaps 12	1382.1	193	387.8	1081	0	N/A
Approach, Flaps 32	1302.0	133	389.5	1071	439.8	0.46

The propeller thrust and efficiency data were obtained from proprietary Hartzell propeller information. These data were used to calculate thrust and efficiency as a function of flight speed, altitude, engine horsepower, and RPM. The Hartzell information utilized data representing an HD-E6C-3A/B propeller hub with six E13482/13890 blades, the same as listed on the aircraft's Type Certification Data Sheet (TCDS). The approach for flaps-12 does not have an associated thrust value because the flight settings appropriate for that condition for the flight test fall outside the flight envelope of the provided Hartzell propeller information. The flight envelope surrounding the desired flight condition was investigated to see if extrapolation to this condition was possible, but points representing similar flight speeds and horsepower at constant RPM were all outside of the Hartzell flight envelope. It was found that reducing the RPM to 1028, compared to the average RPM of 1081 for this flight condition, yielded feasible points. In order to calculate INM R values, the 104 lbs of thrust at this lower RPM was then substituted into the flaps-12 approach as a non-zero estimate for low-speed thrust, despite the very low 15% propeller efficiency.

Since the PW119B used on the Dornier 328 is a turboprop, there is jet thrust produced in addition to the propeller thrust, although it is not a large percentage of that of the total engine. Values for jet thrust were initially obtained from the FAA TCDS for the PW119B, which lists this thrust for maximum takeoff, normal takeoff, and maximum continuous operation. In an effort to provide a rough approximation for jet thrust at other points in the flight envelope, the TCDS information for maximum takeoff and maximum continuous conditions, in conjunction with equivalent flight test information, was used in the general, simplest form of the thrust equation, shown below.

$$F_n = \dot{m}(U_e - U_i) \qquad \text{[Eq. 19]}$$

With the thrust F (TCDS) and flight speed U_i (flight test) known, a mass flow was estimated that would satisfy the maximum engine conditions with a constant exit velocity, for the departure, climb, and cruise segments. A constant mass flow of 13.5 lbm/s was found to be reasonable for all these conditions, which yielded an exit velocity of 815 ft/s. This core mass flow was found to be comparable to the 14.3 lbm/s published mass flow for a PW115, a slightly reduced horsepower turboprop in the same family as the PW119B (Gunston, Aero Engines). Because of the uncertainty associated with the much lower power approach segments, and because it was expected that this engine should not produce much thrust during approach, it was assumed that the jet thrust produced during these segments was negligible. A summary of the jet thrust and total thrust for the relevant flight segments is shown below in Table 35.

Table 35. Summary of Propeller and Jet Thrusts

	Flight Speed (KTAS)	Propeller Thrust per Engine	Exhaust Thrust per Engine	Total Thrust	δ am	Total Net Corrected Thrust
Normal Cruise	251.7	1535	165	1700	0.983	1728
Departure	131.0	3972	250	4222	0.982	4300
Cruise Climb	172.0	3091	222	3314	0.971	3412
Approach, Flaps 12	193.3	104	0	104	0.959	108
Approach, Flaps 32	132.9	440	0	440	0.946	465

The thrust for the Dornier 328 was characterized using the INM jet thrust coefficients, since it is a turboprop aircraft. The E,F,G, and H coefficients were determined using points on a standard INM departure and climb profile, and using Hartzell-provided thrust at each point. Table 36 shows a summary of the jet thrust coefficients. These coefficients were seen to produce reasonable departure and climb profiles up to 16,000 feet MSL.

Table 36. Summary of Jet Thrust Coefficients

	E	F	Ga	Gb	H
Departure	8138.2	-28.1	0.199	-2.10E-05	0
Climb	7752.5	-23.2	0.225	-1.58E-05	0

A.3.1 Aerodynamic Coefficients (B, C, D)

A.3.1.1 Departures

Coefficient C

The liftoff speed was found in the Dornier 328 Airplane Flight Manual (AFM), for maximum performance takeoff only, which corresponded to 12^{o} flaps. The maximum takeoff weight was used for this case.

$$C_{F12} = \frac{V_{C\ F12}}{\sqrt{W}} = \frac{117\ KCAS}{\sqrt{30843\ lbs}} = 0.664 \frac{kts}{lb^{0.5}} \qquad \text{[Eq. 20]}$$

Coefficient B

The takeoff field length for this parameter was taken from the Dornier 328 AFM. Since the parameter B requires ground roll information, but the AFM gives only ‘takeoff run’ and ‘takeoff distance’ (see Figure 24), some estimation had to done to determine the ground roll for this aircraft. A simple linear extrapolation was performed with the given data, assuming a linear flight path from the ground to the midway point to the 35 feet obstacle. With this assumption, a takeoff ground roll of 1476 feet was found. This analysis was completed for the flight test aircraft, which had a slightly reduced takeoff weight due to a small payload.

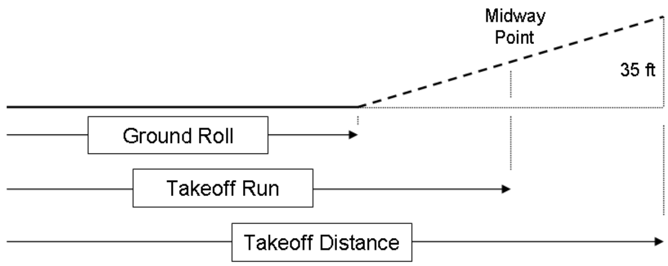

Figure 24. Dornier Takeoff Performance Data

The thrust associated with takeoff was found using the Needles flight test data. The reduced takeoff weight, appropriate for the flight test aircraft, was used as well, as was the atmospheric conditions for the test.

$$B_{F-20} = \frac{s_g \left(N \, {F_N}/{\delta_{am}} \right)}{\theta_{am} \left({W}/{\delta_{am}} \right)^2} = \frac{(1476\,ft)\left(2x4220lbs/0.982 \right)}{0.996 \left(27720/0.982 \right)^2} = 0.0159\ ft/lb \quad \text{[Eq. 21]}$$

A.3.1.2 Approach

Coefficient D

The approach speed coefficient was found using suggested approach speeds in the Dornier 328 AFM. Two speeds were given, for 20^o and 32^o flap deflection, but since only the 32^o deflection was flight tested, only this parameter was calculated. The maximum landing weight was used in these calculations.

$$D_{F-32} = \frac{V_{CA\,F32}}{\sqrt{W}} = \frac{109\,KCAS}{\sqrt{29167\ lbs}} = 0.638 \frac{kts}{lb^{0.5}} \quad \text{[Eq. 22]}$$

A.3.2 Aerodynamic Coefficients (R)

A.3.2.1 Departure

For normal calculation of the R parameter, a flight path angle is required for any flight segment in order to balance aerodynamic forces in that segment. This angle is usually derived from manufacturer information, from what is included in pilot or operator's handbooks, including departure, climb, cruise, and approach information. Since the Dornier 328 manual only included single-engine performance, which is important information but has no bearing on the INM application, specific flight path data had to be derived from the TSPI data.

Departure and cruise climb flight tests were not accomplished at a constant flight speed. Rather, the pilot chose a rather steep climb angle in both cases, which led to a non-negligible bleeding of airspeed as the climb continued. The loss in airspeed was sometimes as great as 10 knots in 400 feet of altitude gained, in the span of 6 seconds. This lack of steady-state maneuvers meant the usual SAE equations could not be used, and required the introduction of the SAE acceleration segment to accurately account for the change in speed over a given distance. The equation for this type of segment is shown below.

$$R_{acc} = \frac{N \cdot F_n / \delta_{am}}{W / \delta_{am}} - \left(\frac{V_{tz}}{V_{tavg}} \right) - \frac{0.95\left(V_{tb}^2 - V_{ta}^2\right)}{2g \cdot S_A} \quad \text{[Eq. 23]}$$

The second term on the right hand side represents the climb rate of the aircraft. Its parameters are represented in Figure 25 below.

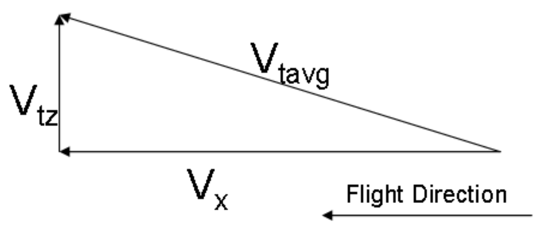

Figure 25. Representation of SAE Equation A10 terms

The parameter S_A is the distance along the ground track the aircraft travels during the acceleration, and the terms V_{ta} and V_{tb} indicate the initial and final velocities, respectively. This data was deduced from the TSPI records. The thrust and weight were taken from the flight test information. A summary of the departure and cruise climb coefficients is shown in Table 37 below.

Table 37. Summary of Departure and Cruise Climb R Calculations

		Velocity		Distance	Altitude	R
		Start	End	total Δ	total Δ	
Series	**Test**	**ft/s**	**ft/s**	**ft**	**ft**	**-**
Departure	310	228.18	218.76	3836.93	937.23	0.0836
Departure	320	230.39	217.39	1377.19	428.99	0.0697
Departure	330	221.61	214.83	3003.53	822.86	0.0550
Departure	340	220.78	201.69	1481.42	500.67	0.0649
Departure	350	225.38	207.55	1092.91	408.12	0.0591
					Average	**0.0664**
Cruise Climb	410	279.99	270.39	2337.39	430.83	0.0910
Cruise Climb	420	288.76	273.99	1774.14	382.95	0.0971
Cruise Climb	430	297.95	288.06	2437.52	440.43	0.0962
Cruise Climb	440	284.06	277.31	2337.39	430.83	0.0816
					Average	**0.0915**

$R_{Depature} = 0.0664$
$R_{CruiseClimb} = 0.915$

A.3.2.2 Cruise

The calculation of the R value for cruise was more straightforward since the cruise segments were at steady-state conditions and a flight path angle of 0°. The thrust and weight information were taken directly from the flight test records to deduce the R_{Cruise} value.

$$R_{Cruise} = \frac{F_n / \delta_{am}}{W / \delta_{am}} - \frac{\sin\gamma}{0.95} = \frac{1700\ lbs}{27720\ lbs} - \frac{\sin(0)}{0.95} = 0.1206 \qquad \text{[Eq. 24]}$$

A.3.2.3 Approach

For approach, R parameters were calculated for approach with 32° flaps, as suggested in the Dornier 328 flight manual. Although the manual suggests an alternative 20° flap approach, this condition was not flight tested, so appropriate coefficients could not be calculated. The flight path angle was derived from TSPI data, as an average, constant descent angle for the higher-flap angle flights.

$$R_{F-32} = \frac{F_n / \delta_{am}}{W / \delta_{am}} - \frac{\sin\gamma}{0.95} = \frac{664\ lbs}{27720\ lbs} - \frac{\sin(-2.77^{o})}{0.95} = 0.0961 \qquad \text{[Eq. 25]}$$

A summary of all relevant data and coefficients for the Dornier 328 is provided in Table 38 below.

Table 38. Summary of Relevant Dornier 328 Aerodynamic Coefficients

Parameter	Value	Units	(L/D)
MTOGW	30843	lbs	
Flight Test TOGW	27719	lbs	
R initial climb	0.0664	-	15.1
R climb, flaps 0 (cruise climb)	0.0916	-	10.9
R normal cruise	0.1206	-	8.3
R approach, flaps 32	0.0825	-	12.1
Coefficient C Max Takeoff	0.666	kt/(lb^1/2)	
Coefficient B Max Takeoff	0.016	ft/lb	
Coefficient D Approach flaps 32	0.638	kt/(lb^1/2)	

A.4 INM Submittal Forms

This section contains information for the INM submittal forms except the noise data which can be found in Appendix E. These values were calculated using the guidance found in the INM Technical Manual[4].

A.4.1 Fixed Wing Aircraft

This section contains the information for the five fixed wing aircraft. Table 39 details the steps for determining takeoff weight and Table 40 details the steps for departure procedures for all fixed wing aircraft.

Table 39. Guidance for Determining Departure Takeoff Weight

Parameter	Planning Rule
Representative Trip Length	Min Range + 0.70*(Max Range-Min Range)
Load Factor	65% Total Payload
Fuel Load	Fuel Required for Representative Trip Length + ATA Domestic up to 3000 nm and International Reserves for trip length >
Cargo	No additional cargo over and above the assumed payload percentage

Table 40. Departure Procedures

Standard Procedure Modified BBN/AAAI Procedure	ICAO A	ICAO B
Takeoff at MaxToPower and Climb to 1000 ft altitude	Takeoff MaxToPower	Take off at MaxToPower
Pitch over and cut back to climb power. Accelerate to zero flaps retracting flaps on schedule †	Climb at constant KCAS to 1500 feet	Climb to 1000 feet and pitch-over to accelerate at full power to clean configuration
Climb at constant speed to 3000 feet altitude	Reduce thrust to Climb Power	At Clean Configuration, cutback top climb power
	Climb at KCAS to 3000 feet	Climb at constant speed to 3000 feet
Upon achieving 3000 feet altitude, accelerate to 250 knots	Accelerate while retracting flaps to Zero.	Upon achieving 3000 feet AFE, accelerate to 250 knots
	Continue accelerating to 250 knots.	
Upon achieving 250 knots, climb out to 10000 feet	Upon achieving 250 knots, climb to 10000 feet	Upon achieving 250 knots, climb to 10000 feet

A.4.1.1 Cessna 182 Skylane

Table 41. Cessna 182 Skylane Reference Conditions for Performance Data

Wind	4 m/s (8 knots) headwind, constant with height above ground
Runway elevation	Mean Sea Level (MSL)
Runway gradient	None
Surface air temperature	15°C (59°F)
Number of engines supplying thrust	All
Atmosphere	International Standard Atmosphere (ISA)

Table 42. Cessna 182 Skylane Engine Data

Aircraft model	Cessna 182
Engine model	Continental O-470-L
Number of engines	1
Engine type (jet, turboprop, piston)	Piston
Engine Installation (tail-or wing-mounted	N/A
Noise stage number (2,3,4)	none
Sea Level rated HP (per engine)	230
Static Thrust (lb)	965
Automated thrust restoration (yes, no)	no
Weight class (small, large, heavy)	Small
Maximum gross takeoff weight (lb)	2800
Maximum gross landing weight (lb)	2800
Maximum landing distance (ft)	1544

Table 43. Cessna 182 Skylane Departure Takeoff Weights

Stage number	Trip length (nmi)	Representative Range	Weight (lb)
1	0-500	350	2800

Table 44. Cessna 182 Skylane Aerodynamic Coefficients

Flap Configuration ID	Operation (A,D)1	Gear	Takeoff B (ft/lb)	Take off C (kt/√lb)	Land D (kt/√lb)	Drag/Lift R
F-20D	Departure	down	0.058	1.204		0.17
Zero	Departure	down	ND*	ND		0.127
Zero-Cruise	Departure					0.097
Zero-Tour	Departure					0.103
Zero-A	Approach	up				0.127
F10APP	Approach	up				0.122
F30APP	Approach				1.285	0.151

Table 45. Cessna 182 Skylane Engine Coefficients Part 2

Thrust Type	Propeller Efficiency	Installed net propulsive horsepower (hp)
Max-Takeoff	0.75	222.4
Max-Climb	0.78	189.8

* ND is an abbreviation for "No Data".

Table 46. Cessna 182 Skylane Departure Procedures

Step Number	Segment Type	Flap Configuration ID	Thrust Type (T/C)	Rate-of-Climb (ft/min)	Endpoint Speed (KCAS)	Endpoint Altitude (ft AFE)
1	Takeoff	F-20D	MaxTO			
2	Accelerate	F-20D	MaxTO	500	80	
3	Climb	ZERO	MaxTO			1000
4	Accelerate	ZERO	MaxTO	500	85	
5	Climb	ZERO	MaxClimb			3000
6	Climb	ZERO	MaxClimb			5000
7	Climb	ZERO	MaxClimb			8000
8	Climb	ZERO	MaxClimb			10000

Table 47. Cessna 182 Skylane Approach Procedures Part 1

Landing weight (lb)	2800
Stopping distance * (ft)	590

* FAR Part 25 field length required for maximum gross landing weight.

Table 48. Cessna 182 Skylane Approach Procedures Part 2

Step #	Step Type	Flap ID	Thrust Type	Starting Altitude (ft AFE)	Start Speed (KTAS)*	Decent Angle (deg)	Touchdown Roll (ft)	Track Distance (Horiz. Length) (ft)	Start Thrust (%static thrust)
1	Descend	ZERO-A		6000	110	3			
2	Descend	ZERO-A		4000	90	3			
3	Descend	ZERO-A		2000	70	3			
4	Descend	F10APP		1000	70	3			
5	Descend	F30APP		500	65	3			
6	Land	F30APP	Normal Thrust				30		
7	Decelerate				65			560	10

A.4.1.2 Cessna 208B Grand Caravan

Table 49. Cessna 208B Reference Conditions for Performance Data

Wind	4 m/s (8 knots) headwind, constant with height above ground
Runway elevation	Mean Sea Level (MSL)
Runway gradient	None
Surface air temperature	15°C (59°F)
Number of engines supplying thrust	All
Atmosphere	International Standard Atmosphere (ISA)

* Landing speed is for reference only; INM calculates landing speed using the D coefficient (Section A.3) and landing weight.

Table 50. Cessna 208B Engine Data

Aircraft model	Cessna 208B
Engine model	PT6A-114A
Number of engines	1
Engine type (jet, turboprop, piston)	Turboprop
Engine Installation (tail-or wing-mounted	N/A
Noise stage number (2,3,4)	None
Sea Level rated HP (per engine)	675
Static Thrust (lb)	2300
Automated thrust restoration (yes, no)	No
Weight class (small, large, heavy)	Small
Maximum gross takeoff weight (lb)	8750
Maximum gross landing wight (lb)	8500
Maximum landing distance (ft)	1740

Table 51. Cessna 208B Departure Takeoff Weights

Stage number	Trip length (nmi)	Representative Range	Weight (lb)
1	0-500	350	8750

Table 52. Cessna 208B Aerodynamic Coefficients

Flap Configuration ID	Operation (A,D)1	Gear	Takeoff B (ft/lb)	Take off C (kt/√lb)	Land D (kt/√lb)	Drag/Lift R
F-20D	Departure	down	0.033202	0.74833		0.105087
Zero	Departure	down	0.05003	0.887307		0.089802
Zero-Cruise	Departure	up				0.087252
Zero-Tour	Departure	up				0.060282
Zero-A	Approach	up				0.089802
F30APP	Approach	down			0.867722	0.099468

Table 53. Cessna 208B Engine Coefficients

Thrust Type	E (lb)	F (lb/kt)	Ga (lb/ft)	Gb (lb/ft^2)	H (lb/°C)
Max-Takeoff	3245.2	-11.69	-1.053E-02	-6.777E-07	-1.62
Max-Climb	2953.9	-8.581	-4.526E-03	-7.2035E-07	-1.44

Table 54. Cessna 208B Default Departure Procedures

Step Number	Segment Type	Flap Configuration ID	Thrust Type †(T/C)	Rate-of-Climb (ft/min)	Endpoint Speed (KCAS)	Endpoint Altitude (ft AFE)
1	Takeoff	F-20D	MaxTO			
2	Accelerate	F-20D	MaxTO	915	104	
3	Climb	ZERO	MaxTO			1000
4	Accelerate	ZERO	MaxClimb	846	115	
5	Climb	ZERO	MaxClimb			2000
6	Climb	ZERO	MaxClimb			4000
7	Climb	ZERO	MaxClimb			6000
8	Climb	ZERO	MaxClimb			8000
9	Climb	ZERO	MaxClimb			10000

Table 55. Cessna 208B Approach Procedures Part 1

Landing weight (lb)	8500
Stopping distance * (ft)	915

*FAR Part 25 field length required for maximum gross landing weight.

Table 56. Cessna 208B Approach Procedures Part 2

Step #	Step Type	Flap ID	Thrust Type	Starting Altitude (ft AFE)	Start Speed (KTAS)*	Decent Angle (deg)	Touchdown Roll (ft)	Track Distance (Horiz. Length) (ft)	Start Thrust (%static thrust)
1	Descend	ZERO-A		6000	140	3			
2	Descend	ZERO-A		4000	124	3			
3	Descend	ZERO-A		2000	108	3			
4	Descend	F30APP		1000	100	3			
5	Descend	F30APP		500	80	3			
6	Land	F30APP	Normal Thrust				100		
7	Decelerate				78			815	10

* Landing speed is for reference only; INM calculates landing speed using the D coefficient (Section A.3) and landing weight.

A.4.1.3 Dornier 228

Table 57. Dornier 228 Reference Conditions for Performance Data

Wind	4 m/s (8 knots) headwind, constant with height above ground
Runway elevation	Mean Sea Level (MSL)
Runway gradient	None
Surface air temperature	15°C (59°F)
Number of engines supplying thrust	All
Atmosphere	International Standard Atmoshpere (ISA)

Table 58. Dornier 228 Engine Data

Aircraft model	Dornier 228-202
Engine model	AiResearch TPE 331-10P-511D
Number of engines	2
Engine type (jet, turboprop, piston)	Turboprop
Engine Installation (tail-or wing-mounted	Wing
Noise stage number (2,3,4)	None
Sea Level rated HP (per engine)	715
Static Thrust (lb)	2240
Automated thrust restoration (yes, no)	No
Weight class (small, large, heavy)	Large
Maximum gross takeoff weight (lb)	13669
Maximum gross landing wight (lb)	13448
Maximum landing distance (ft)	2375

Table 59. Dornier 228 Departure Takeoff Weights

Stage number	Trip length (nmi)	Representative Range	Weight (lb)
1	0-500	350	13669

Table 60. Dornier 228 Aerodynamic Coefficients

Flap Configuration ID	Operation (A,D)1	Gear	Takeoff B (ft/lb)	Take off C (kt/√lb)	Land D (kt/√lb)	Drag/Lift R
Flaps 1	Departure	down	0.02196	0.80401		0.09042
Zero	Departure	down	0.02745	0.86388		0.10717
Zero-Cruise	Departure	up				0.14459
Zero-Tour	Departure	up				0.09218
Zero-A	Approach	up				0.10717
F30APP	Approach	down			0.75885	0.11911

Table 61. Dornier 228 Engine Coefficients

Thrust Type	E (lb)	F (lb/kt)	Ga (lb/ft)	Gb (lb/ft^2)	H (lb/°C)
Max-Takeoff	2524.3	-8.067	6.042E-02	-6.8678E-06	0
Max-Climb	2571.0	-7.9721	7.004E-02	-4.9292E-06	0

Table 62. Dornier 228 Default Departure Procedures

Step Number	Segment Type	Flap Configuration ID	Thrust Type (T/C)	Rate-of-Climb (ft/min)	KIAS	Endpoint Altitude (ft AFE)
1	Takeoff	Flaps1	MaxTO			0
2	Accelerate	Flaps1	MaxTO	1000	101	
3	Climb	ZERO	MaxTO			1000
4	Accelerate	ZERO	MaxClimb	1000	122	
5	Climb	ZERO	MaxClimb			2000
6	Climb	ZERO	MaxClimb			4000
7	Climb	ZERO	MaxClimb			6000
8	Climb	ZERO	MaxClimb			8000
9	Climb	ZERO	MaxClimb			10000

Table 63. Dornier 228 Approach Procedures Part 1

Landing weight (lb)	13448
Stopping distance * (ft)	1421

*FAR Part 25 field length required for maximum gross landing weight.

Table 64. Dornier 228 Approach Procedures Part 2

Step #	Step Type	Flap ID	Starting Altitude (ft AFE)	KIAS	Decent Angle (deg)	ROD/feet	Power
1	Descend	ZERO-A	6000	200	3		65%
2	Descend	ZERO-A	4000	160	3		65%
3	Descend	ZERO-A	2000	120	3		65%
4	Descend	F30APP	1000	100	3		15%
5	Descend	F30APP	50	88	3		15%
6	Land	F30APP				100	
7	Decelerate			80		1320.9	10%

A.4.1.4 Dornier 328

Table 65. Dornier 328 Reference Conditions for Performance Data

Wind	4 m/s (8 knots) headwind, constant with height above ground
Runway elevation	Mean Sea Level (MSL)
Runway gradient	None
Surface air temperature	15°C (59°F)
Number of engines supplying thrust	All
Atmosphere	International Standard Atmoshpere (ISA)

Table 66. Dornier 328 Engine Data

Aircraft model	Dornier 328-100		
Engine model	PW119B		
Number of engines	2		
Engine type (jet, turboprop, piston)	Turboprop		
Engine Installation (tail-or wing-mounted	Wing		
Noise stage number (2,3,4)	3		
Sea Level rater HP (per engine)	2180		
Static Thrust (lb)	6745		
Automated thrust restoration (yes, no)	No		
Weight class (small, large, heavy)	Large		
Maximum gross takeoff weight (lb)	30843		
Maximum gross landing wight (lb)	29167		
Maximum landing distance (ft)	3825		
Reference Certification Levels	TO:	SL:	AP:

Table 67. Dornier 328 Departure Takeoff Weights

Stage number	Trip length (nmi)	Representative Range	Weight (lb)
1	0-500	350	30843

Table 68. Dornier 328 Aerodynamic Coefficients

Flap Configuration ID	Operation (A,D)1	Gear	Takeoff B (ft/lb)	Take off C (kt/√lb)	Land D (kt/√lb)	Drag/Lift R
F12-D	Departure	down	0.016	0.666		0.0664
Zero	Departure	up				0.0916
Zero-Cruise	Departure	up				0.1206
Zero-A	Approach	up				0.0916
F32APP	Approach	down			0.638	0.0961

Table 69. Dornier 328 Engine Coefficients

Thrust Type	E (lb)	F (lb/kt)	Ga (lb/ft)	Gb (lb/ft^2)	H (lb/°C)
Max-Takeoff	8138.2	-28.1	0.199	-2.10E-05	0
Hi-Temp Max-Takeoff	ND	ND	ND	ND	ND
Max-Climb	7752.5	-23.2	0.225	-1.58E-05	0

Table 70. Dornier 328 Default Departure Procedures

Step Number	Segment Type	Flap Configuration ID	Thrust Type (T/C)	Rate-of-Climb (ft/min)	Endpoint Speed (KCAS)	Endpoint Altitude (ft AFE)
1	Takeoff	F12-D	MaxTO			
2	Accelerate	F12-D	MaxTO	1000	120	
3	Climb	ZERO	MaxTO			1000
4	Accelerate	ZERO	MaxTO	1000	130	
5	Climb	ZERO	MaxClimb			2000
6	Climb	ZERO	MaxClimb			4000
7	Climb	ZERO	MaxClimb			6000
8	Climb	ZERO	MaxClimb			8000
9	Climb	ZERO	MaxClimb			10000

Table 71. Dornier 328 Approach Procedures Part 1

Landing weight (lb)	29167
Stopping distance * (ft)	2871

*FAR Part 25 field length required for maximum gross landing weight.

Table 72. Dornier 328 Approach Procedures Part 2

Step #	Step Type	Flap ID	Thrust Type	Starting Altitude (ft AFE)	Start Speed (KTAS)	Decent Angle (deg)	Touchdown Roll (ft)	Track Distance (Horiz. Length) (ft)	Start Thrust (%static thrust)
1	Descend	ZERO-A		6000	200	3			
2	Descend	ZERO-A		4000	175	3			
3	Descend	ZERO-A		2000	150	3			
4	Descend	F32APP		1000	109	3			
5	Descend	F32APP		500	109	3			
6	Land	F32APP	Normal Thrust				50		
7	Decelerate				109			2216	10

A.4.1.5 Piper PA-42 Cheyenne III

Table 73. Piper PA-42 Reference Conditions for Performance Data

Wind	4 m/s (8 knots) headwind, constant with height above ground
Runway elevation	Mean Sea Level (MSL)
Runway gradient	None
Surface air temperature	15°C (59°F)
Number of engines supplying thrust	All
Atmosphere	International Standard Atmoshpere (ISA)

Table 74. Piper PA-42 Engine Data

Aircraft model	Piper PA-42 Cheyenne		
Engine model	PT6A-41		
Number of engines	2		
Engine type (jet, turboprop, piston)	Turboprop		
Engine Installation (tail-or wing-mounted	Wing		
Noise stage number (2,3,4)	None		
Sea Level rated HP (per engine)	720		
Static Thrust (lb)	1800		
Automated thrust restoration (yes, no)	No		
Weight class (small, large, heavy)	Small		
Maximum gross takeoff weight (lb)	11200		
Maximum gross landing wight (lb)	10330		
Maximum landing distance (ft)	3300		
Reference Certification Levels	TO:	SL:	AP:

Table 75. Piper PA-42 Departure Takeoff Weights

Stage number	Trip length (nmi)	Representative Range	Weight (lb)
1	0-500	350	11200

Table 76. Piper PA-42 Aerodynamic Coefficients

Flap Configuration ID	Operation (A,D)1	Gear	Takeoff B (ft/lb)	Take off C (kt/√lb)	Land D (kt/√lb)	Drag/Lift R
Zero-dn	Departure	down	0.06796	1.011055		0.08088
Zero	Departure	up				0.087856
Zero-cruise	Departure	up				0.139096
Zero-tour	Departure	up				0.07651
Zero-A	Approach	up				0.087856
30-dn	Approach	down			1.09213	0.14679

Table 77. Piper PA-42 Engine Coefficients

Thrust Type	E (lb)	F (lb/kt)	Ga (lb/ft)	Gb (lb/ft^2)	H (lb/°C)
Max-Takeoff	2219.6	-5.9898	4.4468E-02	2.8008E-07	-
Hi-Temp Max-Takeoff	ND	ND	ND	ND	ND
Max-Climb	2295.2	-6.6307	4.1917E-02	5.8567E-07	-
Hi-Temp Max-Climb	ND	ND	ND	ND	ND
General Thrust	ND	ND	ND	ND	ND
Hi-Temp General Thrust	ND	ND	ND	ND	ND
	K1a (lb/EPR)	**K1b (lb/EPR^2)**	**or**	**K2 lb/(N1/√θ)**	**K3 lb/(N1/√θ)^2**
General Thrust	ND	ND		ND	ND
Hi-Temp General Thrust	ND	ND		ND	ND

Table 78. Piper PA-42 Default Departure Procedures

Step Number	Segment Type	Flap Configuration ID	Thrust Type (T/C)	Rate-of-Climb (ft/min)	KIAS	Endpoint Altitude (ft AFE)
1	Takeoff	Zero-dn	MaxTO			
2	Accelerate	Zero-dn	MaxTO	1000	118	
3	Climb	Zero-dn	MaxTO			1000
4	Accelerate	Zero	MaxClimb	1000	154	
5	Climb	Zero	MaxClimb			3000
6	Climb	Zero	MaxClimb			4000
7	Climb	Zero	MaxClimb			6000
8	Climb	Zero	MaxClimb			8000
9	Climb	Zero	MaxClimb			10000

Table 79. Piper PA-42 Approach Procedures Part 2

Step #	Step Type	Flap ID	Starting Altitude (ft AFE)	KIAS	Decent Angle (deg)	ROD/feet
1	Descend	Zero-A	6000	151	3	
2	Descend	Zero-A	4000	135	3	
3	Descend	Zero-A	2000	119	3	
4	Descend	30-dn	1000	111	3	
5	Descend	30-dn	50	111	3	
6	Land	30-dn				100
7	Decelerate			111		2245.9

A.4.2 Rotary Wing Aircraft

This section contains the information for the three rotary wing aircraft.

A.4.2.1 Bell 407

Table 80. Bell 407 Reference Conditions for Performance Data

Wind	Zero
Runway/helipad elevation	Mean Sea Level (MSL)
Atmosphere	SAE-AIR-1845, Appendix B
Number of engines supplying thrust	All
Atmosphere	International Standard Atmosphere (ISA)

Table 81. Bell 407 Aircraft and Engine Data

Helicopter model	B407			
Description	Bell 407			
Owner category*	GA			
Engine type ('turboshaft','piston')	turboshaft			
Number of main rotor blades	4			
Main rotor diameter (ft)	35			
Rotor Speed (RPM)	413			
Maximum gross takeoff weight (lb)	6000			
Wheels ('yes' or 'no')	no			
Engine model	Rolls-Royce 250-C47B			
Number of rotors (main plus tail)	2			
Maximum Speed in Level Flight with Maximum Continuous Power, V_H (kt)	127			
Speed for Best Rate of Climb, V_Y (kt)	60			
Never Exceed Speed, V_{NE} (kt)	140			
FAR Part 36 Reference Certification Levels †, either:				
(a) Appendix H, or	TO:	SL:	AP:	LF:
(b) Appendix J	TO:			LF: 85.1

*COM= commercial aviation, and GA = general aviation

Table 82. Bell 407 Speed Coefficients

	Left	Center	Right
B_0	0	0	0
B_1	-92.34	-131.9	-136
B_2	2840	2315	2719

Table 83. Bell 407 Departure Procedures

Segment Type	Duration (Sec)	Endpoint Altitude (ft AFE)	Track Distance (ft)	Endpoint Speed (KCAS)
Ground Idle	30			
Flight Idle	30			
Departure Vertical	3	15		
Departure Horizontal Accelerate			100	30.0
Departure Climb Accelerate		30	500	76.0
Departure Constant Speed		1000	3500	
Departure Horizontal Accelerate	0		2800	133.0
Level Fly			93100	

Table 84. Bell 407 Approach Procedures

Segment Type	Duration (Sec)	Endpoint Altitude (ft AFE)	Track Distance (ft)	Endpoint Speed (KCAS)
Start Altitude †		1000.0	0.0	133.0
Level Fly		0.0	87250.0	
Approach Horizontal Decelerate			5000.0	65.0
Approach Constant Speed	0.0	500.0	4800.0	
Approach Descend Accelerate	0.0	15.0	2850.0	0.0
Approach Vertical	3.0	0.0		
Flight Idle	30.0	0.0		
Ground Idle	30.0	0.0		

†Since there are no track distance and duration information associated with a "Start Altitude" segment, the endpoint speed and altitude correspond to the starting speed and altitude.

A.4.2.2 Robinson R44 Raven

Table 85. Robinson R44 Raven Reference Conditions for Performance Data

Wind	Zero
Runway/helipad elevation	Mean Sea Level (MSL)
Atmosphere	SAE-AIR-1845, Appendix B
Number of engines supplying thrust	All
Atmosphere	International Standard Atmosphere (ISA)

Table 86. Robinson R44 Raven Aircraft and Engine Data

Helicopter model	R44			
Description	Robinson R44 Raven			
Owner category*	GA			
Engine type ('turboshaft','piston')	piston			
Number of main rotor blades	2			
Main rotor diameter (ft)	33			
Rotor Speed (RPM)	400			
Maximum gross takeoff weight (lb)	2400			
Wheels ('yes' or 'no')	no			
Engine model	Lycoming O-540-F1B5			
Number of rotors (main plus tail)	2			
Maximum Speed in Level Flight with Maximum Continuous Power, V_H (kt)	108			
Speed for Best Rate of Climb, V_Y (kt)	55			
Never Exceed Speed, V_{NE} (kt)	130			
FAR Part 36 Reference Certification Levels †, either:				
(a) Appendix H, or	TO:	SL:	AP:	LF:
(b) Appendix J	TO:			LF: 81.9

*COM= commercial aviation, and GA = general aviation
† TO= takeoff; SL = sideline; AP = approach; and LF= level flyover.

Table 87. Robinson R44 Raven Speed Coefficients

	Left	**Center**	**Right**
B_0	0	0	0
B_1	-23.45	12.43	-76.47
B_2	485.1	0	1375

Table 88. Robinson R44 Raven Departure Procedures

Segment Type	**Duration (Sec)**	**Endpoint Altitude (ft AFE)**	**Track Distance (ft)**	**Endpoint Speed (KCAS)**
Ground Idle	30			
Flight Idle	30			
Departure Vertical	3	15		
Departure Horizontal Accelerate			100	30
Departure Climb Accelerate		30	500	67
Departure Constant Speed		1000	3500	
Departure Horizontal Accelerate	0		2800	104
Level Fly			93100	

Table 89. Robinson R44 Raven Approach Procedures

Segment Type	Duration (Sec)	Endpoint Altitude (ft AFE)	Track Distance (ft)	Endpoint Speed (KCAS)
Start Altitude †		1000.0	0.0	104
Level Fly		0.0	87250.0	
Approach Horizontal Decelerate			5000.0	68
Approach Constant Speed	0.0	500.0	4800.0	
Approach Descend Accelerate	0.0	15.0	2850.0	0
Approach Vertical	3.0	0.0		
Flight Idle	30.0	0.0		
Ground Idle	30.0	0.0		

† Since there are no track distance and duration information associated with a "Start Altitude" segment, the endpoint speed and altitude correspond to the starting speed and altitude.

A.4.2.3 Schweizer 300C

Table 90. Schweizer 300C Reference Conditions for Performance Data

Wind	Zero
Runway/helipad elevation	Mean Sea Level (MSL)
Atmosphere	SAE-AIR-1845, Appendix B
Number of engines supplying thrust	All
Atmosphere	International Standard Atmosphere (ISA)

Table 91. Schweizer 300C Aircraft and Engine Data

Helicopter model	300C			
Description	Schweizer 300C			
Owner category*	GA			
Engine type ('turboshaft','piston')	piston			
Number of main rotor blades	3			
Main rotor diameter (ft)	26.83			
Rotor Speed (RPM)	471			
Maximum gross takeoff weight (lb)	2050			
Wheels ('yes' or 'no')	no			
Engine model	Lycoming HIO-360-D1A			
Number of rotors (main plus tail)	2			
Maximum Speed in Level Flight with Maximum Continuous Power, V_H (kt)	86			
Speed for Best Rate of Climb, V_Y (kt)	41			
Never Exceed Speed, V_{NE} (kt)	95			
FAR Part 36 Reference Certification Levels †, either:				
(a) Appendix H, or	TO:	SL:	AP:	LF:
(b) Appendix J	TO:			LF: ND

*COM= commercial aviation, and GA = general aviation
† TO= takeoff; SL = sideline; AP = approach; and LF= level flyover.

Table 92. Schweizer 300C Speed Coefficients

	Left	Center	Right
B_0	0	0	0
B_1	215.7	57.73	158.8
B_2	5592	2621	3119

Table 93. Schweizer 300C Departure Procedures

Segment Type	Duration (Sec)	Endpoint Altitude (ft AFE)	Track Distance (ft)	Endpoint Speed (KCAS)
Ground Idle	30			
Flight Idle	30			
Departure Vertical	3	15		
Departure Horizontal Accelerate			100	30
Departure Climb Accelerate		30	500	39
Departure Constant Speed		1000	3500	
Departure Horizontal Accelerate	0		2800	73
Level Fly			93100	

Table 94. Schweizer 300C Approach Procedures

Segment Type	Duration (Sec)	Endpoint Altitude (ft AFE)	Track Distance (ft)	Endpoint Speed (KCAS)
Start Altitude*		1000.0	0.0	73
Level Fly		0.0	87250.0	
Approach Horizontal Decelerate			5000.0	67
Approach Constant Speed	0.0	500.0	4800.0	
Approach Descend Accelerate	0.0	15.0	2850.0	0
Approach Vertical	3.0	0.0		
Flight Idle	30.0	0.0		
Ground Idle	30.0	0.0		

* Since there are no track distance and duration information associated with a "Start Altitude" segment, the endpoint speed and altitude correspond to the starting speed and altitude.

This page intentionally left blank.

APPENDIX B: STUDY LIST OF SERVICE CONTACTS

Each of the service providers crucial to the success of the three measurement studies are listed with their contact information in Table 95.

Table 95. Study list of contacts

Service Provided	Company	Address	Contact	Telephone Number	Email	Website
Airport Runway	Crisfield Municipal Airport	4784 Jacksonville Rd. Crisfield, MD 21817	Jocelyn Quintanilha	(410) 968-3062	cityairport@dmv.com	NA
Airport Runway	Fitchburg Municipal Airport	567 Airport Rd. Fitchburg, MA 01420	Debbie Silvar	(978) 345-9580	fitairport@wn.net	www.fitchburgairport.com
Airport Runway	Needles Airport	825 E 3RD St, Room 203 San Bernadino, CA 92415	Bill Ingraham	(760) 247-2371	NA	NA
Cessna 182 Skylane	Jumptown	238 North Main Street Orange, MA 01364	Gary Pond	(802) 380-1298	gpond@entergy.com	www.jumptown.com
Cessna 208B Grand Caravan	Sky's the Limit	7 Airport Rd. East Stroudsburg, PA 18301	Jeff Root	(914) 589-4809	jeff@skysthelimit.net	www.skysthelimit.net
Dornier 228	Vision Air	2705 Airport Dr. Las Vegas, NV 89032	Steve Acor	(702) 289-2540	do@visionairlines.net	www.visionairlines.net
Dornier 328	Vision Air	2705 Airport Dr. Las Vegas, NV 89032	Steve Acor	(702) 289-2540	do@visionairlines.net	www.visionairlines.net
Piper PA-42 Cheyenne III	Hortman Aviation Services, Inc.	343 Lurgan Rd. New Hope, PA 18938	Rosemary Farley	(215) 969-0311	hortmanaviation@aol.com	www.hortmanaviation.com
Bell 407	HeloAir	5733 Huntsman Rd, Floor 2 Richmond, VA 23250	Jim MacKenzie	(804) 226-3400	jim@heloair.com	www.heloair.com
Robinson R44 Raven	C-R Helicopters	111 Perimeter Rd, Gate G Nashua, NH 03063	Bob Cloutier	(603) 881-4356	crhelicopters@aol.com	www.crhelicopters.com
Schweizer 300C	Helicopter Flight Services	60 Fostertown Rd. Medford, NJ 08055	Kelly Herlihy	(609) 265-0822	keldou@aol.com	www.helicopterflightservices.com

This page intentionally left blank.

APPENDIX C: METEOROLOGICAL DATA

This appendix presents the test day meteorological data used in the processing of all acoustic data. As noted in Section 4.3, temperature, relative humidity, wind speed and direction, as well as barometric pressure data were collected. Temperature in degrees Fahrenheit and relative humidity in percent taken at the aircraft's time at maximum SPL during flyover, along with average wind speed in knots over the duration of the event are presented for each event in Tables 96 through 106.

Changes in outdoor temperature and relative humidity are assumed to be negligible over short periods of time; accordingly, for the purpose of data processing, temperature and relative humidity were assumed to be constant over the ten-dB down period of each aircraft event.

All acoustic data presented herein were analyzed in accordance with wind speed and direction criteria as specified in FAR 36 / Annex 16. In addition to the overhead temperature and relative humidity data presented for all measurement events, average wind speed and direction data are presented for the periods specific to each helicopter static operation.

C.1 Cessna 182 Skylane

Table 96. Cessna 182 Event Meteorological Data

Event #	Date	Time of Day	Air Temp (^oF)	Humidity (%RH)	Average Wind Speed (kts)
110	10/24/2006	10:38:04	45.2	60	7.0
120	10/24/2006	10:41:47	45.7	60	6.4
140	10/24/2006	11:20:15	46	57	7.4
160	10/24/2006	11:27:36	46	57	8.6
170	10/24/2006	11:31:00	46.2	57	7.0
171	10/24/2006	11:34:49	45.7	57	8.4
172	10/24/2006	11:39:19	46.2	57	11.9
173	10/24/2006	11:42:39	46	57	8.7
174	10/24/2006	11:46:08	46.2	57	8.0
175	10/24/2006	11:49:36	46.9	57	6.2
176	10/24/2006	11:53:17	46.6	57	6.2
220	10/24/2006	12:00:53	47.1	57	7.6
230	10/24/2006	12:03:53	46.9	57	8.2
240	10/24/2006	12:06:49	46.8	57	7.8
250	10/24/2006	12:09:58	46.8	56	8.9
310	10/24/2006	12:16:39	46.8	56	8.6
330	10/24/2006	12:30:32	47.1	57	4.7
340	10/24/2006	12:33:27	46.9	56	6.0
350	10/24/2006	12:36:31	47.1	56	6.8
360	10/24/2006	12:39:58	47.3	56.3	4.3
370	10/24/2006	12:43:05	47.1	57	7.0
380	10/24/2006	12:46:52	47.1	57	6.0
410	10/24/2006	12:56:03	46.9	56	7.0
420	10/24/2006	12:59:36	46.8	56	5.2
430	10/24/2006	13:02:58	NA	NA	NA
440	10/24/2006	13:06:22	NA	NA	NA
450	10/24/2006	13:09:46	NA	NA	NA
460	10/24/2006	13:13:10	NA	NA	NA
470	10/24/2006	13:16:51	NA	NA	NA
480	10/24/2006	13:20:55	NA	NA	NA
510	10/24/2006	14:54:14	NA	NA	NA
520	10/24/2006	14:58:24	49.4	53	8.9
530	10/24/2006	15:02:36	48.2	53	9.7
540	10/24/2006	15:06:38	48.6	53	7.2
560	10/24/2006	15:21:38	47.7	54	6.0
570	10/24/2006	15:26:09	47.7	54	6.6
581	10/24/2006	15:38:51	47.1	54	10.3
582	10/24/2006	15:43:32	47.1	53	9.7
610	10/24/2006	15:48:34	47.5	53	7.8
630	10/24/2006	16:00:49	47.5	54	8.2
640	10/24/2006	16:06:29	47.6	53	7.2
650	10/24/2006	16:11:39	47.7	53	7.8

C.2 Cessna 208B Grand Caravan

Table 97. Cessna 208B Event Meteorological Data

Event #	Date	Time of Day	Air Temp (^oF)	Humidity (%RH)	Average Wind Speed (kts)
110	10/25/2006	13:47:40	53.1	46	12.6
120	10/25/2006	13:50:33	52.5	45	14.6
140	10/25/2006	14:03:07	52.2	46	12.8
150	10/25/2006	14:06:22	52.5	46	9.1
160	10/25/2006	14:09:44	51.1	45	11.5
210	10/25/2006	14:12:58	52.7	45	12.1
220	10/25/2006	14:15:20	52.7	45	9.9
230	10/25/2006	14:17:54	51.4	45	12.6
240	10/25/2006	14:20:32	51.1	45	13.6
310	10/25/2006	14:24:29	53.4	46	12.4
320	10/25/2006	14:27:58	52.6	45	10.1
330	10/25/2006	14:30:36	53.1	45	7.8
340	10/25/2006	14:33:51	53.1	44	10.7
410	10/25/2006	14:38:20	52.7	44	16.7
420	10/25/2006	14:41:52	52.2	44	11.5
430	10/25/2006	14:45:24	53.4	44	14.2
440	10/25/2006	14:48:43	53.2	44	12.6
450	10/25/2006	14:52:24	52.5	44	12.8
510	10/25/2006	14:56:08	52	44	12.2
520	10/25/2006	14:59:52	51.4	45	8.7
530	10/25/2006	15:08:37	51.1	46	13.0
540	10/25/2006	15:12:11	52.5	46	7.8
610	10/25/2006	15:16:24	52.7	45	9.5
620	10/25/2006	15:20:27	52.4	45	10.1
630	10/25/2006	15:24:15	52.5	45	10.1
640	10/25/2006	15:28:25	51.6	45	9.1

C.3 Dornier 228

Table 98. Dornier 228 Event Meteorological Data

Event #	Date	Time of Day	Air Temp (°F)	Humidity (%RH)	Average Wind Speed (kts)
110	1/20/2007	8:55:00	47.8	65	2.5
130	1/20/2007	9:03:42	46	67	2.7
140	1/20/2007	9:07:23	46	68	3.5
150	1/20/2007	9:11:14	45.7	68	2.3
210	1/20/2007	9:15:13	45.7	73	2.9
220	1/20/2007	9:19:01	45.4	69	4.1
230	1/20/2007	9:22:26	46.3	68	2.7
240	1/20/2007	9:25:57	46.5	66.7	3.5
310	1/20/2007	9:30:04	45.7	66	3.1
320	1/20/2007	9:35:32	46.2	67	3.1
330	1/20/2007	9:39:41	47.1	65	3.1
340	1/20/2007	9:43:40	48	64	1.9
350	1/20/2007	9:54:26	49	63	1.6
410	1/20/2007	9:58:13	50.2	63	0.4
420	1/20/2007	10:01:51	49.5	62	1.0
430	1/20/2007	10:05:10	49.5	62	2.3
450	1/20/2007	10:20:48	52.2	59	2.5
510	1/20/2007	10:51:48	51.6	64	2.5
520	1/20/2007	10:55:12	53.4	63	1.6
530	1/20/2007	10:58:27	51.5	63	3.3
540	1/20/2007	11:01:36	50.7	64	1.6
610	1/20/2007	11:05:15	52.2	65	4.9
620	1/20/2007	11:08:49	51.4	64	2.1
630	1/20/2007	11:12:38	52.5	63	3.3
640	1/20/2007	11:16:06	52	63	3.5

C.4 Dornier 328

Table 99. Dornier 328 Event Meteorological Data

Event #	Date	Time of Day	Air Temp (°F)	Humidity (%RH)	Average Wind Speed (kts)
110	1/20/2007	14:29:38	58.5	58	2.3
120	1/20/2007	14:37:06	58.5	58	3.1
130	1/20/2007	14:43:39	59	56	4.3
140	1/20/2007	14:50:15	59.7	54	3.9
150	1/20/2007	14:56:39	58.3	54	4.7
310	1/20/2007	15:05:23	59.2	54	5.4
320	1/20/2007	15:13:58	59.8	53	3.1
330	1/20/2007	15:22:03	59	54	4.3
340	1/20/2007	15:30:03	58.3	53	7.8
350	1/20/2007	15:37:22	57.7	53	7.4
410	1/20/2007	15:43:32	58.1	53	5.1
420	1/20/2007	15:51:01	57.7	53	5.6
430	1/20/2007	15:57:38	57.9	53	4.1

Event #	Date	Time of Day	Air Temp (^{o}F)	Humidity (%RH)	Average Wind Speed (kts)
440	1/20/2007	16:03:57	57.9	54	6.6
510	1/20/2007	16:12:37	57.2	54	5.8
520	1/20/2007	16:19:14	57.2	56	4.5
530	1/20/2007	16:25:17	56.5	56	5.6
540	1/20/2007	16:31:10	56.5	56	4.7
610	1/20/2007	16:38:34	55.6	57	3.7
620	1/20/2007	16:45:24	55.2	58	6.2
630	1/20/2007	16:50:07	55	58	3.9
640	1/20/2007	16:56:28	54.5	59	2.9

C.5 Piper PA-42 Cheyenne III

Table 100. Piper PA-42 Event Meteorological Data

Event #	Date	Time of Day	Air Temp (°F)	Humidity (%RH)	Average Wind Speed (kts)
160	10/7/2008	13:47:45	64.6	41	5.4
170	10/7/2008	13:53:16	64.9	40	5.6
180	10/7/2008	13:58:55	63.7	40	5.6
210	10/11/2008	9:00:32	62.4	74	3.7
220	10/11/2008	9:03:53	62.8	75	5.8
230	10/11/2008	9:08:37	62.4	75	4.1
240	10/11/2008	9:13:53	63	76	2.7
250	10/11/2008	9:19:39	63.5	75	3.9
310	10/7/2008	14:03:53	64.6	40	7.2
310	10/11/2008	9:28:02	63.1	76	3.5
320	10/7/2008	14:08:16	64.6	39	7.8
320	10/11/2008	9:37:41	64.8	73	5.8
330	10/11/2008	9:48:05	66	72	6.8
340	10/11/2008	9:58:34	66.9	69	4.1
610	10/11/2008	10:07:20	68.7	69	0.8
620	10/11/2008	10:15:19	69.4	67	4.7
630	10/11/2008	10:23:40	69.1	67	3.9
640	10/11/2008	10:33:15	69.1	65	4.3
650	10/11/2008	10:41:09	69.1	62	4.1
710	10/11/2008	10:50:15	70.7	58	6.4

C.6 Bell 407

Table 101. Bell 407 Meteorological Data for Dynamic Operations

Event #	Date	Time of Day	Air Temp (^oF)	Humidity (%RH)	Average Wind Speed (kts)
110	10/8/2008	10:46:30	65.6	56	3.9
120	10/8/2008	10:50:59	64.9	56	5.4
130	10/8/2008	10:55:05	65.4	56	4.9
210	10/8/2008	10:59:10	64.8	56	4.1
220	10/8/2008	11:03:21	65.7	55	2.9
230	10/8/2008	11:06:55	65.6	55.2	3.7
310	10/8/2008	11:11:27	64.8	55	5.1
320	10/8/2008	11:15:09	65.1	55	3.5
330	10/8/2008	11:18:55	65.1	54	4.3
340	10/8/2008	11:23:02	65.3	53.7	2.5
410	10/8/2008	11:28:17	64.8	54	5.2
420	10/8/2008	11:32:43	64.8	54	6.6
430	10/8/2008	11:37:24	64.9	52	2.5
440	10/8/2008	11:41:47	64.8	52	2.3
520	10/8/2008	13:26:31	69.3	47	2.7
530	10/8/2008	13:31:19	67.6	47	7.0
540	10/8/2008	13:35:52	66.9	48	3.9
550	10/8/2008	13:41:56	68.1	48	5.4
710	10/8/2008	13:47:12	68.6	48	7.4
720	10/8/2008	13:52:21	68.5	47	5.6
730	10/8/2008	13:57:44	68	48	5.6
740	10/8/2008	14:04:27	68.5	48	8.0
750	10/8/2008	14:09:14	69.1	49	4.7
810	10/8/2008	14:14:38	69.3	48	5.4
820	10/8/2008	14:20:31	68.5	48	5.2
830	10/8/2008	14:26:17	69.8	48	4.5
910	10/8/2008	14:33:43	68.3	48	5.4
920	10/8/2008	14:41:18	68.1	49	5.1
1010	10/8/2008	14:45:27	68.8	50	1.6
1020	10/8/2008	14:48:19	68.7	49	4.1
1030	10/8/2008	14:51:22	68.5	50	4.7
1110	10/8/2008	14:54:26	69.1	50	2.5
1120	10/8/2008	14:56:44	68.5	50	5.6

One-second wind speed and direction data over the course of the measured HIGE, HOGE, ground idle and flight idle events were arithmetically averaged and included in Table 102, Table 104, and Table 106. Average wind direction is measured in degrees from north (i.e., a wind direction of zero degrees indicates a wind blowing *from* the north).

Table 102. Bell 407 Hover and Idle Meteorological Data

Series #	Config.	Date	Time of Day	Air Temp (°F)	Humidity (%RH)	Avg. Wind Speed (kts)	Avg. Wind Direction (degrees)
2100	HIGE	10/9/2008	11:24:59	69.3	65.4	4.3	205
2200	HOGE	10/9/2008	11:36:25	68.3	63.3	5.4	221
2300	Flight Idle	10/9/2008	11:10:23	71.7	69.3	4.3	210
2400	Ground Idle	10/9/2008	11:08:36	70.7	67.7	4.7	210

C.7 Robinson R44

Table 103. Robinson R44 Meteorological Data for Dynamic Operations

Event #	Date	Time of Day	Air Temp (°F)	Humidity (%RH)	Average Wind Speed (kts)
110	10/25/2006	10:02:36	48	55	7.6
120	10/25/2006	10:05:02	47.7	55	8.7
130	10/25/2006	10:11:46	49.3	54	8.0
140	10/25/2006	10:14:34	49.3	53	8.6
210	10/25/2006	10:18:40	50	53	10.7
220	10/25/2006	10:21:22	49.2	52	8.7
230	10/25/2006	10:26:08	48.2	53	10.1
240	10/25/2006	10:30:02	48	53	11.9
310	10/25/2006	10:34:23	48.2	53	11.7
320	10/25/2006	10:38:05	48.8	53	8.2
330	10/25/2006	10:43:23	49.4	52	10.1
340	10/25/2006	10:48:02	49.2	52	8.4
510	10/25/2006	10:53:29	48.3	52	7.8
520	10/25/2006	10:57:29	50	52	13.2
530	10/25/2006	11:02:05	50.9	50	9.7
540	10/25/2006	11:16:29	50.6	51	8.7
610	10/25/2006	11:21:08	48.9	50	11.9
620	10/25/2006	11:24:52	49.1	51	11.5
630	10/25/2006	11:29:36	48.7	52	12.8
640	10/25/2006	11:34:02	50.5	51	12.1
710	10/25/2006	11:58:21	51.4	49	10.7
720	10/25/2006	12:01:35	50	49	10.7
730	10/25/2006	12:05:03	51.9	49	14.4
810	10/25/2006	12:09:44	52	48	15.4
820	10/25/2006	12:13:49	50.7	48	9.9
830	10/25/2006	12:21:06	53.1	47	11.7

Table 104. Robinson R44 Hover and Idle Meteorological Data

Series #	Config.	Date	Time of Day	Air Temp (°F)	Humidity (%RH)	Avg. Wind Speed (kts)	Avg. Wind Direction (degrees)
2100	HIGE	10/25/2006	9:12:00	45.6	61	7.4	320
2200	HOGE	10/25/2006	9:26:46	46.2	60	7.6	328
2300	Flight Idle	10/25/2006	9:04:40	44.7	62	7.6	310
2400	Ground Idle	10/25/2006	8:56:30	44.4	61	7.8	323

C.8 Schweizer 300C

Table 105. Schweizer 300C Meteorological Data for Dynamic Operations

Event #	Date	Time of Day	Air Temp (^oF)	Humidity (%RH)	Average Wind Speed (kts)
110	10/10/2008	10:17:02	73.2	54	6.6
120	10/10/2008	10:20:54	74	53.7	4.7
130	10/10/2008	10:25:13	73	52	8.2
140	10/10/2008	10:29:16	73.2	53	8.4
210	10/10/2008	10:33:23	73.3	51	9.3
220	10/10/2008	10:37:40	73.6	51	7.8
230	10/10/2008	10:41:47	74.1	51	6.4
240	10/10/2008	10:47:16	73.6	51	9.9
310	10/10/2008	10:52:05	74	51.3	7.2
320	10/10/2008	10:59:42	74.2	51	8.7
330	10/10/2008	11:07:09	74.2	51	9.5
340	10/10/2008	11:12:52	75.2	50.4	5.8
350	10/10/2008	11:18:17	74.7	51	9.1
410	10/10/2008	11:23:05	76.2	51	7.0
420	10/10/2008	11:27:11	75.7	51	8.2
430	10/10/2008	11:32:47	75.9	49	5.8
440	10/10/2008	11:37:37	76.4	50	7.0
450	10/10/2008	11:42:39	75.9	49	8.2
510	10/10/2008	11:47:33	76.5	50	9.7
520	10/10/2008	11:53:04	75.6	49	7.0
530	10/10/2008	11:57:14	75.6	49	6.2
540	10/10/2008	12:02:20	75.7	50	8.4
830	10/10/2008	14:15:02	78.3	44	8.9
840	10/10/2008	14:19:27	78.8	44	4.9
1010	10/10/2008	14:25:02	79	44.3	3.7
1020	10/10/2008	14:29:10	79.7	43	4.3
1030	10/10/2008	14:33:25	78.4	42	5.1
1110	10/10/2008	14:38:19	77.6	44	3.9
1120	10/10/2008	14:42:51	78.3	44.9	3.5
1130	10/10/2008	14:48:03	79.2	44.7	4.9

Table 106. Schweizer 300C Hover and Idle Meteorological Data

Series #	Config.	Date	Time of Day	Air Temp (^oF)	Humidity (%RH)	Avg. Wind Speed (kts)	Avg. Wind Direction (degrees)
2100	HIGE	10/10/2008	15:44:35	76.6	72	3.1	217
2200	HOGE	10/10/2008	15:58:30	76.6	71.7	2.7	202
2300	Flight Idle	10/10/2008	15:35:01	76.2	70	3.3	200
2400	Ground Idle	10/10/2008	15:33:22	76.6	70.1	3.7	221

APPENDIX D: TIME-SPACE-POSITION INFORMATION (TSPI)

This appendix presents a summary of the TSPI data used in the processing of the acoustic data measured for each aircraft event, including overhead time, aircraft test altitude in feet, test speed in kts, descent angle in degrees, and reference speed in kts. Altitude data represent instantaneous altitude at the overhead time, whereas groundspeed represents an average over the sound level time history 10-dB-down duration. Descent angle, the angle at which the aircraft approaches, is represented by the target angle of approach given for the event. A diagram of descent angle geometry is presented in Figure D-1. Departure events, which do not have an angle of descent, are denoted with “NA” (not applicable).

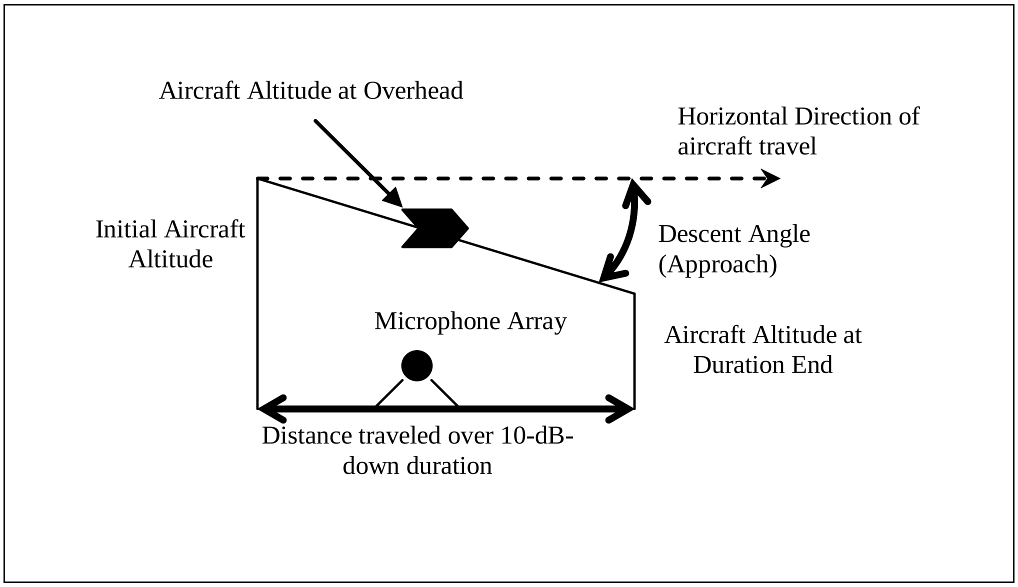

Figure 26. Aircraft Descent Angle Geometry

Data presented in Tables 124 through 131 include aircraft-specific test and reference conditions. For completeness, values of DUR_{ADJ}, used to adjust exposure-based metrics from these conditions to the appropriate reference speed required for inclusion in the INM, are provided in the last column.

D.1 Cessna 182 Skylane

Table 107. Cessna 182 Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Reference Speed (kts)	DUR_{ADJ} (dB)
110	10:38:04	364	122.1	0	160	1.2
120	10:41:47	458	116	0	160	1.4
140	11:20:15	517	111.8	0	160	1.6
160	11:27:36	539	109.8	0	160	1.6
170	11:31:00	521	114.2	0	160	1.5
171	11:34:49	472	107.1	0	160	1.7
172	11:39:19	496	107.9	0	160	1.7
173	11:42:39	482	115.5	0	160	1.4
174	11:46:08	499	114.6	0	160	1.4
175	11:49:36	462	113.2	0	160	1.5
176	11:53:17	486	112.7	0	160	1.5
220	12:00:53	480	130.9	0	160	0.9
230	12:03:53	476	133.4	0	160	0.8
240	12:06:49	461	128.4	0	160	1.0
250	12:09:58	488	131.2	0	160	0.9
310	12:16:39	264	101.3	NA	160	2.0
330	12:30:32	364	92.4	NA	160	2.4
340	12:33:27	478	92.3	NA	160	2.4
350	12:36:31	542	90.1	NA	160	2.5
360	12:39:58	433	91.3	NA	160	2.4
370	12:43:05	470	88.5	NA	160	2.6
380	12:46:52	469	83.2	NA	160	2.8
410	12:56:03	349	97.7	NA	160	2.1
420	12:59:36	561	84.4	NA	160	2.8
430	13:02:58	543	92.2	NA	160	2.4
440	13:06:22	497	91.1	NA	160	2.4
450	13:09:46	685	88.1	NA	160	2.6
460	13:13:10	504	88.8	NA	160	2.6
470	13:16:51	572	86.6	NA	160	2.7
480	13:20:55	572	90.1	NA	160	2.5
510	14:54:14	552	86.7	3	160	2.7
520	14:58:24	486	97.2	3	160	2.2
530	15:02:36	508	96.9	3	160	2.2
540	15:06:38	428	84.7	3	160	2.8
560	15:21:38	500	91.5	3	160	2.4
570	15:26:09	481	89.3	3	160	2.5
581	15:38:51	511	91.5	3	160	2.4
582	15:43:32	530	91.4	3	160	2.4
610	15:48:34	513	80.8	3	160	3.0
630	16:00:49	496	72.4	3	160	3.4
640	16:06:29	500	73.3	3	160	3.4
650	16:11:39	500	75	3	160	3.3

D.2 Cessna 208B Grand Caravan

Table 108. Cessna 208B Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Reference Speed (kts)	DUR_{ADJ} (dB)
110	13:47:40	477	111.3	0	160	1.6
120	13:50:33	414	110.8	0	160	1.6
140	14:03:07	421	108	0	160	1.7
150	14:06:22	491	110.2	0	160	1.6
160	14:09:44	457	119.2	0	160	1.3
210	14:12:58	537	147.7	0	160	0.3
220	14:15:20	474	153.1	0	160	0.2
230	14:17:54	442	147.7	0	160	0.3
240	14:20:32	456	145	0	160	0.4
310	14:24:29	432	93.4	NA	160	2.3
320	14:27:58	406	101.9	NA	160	2.0
330	14:30:36	538	93.1	NA	160	2.4
340	14:33:51	407	102.8	NA	160	1.9
410	14:38:20	358	93.7	NA	160	2.3
420	14:41:52	488	105.2	NA	160	1.8
430	14:45:24	443	102.9	NA	160	1.9
440	14:48:43	466	99.8	NA	160	2.0
450	14:52:24	316	101	NA	160	2.0
510	14:56:08	210	100.9	3	160	2.0
520	14:59:52	492	121.3	3	160	1.2
530	15:08:37	505	107.2	3	160	1.7
540	15:12:11	491	117.3	3	160	1.3
610	15:16:24	469	86.1	3	160	2.7
620	15:20:27	503	79.5	3	160	3.0
630	15:24:15	473	77.8	3	160	3.1
640	15:28:25	511	90	3	160	2.5

D.3 Dornier 228

Table 109. Dornier 228 Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Reference Speed (kts)	DUR_{ADJ} (dB)
110	08:55:00	519	206.5	0	160	-1.1
130	09:03:42	490	206.4	0	160	-1.1
140	09:07:23	505	209.2	0	160	-1.2
150	09:11:14	507	211	0	160	-1.2
210	09:15:13	493	150.7	0	160	0.3
220	09:19:01	503	152.9	0	160	0.2
230	09:22:26	517	152.5	0	160	0.2
240	09:25:57	498	156.7	0	160	0.1
310	09:30:04	358	125.6	NA	160	1.1
320	09:35:32	473	119.1	NA	160	1.3
330	09:39:41	508	114.2	NA	160	1.5
340	09:43:40	512	121.3	NA	160	1.2
350	09:54:26	562	117.9	NA	160	1.3
410	09:58:13	412	150.1	NA	160	0.3
420	10:01:51	415	145.1	NA	160	0.4
430	10:05:10	432	140.6	NA	160	0.6
450	10:20:48	481	143.9	NA	160	0.5
510	10:51:48	511	131	3	160	0.9
520	10:55:12	443	137.3	3	160	0.7
530	10:58:27	291	142.3	3	160	0.5
540	11:01:36	420	137.6	3	160	0.7
610	11:05:15	547	104	3	160	1.9
620	11:08:49	573	105	3	160	1.8
630	11:12:38	556	109.4	3	160	1.7
640	11:16:06	496	105	3	160	1.8

D.4 Dornier 328

Table 110. Dornier 328 Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Reference Speed (kts)	DUR_{ADJ} (dB)
110	14:29:38	602	252	0	160	-2.0
120	14:37:06	460	257.7	0	160	-2.1
130	14:43:39	517	254.7	0	160	-2.0
140	14:50:15	484	260.4	0	160	-2.1
150	14:56:39	486	260.9	0	160	-2.1
310	15:05:23	402	138.1	NA	160	0.6
320	15:13:58	444	135.6	NA	160	0.7
330	15:22:03	669	129.7	NA	160	0.9
340	15:30:03	586	120.8	NA	160	1.2
350	15:37:22	462	132	NA	160	0.8
410	15:43:32	631	160.7	NA	160	0.0
420	15:51:01	534	165.9	NA	160	-0.2
430	15:57:38	513	175.2	NA	160	-0.4
440	16:03:57	548	163.6	NA	160	-0.1
510	16:12:37	581	183.9	3	160	-0.6
520	16:19:14	573	176	3	160	-0.4
530	16:25:17	484	187.3	3	160	-0.7
540	16:31:10	459	172.7	3	160	-0.3
610	16:38:34	370	115.4	3	160	1.4
620	16:45:24	280	121.1	3	160	1.2
630	16:50:07	480	116.3	3	160	1.4
640	16:56:28	491	116.8	3	160	1.4

D.5 Piper PA-42 Cheyenne III

Table 111. Piper PA-42 Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Reference Speed (kts)	DUR_{ADJ} (dB)
160	13:47:45	360	166	0	160	-0.2
170	13:53:16	273	166.8	0	160	-0.2
180	13:58:55	258	164.3	0	160	-0.1
210	09:00:32	1479	214.2	0	160	-1.3
220	09:03:53	449	240.6	0	160	-1.8
230	09:08:37	501	243.9	0	160	-1.8
240	09:13:53	480	241.4	0	160	-1.8
250	09:19:39	413	244.4	0	160	-1.8
310	09:28:02	378	130.3	NA	160	0.9
320	09:37:41	513	145.3	NA	160	0.4
330	09:48:05	496	138.8	NA	160	0.6
340	09:58:34	558	141	NA	160	0.5
610	10:07:20	205	173.7	3	160	-0.4
620	10:15:19	231	179.4	3	160	-0.5
630	10:23:40	176	160.8	3	160	0.0
640	10:33:15	455	161.7	3	160	0.0
650	10:41:09	471	161.4	3	160	0.0
710	10:50:15	520	123.4	3	160	1.1

D.6 Bell 407

Reference speeds for the Bell 407 helicopter are based on a maximum speed in level flight with maximum continuous power (V_H) of 126 knots, a speed for best rate of climb (V_Y) of 60 knots, and a not-to-exceed speed (V_{NE}) of 140 knots. The adjustment factors used to calculate the helicopter reference speeds are included in Table 112.

Table 112. Bell 407 Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Ref. Speed (kts)	Ref. Speed Adj. Factor	DUR_{ADJ} (dB)
110	10:46:30	496	92.3	0	94	$0.6*V_{NE}$	0.1
120	10:50:59	480	95.7	0	94	$0.6*V_{NE}$	-0.1
130	10:55:05	492	93.3	0	94	$0.6*V_{NE}$	0.0
210	10:59:10	480	134	0	133	$0.9* V_{NE}$	0.0
220	11:03:21	510	132.2	0	133	$0.9* V_{NE}$	0.0
230	11:06:55	511	133.3	0	133	$0.9* V_{NE}$	0.0
310	11:11:27	423	67.1	NA	80	$1.0*V_Y$	0.8
320	11:15:09	449	77	NA	80	$1.0*V_Y$	0.2
330	11:18:55	394	76.3	NA	80	$1.0*V_Y$	0.2
340	11:23:02	491	86.3	NA	80	$1.0*V_Y$	-0.3
410	11:28:17	380	71.3	NA	76	$1.0*V_Y$	0.3
420	11:32:43	514	83	NA	76	$1.0*V_Y$	-0.4
430	11:37:24	447	76.4	NA	76	$1.0*V_Y$	0.0
440	11:41:47	556	76.1	NA	76	$1.0*V_Y$	0.0
520	13:26:31	460	65.9	6	65	$1.0*V_Y$	-0.1
530	13:31:19	533	65.4	6	65	$1.0*V_Y$	0.0
540	13:35:52	627	68.4	6	65	$1.0*V_Y$	-0.2
550	13:41:56	634	62.5	6	65	$1.0*V_Y$	0.2
710	13:47:12	533	58.7	3	61	$1.0*V_Y$	0.2
720	13:52:21	492	54.1	3	61	$1.0*V_Y$	0.5
730	13:57:44	585	66.8	3	61	$1.0*V_Y$	-0.4
740	14:04:27	409	63.5	3	61	$1.0*V_Y$	-0.2
750	14:09:14	594	62.1	3	61	$1.0*V_Y$	-0.1
810	14:14:38	596	39.7	9	36	$1.0*V_Y$	-0.4
820	14:20:31	492	38.4	9	36	$1.0*V_Y$	-0.3
830	14:26:17	499	31.3	9	36	$1.0*V_Y$	0.6
910	14:33:43	439	18.8	12	21	$1.2* V_Y$	0.5
920	14:41:18	504	23.5	12	21	$1.2*V_Y$	-0.5
1010	14:45:27	522	111.8	0	109	$0.8*V_H$	-0.1
1020	14:48:19	467	104.7	0	109	$0.8*V_H$	0.2
1030	14:51:20	506	110.3	0	109	$0.8*V_H$	-0.1
1110	14:54:25	506	97.3	0	98	$0.7*V_H$	0.0
1120	14:56:44	501	99.2	0	98	$0.7*V_H$	-0.1

D.7 Robinson R44

Reference speeds for the R44 helicopter are based on a maximum speed in level flight with maximum continuous power (V_H) of 108 knots, a speed for best rate of climb (V_Y) of 55 knots, and a not-to-exceed speed (V_{NE}) of 130 knots. The adjustment factors used to calculate the helicopter reference speeds are included in Table 113.

Table 113. Robinson R44 Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Ref. Speed (kts)	Ref. Speed Adj. Factor	DUR_{ADJ} (dB)
110	10:02:36	265	83.6	0	83	$0.6*V_{NE}$	0.0
120	10:05:02	302	87.1	0	83	$0.6*V_{NE}$	-0.2
130	10:11:46	273	81.1	0	83	$0.6*V_{NE}$	0.1
140	10:14:34	368	84.5	0	83	$0.6*V_{NE}$	-0.1
210	10:18:40	498	110.1	0	104	$0.9*V_{NE}$	-0.2
220	10:21:22	353	110.5	0	104	$0.9*V_{NE}$	-0.3
230	10:26:08	353	98	0	104	$0.9*V_{NE}$	0.3
240	10:30:02	368	99.5	0	104	$0.9*V_{NE}$	0.2
310	10:34:23	554	64.1	NA	67	$1.0*V_Y$	0.2
320	10:38:05	350	62.7	NA	67	$1.0*V_Y$	0.3
330	10:43:23	383	64.4	NA	67	$1.0*V_Y$	0.2
340	10:48:02	271	71.4	NA	67	$1.0*V_Y$	-0.3
400	No Data						
510	10:53:29	84	72.4	12	66	$1.2*V_Y$	-0.4
520	10:57:29	89	69.7	12	66	$1.2*V_Y$	-0.2
530	11:02:05	82	61.6	12	66	$1.2*V_Y$	0.3
540	11:16:29	287	61.9	12	66	$1.2*V_Y$	0.3
610	11:21:08	373	45.5	9	47	$1.0*V_Y$	0.1
620	11:24:52	418	41.4	9	47	$1.0*V_Y$	0.6
630	11:29:36	512	52.7	9	47	$1.0*V_Y$	-0.5
640	11:34:02	242	53	9	47	$1.0*V_Y$	-0.5
710	11:58:21	459	68.2	6	68	$1.0*V_Y$	0.0
720	12:01:35	534	68.5	6	68	$1.0*V_Y$	0.0
730	12:05:36	708	68.2	6	68	$1.0*V_Y$	0.0
810	12:09:44	708	61.9	3	64	$1.0*V_Y$	0.1
820	12:13:49	286	77.2	3	64	$1.0*V_Y$	-0.8
830	12:21:06	381	57.2	3	64	$1.0*V_Y$	0.5

D.8 Schweizer 300C

Reference speeds for the Schweizer 300C helicopter are based on a maximum speed in level flight with maximum continuous power (V_H) of 86 knots, a speed for best rate of climb (V_Y) of 41 knots, and a not-to-exceed speed (V_{NE}) of 95 knots. The adjustment factors used to calculate the helicopter reference speeds are included in Table 114.

Table 114. Schweizer 300C Event TSPI Data

Event #	Time at L_{ASmx}	Test Altitude (ft, AGL)	Test Speed (kts)	Test Descent angle (degrees)	Ref. Speed (kts)	Ref. Speed Adj. Factor	DUR_{ADJ} (dB)
110	10:17:02	495	57.5	0	55	$0.6*V_{NE}$	-0.2
120	10:20:54	499	53.5	0	55	$0.6*V_{NE}$	0.1
130	10:25:13	485	52.5	0	55	$0.6*V_{NE}$	0.2
140	10:29:16	489	52.7	0	55	$0.6*V_{NE}$	0.2
210	10:33:23	496	71.3	0	73	$0.9*V_{NE}$	0.1
220	10:37:40	496	73.3	0	73	$0.9*V_{NE}$	0.0
230	10:41:47	497	73.1	0	73	$0.9*V_{NE}$	0.0
240	10:47:16	508	74.8	0	73	$0.9*V_{NE}$	-0.1
310	10:52:05	706	39.6	NA	39	$1.0*V_Y$	-0.1
320	10:59:42	723	43.8	NA	39	$1.0*V_Y$	-0.5
330	11:07:09	595	36.8	NA	39	$1.0*V_Y$	0.3
340	11:12:52	538	36.8	NA	39	$1.0*V_Y$	0.3
350	11:18:17	533	41.7	NA	39	$1.0*V_Y$	-0.3
410	11:23:05	585	54.6	NA	42	$0.7*V_H$	-1.1
420	11:27:11	617	53.3	NA	42	$0.7*V_H$	-1.0
430	11:32:47	696	39.2	NA	42	$1.0*V_Y$	0.3
440	11:37:37	627	36.1	NA	42	$1.0*V_Y$	0.7
450	11:42:39	568	44.3	NA	42	$1.0*V_Y$	-0.2
510	11:47:33	447	63	6	67	$1.0*V_Y$	0.3
520	11:53:04	484	66.3	6	67	$1.0*V_Y$	0.0
530	11:57:14	513	66.7	6	67	$1.0*V_Y$	0.0
540	12:02:20	492	66.8	9	67	$1.0*V_Y$	0.0
830	14:15:02	469	62.8	9	61	$1.0*V_Y$	-0.1
840	14:19:27	451	56.6	9	61	$1.0*V_Y$	0.3
1010	14:25:02	511	69.2	0	70	$0.8*V_H$	0.0
1020	14:29:10	492	69.6	0	70	$0.8*V_H$	0.0
1030	14:33:25	507	73.1	0	70	$0.8*V_H$	-0.2
1110	14:38:19	494	57.6	0	63	$0.7*V_H$	0.4
1120	14:42:51	496	67.2	0	63	$0.7*V_H$	-0.3
1130	14:48:03	507	63.3	0	63	$0.7*V_H$	0.0

This page intentionally left blank.

APPENDIX E: AIRCRAFT NOISE-POWER-DISTANCE TABLES

Appendix E presents left-side, center, and right-side (relative to the direction of travel) NPDs for all measured aircraft. Hover data for helicopters are presented in tabular format. The helicopter noise calculation methodology to be included in the INM 7.0 Series utilizes centerline and sideline NPDs to account for directivity. Data presented include tabular NPD results generated for four noise metrics: sound exposure level (SEL), denoted by the ANSI symbol L_{AE}, maximum, slow time- and A-weighted sound level (MXSA), denoted by the ANSI symbol L_{ASmx}, effective perceived noise level (EPNL), denoted by the ANSI symbol L_{EPN}, and tone-adjusted maximum, slow time-weighted, perceived noise level (MXSPNT), denoted by the symbol L_{PNTSmx}. If the noise from a prescribed study series was not collected or could not be used in the data processing, the missing data are indicated with “ND” (No Data) in the tables. If the noise from a study series was not applicable to a particular aircraft, the missing data is indicated with “NA” (Not Applicable) in the tables. Each aircraft’s reference speeds (RS) are also noted in the tables. All speeds are in knots (kts).

E.1 Dynamic Operations Noise-Power-Distance Tables

E.1.1 Cessna 182 Skylane

Table 115. Cessna 182 L_{AE} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft L_{AE} @ 160 kts			200 Series LFO: Normal Cruise @ 500 ft L_{AE} @ 160 kts			300 Series DEP: Departure L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	83.0	82.6	82.2	87.2	86.2	85.6	95.7	95.4	95.2
400	78.9	78.6	78.2	83.1	82.2	81.6	91.6	91.3	91.1
630	76.2	75.8	75.5	80.3	79.5	78.9	88.8	88.5	88.3
1000	73.2	73.0	72.7	77.2	76.6	76.0	85.8	85.4	85.3
2000	68.3	68.3	68.1	72.3	71.9	71.3	80.6	80.3	80.2
4000	62.9	63.2	63.0	66.7	66.6	65.9	74.4	74.1	74.2
6300	58.8	59.5	59.2	62.6	62.8	61.9	69.5	69.2	69.4
10000	54.3	55.4	54.9	58.0	58.5	57.3	63.7	63.4	63.7
16000	49.1	50.8	49.9	52.7	53.5	51.9	56.7	56.5	56.9
25000	43.4	45.9	44.2	46.9	48.2	46.0	49.1	49.3	49.3

Dist. (ft)	400 Series DEP: Cruise Climb L_{AE} @ 160 kts			500 Series APP: Flaps 10 L_{AE} @ 160 kts			600 Series APP: Flaps 30 L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	87.7	87.8	86.8	76.5	75.6	76.5	76.7	76.2	76.4
400	83.7	83.8	82.8	72.5	71.7	72.5	72.7	72.3	72.4
630	80.9	81.1	80.1	69.7	69.0	69.8	69.9	69.6	69.7
1000	78.0	78.2	77.2	66.7	66.2	66.9	66.9	66.8	66.9
2000	73.3	73.6	72.6	62.0	61.7	62.3	62.2	62.3	62.3
4000	68.0	68.2	67.2	56.5	56.7	57.1	56.8	57.3	57.3
6300	63.9	64.2	63.1	52.5	53.1	53.3	52.9	53.7	53.5
10000	59.2	59.6	58.3	47.9	49.2	49.0	48.3	49.7	49.2
16000	53.8	54.2	52.7	42.6	44.7	43.9	43.0	45.1	44.1
25000	47.7	48.4	46.5	36.8	39.8	38.2	37.4	40.2	38.4

Table 116. Cessna 182 L_{ASmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: Normal Cruise @ 500 ft			300 Series DEP: Departure		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	80.3	80.1	80.2	84.7	84.0	83.4	96.8	96.1	96.1
400	74.0	73.9	74.0	78.4	77.7	77.1	90.5	89.8	89.8
630	69.7	69.7	69.8	74.1	73.5	72.9	86.2	85.5	85.5
1000	65.3	65.3	65.4	69.6	69.1	68.6	81.6	80.9	81.0
2000	58.1	58.4	58.6	62.4	62.1	61.6	74.2	73.5	73.7
4000	50.4	51.0	51.2	54.5	54.6	54.0	65.8	65.0	65.3
6300	44.9	45.8	45.9	49.0	49.3	48.5	59.4	58.6	59.1
10000	38.9	40.2	40.1	42.8	43.5	42.4	52.1	51.3	51.9
16000	32.2	34.1	33.6	36.0	37.0	35.5	43.6	43.0	43.5
25000	25.0	27.7	26.5	28.8	30.3	28.1	34.5	34.3	34.5

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 10			600 Series APP: Flaps 30		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	86.9	87.5	86.6	73.6	73.3	73.0	73.2	73.9	73.3
400	80.6	81.2	80.4	67.3	67.1	66.8	66.9	67.7	67.1
630	76.4	77.0	76.2	63.0	62.9	62.6	62.6	63.5	62.9
1000	72.0	72.7	71.9	58.5	58.6	58.2	58.2	59.2	58.6
2000	65.0	65.7	65.0	51.5	51.8	51.3	51.1	52.5	51.8
4000	57.4	58.2	57.4	43.8	44.6	43.9	43.5	45.4	44.4
6300	51.9	52.7	51.8	38.3	39.6	38.6	38.1	40.3	39.2
10000	45.7	46.6	45.4	32.2	34.1	32.8	32.0	34.8	33.4
16000	38.7	39.7	38.2	25.3	28.1	26.2	25.2	28.8	26.8
25000	31.2	32.3	30.6	18.1	21.8	19.0	18.1	22.4	19.6

Table 117. Cessna 182 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: Normal Cruise @ 500 ft			300 Series DEP: Departure		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	95.1	92.7	92.3	95.9	94.3	93.8	103.8	102.4	102.7
400	88.6	86.1	85.8	89.4	87.9	87.3	97.3	95.9	96.2
630	84.1	81.7	81.3	84.9	83.4	82.8	92.9	91.5	91.8
1000	79.2	76.6	76.4	80.0	78.5	77.9	88.1	86.8	87.0
2000	71.5	68.7	68.8	72.0	70.6	70.1	80.4	79.1	79.3
4000	63.1	60.2	60.3	63.5	62.0	61.6	71.9	70.5	70.7
6300	57.1	54.6	54.3	58.0	56.1	55.9	66.2	64.9	64.9
10000	49.9	47.1	45.8	51.9	50.0	47.9	60.0	58.9	58.6
16000	38.4	34.9	32.1	42.6	40.1	34.9	51.6	50.8	49.4
25000	21.0	16.7	11.4	28.5	25.2	15.4	39.0	38.5	35.6

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 10			600 Series APP: Flaps 30		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	101.8	97.8	97.0	88.8	86.8	88.0	88.5	88.2	89.1
400	95.4	91.3	90.5	82.0	80.2	81.2	81.7	81.7	82.4
630	91.0	87.0	86.1	77.4	75.3	76.5	77.1	77.0	77.7
1000	86.3	82.3	81.5	72.4	70.2	71.5	72.1	71.9	72.7
2000	78.8	74.7	74.0	64.5	62.0	63.4	64.1	63.7	64.7
4000	70.4	66.3	65.7	55.2	53.0	54.6	54.8	54.7	55.8
6300	64.7	60.7	60.0	48.5	45.5	47.8	48.2	47.5	48.2
10000	58.6	54.7	52.4	38.1	33.5	36.8	38.1	35.8	36.1
16000	48.7	44.9	40.2	21.2	14.1	19.1	21.7	16.8	16.4
25000	33.8	30.2	21.8	-4.1	-15.0	-7.5	-2.9	-11.7	-13.2

Table 118. Cessna 182 L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: Normal Cruise @ 500 ft			300 Series DEP: Departure		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	96.4	96.4	95.3	99.1	99.3	97.3	107.8	107.4	107.4
400	89.8	89.9	88.8	92.5	92.8	90.8	101.3	100.9	100.9
630	85.3	85.4	84.3	88.0	88.4	86.3	96.8	96.5	96.4
1000	80.5	80.4	79.5	83.2	83.4	81.4	92.1	91.8	91.7
2000	72.7	72.5	71.8	75.2	75.5	73.6	84.4	84.1	84.0
4000	64.4	63.9	63.3	66.7	66.9	65.1	75.8	75.5	75.4
6300	58.3	58.4	57.4	61.2	61.0	59.4	70.1	69.9	69.5
10000	51.2	50.9	48.9	55.1	54.9	51.4	64.0	64.0	63.3
16000	39.6	38.7	35.1	45.7	45.0	38.4	55.6	55.8	54.1
25000	22.3	20.5	14.4	31.7	30.2	18.9	43.0	43.5	40.2

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 10			600 Series APP: Flaps 30		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	101.8	101.5	100.2	89.2	91.1	88.3	88.2	92.1	89.6
400	95.4	95.0	93.7	82.5	84.5	81.6	81.4	85.6	83.0
630	91.0	90.7	89.4	77.8	79.7	76.8	76.8	80.8	78.3
1000	86.3	86.0	84.7	72.9	74.5	71.8	71.8	75.7	73.3
2000	78.8	78.4	77.2	64.9	66.4	63.7	63.8	67.6	65.3
4000	70.4	70.0	68.9	55.6	57.3	54.9	54.5	58.6	56.3
6300	64.7	64.4	63.2	48.9	49.8	48.1	47.9	51.4	48.8
10000	58.6	58.4	55.6	38.5	37.9	37.2	37.8	39.6	36.6
16000	48.7	48.6	43.4	21.7	18.4	19.5	21.4	20.7	16.9
25000	33.8	33.9	25.0	-3.6	-10.7	-7.2	-3.2	-7.8	-12.6

E.1.2 Cessna 208B Grand Caravan

Table 119. Cessna 208B L_{AE} NPDs

Dist. (ft)	Series 100 LFO: Tour Cruise @ 500 ft			Series 200 LFO: Normal Cruise @ 500 ft			Series 300 DEP: Departure		
	L_{AE} @ 160 kts			L_{AE} @ 160 kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	85.0	84.8	83.7	89.1	88.1	87.9	90.8	89.7	89.0
400	80.9	80.8	79.6	85.1	84.1	83.9	86.9	85.8	85.1
630	78.2	78.1	76.9	82.4	81.4	81.2	84.2	83.2	82.5
1000	75.3	75.3	74.0	79.5	78.5	78.3	81.4	80.4	79.7
2000	70.7	70.7	69.5	74.8	73.8	73.7	76.9	75.9	75.2
4000	65.6	65.5	64.3	69.5	68.4	68.3	71.8	70.9	70.2
6300	61.6	61.6	60.5	65.4	64.3	64.3	67.9	67.1	66.3
10000	56.9	56.9	55.9	60.6	59.4	59.5	63.3	62.6	61.8
16000	51.2	51.1	50.4	54.7	53.4	53.6	57.6	57.1	56.2
25000	44.5	44.4	43.9	47.9	46.5	46.8	50.9	50.9	49.7

Dist. (ft)	Series 400 DEP: Cruise Climb			Series 500 APP: Flaps 20, Fast			600 Series APP: 20, Slow		
	L_{AE} @ 160 kts			L_{AE} @ 160 kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	87.9	87.7	86.8	90.3	89.9	89.3	89.8	89.4	89.1
400	84.0	83.8	82.9	86.2	85.8	85.2	85.0	85.3	85.1
630	81.3	81.1	80.2	83.5	83.0	82.5	81.7	82.4	82.3
1000	78.5	78.3	77.4	80.6	80.1	79.6	78.3	79.4	79.3
2000	73.9	73.7	72.8	75.8	75.4	74.9	72.9	74.7	74.6
4000	68.6	68.4	67.6	70.4	70.1	69.7	66.9	69.3	69.4
6300	64.5	64.3	63.6	66.3	65.9	65.6	62.4	65.3	65.4
10000	59.5	59.4	58.8	61.2	61.0	60.8	57.1	60.6	60.7
16000	53.4	53.2	52.8	55.0	54.7	54.8	50.8	54.7	54.9
25000	46.2	46.1	45.8	47.7	47.4	47.9	43.4	47.9	48.1

Table 120. Cessna 208B L_{ASmx} NPDs

Dist. (ft)	Series 100 LFO: Tour Cruise @ 500 ft			Series 200 LFO: Normal Cruise @ 500 ft			Series 300 DEP: Departure		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	84.9	85.2	83.1	88.2	86.8	87.5	91.0	90.0	89.3
400	78.7	78.9	76.8	81.9	80.6	81.2	84.8	83.8	83.2
630	74.4	74.7	72.6	77.7	76.4	77.0	80.7	79.7	79.0
1000	70.1	70.4	68.2	73.3	72.0	72.6	76.4	75.4	74.7
2000	63.2	63.6	61.4	66.3	65.0	65.7	69.6	68.7	68.0
4000	55.8	56.1	54.0	58.7	57.4	58.1	62.3	61.4	60.7
6300	50.4	50.7	48.7	53.2	51.8	52.6	56.9	56.1	55.4
10000	44.2	44.5	42.6	46.9	45.4	46.3	50.8	50.1	49.4
16000	36.9	37.2	35.5	39.5	37.8	38.9	43.5	43.1	42.2
25000	28.7	29.0	27.6	31.2	29.5	30.6	35.4	35.4	34.2

Dist. (ft)	Series 400 DEP: Cruise Climb			Series 500 APP: Flaps 20, Fast			600 Series APP: 20, Slow		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	89.0	88.2	87.2	90.5	90.0	89.1	89.4	90.3	89.4
400	82.8	82.0	81.0	84.2	83.6	82.8	83.1	84.0	83.1
630	78.7	77.8	76.9	79.9	79.4	78.6	78.8	79.7	78.8
1000	74.3	73.5	72.6	75.5	75.0	74.2	74.4	75.2	74.4
2000	67.5	66.7	65.8	68.5	68.0	67.3	67.5	68.2	67.4
4000	59.9	59.1	58.3	60.8	60.4	59.7	60.0	60.6	59.9
6300	54.3	53.5	52.8	55.2	54.8	54.2	54.5	55.1	54.5
10000	47.9	47.1	46.5	48.7	48.3	47.9	48.3	48.7	48.2
16000	40.2	39.4	38.9	40.9	40.5	40.4	40.9	41.1	40.9
25000	31.6	30.8	30.5	32.2	31.7	32.0	32.5	32.6	32.7

Table 121. Cessna 208B L_{EPN} NPDs

Dist. (ft)	Series 100 LFO: Tour Cruise @ 500 ft			Series 200 LFO: Normal Cruise @ 500 ft			Series 300 DEP: Departure		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	96.7	94.9	94.9	98.4	96.1	96.7	102.1	99.8	100.1
400	90.1	88.3	88.3	91.9	89.5	90.1	95.6	93.3	93.6
630	85.6	83.7	83.8	87.4	84.9	85.7	91.3	88.9	89.3
1000	80.8	78.8	79.0	82.7	80.0	81.0	86.7	84.3	84.7
2000	72.9	70.9	71.1	75.0	72.3	73.3	79.5	76.8	77.5
4000	64.1	62.2	62.2	66.3	63.6	64.7	71.3	68.6	69.2
6300	57.7	55.9	56.0	60.2	57.3	58.4	65.2	62.5	63.4
10000	48.9	47.0	47.2	53.5	50.1	51.5	58.0	54.9	57.0
16000	34.9	32.8	33.0	42.7	38.4	40.4	46.3	42.7	46.6
25000	13.9	11.3	11.7	26.6	20.8	23.6	28.8	24.3	31.0

Dist. (ft)	Series 400 DEP: Cruise Climb			Series 500 APP: Flaps 20, Fast			600 Series APP: 20, Slow		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	99.7	97.4	97.0	101.2	99.8	99.5	102.3	101.6	101.2
400	93.1	90.8	90.4	94.6	93.1	92.9	95.7	94.9	94.6
630	88.6	86.3	86.0	90.0	88.5	88.3	91.1	90.3	90.1
1000	83.9	81.5	81.3	85.1	83.6	83.5	86.3	85.4	85.2
2000	76.3	73.9	73.7	77.2	75.7	75.7	78.6	77.4	77.5
4000	67.8	65.5	65.2	68.3	67.0	66.9	69.8	68.7	68.7
6300	61.7	59.3	59.0	61.9	60.7	60.6	63.4	62.3	62.5
10000	54.3	50.9	50.0	54.9	52.3	52.7	55.5	54.9	55.8
16000	43.6	37.2	35.3	43.6	38.8	40.0	42.7	43.4	44.8
25000	27.6	16.6	13.3	26.5	18.4	20.9	23.5	26.2	28.4

Table 122. Cessna 208B L_{PNTSmx} NPDs

Dist. (ft)	Series 100 LFO: Tour Cruise @ 500 ft			Series 200 LFO: Normal Cruise @ 500 ft			Series 300 DEP: Departure		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	101.1	100.8	99.2	103.1	102.3	102.4	106.3	105.5	104.4
400	94.5	94.1	92.6	96.6	95.7	95.9	99.8	99.0	98.0
630	89.9	89.5	88.1	92.1	91.1	91.4	95.5	94.6	93.6
1000	85.1	84.7	83.3	87.4	86.3	86.7	90.9	90.0	89.0
2000	77.3	76.8	75.4	79.7	78.5	79.0	83.7	82.5	81.8
4000	68.4	68.1	66.5	71.0	69.9	70.4	75.5	74.2	73.5
6300	62.1	61.7	60.3	64.9	63.5	64.2	69.4	68.1	67.7
10000	53.2	52.9	51.5	58.2	56.3	57.3	62.2	60.6	61.3
16000	39.2	38.6	37.3	47.4	44.6	46.1	50.5	48.3	50.9
25000	18.3	17.2	16.0	31.3	27.0	29.4	33.0	29.9	35.3

Dist. (ft)	Series 400 DEP: Cruise Climb			Series 500 APP: Flaps 20, Fast			600 Series APP: 20, Slow		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	103.8	103.1	101.6	105.5	106.0	104.4	105.4	106.5	105.1
400	97.2	96.6	95.1	98.9	99.3	97.8	98.8	99.8	98.5
630	92.7	92.1	90.6	94.3	94.7	93.2	94.2	95.3	93.9
1000	88.0	87.3	85.9	89.4	89.8	88.3	89.4	90.3	89.1
2000	80.5	79.7	78.3	81.5	81.9	80.6	81.7	82.4	81.3
4000	72.0	71.3	69.8	72.7	73.2	71.8	72.9	73.6	72.5
6300	65.8	65.1	63.6	66.2	66.8	65.4	66.5	67.2	66.4
10000	58.4	56.7	54.6	59.2	58.5	57.6	58.6	59.8	59.6
16000	47.7	42.9	39.9	47.9	44.9	44.9	45.8	48.3	48.7
25000	31.7	22.4	17.9	30.8	24.6	25.8	26.6	31.2	32.2

E.1.3 Dornier 228

Table 123. Dornier 228 L_{AE} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series LFO: Tour Cruise @ 500 ft			300 Series DEP: Departure		
	L_{AE} @ 160 kts			L_{AE} @ 160 kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	93.9	93.1	93.5	88.5	88.2	88.2	88.9	89.9	89.1
400	89.7	88.9	89.3	84.3	83.9	83.9	84.8	85.7	85.0
630	86.8	85.9	86.2	81.4	80.9	80.8	82.0	82.8	82.1
1000	83.6	82.7	82.9	78.3	77.7	77.5	79.1	79.7	79.1
2000	78.5	77.3	77.4	73.2	72.4	72.0	74.3	74.6	74.2
4000	72.7	71.2	70.8	67.4	66.3	65.7	68.9	68.9	68.6
6300	68.5	66.5	65.9	62.9	61.8	61.0	64.9	64.6	64.5
10000	63.7	61.4	60.4	57.8	56.7	55.6	60.4	59.8	59.9
16000	58.4	55.7	54.1	51.9	51.0	49.7	55.3	54.5	54.4
25000	52.9	49.9	47.6	45.7	45.2	43.4	49.9	49.1	48.2

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 1, gear up			600 Series APP: Flaps 2, gear down		
	L_{AE} @ 160 kts			L_{AE} @ 160 kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	89.7	89.7	89.5	88.0	88.5	88.8	87.2	86.7	87.5
400	85.6	85.5	85.2	83.8	84.1	84.3	83.0	82.3	83.0
630	82.8	82.6	82.3	80.9	81.1	81.1	80.1	79.3	79.9
1000	79.8	79.6	79.1	77.8	77.8	77.6	76.9	76.0	76.5
2000	75.0	74.6	73.9	72.7	72.4	71.7	71.8	70.6	70.8
4000	69.5	69.1	68.0	67.0	66.4	65.1	65.8	64.5	64.3
6300	65.4	65.1	63.6	62.6	61.9	60.3	61.4	59.9	59.5
10000	60.8	60.8	58.6	57.6	56.9	54.9	56.2	54.8	54.1
16000	55.7	56.2	52.9	51.8	51.0	48.8	50.2	48.9	48.0
25000	50.1	51.4	46.7	45.6	44.8	42.1	43.7	42.7	41.3

Table 124. Dornier 228 L_{ASmx} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series LFO: Tour Cruise @ 500 ft			300 Series DEP: Departure		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	90.4	89.4	90.1	85.3	84.8	85.0	86.6	88.1	87.6
400	84.0	82.9	83.5	78.8	78.2	78.4	80.3	81.6	81.2
630	79.6	78.5	79.0	74.4	73.7	73.9	76.0	77.2	76.9
1000	75.0	73.7	74.2	69.8	69.0	69.1	71.6	72.6	72.3
2000	67.6	66.1	66.4	62.5	61.4	61.3	64.5	65.3	65.1
4000	59.5	57.7	57.6	54.3	53.1	52.7	56.8	57.3	57.3
6300	53.8	51.6	51.2	48.4	47.1	46.5	51.4	51.5	51.7
10000	47.5	44.9	44.2	41.8	40.5	39.7	45.4	45.2	45.6
16000	40.7	37.7	36.4	34.4	33.3	32.2	38.8	38.4	38.6
25000	33.7	30.4	28.4	26.7	26.0	24.5	31.9	31.5	31.0

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 1, gear up			600 Series APP: Flaps 2, gear down		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	87.0	86.9	86.9	85.1	85.5	86.0	84.6	84.2	85.1
400	80.6	80.5	80.4	78.7	78.8	79.2	78.1	77.5	78.4
630	76.3	76.1	76.0	74.3	74.3	74.5	73.7	73.0	73.8
1000	71.8	71.5	71.3	69.7	69.5	69.5	69.0	68.2	68.8
2000	64.7	64.3	63.8	62.4	61.8	61.4	61.6	60.5	60.9
4000	57.0	56.6	55.7	54.3	53.5	52.5	53.5	52.2	52.2
6300	51.4	51.1	49.8	48.5	47.6	46.2	47.5	46.2	45.9
10000	45.4	45.3	43.3	42.0	41.1	39.3	40.8	39.5	39.0
16000	38.7	39.1	36.1	34.7	33.7	31.6	33.3	32.1	31.3
25000	31.7	32.9	28.4	27.0	26.0	23.5	25.3	24.5	23.2

Table 125. Dornier 228 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series LFO: Tour Cruise @ 500 ft			300 Series DEP: Departure		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	99.8	98.8	99.0	95.5	96.3	95.9	97.4	98.6	98.7
400	92.9	92.0	92.0	88.5	89.4	88.9	90.8	92.0	92.0
630	88.2	87.4	87.1	83.5	84.7	84.0	86.2	87.4	87.4
1000	83.0	82.3	81.8	78.2	79.3	78.6	81.4	82.3	82.6
2000	74.7	73.9	72.9	69.8	70.7	69.8	73.4	74.0	74.6
4000	65.9	64.6	63.5	60.9	61.4	60.3	65.0	65.0	65.7
6300	60.0	58.1	57.4	55.0	54.7	53.9	59.5	58.8	59.9
10000	53.8	51.6	50.5	48.6	46.7	46.5	53.7	52.6	53.8
16000	45.1	41.8	39.8	38.9	33.7	34.7	45.2	43.7	44.7
25000	32.0	27.0	23.6	24.4	14.3	17.0	32.5	30.2	31.0

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 1, gear up			600 Series APP: Flaps 2, gear down		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	97.1	99.2	97.4	95.8	96.3	97.2	95.9	95.9	96.8
400	90.4	92.6	90.7	88.8	89.1	89.9	88.9	88.8	89.7
630	85.9	88.0	86.1	83.9	83.8	84.7	84.0	83.8	84.6
1000	81.0	83.2	81.1	78.6	78.3	79.0	78.7	78.3	79.1
2000	73.0	75.1	72.9	70.3	69.8	69.5	70.3	69.7	70.3
4000	64.5	66.2	64.0	61.7	60.4	60.1	61.1	60.2	60.8
6300	58.8	59.9	57.9	55.8	53.9	53.8	54.9	53.2	54.5
10000	53.1	52.3	51.4	49.4	46.8	46.5	47.9	45.1	47.3
16000	45.0	40.0	41.0	40.0	35.3	34.9	37.6	32.1	35.9
25000	32.8	21.6	25.6	25.8	18.0	17.6	22.0	12.6	18.8

Table 126. Dornier 228 L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series LFO: Tour Cruise @ 500 ft			300 Series DEP: Departure		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	104.4	104.3	103.6	98.5	101.5	99.8	100.7	104.0	103.2
400	97.5	97.5	96.6	91.5	94.7	92.8	94.1	97.4	96.5
630	92.8	92.9	91.7	86.5	89.9	87.9	89.5	92.7	92.0
1000	87.6	87.8	86.4	81.2	84.6	82.5	84.7	87.7	87.1
2000	79.2	79.4	77.5	72.8	76.0	73.8	76.7	79.4	79.1
4000	70.5	70.1	68.1	63.9	66.6	64.2	68.3	70.4	70.2
6300	64.5	63.6	62.0	58.1	59.9	57.8	62.8	64.1	64.4
10000	58.4	57.1	55.1	51.6	51.9	50.4	57.0	58.0	58.3
16000	49.7	47.3	44.4	41.9	39.0	38.6	48.5	49.1	49.2
25000	36.6	32.5	28.2	27.4	19.5	20.9	35.8	35.6	35.5

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 1, gear up			600 Series APP: Flaps 2, gear down		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	101.5	105.0	101.5	98.6	100.7	100.7	98.2	100.1	99.5
400	94.8	98.4	94.8	91.5	93.5	93.5	91.2	93.0	92.4
630	90.2	93.9	90.2	86.6	88.3	88.3	86.3	88.0	87.3
1000	85.4	89.0	85.2	81.3	82.7	82.5	80.9	82.5	81.8
2000	77.4	81.0	77.0	73.0	74.2	73.0	72.5	73.9	73.0
4000	68.9	72.0	68.1	64.4	64.8	63.6	63.4	64.4	63.5
6300	63.1	65.7	62.1	58.5	58.3	57.3	57.1	57.4	57.3
10000	57.5	58.1	55.5	52.1	51.2	50.0	50.2	49.3	50.0
16000	49.4	45.8	45.2	42.7	39.7	38.5	39.8	36.3	38.6
25000	37.2	27.4	29.7	28.5	22.4	21.1	24.3	16.8	21.5

E.1.4 Dornier 328

Table 127. Dornier 328 L_{AE} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series N/A			300 Series DEP: Departure		
	L_{AE} @ 160 kts			L_{AE} @ kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	95.9	97.1	95.8	NA	NA	NA	90.9	90.2	89.3
400	91.6	92.7	91.5	NA	NA	NA	86.9	86.0	85.1
630	88.5	89.7	88.5	NA	NA	NA	84.1	83.2	82.2
1000	85.2	86.4	85.2	NA	NA	NA	81.2	80.3	79.2
2000	79.7	80.9	79.7	NA	NA	NA	76.7	75.8	74.3
4000	73.0	74.4	73.0	NA	NA	NA	71.9	71.0	69.0
6300	67.9	69.3	67.8	NA	NA	NA	68.4	67.6	65.2
10000	61.9	63.7	61.8	NA	NA	NA	64.6	63.8	61.0
16000	55.0	57.5	54.8	NA	NA	NA	60.4	59.5	56.3
25000	48.0	51.6	47.5	NA	NA	NA	55.8	54.8	51.3

NA - Note that the Dornier 328 does not have a 200 Series (tour cruise) since the Dornier 328 is not used for air tours (see Section 1).

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 12, gear up			600 Series APP: Flaps 20, gear down		
	L_{AE} @ 160 kts			L_{AE} @ 160 kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	90.8	90.0	90.3	97.0	95.0	94.3	95.6	95.3	93.0
400	86.5	85.7	86.0	92.1	90.3	89.6	90.7	90.4	88.2
630	83.5	82.7	83.0	88.4	86.8	86.2	86.9	86.7	84.6
1000	80.3	79.6	79.8	84.2	82.8	82.4	82.6	82.5	80.6
2000	75.2	74.6	74.6	76.9	76.2	75.9	75.0	75.1	73.6
4000	69.4	69.1	68.6	68.7	68.8	68.5	66.3	66.9	65.7
6300	65.2	65.0	64.1	62.8	63.6	63.1	60.2	61.3	60.1
10000	60.4	60.5	58.8	56.2	57.8	57.0	53.8	55.3	54.1
16000	54.8	55.4	52.8	48.9	51.4	50.1	46.9	48.8	47.4
25000	48.8	50.1	46.3	41.2	45.1	42.9	39.7	42.2	40.5

Table 128. Dornier 328 L_{ASmx} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series N/A			300 Series DEP: Departure		
	L_{ASmx} @ 160 kts			L_{ASmx} @ kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	92.5	94.5	92.3	NA	NA	NA	89.8	88.8	87.8
400	86.0	87.9	85.8	NA	NA	NA	83.5	82.4	81.3
630	81.5	83.4	81.3	NA	NA	NA	79.3	78.2	77.0
1000	76.6	78.6	76.5	NA	NA	NA	74.9	73.8	72.4
2000	68.8	70.8	68.7	NA	NA	NA	68.1	67.0	65.3
4000	59.9	62.0	59.8	NA	NA	NA	61.0	59.9	57.7
6300	53.3	55.5	53.2	NA	NA	NA	56.1	55.0	52.5
10000	45.8	48.3	45.6	NA	NA	NA	50.8	49.7	46.8
16000	37.4	40.7	37.1	NA	NA	NA	45.0	43.9	40.5
25000	28.9	33.3	28.3	NA	NA	NA	38.9	37.8	34.0

NA - Note that the Dornier 328 does not have a 200 Series (tour cruise) since the Dornier 328 is not used for air tours (see Section 1).

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 12, gear up			600 Series APP: Flaps 20, gear down		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	88.6	87.2	87.8	94.7	91.0	90.8	93.5	91.8	89.7
400	82.0	80.6	81.2	87.5	84.0	83.8	86.3	84.6	82.6
630	77.6	76.2	76.8	82.4	79.0	78.9	81.1	79.4	77.6
1000	72.9	71.5	72.0	76.7	73.6	73.6	75.2	73.7	72.0
2000	65.5	64.3	64.6	67.1	64.7	64.8	65.4	64.1	62.8
4000	57.5	56.5	56.3	56.6	55.1	55.2	54.4	53.6	52.6
6300	51.8	51.0	50.3	49.3	48.4	48.3	46.8	46.5	45.6
10000	45.4	44.9	43.6	41.2	41.1	40.7	38.9	39.0	38.1
16000	38.3	38.3	36.0	32.3	33.2	32.3	30.4	31.1	29.9
25000	30.9	31.6	28.1	23.2	25.4	23.6	21.8	22.9	21.5

Table 129. Dornier 328 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series N/A			300 Series DEP: Departure		
	L_{EPN} @ 160 kts			L_{EPN} @ kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	100.6	102.2	105.0	NA	NA	NA	104.0	101.6	105.5
400	93.6	95.3	98.0	NA	NA	NA	97.4	95.0	98.8
630	88.7	90.4	93.1	NA	NA	NA	92.9	90.5	94.2
1000	83.2	84.9	87.7	NA	NA	NA	88.2	85.8	89.3
2000	74.1	76.1	78.8	NA	NA	NA	80.8	78.2	81.3
4000	64.4	66.5	69.2	NA	NA	NA	72.5	69.7	72.5
6300	57.7	60.1	63.0	NA	NA	NA	66.6	63.7	66.2
10000	50.8	54.1	56.0	NA	NA	NA	59.6	56.6	58.7
16000	40.1	45.3	45.1	NA	NA	NA	48.3	45.1	46.7
25000	24.1	32.2	28.6	NA	NA	NA	31.4	27.8	28.5

NA - Note that the Dornier 328 does not have a 200 Series (tour cruise) since the Dornier 328 is not used for air tours (see Section 1).

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 12, gear up			600 Series APP: Flaps 20, gear down		
	L_{EPN} @ 160 kts			L_{EPN} @ 160 kts			L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	98.0	98.4	101.4	104.3	103.4	105.4	104.6	103.2	104.4
400	91.0	91.7	94.4	97.0	96.2	98.2	97.3	95.8	97.0
630	86.1	87.0	89.4	91.6	90.9	92.9	91.9	90.5	91.7
1000	80.9	81.9	84.1	85.4	84.8	86.9	85.6	84.3	85.7
2000	72.7	73.4	75.8	74.2	74.0	76.4	74.6	73.6	75.1
4000	63.8	64.3	66.6	62.4	62.8	65.8	61.9	61.2	63.4
6300	57.3	57.8	60.4	55.1	55.7	58.8	53.9	54.3	56.3
10000	51.2	50.2	53.7	47.0	47.6	50.9	45.3	46.6	47.9
16000	42.3	38.0	43.0	35.0	34.9	38.6	32.2	35.0	34.7
25000	29.1	19.6	27.0	16.8	16.0	20.1	12.5	17.6	15.0

Table 130. Dornier 328 L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series N/A			300 Series DEP: Departure		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	106.6	108.8	99.3	NA	NA	NA	109.1	107.7	100.2
400	99.6	101.9	92.4	NA	NA	NA	102.5	101.1	93.6
630	94.7	96.9	87.4	NA	NA	NA	98.0	96.6	89.0
1000	89.1	91.5	82.0	NA	NA	NA	93.3	91.8	84.0
2000	80.1	82.7	73.1	NA	NA	NA	85.9	84.2	76.1
4000	70.3	73.1	63.6	NA	NA	NA	77.6	75.7	67.2
6300	63.7	66.7	57.4	NA	NA	NA	71.7	69.8	61.0
10000	56.7	60.7	50.3	NA	NA	NA	64.8	62.7	53.5
16000	46.1	51.9	39.4	NA	NA	NA	53.5	51.2	41.4
25000	30.1	38.8	23.0	NA	NA	NA	36.5	33.9	23.3

NA - Note that the Dornier 328 does not have a 200 Series (tour cruise) since the Dornier 328 is not used for air tours (see Section 1).

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flaps 12, gear up			600 Series APP: Flaps 20, gear down		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	102.3	104.2	97.6	108.7	107.4	101.7	107.9	106.3	102.3
400	95.3	97.5	90.6	101.4	100.1	94.4	100.6	99.0	95.0
630	90.5	92.8	85.6	96.0	94.8	89.2	95.2	93.7	89.7
1000	85.3	87.7	80.3	89.8	88.7	83.1	88.9	87.5	83.6
2000	77.1	79.2	71.9	78.6	77.9	72.7	77.9	76.8	73.0
4000	68.2	70.0	62.8	66.8	66.8	62.0	65.2	64.4	61.3
6300	61.7	63.6	56.6	59.5	59.6	55.1	57.2	57.5	54.2
10000	55.5	56.0	49.9	51.4	51.5	47.1	48.6	49.7	45.8
16000	46.7	43.8	39.2	39.3	38.9	34.8	35.5	38.2	32.6
25000	33.4	25.4	23.2	21.2	19.9	16.3	15.9	20.8	12.9

E.1.5 Piper PA-42 Cheyenne III

Table 131. Piper PA-42 L_{AE} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: Normal Cruise @ 500 ft			300 Series DEP: Departure		
	L_{AE} @ 160 kts			L_{AE} @ 160 kts			L_{AE} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	85.4	85.5	86.5	93.2	92.5	92.4	87.4	87.2	86.7
400	81.1	81.3	82.1	89.1	88.3	88.2	83.4	83.3	82.7
630	78.1	78.3	78.9	86.3	85.4	85.4	80.6	80.6	80.0
1000	74.9	75.1	75.5	83.2	82.4	82.3	77.8	77.7	77.2
2000	69.5	69.8	69.9	78.3	77.4	77.3	73.2	73.2	72.6
4000	63.4	63.9	63.5	72.9	71.8	71.6	68.1	68.0	67.6
6300	59.0	59.5	58.9	69.0	67.7	67.5	64.4	64.1	63.9
10000	54.1	54.7	53.8	64.5	63.0	62.7	60.0	59.6	59.5
16000	48.8	49.1	48.4	59.3	57.5	57.1	54.8	54.0	54.2
25000	43.3	43.1	43.3	53.2	51.6	50.5	48.7	47.5	47.9

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flap up			600 Series APP: Flaps 10			700 Series APP: Flaps 30, gear down		
	L_{AE} @ kts			L_{AE} @ kts			L_{AE} @ 160 kts			L_{AE} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	ND	ND	ND	87.3	87.8	88.0	ND	ND	ND
400	ND	ND	ND	ND	ND	ND	83.0	83.6	83.6	ND	ND	ND
630	ND	ND	ND	ND	ND	ND	80.0	80.7	80.5	ND	ND	ND
1000	ND	ND	ND	ND	ND	ND	76.8	77.6	77.1	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	71.6	72.5	71.6	ND	ND	ND
4000	ND	ND	ND	ND	ND	ND	65.6	66.7	65.5	ND	ND	ND
6300	ND	ND	ND	ND	ND	ND	61.2	62.3	61.0	ND	ND	ND
10000	ND	ND	ND	ND	ND	ND	56.0	57.3	55.8	ND	ND	ND
16000	ND	ND	ND	ND	ND	ND	50.1	51.3	49.7	ND	ND	ND
25000	ND	ND	ND	ND	ND	ND	43.5	44.8	42.9	ND	ND	ND

ND - Due to a temporary malfunction of the dGPSI System, along with time constraints, data for Series 400, 500 and 600 were not collected.

Table 132. Piper PA-42 L_{ASmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: Normal Cruise @ 500 ft			300 Series DEP: Departure		
	L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts			L_{ASmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	82.6	82.3	83.6	91.1	89.7	89.8	86.5	85.9	86.0
400	76.0	75.7	76.9	84.7	83.3	83.4	80.3	79.6	79.8
630	71.6	71.3	72.3	80.4	78.9	79.0	76.0	75.4	75.6
1000	66.8	66.5	67.4	75.8	74.3	74.4	71.7	71.1	71.2
2000	59.2	59.0	59.5	68.7	67.1	67.1	64.8	64.3	64.4
4000	50.9	50.8	50.8	61.0	59.3	59.2	57.5	56.9	57.1
6300	44.9	45.0	44.7	55.6	53.7	53.6	52.3	51.5	51.9
10000	38.5	38.6	38.1	49.6	47.5	47.3	46.4	45.4	46.0
16000	31.7	31.6	31.2	42.8	40.5	40.2	39.7	38.3	39.2
25000	24.7	24.1	24.7	35.3	33.1	32.2	32.1	30.4	31.5

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flap up			600 Series APP: Flaps 10			700 Series APP: Flaps 30, gear down		
	L_{ASmx} @ kts			L_{ASmx} @ kts			L_{ASmx} @ 160 kts			L_{AE} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	ND	ND	ND	85.2	83.6	85.5	ND	ND	ND
400	ND	ND	ND	ND	ND	ND	78.6	77.2	78.8	ND	ND	ND
630	ND	ND	ND	ND	ND	ND	74.1	72.8	74.3	ND	ND	ND
1000	ND	ND	ND	ND	ND	ND	69.4	68.2	69.4	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	61.9	60.9	61.7	ND	ND	ND
4000	ND	ND	ND	ND	ND	ND	53.7	52.8	53.3	ND	ND	ND
6300	ND	ND	ND	ND	ND	ND	47.8	47.0	47.3	ND	ND	ND
10000	ND	ND	ND	ND	ND	ND	41.1	40.4	40.6	ND	ND	ND
16000	ND	ND	ND	ND	ND	ND	33.6	32.8	32.9	ND	ND	ND
25000	ND	ND	ND	ND	ND	ND	25.7	24.9	24.7	ND	ND	ND

ND - Due to a temporary malfunction of the dGPSI System, along with time constraints, data for Series 400, 500 and 600 were not collected.

Table 133. Piper PA-42 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft L_{EPN} @ 160 kts			200 Series LFO: Normal Cruise @ 500 ft L_{EPN} @ 160 kts			300 Series DEP: Departure L_{EPN} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	94.2	91.9	94.7	100.4	98.6	99.1	99.1	96.7	97.8
400	87.3	84.9	87.6	93.8	92.0	92.5	92.5	90.2	91.3
630	82.5	79.9	82.4	89.3	87.4	87.9	88.0	85.8	86.8
1000	77.2	74.5	76.7	84.4	82.5	83.0	83.3	81.2	82.1
2000	68.7	66.2	67.4	76.6	74.4	75.1	75.7	73.5	74.6
4000	59.3	57.1	57.8	67.8	65.4	66.3	67.1	65.0	65.9
6300	52.4	51.2	51.0	61.9	58.9	60.2	60.9	58.9	59.7
10000	43.7	44.2	42.9	56.2	52.8	54.3	52.1	50.8	51.8
16000	29.7	33.0	29.7	48.0	44.4	45.8	37.8	37.8	39.1
25000	8.6	16.3	9.9	35.7	32.0	33.0	16.3	18.2	19.9

Dist. (ft)	400 Series DEP: Cruise Climb L_{EPN} @ kts			500 Series APP: Flap up L_{EPN} @ kts			600 Series APP: Flaps 10 L_{EPN} @ 160 kts			700 Series APP: Flaps 30, gear down L_{AE} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	ND	ND	ND	95.9	94.6	96.4	ND	ND	ND
400	ND	ND	ND	ND	ND	ND	88.9	87.9	89.2	ND	ND	ND
630	ND	ND	ND	ND	ND	ND	84.1	83.3	84.1	ND	ND	ND
1000	ND	ND	ND	ND	ND	ND	78.8	78.2	78.5	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	70.3	70.0	69.8	ND	ND	ND
4000	ND	ND	ND	ND	ND	ND	60.9	61.0	60.2	ND	ND	ND
6300	ND	ND	ND	ND	ND	ND	54.4	54.3	53.5	ND	ND	ND
10000	ND	ND	ND	ND	ND	ND	46.1	46.4	46.2	ND	ND	ND
16000	ND	ND	ND	ND	ND	ND	32.8	33.5	34.3	ND	ND	ND
25000	ND	ND	ND	ND	ND	ND	12.8	14.1	16.5	ND	ND	ND

ND - Due to a temporary malfunction of the dGPSI System, along with time constraints, data for Series 400, 500 and 600 were not collected.

Table 134. Piper PA-42 L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: Normal Cruise @ 500 ft			300 Series DEP: Departure		
	L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts			L_{PNTSmx} @ 160 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	98.3	97.1	99.3	106.7	105.9	104.9	103.9	101.4	103.1
400	91.4	90.1	92.2	100.1	99.3	98.3	97.3	95.0	96.6
630	86.6	85.1	87.1	95.6	94.8	93.7	92.9	90.6	92.1
1000	81.2	79.7	81.4	90.7	89.9	88.8	88.1	85.9	87.4
2000	72.7	71.3	72.0	82.9	81.8	81.0	80.5	78.3	79.8
4000	63.4	62.3	62.4	74.1	72.8	72.1	71.9	69.8	71.2
6300	56.5	56.4	55.7	68.2	66.3	66.0	65.7	63.6	65.0
10000	47.8	49.3	47.5	62.5	60.1	60.1	56.9	55.6	57.1
16000	33.8	38.2	34.3	54.3	51.8	51.6	42.6	42.5	44.3
25000	12.7	21.5	14.6	42.0	39.4	38.8	21.1	23.0	25.2

Dist. (ft)	400 Series DEP: Cruise Climb			500 Series APP: Flap up			600 Series APP: Flaps 10			700 Series APP: Flaps 30, gear down		
	L_{PNTSmx} @ kts			L_{PNTSmx} @ kts			L_{PNTSmx} @ 160 kts			L_{AE} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	ND	ND	ND	100.6	99.4	101.1	ND	ND	ND
400	ND	ND	ND	ND	ND	ND	93.7	92.7	94.0	ND	ND	ND
630	ND	ND	ND	ND	ND	ND	88.9	88.1	88.9	ND	ND	ND
1000	ND	ND	ND	ND	ND	ND	83.6	83.0	83.3	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	75.1	74.8	74.6	ND	ND	ND
4000	ND	ND	ND	ND	ND	ND	65.7	65.8	65.0	ND	ND	ND
6300	ND	ND	ND	ND	ND	ND	59.1	59.1	58.3	ND	ND	ND
10000	ND	ND	ND	ND	ND	ND	50.9	51.2	50.9	ND	ND	ND
16000	ND	ND	ND	ND	ND	ND	37.6	38.3	39.1	ND	ND	ND
25000	ND	ND	ND	ND	ND	ND	17.6	18.9	21.2	ND	ND	ND

ND - Due to a temporary malfunction of the dGPSI System, along with time constraints, data for Series 400, 500 and 600 were not collected.

E.1.6 Bell 407

Table 135. Bell 407 L_{AE} NPDs

Dist. (ft)	Series 100 LFO: Normal Cruise @ 500 ft			Series 200 LFO: High Cruise (0.9*Vne)			Series 300 DEP: Departure			Series 400 DEP: Cruise Climb (Accel.)		
	L_{AE} @ 94 kts			L_{AE} @ 133 kts			L_{AE} @ 80 kts			L_{AE} @ 76 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	90.0	90.4	89.4	97.0	92.8	93.0	90.7	90.3	90.1	89.0	88.2	89.6
400	86.5	87.0	85.9	93.6	89.5	89.6	87.3	86.8	86.6	85.6	84.9	86.2
630	84.1	84.7	83.4	91.2	87.2	87.1	84.9	84.4	84.1	83.2	82.6	83.8
1000	81.4	82.1	80.7	88.6	84.7	84.4	82.3	81.8	81.4	80.6	80.0	81.1
2000	76.9	78.0	76.1	84.2	80.6	79.8	77.8	77.4	76.7	76.1	75.8	76.6
4000	71.4	73.1	70.6	78.8	75.8	74.2	72.5	72.3	70.9	70.7	70.8	71.1
6300	67.2	69.3	66.4	74.6	72.0	69.8	68.3	68.4	66.5	66.5	66.9	66.9
10000	62.3	64.7	61.5	69.4	67.4	64.6	63.4	63.8	61.3	61.7	62.4	62.0
16000	57.1	59.2	55.9	63.4	61.8	58.4	57.7	58.5	55.3	56.3	57.1	56.6
25000	51.8	52.9	49.9	56.9	55.4	51.8	51.6	52.6	49.2	50.6	51.1	50.8

Dist. (ft)	Series 500 APP: -6 degrees			Series 600 APP: -6 degrees, Decel.			Series 700 APP: -3 degrees			Series 800 APP: -9 degrees		
	L_{AE} @ 65 kts			L_{AE} @ kts			L_{AE} @ 61 kts			L_{AE} @ 36 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	89.4	93.9	94.5	ND	ND	ND	90.7	91.8	96.5	93.6	94.0	89.1
400	86.1	90.7	91.3	ND	ND	ND	87.4	88.5	93.1	90.2	90.7	85.7
630	83.9	88.5	89.0	ND	ND	ND	85.1	86.2	90.8	88.0	88.5	83.4
1000	81.5	86.1	86.6	ND	ND	ND	82.7	83.8	88.3	85.5	86.1	80.9
2000	77.5	82.2	82.5	ND	ND	ND	78.6	79.6	83.9	81.3	82.1	76.6
4000	72.9	77.5	77.4	ND	ND	ND	73.7	74.7	78.4	76.3	77.3	71.6
6300	69.4	73.7	73.3	ND	ND	ND	69.7	70.9	73.8	72.4	73.6	67.7
10000	65.2	69.1	68.1	ND	ND	ND	65.0	66.2	68.1	67.6	69.2	63.1
16000	60.2	63.3	61.5	ND	ND	ND	59.4	60.6	61.2	61.7	63.8	57.7
25000	54.6	56.6	53.9	ND	ND	ND	53.5	54.5	53.8	55.1	57.6	51.6

ND - Due to time constraints, data for Series 600 were not collected.

Dist. (ft)	Series 900 APP: -12 degrees			Series 1000 LFO: Cruise (0.8*Vh)			Series 1100 LFO: Cruise (0.7*Vh)		
	L_{AE} @ 21 kts			L_{AE} @ 109 kts			L_{AE} @ 98 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	93.0	94.0	92.7	90.4	92.4	92.9	90.5	93.5	94.0
400	89.5	90.6	89.3	86.9	89.1	89.5	87.0	90.2	90.6
630	87.1	88.2	86.9	84.4	86.8	87.1	84.5	87.9	88.3
1000	84.5	85.7	84.3	81.7	84.3	84.5	81.8	85.5	85.7
2000	80.0	81.4	80.0	77.0	80.2	80.0	77.1	81.5	81.3
4000	74.8	76.4	74.8	71.4	75.3	74.7	71.6	76.6	75.8
6300	70.8	72.6	70.8	67.1	71.5	70.6	67.4	72.7	71.4
10000	66.3	68.3	66.2	62.1	66.9	65.8	62.6	68.0	66.2
16000	61.3	63.2	60.8	56.3	61.3	60.4	57.0	62.4	60.3
25000	56.2	57.7	55.0	49.9	55.0	54.9	51.1	56.1	54.6

Table 136. Bell 407 L_{ASmx} NPDs

Dist. (ft)	Series 100 LFO: Normal Cruise @ 500 ft			Series 200 LFO: High Cruise (0.9*Vne)			Series 300 DEP: Departure			Series 400 DEP: Cruise Climb (Accel.)		
	L_{ASmx} @ 94 kts			L_{ASmx} @ 133 kts			L_{ASmx} @ 80 kts			L_{ASmx} @ 76 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	86.7	86.1	84.5	97.1	90.4	89.4	87.9	86.3	86.1	84.0	82.4	84.8
400	80.3	79.8	78.0	90.7	84.1	82.9	81.4	79.8	79.6	77.6	76.0	78.3
630	75.9	75.5	73.6	86.4	79.9	78.5	77.1	75.4	75.1	73.3	71.7	74.0
1000	71.2	70.9	68.8	81.8	75.4	73.8	72.4	70.8	70.4	68.6	67.2	69.3
2000	63.6	63.8	61.2	74.4	68.3	66.2	65.0	63.4	62.7	61.2	59.9	61.7
4000	55.1	55.8	52.7	66.0	60.5	57.6	56.6	55.2	53.9	52.7	51.9	53.3
6300	48.9	50.1	46.5	59.7	54.7	51.2	50.5	49.4	47.5	46.6	46.1	47.1
10000	42.1	43.5	39.6	52.6	48.1	44.0	43.6	42.8	40.3	39.7	39.6	40.2
16000	34.8	35.9	32.0	44.5	40.4	35.8	35.8	35.4	32.3	32.3	32.2	32.7
25000	27.6	27.7	24.0	36.1	32.1	27.3	27.7	27.5	24.2	24.7	24.2	25.0

Dist. (ft)	Series 500 APP: -6 degrees			Series 600 APP: -6 degrees, Decel.			Series 700 APP: -3 degrees			Series 800 APP: -9 degrees		
	L_{ASmx} @ 65 kts			L_{ASmx} @ kts			L_{ASmx} @ 61 kts			L_{ASmx} @ 36 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	84.7	91.9	91.4	ND	ND	ND	86.6	86.3	94.6	87.3	87.0	83.0
400	78.4	85.7	85.1	ND	ND	ND	80.3	80.0	88.3	81.0	80.7	76.7
630	74.2	81.5	80.9	ND	ND	ND	76.1	75.8	84.0	76.7	76.5	72.3
1000	69.7	77.1	76.4	ND	ND	ND	71.6	71.3	79.5	72.2	72.0	67.8
2000	62.8	70.2	69.3	ND	ND	ND	64.5	64.1	72.1	65.1	65.0	60.5
4000	55.2	62.4	61.3	ND	ND	ND	56.6	56.2	63.6	57.1	57.3	52.5
6300	49.7	56.7	55.2	ND	ND	ND	50.7	50.4	57.0	51.1	51.6	46.6
10000	43.5	50.0	48.0	ND	ND	ND	43.9	43.7	49.3	44.4	45.2	40.1
16000	36.5	42.2	39.3	ND	ND	ND	36.3	36.1	40.3	36.5	37.7	32.6
25000	28.9	33.6	29.8	ND	ND	ND	28.4	28.0	31.0	27.9	29.6	24.6

ND - Due to time constraints, data for Series 600 were not collected.

Dist. (ft)	Series 900 APP: -12 degrees			Series 1000 LFO: Cruise (0.8*Vh)			Series 1100 LFO: Cruise (0.7*Vh)		
	L_{ASmx} @ 21 kts			L_{ASmx} @ 109 kts			L_{ASmx} @ 98 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	83.7	84.1	83.1	86.3	89.0	88.5	85.2	89.8	91.1
400	77.3	77.7	76.7	79.8	82.7	82.1	78.7	83.5	84.7
630	72.9	73.4	72.4	75.4	78.4	77.7	74.2	79.3	80.4
1000	68.2	68.8	67.8	70.6	74.0	73.1	69.5	74.8	75.8
2000	60.8	61.5	60.4	63.0	66.9	65.6	61.8	67.8	68.4
4000	52.5	53.5	52.2	54.4	59.0	57.3	53.3	59.9	59.9
6300	46.5	47.7	46.3	48.1	53.1	51.2	47.1	54.1	53.6
10000	40.1	41.4	39.7	41.1	46.5	44.5	40.3	47.4	46.3
16000	33.1	34.3	32.2	33.2	38.9	37.1	32.7	39.7	38.4
25000	26.0	26.8	24.5	24.9	30.7	29.6	24.8	31.5	30.8

Table 137. Bell 407 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series LFO: High Cruise (0.9*Vne)			300 Series DEP: Departure			400 Series DEP: Cruise Climb (Accel.)		
	L_{EPN} @ 94 kts			L_{EPN} @ 133 kts			L_{EPN} @ 80 kts			L_{EPN} @ 76 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	105.7	104.2	99.6	107.4	102.7	108.5	107.6	101.3	100.0	97.9	95.1	98.0
400	99.1	97.6	92.6	100.7	96.2	102.0	100.8	94.7	93.0	91.2	88.4	91.3
630	94.4	93.0	87.7	96.1	91.6	97.5	96.2	90.0	88.1	86.6	83.8	86.6
1000	89.2	88.1	82.4	91.2	86.8	92.7	91.1	84.2	82.8	81.5	78.7	81.6
2000	80.9	80.3	74.1	83.1	79.1	84.9	82.8	76.3	74.4	73.4	70.6	73.4
4000	71.8	71.5	64.7	74.1	70.5	76.3	73.6	68.4	65.1	64.3	61.6	64.2
6300	65.2	65.1	57.8	67.6	64.4	70.0	67.0	61.8	58.2	57.6	55.6	57.7
10000	57.6	57.3	50.5	61.1	58.4	63.8	60.0	52.9	50.7	50.6	49.2	49.6
16000	46.7	45.4	39.3	53.6	50.8	57.6	50.4	37.9	38.7	39.7	39.2	36.5
25000	30.3	27.5	22.4	43.0	39.5	49.0	35.9	15.2	20.7	23.3	24.2	16.7

Dist. (ft)	500 Series APP: -6 degrees			600 Series APP: -6 degrees, Decel.			700 Series APP: -3 degrees			800 Series APP: -9 degrees		
	L_{EPN} @ 65 kts			L_{EPN} @ kts			L_{EPN} @ 61 kts			L_{EPN} @ 36 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	101.0	104.7	103.5	ND	ND	ND	101.2	100.1	103.5	103.3	102.2	100.9
400	94.4	98.2	97.0	ND	ND	ND	94.5	93.5	96.8	96.7	95.6	94.2
630	89.8	93.8	92.5	ND	ND	ND	89.9	88.9	92.2	92.1	91.1	89.5
1000	84.9	89.0	87.7	ND	ND	ND	85.0	84.0	87.3	87.2	86.3	84.5
2000	77.0	81.5	79.9	ND	ND	ND	77.1	76.1	79.4	79.4	78.6	76.4
4000	68.1	73.0	71.2	ND	ND	ND	68.2	67.3	70.4	70.7	70.2	67.5
6300	61.8	67.0	64.7	ND	ND	ND	61.6	61.3	64.1	64.8	64.6	61.7
10000	55.0	60.3	57.5	ND	ND	ND	54.8	54.2	56.9	58.2	58.4	54.9
16000	44.5	50.3	45.9	ND	ND	ND	44.9	43.1	46.1	47.8	48.7	44.2
25000	28.9	35.2	28.3	ND	ND	ND	30.2	26.5	29.8	32.4	34.2	28.3

ND - Due to time constraints, data for Series 600 were not collected.

Dist. (ft)	900 Series APP: -12 degrees			1000 Series LFO: Cruise (0.8*Vh)			1100 Series LFO: Cruise (0.7*Vh)		
	L_{EPN} @ 21 kts			L_{EPN} @ 109 kts			L_{EPN} @ 98 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	102.2	101.7	102.0	105.5	102.8	107.3	109.8	106.8	110.2
400	95.4	95.0	95.3	99.0	97.2	101.7	103.3	100.3	103.7
630	90.6	90.3	90.7	94.4	92.6	96.3	98.8	95.8	99.2
1000	85.5	85.2	85.6	89.5	87.8	92.3	94.0	91.0	94.5
2000	77.3	77.2	77.5	81.7	80.0	83.3	86.1	83.1	86.4
4000	68.3	68.2	68.5	73.0	70.4	74.4	77.5	74.4	77.4
6300	62.5	62.2	62.1	66.6	64.9	67.8	71.2	68.1	71.0
10000	56.0	56.2	55.2	59.2	58.4	61.2	63.8	60.8	63.7
16000	47.2	47.4	44.0	48.3	48.9	51.7	52.6	50.0	54.6
25000	34.0	34.2	27.2	32.0	34.7	37.5	35.9	33.7	40.9

Table 138. Bell 407 L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Normal Cruise @ 500 ft			200 Series LFO: High Cruise (0.9*Vne)			300 Series DEP: Departure			400 Series DEP: Cruise Climb (Accel.)		
	L_{PNTSmx} @ 94 kts			L_{PNTSmx} @ 133 kts			L_{PNTSmx} @ 80 kts			L_{PNTSmx} @ 76 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	106.0	106.7	99.4	108.8	105.4	109.6	106.9	103.0	99.4	97.9	96.0	98.3
400	99.4	100.1	92.4	102.1	98.8	103.1	100.2	96.3	92.4	91.2	89.3	91.6
630	94.6	95.5	87.5	97.5	94.3	98.6	95.6	91.7	87.4	86.5	84.7	86.9
1000	89.4	90.6	82.2	92.6	89.5	93.8	90.4	85.9	82.2	81.5	79.6	81.9
2000	81.1	82.7	73.9	84.5	81.7	86.0	82.1	78.0	73.8	73.3	71.5	73.7
4000	72.0	74.0	64.6	75.6	73.1	77.3	73.0	70.0	64.5	64.2	62.5	64.5
6300	65.5	67.5	57.6	69.1	67.0	71.1	66.4	63.5	57.6	57.6	56.5	58.0
10000	57.8	59.8	50.3	62.5	61.0	64.9	59.3	54.6	50.0	50.6	50.1	49.9
16000	46.9	47.9	39.1	55.1	53.5	58.6	49.7	39.6	38.0	39.6	40.1	36.7
25000	30.6	30.0	22.2	44.4	42.2	50.0	35.2	16.9	20.0	23.2	25.1	17.0

Dist. (ft)	500 Series APP: -6 degrees			600 Series APP: -6 degrees, Decel.			700 Series APP: -3 degrees			800 Series APP: -9 degrees		
	L_{PNTSmx} @ 65 kts			L_{PNTSmx} @ kts			L_{PNTSmx} @ 61 kts			L_{PNTSmx} @ 36 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	100.8	107.2	104.3	ND	ND	ND	100.1	99.6	101.7	100.8	100.3	96.9
400	94.2	100.7	97.7	ND	ND	ND	93.5	93.0	95.1	94.1	93.7	90.1
630	89.6	96.3	93.2	ND	ND	ND	88.9	88.4	90.4	89.5	89.2	85.5
1000	84.7	91.5	88.4	ND	ND	ND	84.0	83.5	85.6	84.6	84.4	80.4
2000	76.8	83.9	80.7	ND	ND	ND	76.1	75.6	77.6	76.8	76.6	72.3
4000	67.9	75.5	72.0	ND	ND	ND	67.2	66.8	68.6	68.2	68.2	63.5
6300	61.6	69.5	65.5	ND	ND	ND	60.6	60.7	62.3	62.2	62.6	57.6
10000	54.7	62.8	58.3	ND	ND	ND	53.8	53.7	55.1	55.6	56.5	50.8
16000	44.3	52.7	46.6	ND	ND	ND	43.9	42.6	44.3	45.3	46.8	40.2
25000	28.7	37.7	29.1	ND	ND	ND	29.2	26.0	28.0	29.8	32.2	24.2

ND - Due to time constraints, data for Series 600 were not collected.

Dist. (ft)	900 Series APP: -12 degrees			1000 Series LFO: Cruise (0.8*Vh)			1100 Series LFO: Cruise (0.7*Vh)		
	L_{PNTSmx} @ 21 kts			L_{PNTSmx} @ 109 kts			L_{PNTSmx} @ 98 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	97.8	98.3	97.4	105.5	104.2	107.7	110.3	108.2	110.9
400	90.9	91.6	90.7	98.9	98.5	102.1	103.8	101.7	104.4
630	86.2	86.9	86.1	94.4	93.9	96.7	99.3	97.2	99.9
1000	81.1	81.9	81.0	89.5	89.1	92.7	94.5	92.4	95.2
2000	72.9	73.8	72.9	81.6	81.3	83.7	86.6	84.5	87.1
4000	63.9	64.9	63.9	72.9	71.7	74.8	78.0	75.8	78.1
6300	58.0	58.9	57.5	66.5	66.2	68.2	71.7	69.5	71.6
10000	51.6	52.9	50.6	59.2	59.7	61.6	64.3	62.2	64.3
16000	42.8	44.1	39.4	48.3	50.2	52.1	53.1	51.4	55.2
25000	29.6	30.9	22.6	31.9	36.0	37.9	36.4	35.1	41.5

E.1.7 Robinson R44

Table 139. Robinson R44 L_{AE} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: High Cruise @ 500 ft			300 Series DEP: Departure			400 Series N/A		
	L_{AE} @ 83 kts			L_{AE} @ 104 kts			L_{AE} @ 67 kts			L_{AE} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	88.4	89.6	87.7	88.1	88.2	87.4	88.6	87.5	88.1	NA	NA	NA
400	85.0	86.3	84.4	84.7	84.9	84.0	85.2	84.2	84.8	NA	NA	NA
630	82.6	84.0	82.1	82.3	82.7	81.7	82.8	81.9	82.4	NA	NA	NA
1000	79.9	81.5	79.6	79.7	80.2	79.1	80.1	79.5	79.9	NA	NA	NA
2000	75.5	77.4	75.5	75.2	76.1	74.8	75.6	75.4	75.7	NA	NA	NA
4000	70.1	72.4	70.6	70.0	71.2	69.6	70.3	70.8	70.7	NA	NA	NA
6300	66.0	68.4	66.7	66.0	67.4	65.7	66.2	67.3	66.8	NA	NA	NA
10000	61.3	63.5	62.1	61.4	62.8	61.0	61.6	63.1	62.2	NA	NA	NA
16000	55.6	57.5	56.3	56.0	57.0	55.4	56.2	58.0	56.8	NA	NA	NA
25000	49.3	50.7	49.6	50.1	50.5	49.4	50.3	52.2	51.0	NA	NA	NA

NA - Note that R44 did not have a 400 Series. Helicopters typically have one set of departure NPDs (Series 300 for the R44) and supplemental variations of departures were measured only if time permitted.

Dist. (ft)	500 Series APP: -12 degrees			Series 600 APP: -9 degrees			Series 700 APP: -6 degrees			Series 800 APP: -3 degrees		
	L_{AE} @ 66 kts			L_{AE} @ 47 kts			L_{AE} @ 68 kts			L_{AE} @ 64 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	86.3	86.2	84.9	88.8	92.8	92.1	87.5	88.5	89.7	87.3	91.4	90.2
400	82.9	82.9	81.5	85.5	89.5	88.8	84.2	85.3	86.4	84.0	88.1	86.8
630	80.5	80.7	79.2	83.3	87.3	86.6	81.8	83.1	84.2	81.7	85.9	84.6
1000	78.0	78.3	76.6	80.9	84.9	84.1	79.3	80.7	81.8	79.3	83.5	82.1
2000	73.7	74.4	72.2	76.9	81.0	80.1	75.1	76.7	77.8	75.2	79.4	78.0
4000	68.7	69.9	67.0	72.3	76.3	75.2	70.1	72.2	73.1	70.4	74.6	73.1
6300	65.0	66.5	63.1	68.7	72.6	71.4	66.4	68.6	69.4	66.8	70.7	69.3
10000	60.7	62.4	58.5	64.5	68.1	66.7	62.0	64.5	65.0	62.6	66.1	64.6
16000	55.6	57.6	53.1	59.4	62.6	61.0	56.9	59.4	59.5	57.6	60.4	58.8
25000	49.8	52.0	47.1	53.5	56.3	54.4	51.3	53.7	53.2	52.1	54.1	52.2

Table 140. Robinson R44 L_{ASmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: High Cruise @ 500 ft			300 Series DEP: Departure			400 Series N/A		
	L_{ASmx} @ 83 kts			L_{ASmx} @ 104 kts			L_{ASmx} @ 67 kts			L_{ASmx} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	84.8	87.4	85.1	84.4	86.1	83.8	83.8	82.1	82.9	NA	NA	NA
400	78.4	81.1	78.8	78.0	79.8	77.4	77.4	75.7	76.5	NA	NA	NA
630	74.0	76.8	74.5	73.7	75.6	73.1	73.0	71.5	72.2	NA	NA	NA
1000	69.3	72.3	70.0	69.0	71.1	68.5	68.3	67.1	67.7	NA	NA	NA
2000	61.9	65.2	62.9	61.6	64.0	61.2	60.8	60.0	60.5	NA	NA	NA
4000	53.5	57.1	55.0	53.4	56.1	53.0	52.4	52.4	52.5	NA	NA	NA
6300	47.4	51.2	49.1	47.4	50.3	47.1	46.4	46.9	46.6	NA	NA	NA
10000	40.7	44.3	42.5	40.8	43.7	40.4	39.8	40.7	40.0	NA	NA	NA
16000	33.0	36.3	34.6	33.4	35.9	32.8	32.3	33.6	32.6	NA	NA	NA
25000	24.8	27.5	26.0	25.5	27.4	24.8	24.5	25.8	24.9	NA	NA	NA

NA - Note that R44 did not have a 400 Series. Helicopters typically have one set of departure NPDs (Series 300 for the R44) and supplemental variations of departures were measured only if time permitted.

Dist. (ft)	500 Series APP: -12 degrees			Series 600 APP: -9 degrees			Series 700 APP: -6 degrees			Series 800 APP: -3 degrees		
	L_{ASmx} @ 66 kts			L_{ASmx} @ 47 kts			L_{ASmx} @ 68 kts			L_{ASmx} @ 64 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	80.6	80.5	81.9	82.5	87.3	88.5	84.1	82.2	86.0	83.7	88.6	86.5
400	74.2	74.2	75.5	76.2	81.1	82.2	77.7	75.9	79.8	77.4	82.3	80.2
630	69.9	70.0	71.1	72.0	76.9	78.0	73.4	71.7	75.5	73.1	78.1	76.0
1000	65.3	65.6	66.5	67.6	72.5	73.5	68.9	67.3	71.1	68.7	73.7	71.5
2000	58.0	58.7	59.1	60.6	65.5	66.5	61.7	60.4	64.1	61.6	66.6	64.4
4000	50.1	51.1	51.0	53.0	57.8	58.6	53.7	52.8	56.4	53.8	58.8	56.5
6300	44.4	45.8	45.1	47.4	52.2	52.8	48.0	47.3	50.8	48.3	53.0	50.7
10000	38.0	39.7	38.5	41.2	45.7	46.1	41.6	41.1	44.4	42.0	46.3	44.0
16000	30.9	32.8	31.0	34.0	38.2	38.3	34.4	34.0	36.8	35.0	38.7	36.2
25000	23.1	25.3	23.1	26.3	29.9	29.9	26.9	26.3	28.6	27.5	30.4	27.7

Table 141. Robinson R44 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: High Cruise @ 500 ft			300 Series DEP: Departure			400 Series N/A		
	L_{EPN} @ 83 kts			L_{EPN} @ 104 kts			L_{EPN} @ 67 kts			L_{EPN} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	97.2	97.8	96.8	96.6	96.5	97.6	97.8	96.4	98.3	NA	NA	NA
400	90.5	91.1	90.2	89.8	89.8	90.9	90.9	89.8	91.6	NA	NA	NA
630	85.9	86.5	85.6	85.0	85.3	86.3	86.2	85.3	87.0	NA	NA	NA
1000	81.0	81.7	80.8	80.1	80.4	81.4	81.2	80.3	82.1	NA	NA	NA
2000	72.9	73.8	72.9	72.0	72.6	73.4	73.1	72.4	74.2	NA	NA	NA
4000	64.2	65.0	64.2	63.1	64.3	64.4	64.1	63.6	65.3	NA	NA	NA
6300	58.1	59.0	58.2	57.1	58.6	58.5	57.9	57.6	58.5	NA	NA	NA
10000	50.4	51.7	51.2	50.0	51.4	50.9	49.9	49.6	48.4	NA	NA	NA
16000	38.3	40.9	39.8	39.4	40.3	38.6	37.2	36.7	32.1	NA	NA	NA
25000	20.1	24.8	22.8	23.4	23.7	20.2	18.1	17.4	7.7	NA	NA	NA

NA - Note that R44 did not have a 400 Series. Helicopters typically have one set of departure NPDs (Series 300 for the R44) and supplemental variations of departures were measured only if time permitted.

Dist. (ft)	500 Series APP: -12 degrees			Series 600 APP: -9 degrees			Series 700 APP: -6 degrees			Series 800 APP: -3 degrees		
	L_{EPN} @ 66 kts			L_{EPN} @ 47 kts			L_{EPN} @ 68 kts			L_{EPN} @ 64 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	94.2	93.1	96.6	96.8	98.8	99.8	97.2	94.6	97.6	99.4	99.8	99.5
400	87.5	86.5	89.8	90.2	92.3	93.2	90.5	88.0	91.0	92.7	93.2	92.8
630	82.9	81.9	85.2	85.7	87.9	88.7	85.8	83.5	86.4	88.1	88.8	88.2
1000	77.9	77.0	80.2	80.8	83.1	83.9	80.8	78.6	81.6	83.1	84.0	83.3
2000	69.9	69.1	72.2	73.0	75.6	76.2	72.8	70.9	73.9	75.2	76.3	75.4
4000	61.1	61.1	63.2	64.5	67.6	68.0	64.0	62.6	66.1	66.8	68.2	66.7
6300	55.2	55.6	57.0	58.8	62.2	62.3	57.8	57.1	60.6	60.8	62.7	60.9
10000	46.4	47.5	49.3	50.4	55.1	56.0	50.7	49.0	53.8	54.5	56.6	53.7
16000	32.3	34.5	36.9	36.9	43.7	46.0	40.3	35.9	42.7	45.6	47.3	42.3
25000	11.0	15.0	18.3	16.5	26.6	31.0	24.9	16.2	26.0	32.2	33.5	25.3

Table 142. Robinson R44 L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft			200 Series LFO: High Cruise @ 500 ft			300 Series DEP: Departure			400 Series N/A		
	L_{PNTSmx} @ 83 kts			L_{PNTSmx} @ 104 kts			L_{PNTSmx} @ 67 kts			L_{PNTSmx} @ kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	97.5	99.9	98.6	97.5	98.8	97.9	97.4	97.5	97.8	NA	NA	NA
400	90.8	93.3	92.0	90.7	92.2	91.2	90.5	90.9	91.1	NA	NA	NA
630	86.2	88.7	87.4	85.9	87.6	86.6	85.9	86.3	86.5	NA	NA	NA
1000	81.3	83.8	82.6	80.9	82.8	81.7	80.9	81.4	81.6	NA	NA	NA
2000	73.2	75.9	74.7	72.8	74.9	73.7	72.7	73.5	73.7	NA	NA	NA
4000	64.4	67.2	66.0	64.0	66.6	64.8	63.7	64.7	64.8	NA	NA	NA
6300	58.4	61.1	60.0	58.0	61.0	58.8	57.5	58.7	58.0	NA	NA	NA
10000	50.7	53.9	53.0	50.9	53.7	51.2	49.5	50.7	47.9	NA	NA	NA
16000	38.6	43.1	41.6	40.2	42.7	39.0	36.8	37.8	31.6	NA	NA	NA
25000	20.3	26.9	24.6	24.3	26.0	20.6	17.8	18.4	7.2	NA	NA	NA

NA - Note that R44 did not have a 400 Series. Helicopters typically have one set of departure NPDs (Series 300 for the R44) and supplemental variations of departures were measured only if time permitted.

Dist. (ft)	500 Series APP: -12 degrees			Series 600 APP: -9 degrees			Series 700 APP: -6 degrees			Series 800 APP: -3 degrees		
	L_{PNTSmx} @ 66 kts			L_{PNTSmx} @ 47 kts			L_{PNTSmx} @ 68 kts			L_{PNTSmx} @ 64 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	94.8	94.2	95.3	96.3	99.7	100.0	98.5	95.7	97.7	98.6	100.8	99.7
400	88.1	87.6	88.5	89.7	93.2	93.4	91.8	89.1	91.0	91.9	94.3	93.1
630	83.4	83.0	83.9	85.2	88.7	88.9	87.0	84.6	86.5	87.3	89.8	88.5
1000	78.5	78.1	78.9	80.3	84.0	84.1	82.0	79.7	81.7	82.3	85.0	83.6
2000	70.5	70.2	70.9	72.5	76.4	76.4	74.0	72.0	74.0	74.4	77.4	75.7
4000	61.7	62.2	61.9	64.0	68.5	68.2	65.2	63.7	66.1	66.0	69.2	67.0
6300	55.7	56.7	55.7	58.3	63.0	62.5	59.1	58.2	60.7	60.0	63.7	61.1
10000	47.0	48.6	48.0	49.9	56.0	56.2	52.0	50.1	53.9	53.7	57.6	53.9
16000	32.8	35.6	35.6	36.4	44.6	46.2	41.6	37.0	42.7	44.8	48.4	42.6
25000	11.6	16.1	17.0	16.0	27.5	31.2	26.1	17.3	26.1	31.4	34.5	25.6

E.1.7 Schweizer 300c

Table 143. Schweizer 300C L_{AE} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft (0.6*Vne)			200 Series LFO: High Cruise @ 500 ft (0.9*Vne)			300 Series DEP: Departure			400 Series DEP: Cruise Climb (Accel.)		
	L_{AE} @ 55 kts			L_{AE} @ 73 kts			L_{AE} @ 39 kts			L_{AE} @ 42 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	86.1	85.4	85.9	86.5	84.8	86.0	88.6	87.2	87.7	88.4	86.7	87.5
400	82.6	82.0	82.4	83.1	81.3	82.5	85.1	83.8	84.3	84.9	83.3	84.1
630	80.2	79.6	80.0	80.7	79.0	80.1	82.7	81.4	81.9	82.5	80.9	81.7
1000	77.5	77.1	77.3	78.0	76.4	77.5	80.0	78.8	79.3	79.8	78.3	79.1
2000	72.9	72.8	72.8	73.5	72.0	72.8	75.4	74.5	74.8	75.2	73.9	74.7
4000	67.4	67.9	67.2	67.9	66.9	67.2	69.9	69.3	69.4	69.7	68.7	69.4
6300	63.1	64.0	62.8	63.5	63.1	62.6	65.6	65.3	65.1	65.4	64.7	65.3
10000	58.0	59.4	57.4	58.3	58.4	57.2	60.5	60.5	60.0	60.3	59.9	60.4
16000	51.8	53.6	50.9	52.0	52.7	50.5	54.3	54.7	53.8	54.1	54.2	54.4
25000	44.8	46.8	43.6	45.0	46.1	43.0	47.2	47.8	46.8	47.0	47.5	47.5

Dist. (ft)	500 Series APP: -6 degrees			Series 600 APP: -6 degrees, Descent Decel.			Series 700 APP: -3 degrees			Series 800 APP: -9 degrees		
	L_{AE} @ 67 kts			L_{AE} @ 52 kts			L_{AE} @ 64 kts			L_{AE} @ 61 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	85.1	85.1	85.5	83.0	85.8	84.8	82.0	80.7	81.3	85.6	88.6	87.5
400	81.6	81.7	82.1	79.7	82.5	81.5	78.6	77.3	77.9	82.2	85.3	84.2
630	79.2	79.4	79.8	77.3	80.2	79.2	76.2	75.0	75.5	79.9	83.1	81.9
1000	76.5	76.8	77.2	74.8	77.7	76.7	73.5	72.5	72.9	77.2	80.7	79.4
2000	71.8	72.6	72.8	70.5	73.6	72.6	69.0	68.3	68.4	72.9	76.6	75.3
4000	66.3	67.8	67.5	65.5	68.5	67.5	63.5	63.5	63.0	67.6	71.9	70.4
6300	62.0	64.0	63.4	61.6	64.5	63.5	59.3	59.7	58.8	63.5	68.3	66.5
10000	57.0	59.5	58.5	57.0	59.5	58.6	54.3	55.2	53.8	58.7	63.9	62.0
16000	51.0	53.9	52.7	51.6	53.6	52.6	48.3	49.6	47.7	53.0	58.6	56.4
25000	44.2	47.3	46.1	45.3	47.0	45.7	41.6	43.0	40.8	46.5	52.4	50.1

Dist. (ft)	Series 900 APP: -12 degrees			Series 1000 LFO: Cruise (0.8*Vh)			Series 1100 LFO: Cruise (0.7*Vh)		
	L_{AE} @ kts			L_{AE} @ 70 kts			L_{AE} @ 63 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	85.2	83.8	85.2	85.0	84.2	85.2
400	ND	ND	ND	81.8	80.4	81.8	81.6	80.8	81.8
630	ND	ND	ND	79.4	78.0	79.4	79.2	78.5	79.4
1000	ND	ND	ND	76.8	75.5	76.8	76.5	75.9	76.7
2000	ND	ND	ND	72.3	71.2	72.3	72.0	71.6	72.2
4000	ND	ND	ND	66.9	66.3	66.8	66.6	66.6	66.6
6300	ND	ND	ND	62.6	62.6	62.4	62.3	62.8	62.2
10000	ND	ND	ND	57.5	58.1	57.1	57.3	58.2	56.8
16000	ND	ND	ND	51.2	52.6	50.6	51.2	52.5	50.4
25000	ND	ND	ND	44.2	46.1	43.1	44.4	45.9	43.1

ND - Due to time constraints, data for Series 900 were not collected.

Table 144. Schweizer 300C L_{ASmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft (0.6*Vne)			200 Series LFO: High Cruise @ 500 ft (0.9*Vne)			300 Series DEP: Departure			400 Series DEP: Cruise Climb (Accel.)		
	L_{ASmx} @ 55 kts			L_{ASmx} @ 73 kts			L_{ASmx} @ 39 kts			L_{ASmx} @ 42 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	80.4	79.8	80.2	81.9	79.7	82.6	81.8	80.5	82.2	82.8	80.6	81.7
400	73.9	73.4	73.8	75.4	73.3	76.1	75.3	74.1	75.8	76.3	74.1	75.3
630	69.5	69.1	69.4	71.0	68.9	71.7	70.9	69.7	71.4	71.9	69.8	70.9
1000	64.8	64.5	64.7	66.4	64.3	67.1	66.2	65.1	66.8	67.2	65.2	66.3
2000	57.2	57.3	57.1	58.8	57.0	59.4	58.6	57.8	59.3	59.6	57.8	58.9
4000	48.7	49.3	48.5	50.3	48.9	50.8	50.1	49.6	50.9	51.1	49.6	50.6
6300	42.4	43.5	42.1	43.9	43.0	44.2	43.8	43.6	44.6	44.9	43.6	44.5
10000	35.3	36.8	34.7	36.7	36.4	36.8	36.7	36.8	37.5	37.8	36.8	37.6
16000	27.1	29.0	26.2	28.3	28.6	28.1	28.5	28.9	29.3	29.5	29.0	29.5
25000	18.1	20.3	16.9	19.4	20.1	18.7	19.4	20.1	20.3	20.4	20.4	20.7

Dist. (ft)	500 Series APP: -6 degrees			Series 600 APP: -6 degrees, Descent Decel.			Series 700 APP: -3 degrees			Series 800 APP: -9 degrees		
	L_{ASmx} @ 67 kts			L_{ASmx} @ 52 kts			L_{ASmx} @ 64 kts			L_{ASmx} @ 61 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	80.6	79.8	80.4	80.6	85.2	85.6	81.7	79.6	80.6	79.5	86.0	84.0
400	74.1	73.5	74.0	74.1	78.9	79.3	75.3	73.2	74.2	73.0	79.7	77.7
630	69.7	69.1	69.7	69.7	74.6	75.0	71.0	68.9	69.8	68.6	75.5	73.4
1000	65.0	64.6	65.1	65.0	70.2	70.5	66.5	64.4	65.2	64.0	71.0	69.0
2000	57.3	57.4	57.7	57.3	63.0	63.3	59.2	57.2	57.7	56.4	64.0	61.8
4000	48.8	49.5	49.4	48.8	54.9	55.3	51.1	49.3	49.3	48.0	56.3	53.9
6300	42.5	43.8	43.3	42.5	48.9	49.3	45.3	43.6	43.1	41.8	50.7	48.1
10000	35.5	37.3	36.5	35.5	42.0	42.4	38.7	37.1	36.1	34.8	44.3	41.5
16000	27.4	29.6	28.6	27.4	34.0	34.4	31.2	29.4	28.0	26.8	36.9	33.9
25000	18.7	21.0	20.0	18.7	25.4	25.6	23.0	20.9	19.1	18.1	28.8	25.7

Dist. (ft)	Series 900 APP: -12 degrees			Series 1000 LFO: Cruise (0.8*Vh)			Series 1100 LFO: Cruise (0.7*Vh)		
	L_{ASmx} @ kts			L_{ASmx} @ 70 kts			L_{ASmx} @ 63 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	80.4	78.6	81.3	79.3	79.1	79.8
400	ND	ND	ND	74.0	72.2	74.9	72.8	72.7	73.4
630	ND	ND	ND	69.6	67.9	70.5	68.4	68.4	69.0
1000	ND	ND	ND	65.0	63.3	65.9	63.8	63.8	64.4
2000	ND	ND	ND	57.5	56.1	58.4	56.2	56.5	56.8
4000	ND	ND	ND	49.0	48.2	49.8	47.8	48.5	48.2
6300	ND	ND	ND	42.8	42.5	43.5	41.6	42.7	41.8
10000	ND	ND	ND	35.7	36.0	36.2	34.5	36.1	34.5
16000	ND	ND	ND	27.4	28.4	27.6	26.4	28.4	26.0
25000	ND	ND	ND	18.4	19.9	18.3	17.7	19.8	16.8

ND - Due to time constraints, data for Series 900 were not collected.

Table 145. Robinson R44 L_{EPN} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft (0.6*Vne)			200 Series LFO: High Cruise @ 500 ft (0.9*Vne)			300 Series DEP: Departure			400 Series DEP: Cruise Climb (Accel.)		
	L_{EPN} @ 55 kts			L_{EPN} @ 73 kts			L_{EPN} @ 39 kts			L_{EPN} @ 42 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	95.2	94.1	94.8	95.6	93.0	94.5	99.8	96.0	97.9	98.3	95.8	97.7
400	88.3	87.3	88.0	88.8	86.2	87.7	93.0	89.2	91.2	91.4	89.0	90.9
630	83.4	82.6	83.3	84.0	81.5	83.1	88.3	84.5	86.5	86.7	84.3	86.2
1000	78.2	77.6	78.3	79.0	76.5	78.1	83.3	79.5	81.4	81.7	79.2	81.2
2000	69.8	69.5	70.0	70.7	68.3	69.9	75.1	71.3	73.2	73.5	71.1	72.9
4000	60.2	60.2	60.9	61.2	59.1	60.6	65.9	62.1	63.8	64.1	61.9	63.6
6300	53.5	53.8	54.5	54.6	52.6	54.3	59.0	55.5	56.8	57.2	55.1	56.9
10000	44.4	44.7	45.0	45.2	43.5	45.5	49.2	46.8	47.4	46.9	46.3	48.4
16000	29.5	29.9	29.5	30.1	28.8	31.3	33.2	32.6	32.1	30.4	32.1	34.5
25000	7.2	7.8	6.3	7.5	6.7	10.0	9.1	11.3	9.3	5.5	10.7	13.7

Dist. (ft)	500 Series APP: -6 degrees			Series 600 APP: -6 degrees, Descent Decel.			Series 700 APP: -3 degrees			Series 800 APP: -9 degrees		
	L_{EPN} @ 67 kts			L_{EPN} @ 52 kts			L_{EPN} @ 64 kts			L_{EPN} @ 61 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	94.7	94.1	95.5	97.2	97.4	97.8	96.1	93.3	95.1	97.8	98.3	99.0
400	87.6	87.4	88.7	90.5	90.7	91.2	89.2	86.6	88.5	91.1	91.7	92.3
630	82.7	82.7	84.1	85.9	86.1	86.7	84.5	81.9	83.8	86.4	87.1	87.8
1000	77.5	77.7	79.1	80.9	81.3	81.9	79.5	76.9	78.8	81.5	82.2	82.9
2000	69.1	69.7	71.0	72.9	73.5	74.0	71.3	68.9	70.8	73.4	74.4	75.0
4000	59.8	60.6	62.2	64.1	64.9	65.6	61.9	59.9	62.1	64.9	66.1	66.5
6300	53.4	54.1	56.0	58.2	59.1	59.8	55.1	53.6	55.9	59.0	60.5	60.6
10000	45.2	44.7	47.2	50.7	51.9	51.5	45.2	45.2	46.4	51.4	53.7	52.6
16000	31.9	29.4	32.9	38.5	40.3	37.9	29.0	31.5	31.2	39.2	42.7	39.6
25000	12.0	6.5	11.4	20.2	22.9	17.4	4.8	11.0	8.2	20.9	26.1	20.1

Dist. (ft)	Series 900 APP: -12 degrees			Series 1000 LFO: Cruise (0.8*Vh)			Series 1100 LFO: Cruise (0.7*Vh)		
	L_{EPN} @ kts			L_{EPN} @ 70 kts			L_{EPN} @ 63 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	94.9	92.4	94.3	94.6	92.8	93.9
400	ND	ND	ND	88.1	85.6	87.6	87.8	86.0	87.1
630	ND	ND	ND	83.4	80.9	83.0	83.1	81.3	82.4
1000	ND	ND	ND	78.3	75.9	78.0	78.0	76.4	77.4
2000	ND	ND	ND	70.0	67.8	69.9	69.8	68.3	69.2
4000	ND	ND	ND	60.7	58.6	60.8	60.4	59.0	60.0
6300	ND	ND	ND	53.9	52.1	54.5	53.4	52.9	53.6
10000	ND	ND	ND	44.0	43.2	45.2	43.8	44.3	44.6
16000	ND	ND	ND	28.1	28.6	30.2	28.1	30.2	30.0
25000	ND	ND	ND	4.2	6.8	7.6	4.7	9.1	8.0

ND - Due to time constraints, data for Series 900 were not collected.

Table 146. Schweizer 300C L_{PNTSmx} NPDs

Dist. (ft)	100 Series LFO: Tour Cruise @ 500 ft (0.6*Vne)			200 Series LFO: High Cruise @ 500 ft (0.9*Vne)			300 Series DEP: Departure			400 Series DEP: Cruise Climb (Accel.)		
	L_{PNTSmx} @ 55 kts			L_{PNTSmx} @ 73 kts			L_{PNTSmx} @ 39 kts			L_{PNTSmx} @ 42 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	93.5	94.5	92.3	94.8	94.4	94.5	97.1	95.1	95.9	96.5	95.0	95.2
400	86.5	87.7	85.5	88.0	87.6	87.8	90.3	88.3	89.2	89.6	88.1	88.4
630	81.6	83.0	80.8	83.3	82.9	83.1	85.6	83.6	84.5	84.9	83.5	83.7
1000	76.5	78.0	75.8	78.2	77.9	78.1	80.6	78.6	79.5	79.9	78.4	78.7
2000	68.1	69.9	67.5	69.9	69.7	70.0	72.4	70.5	71.2	71.7	70.3	70.4
4000	58.5	60.6	58.5	60.4	60.5	60.6	63.2	61.3	61.8	62.4	61.1	61.1
6300	51.8	54.2	52.1	53.8	54.0	54.3	56.3	54.6	54.8	55.4	54.3	54.5
10000	42.6	45.1	42.5	44.5	44.9	45.6	46.5	45.9	45.4	45.2	45.5	45.9
16000	27.8	30.3	27.0	29.4	30.1	31.4	30.5	31.7	30.2	28.6	31.3	32.1
25000	5.5	8.2	3.8	6.7	8.0	10.1	6.4	10.5	7.3	3.7	9.9	11.3

Dist. (ft)	500 Series APP: -6 degrees			Series 600 APP: -6 degrees, Descent Decel.			Series 700 APP: -3 degrees			Series 800 APP: -9 degrees		
	L_{PNTSmx} @ 67 kts			L_{PNTSmx} @ 52 kts			L_{PNTSmx} @ 64 kts			L_{PNTSmx} @ 61 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	93.7	95.3	93.7	95.2	97.7	97.3	94.3	94.3	93.8	96.7	99.4	98.0
400	86.7	88.6	87.0	88.6	91.0	90.7	87.4	87.5	87.1	89.9	92.8	91.3
630	81.8	83.9	82.3	84.0	86.4	86.2	82.7	82.9	82.5	85.3	88.2	86.8
1000	76.5	78.9	77.4	79.0	81.6	81.3	77.7	77.9	77.5	80.3	83.4	81.9
2000	68.2	70.9	69.3	71.0	73.8	73.5	69.5	69.9	69.4	72.2	75.6	74.0
4000	58.9	61.8	60.5	62.2	65.2	65.0	60.1	60.9	60.7	63.7	67.2	65.5
6300	52.5	55.3	54.3	56.3	59.4	59.3	53.3	54.6	54.5	57.8	61.6	59.7
10000	44.3	45.8	45.5	48.8	52.2	50.9	43.4	46.2	45.1	50.3	54.8	51.6
16000	31.0	30.6	31.1	36.6	40.6	37.3	27.2	32.5	29.8	38.1	43.8	38.6
25000	11.0	7.6	9.7	18.3	23.2	16.9	3.0	12.0	6.9	19.8	27.2	19.1

Dist. (ft)	Series 900 APP: -12 degrees			Series 1000 LFO: Cruise (0.8*Vh)			Series 1100 LFO: Cruise (0.7*Vh)		
	L_{PNTSmx} @ kts			L_{PNTSmx} @ 70 kts			L_{PNTSmx} @ 63 kts		
	Left	Center	Right	Left	Center	Right	Left	Center	Right
200	ND	ND	ND	93.7	93.6	93.7	93.0	93.8	92.1
400	ND	ND	ND	86.9	86.8	87.0	86.2	87.0	85.2
630	ND	ND	ND	82.2	82.1	82.3	81.5	82.3	80.5
1000	ND	ND	ND	77.1	77.1	77.3	76.4	77.4	75.5
2000	ND	ND	ND	68.9	69.0	69.2	68.2	69.3	67.3
4000	ND	ND	ND	59.5	59.8	60.2	58.7	60.0	58.2
6300	ND	ND	ND	52.7	53.4	53.9	51.8	53.9	51.8
10000	ND	ND	ND	42.9	44.4	44.6	42.1	45.3	42.8
16000	ND	ND	ND	26.9	29.8	29.6	26.5	31.2	28.1
25000	ND	ND	ND	3.1	8.0	7.0	3.1	10.1	6.2

ND - Due to time constraints, data for Series 900 were not collected.

E.2 L_{AE} NPD Plots

Presented below are graphical representations of the L_{AE} NPDs derived using the simplified procedure for the dynamic operations series for each aircraft measured. Sound levels from the centerline and sideline microphones are presented in the figures as aircraft left (AC Left), centerline (CL), and aircraft right (AC Right) data.

E.2.1 Cessna 182 Skylane

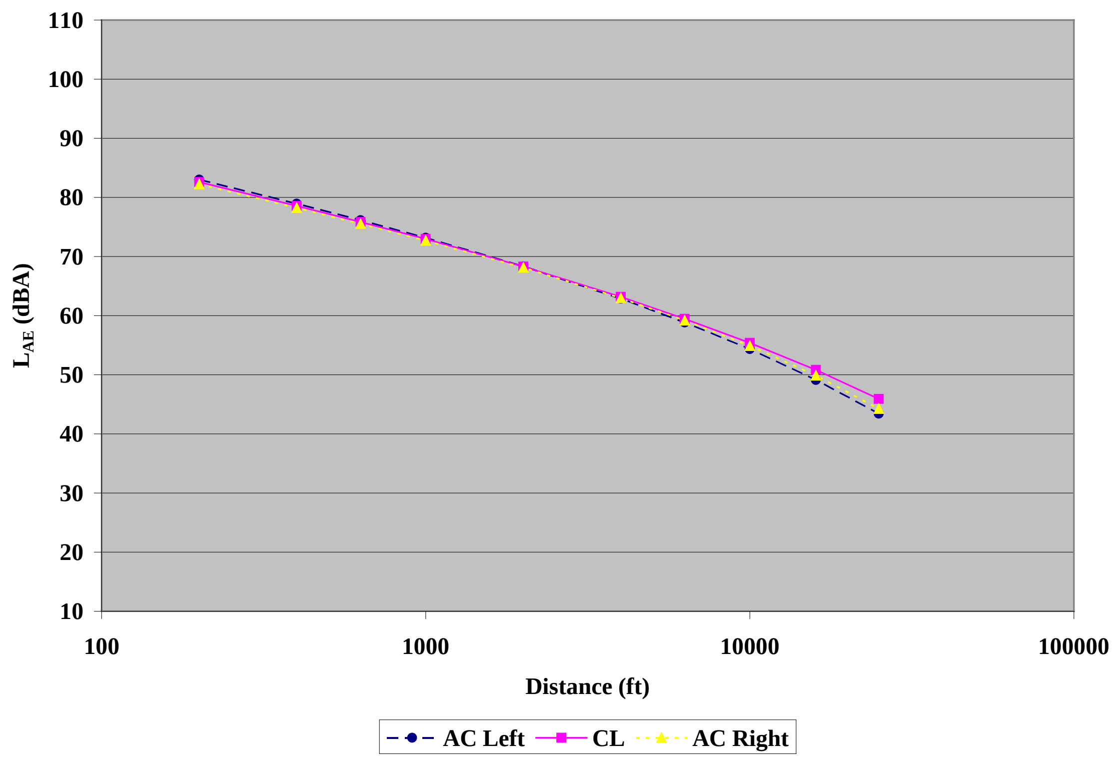

Figure 27. Cessna 182 100 Series L_{AE} Data (Ref. Spd. = 160 kts.)

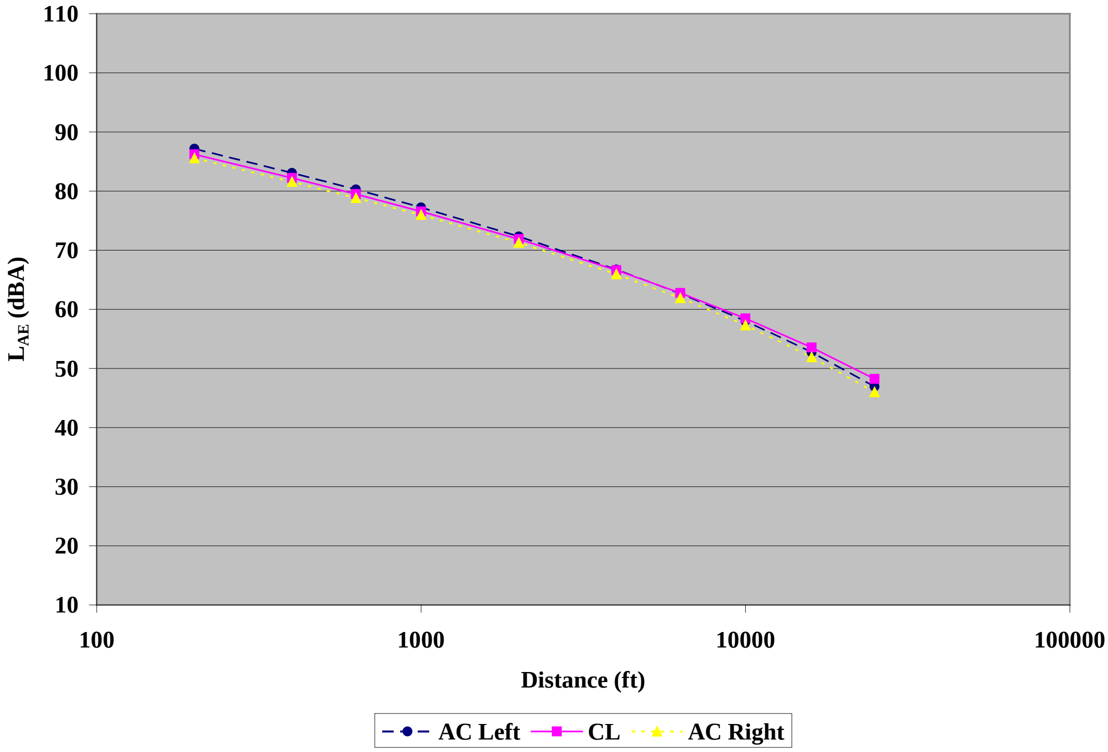

Figure 28. Cessna 182 200 Series L_{AE} Data (Ref. Spd. = 160 kts)

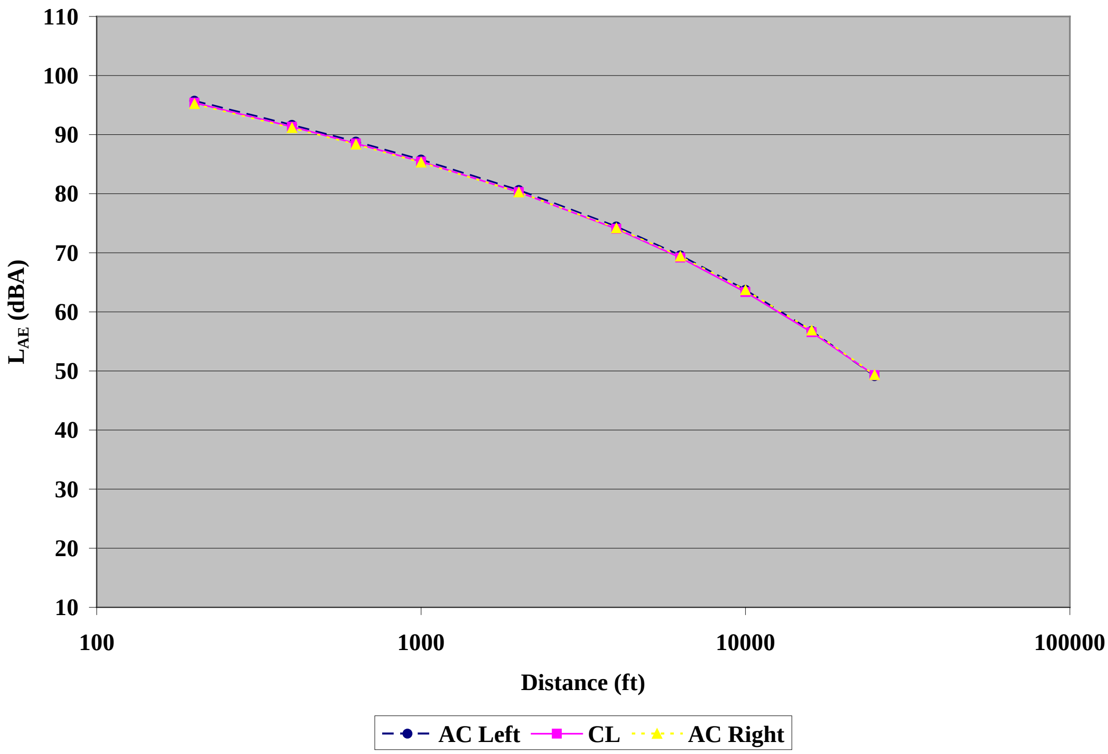

Figure 29. Cessna 182 300 Series L_{AE} Data (Ref. Spd. = 160 kts)

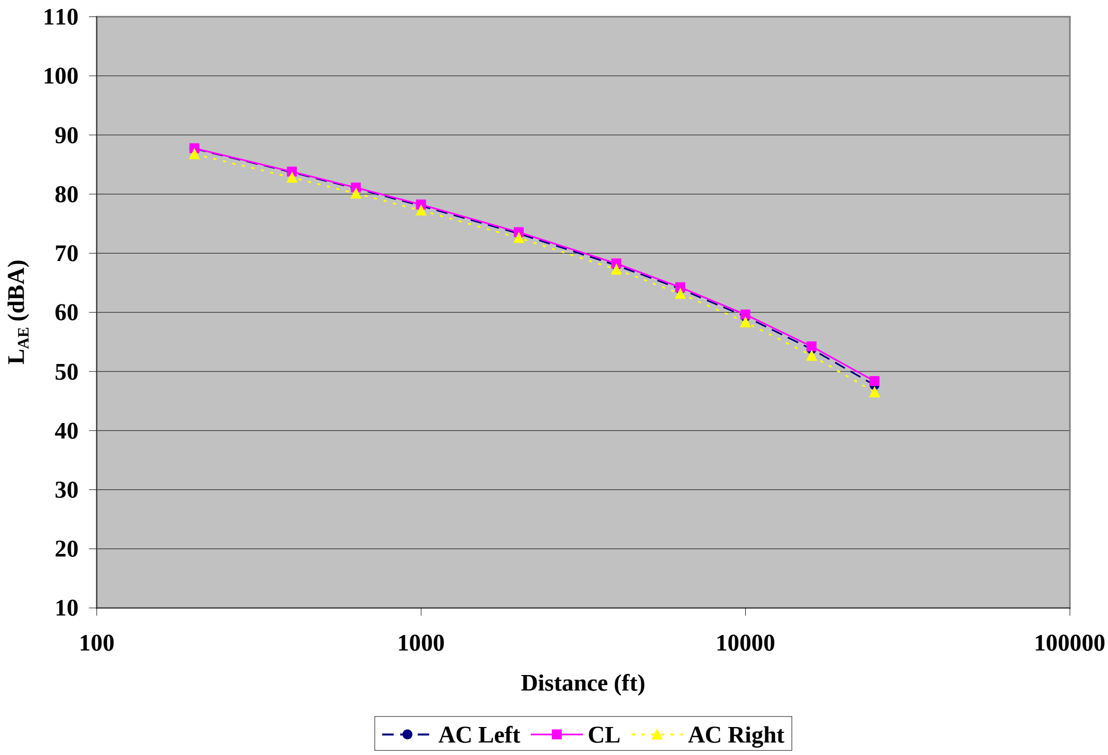

Figure 30. Cessna 182 400 Series L_{AE} Data (Ref. Spd. = 160 kts)

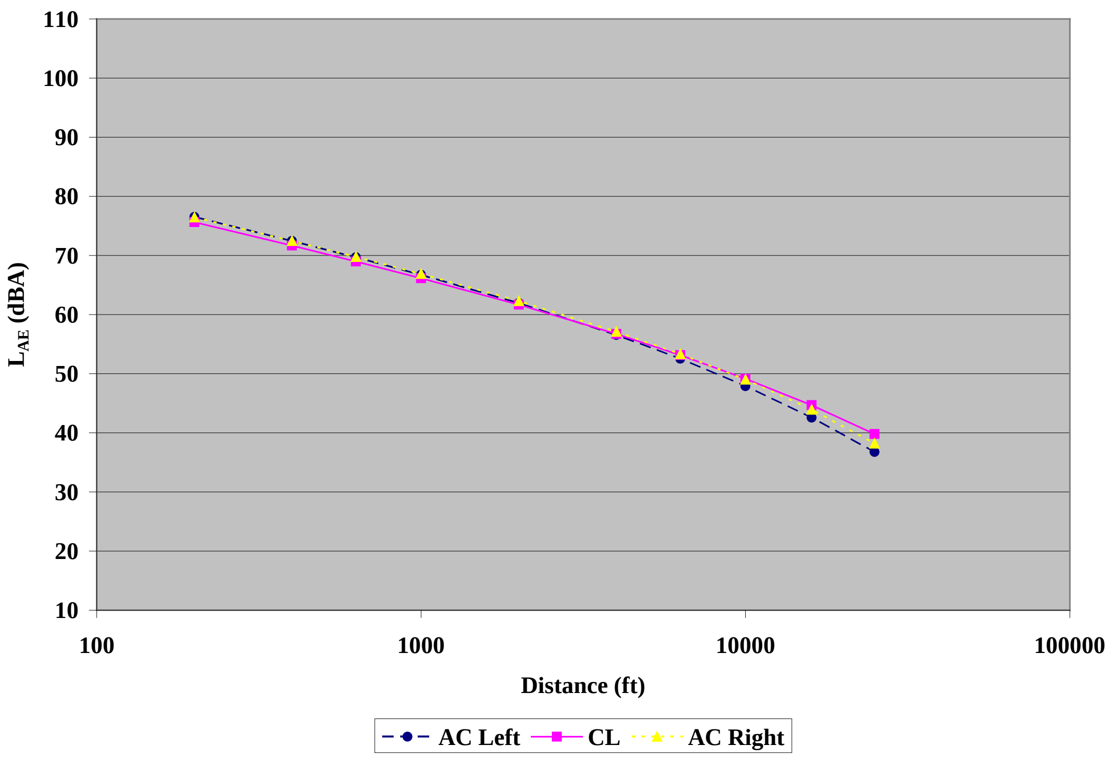

Figure 31. Cessna 182 500 Series L_{AE} Data (Ref. Spd. = 160 kts)

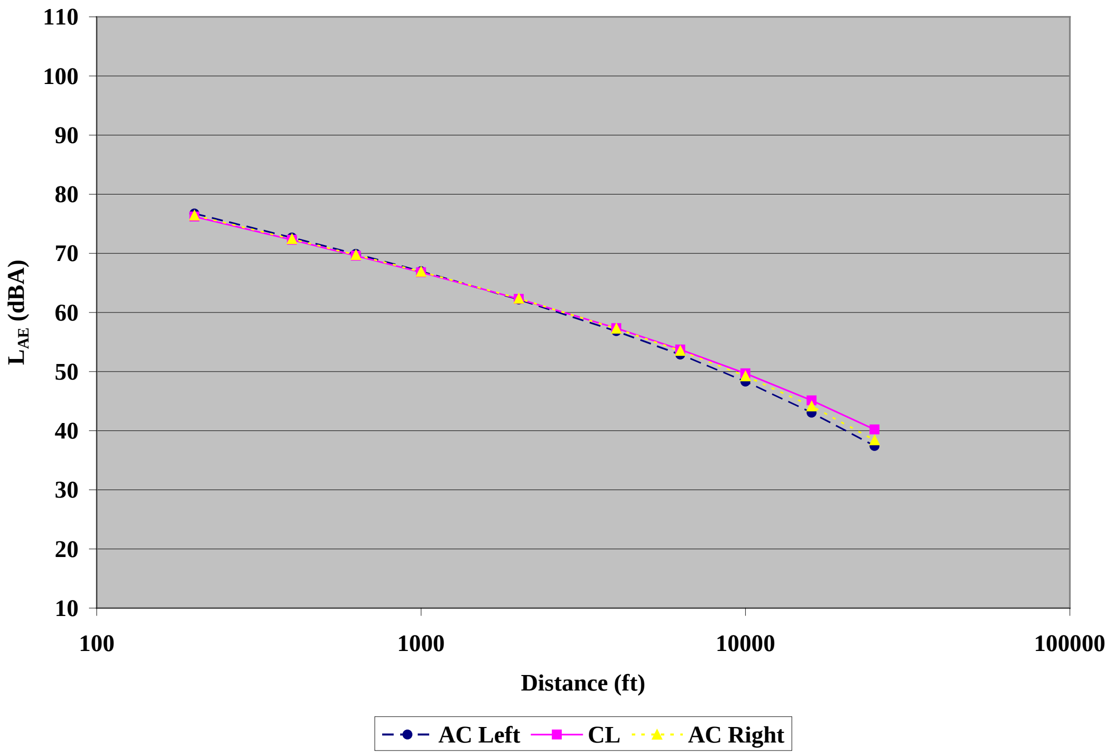

Figure 32. Cessna 182 600 Series L_{AE} Data (Ref. Spd. = 160 kts)

E.2.2 Cessna 208B Grand Caravan

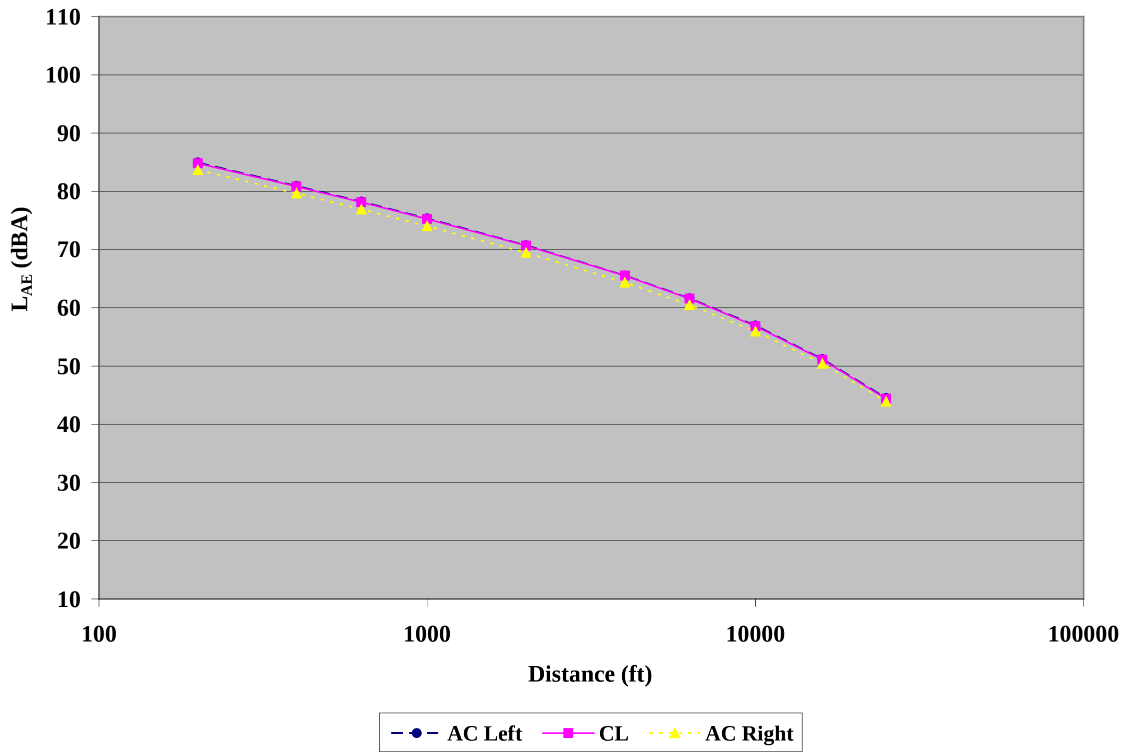

Figure 33. Cessna 208B 100 Series L_{AE} Data (Ref. Spd. = 160 kts)

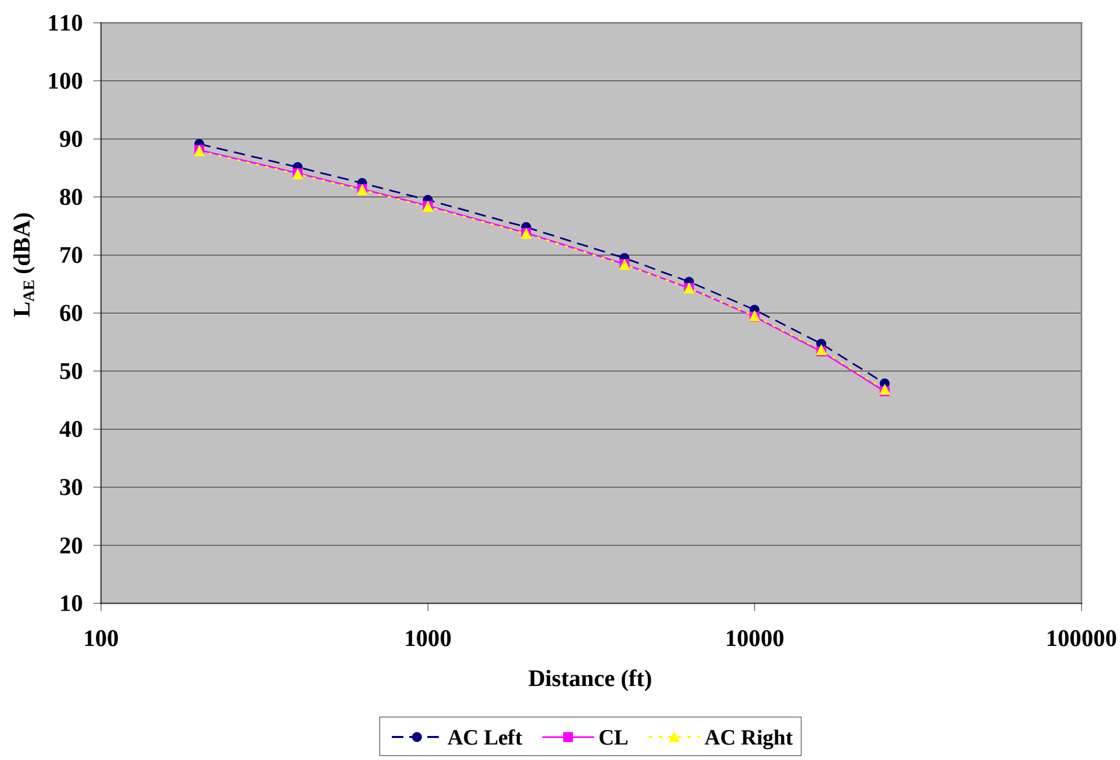

Figure 34. Cessna 208B 200 Series L_{AE} Data (Ref. Spd. = 160 kts)

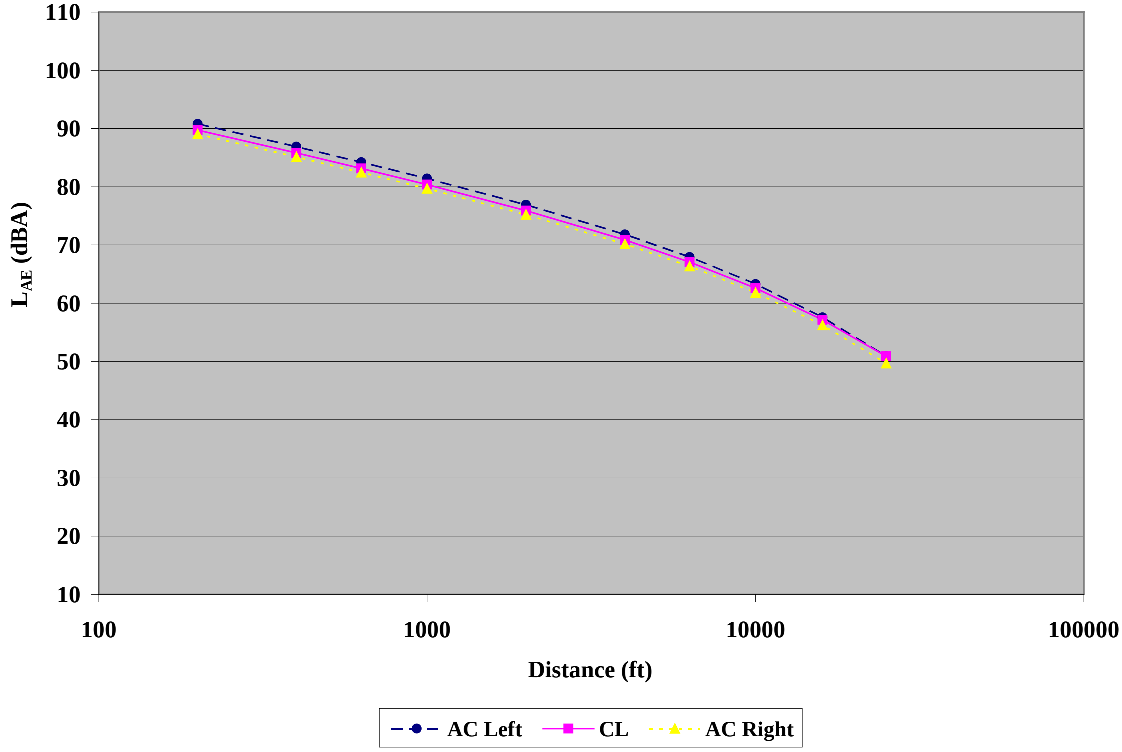

Figure 35. Cessna 208B 300 Series L_{AE} Data (Ref. Spd. = 160 kts)

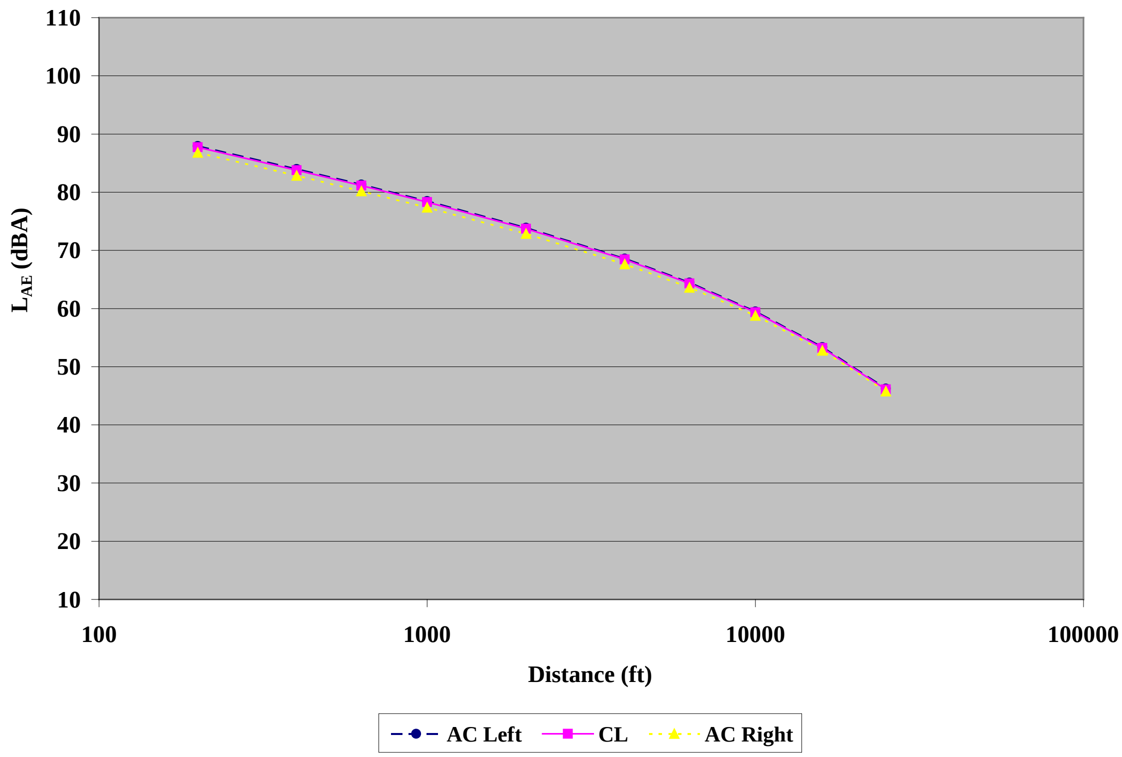

Figure 36. Cessna 208B 400 Series L_{AE} Data (Ref. Spd. = 160 kts)

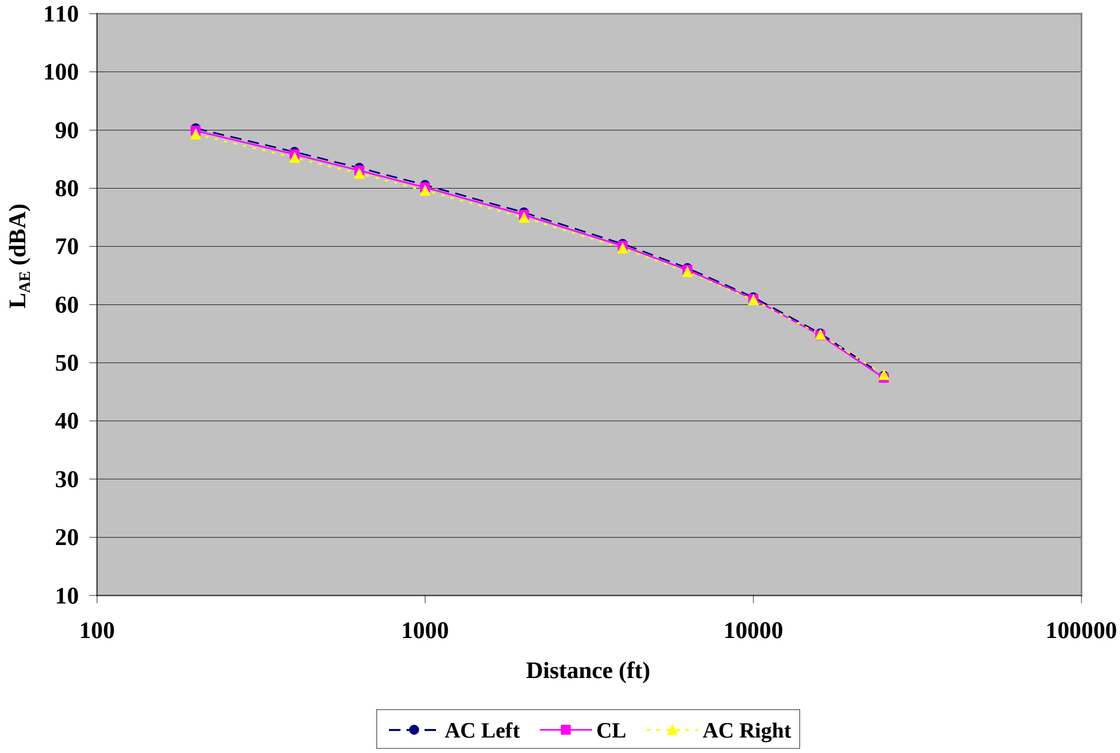

Figure 37. Cessna 208B 500 Series L_{AE} Data (Ref. Spd. = 160 kts)

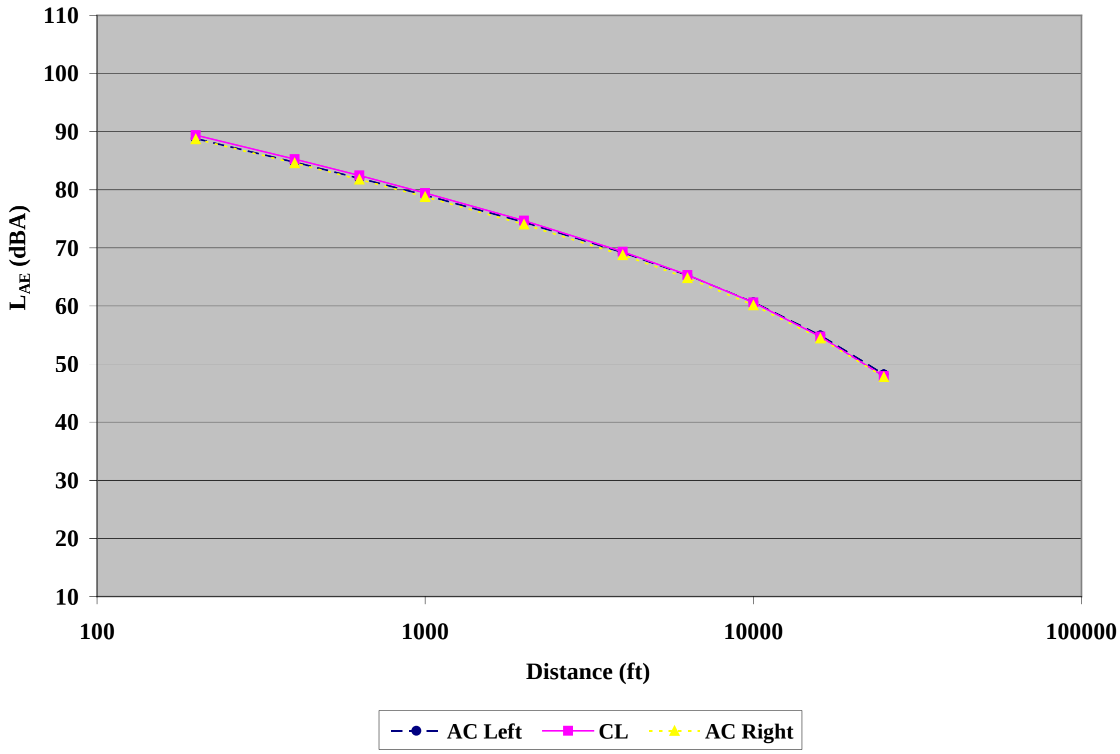

Figure 38. Cessna 208B 600 Series L_{AE} Data (Ref. Spd. = 160 kts)

E.2.3 Dornier 228

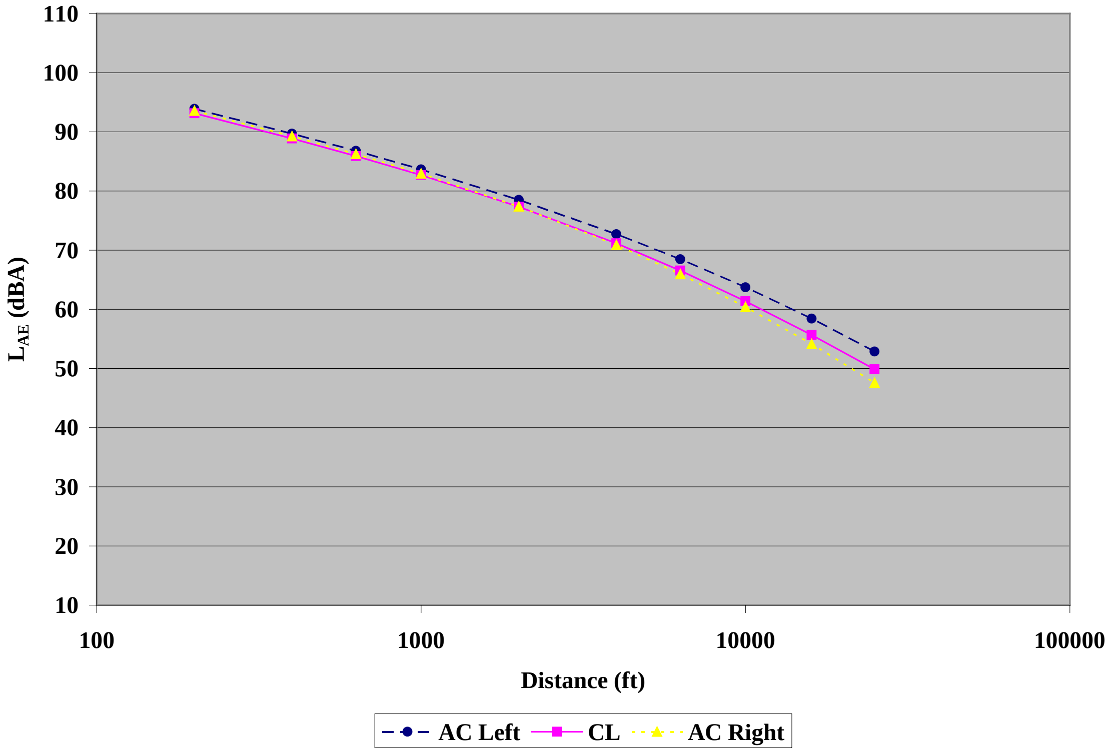

Figure 39. Dornier 228 100 Series L_{AE} Data (Ref. Spd. = 160 kts)

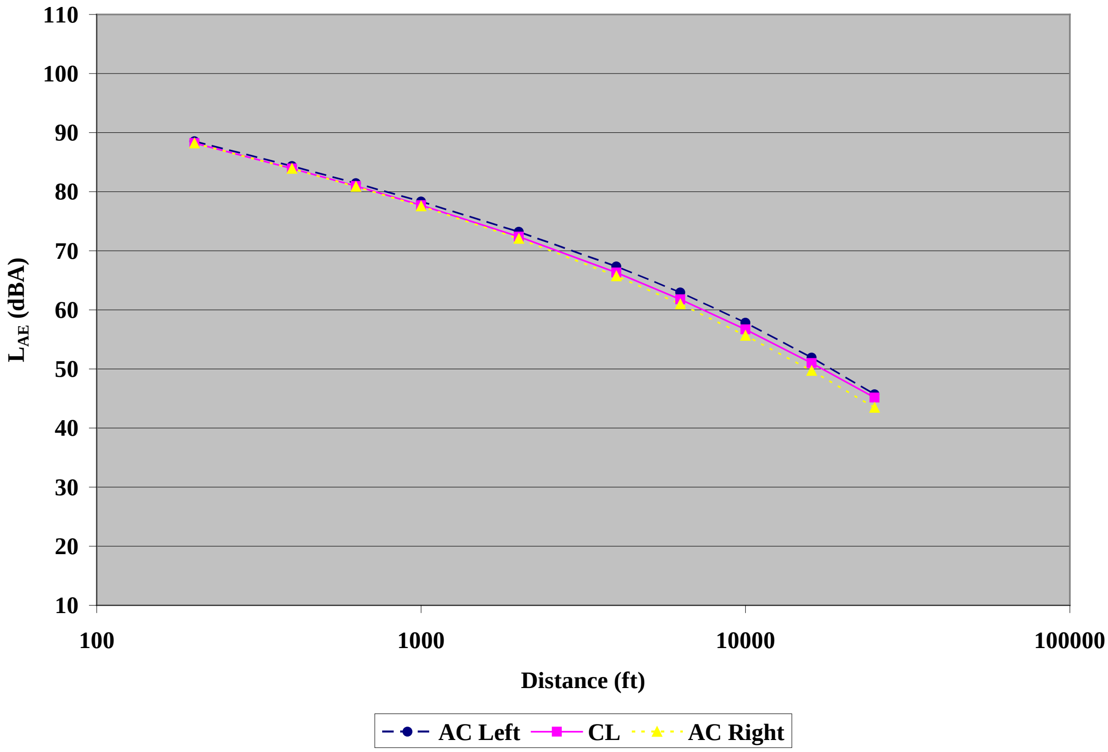

Figure 40. Dornier 228 200 Series L_{AE} Data (Ref. Spd. = 160 kts)

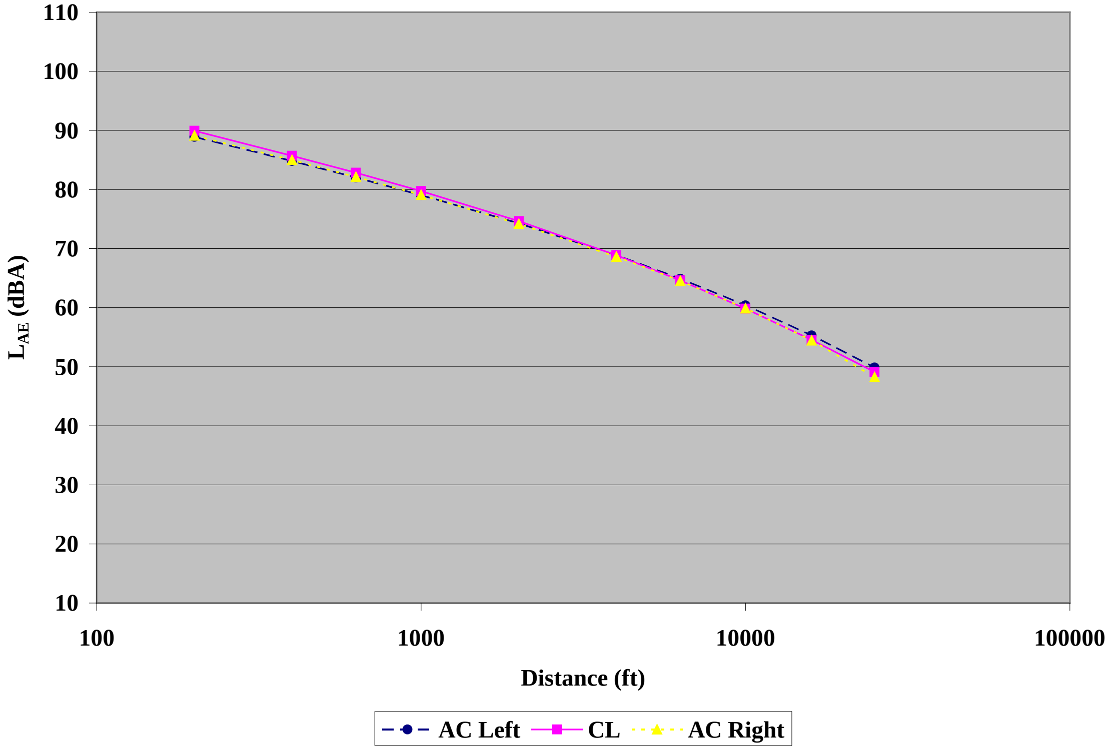

Figure 41. Dornier 228 300 Series L_{AE} Data (Ref. Spd. = 160 kts)

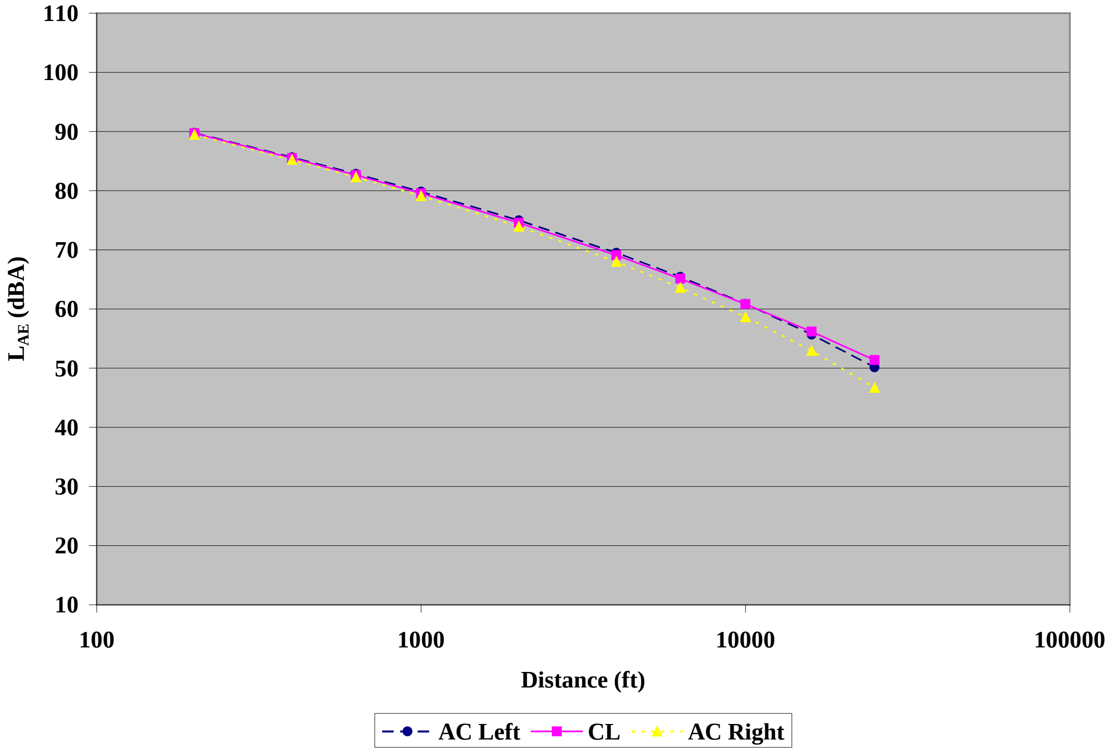

Figure 42. Dornier 228 400 Series L_{AE} Data (Ref. Spd. = 160 kts)

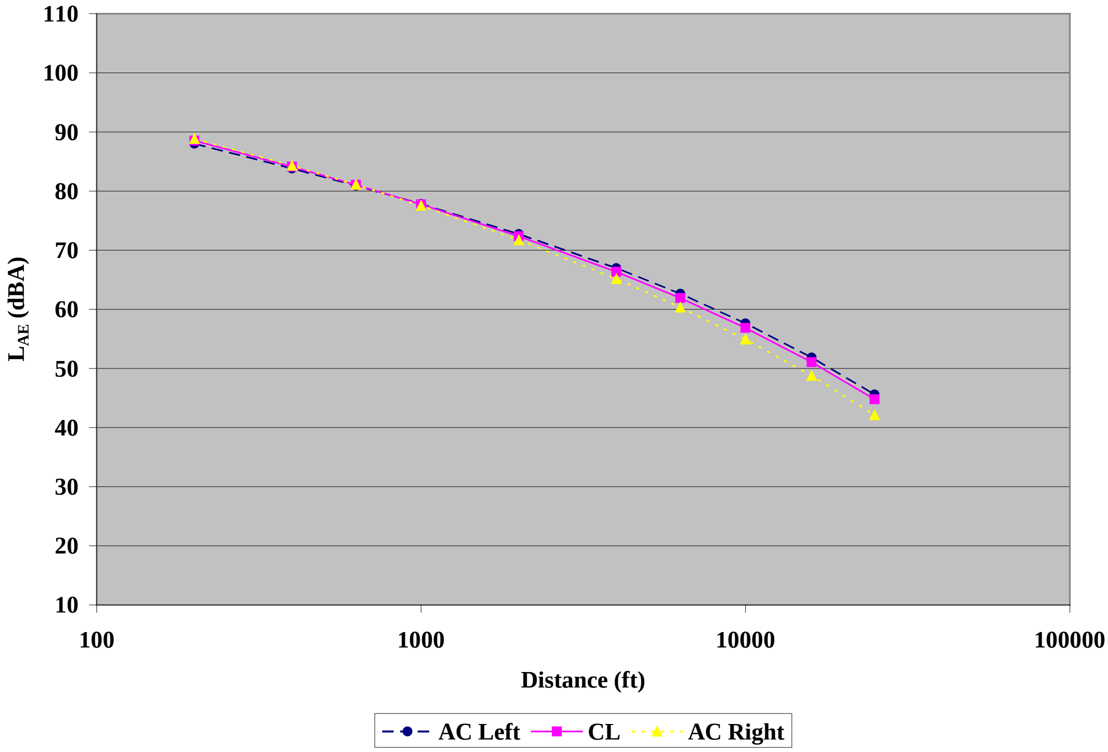

Figure 43. Dornier 228 500 Series L_{AE} Data (Ref. Spd. = 160 kts)

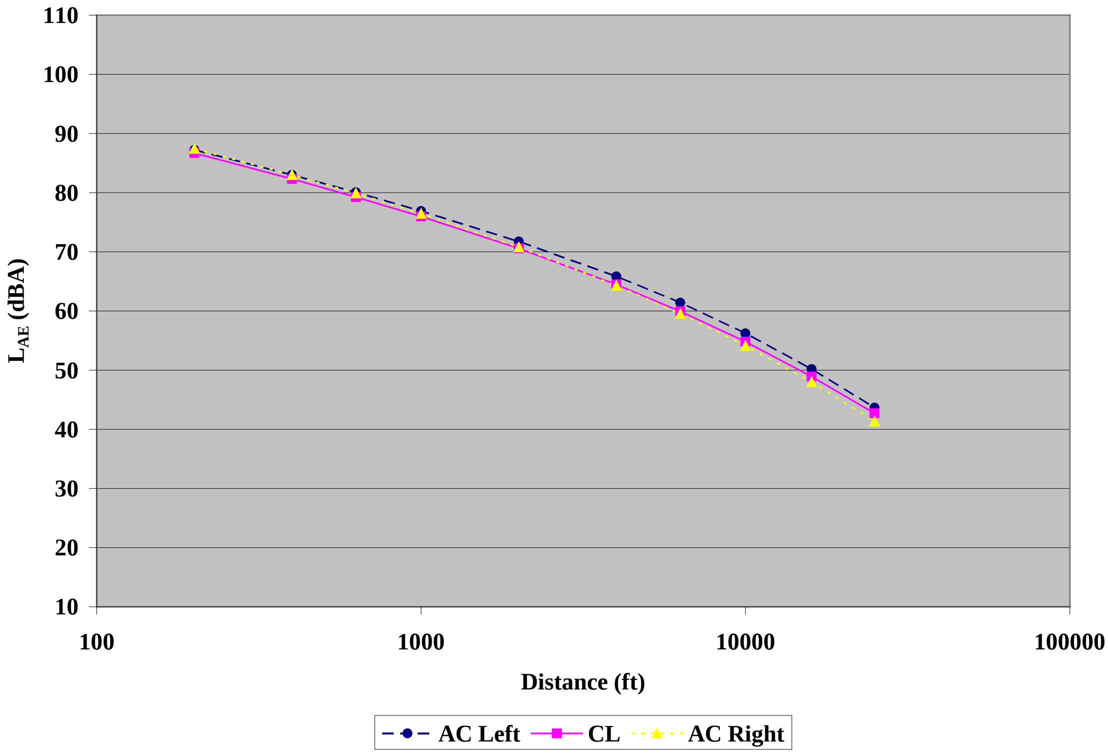

Figure 44. Dornier 228 600 Series L_{AE} Data (Ref. Spd. = 160 kts)

E.2.4 Dornier 328

Note that the Dornier 328 does not have a 200 Series (tour cruise) since the Dornier 328 is not used for air tours (see Section 1).

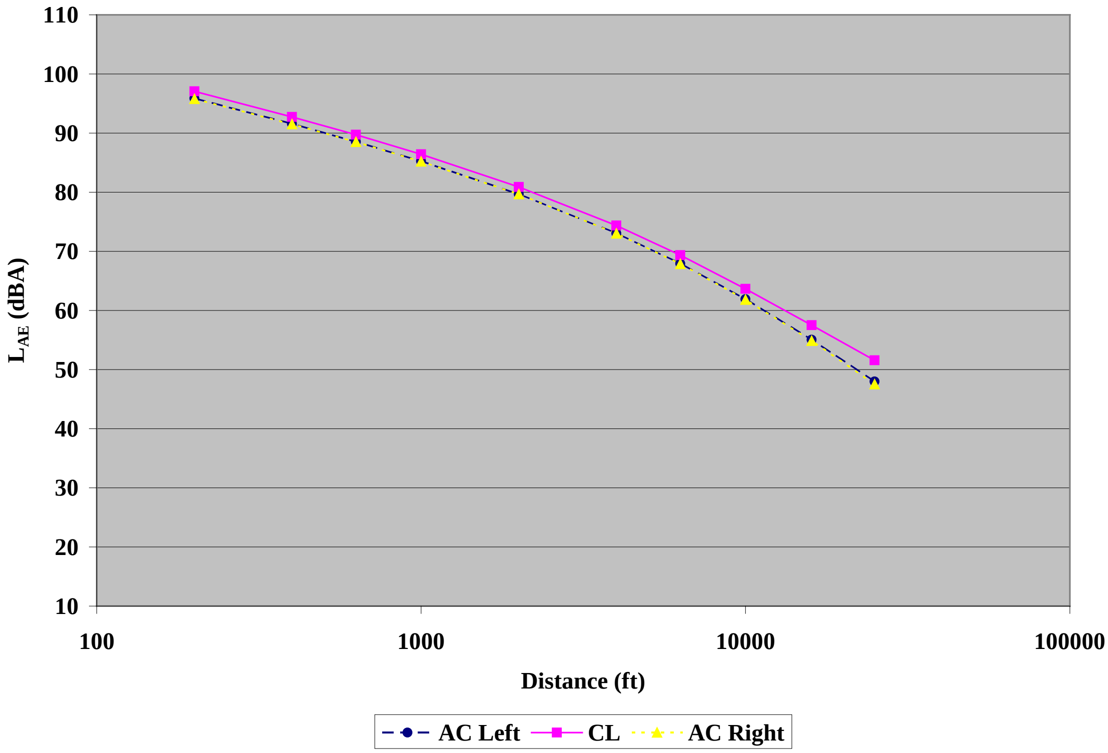

Figure 45. Dornier 328 100 Series L_{AE} Data (Ref. Spd. = 160 kts)

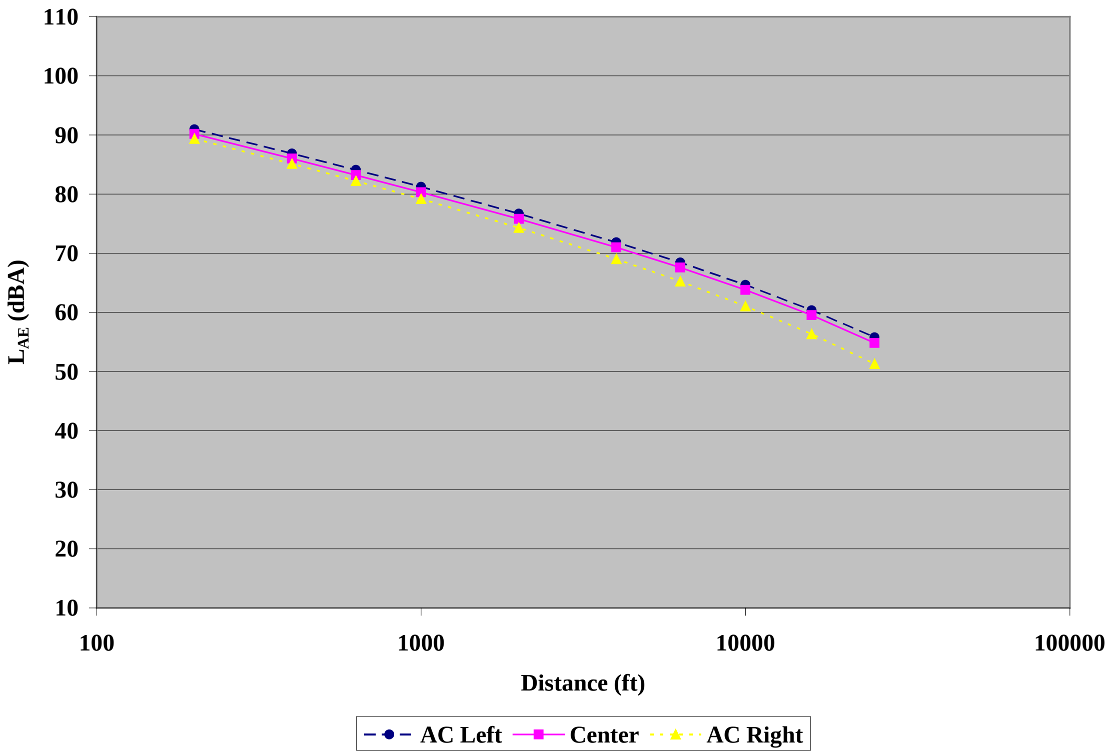

Figure 46. Dornier 328 300 Series L_{AE} Data (Ref. Spd. = 160 kts)

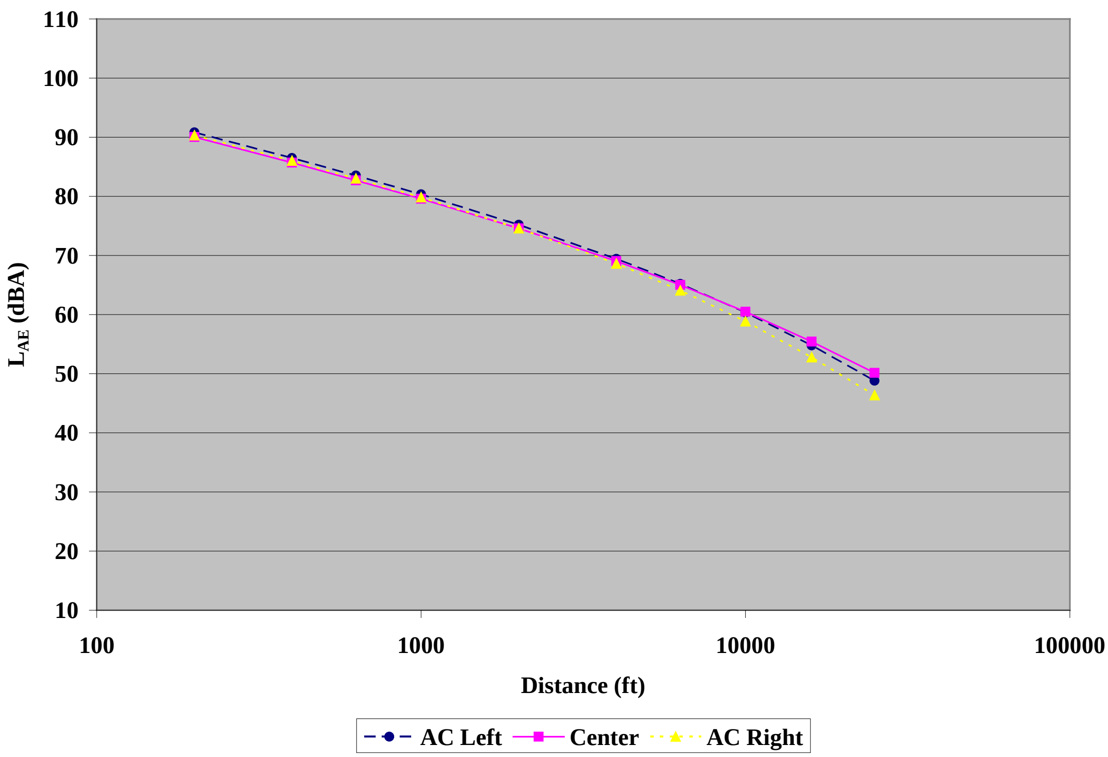

Figure 47. Dornier 328 400 Series L_{AE} Data (Ref. Spd. = 160 kts)

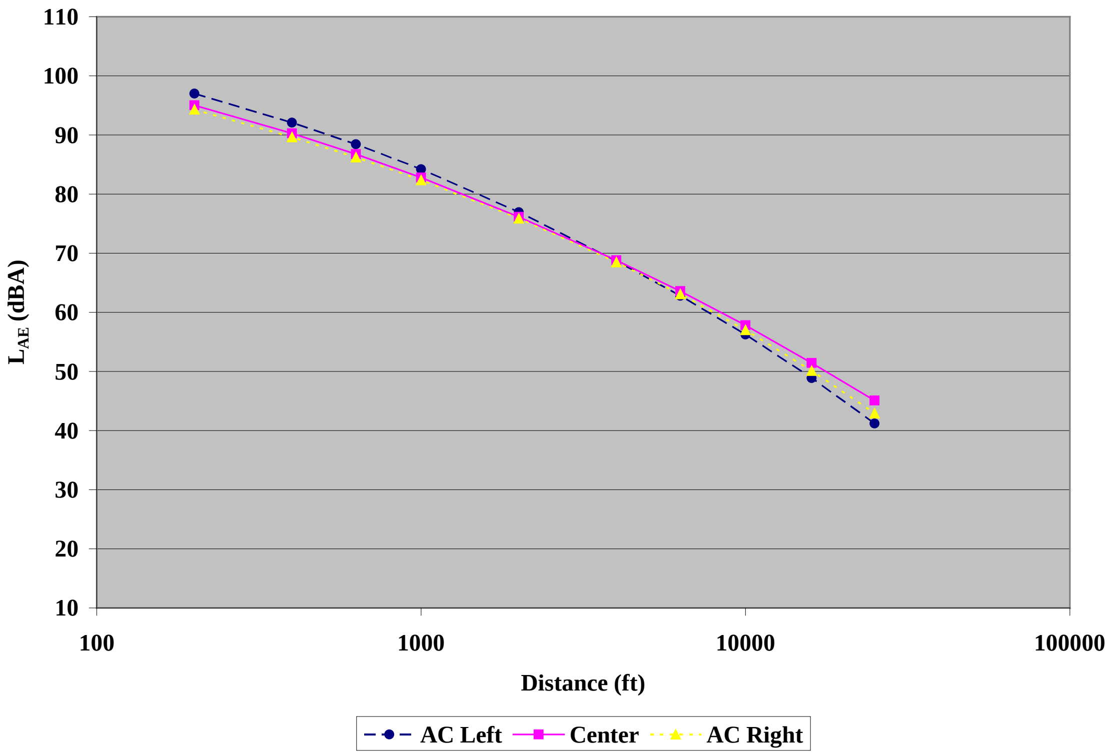

Figure 48. Dornier 328 500 Series L_{AE} Data (Ref. Spd. = 160 kts)

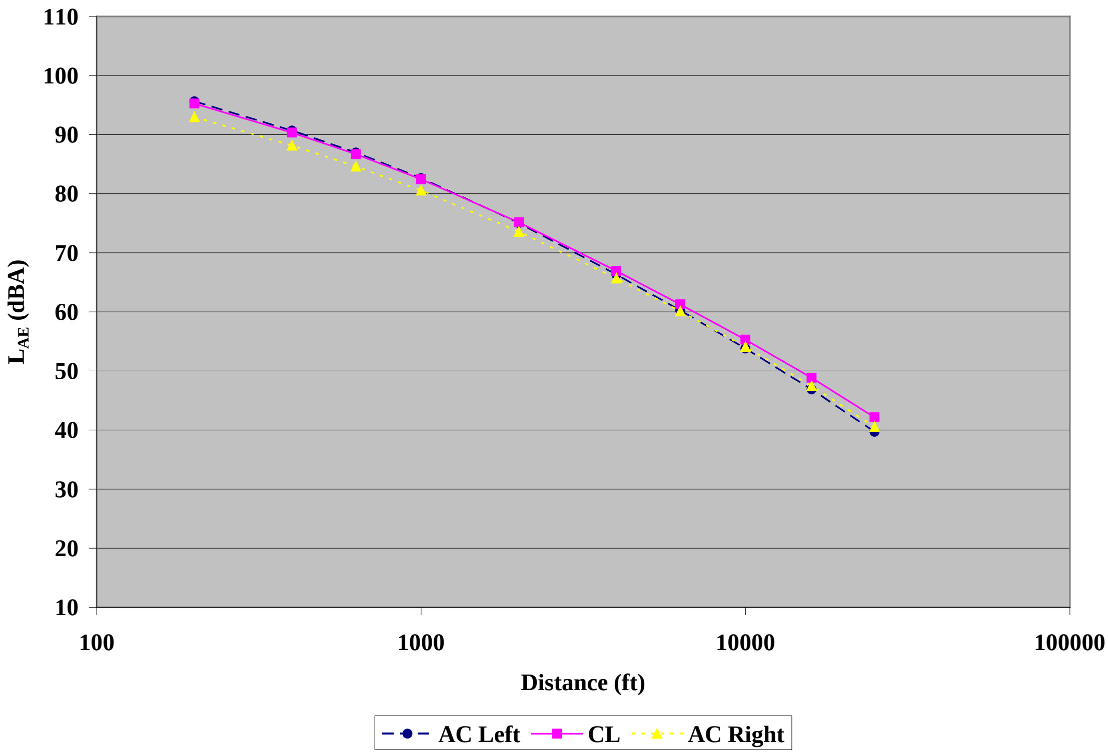

Figure 49. Dornier 328 600 Series L_{AE} Data (Ref. Spd. = 160 kts)

E.2.5 Piper PA-42 Cheyenne III

Due to a temporary malfunction of the dGPSI System, along with time constraints, data for Series 400, 500 and 600 were not collected.

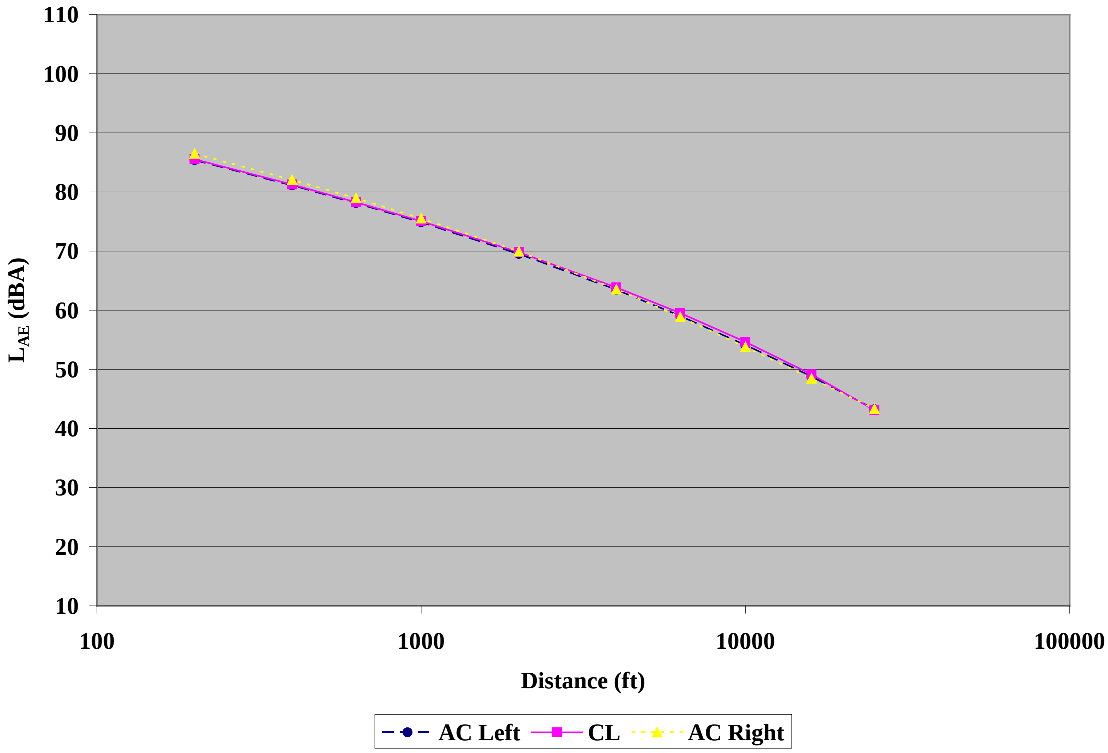

Figure 50. Piper PA-42 100 Series L_{AE} Data (Ref. Spd. = 160 kts)

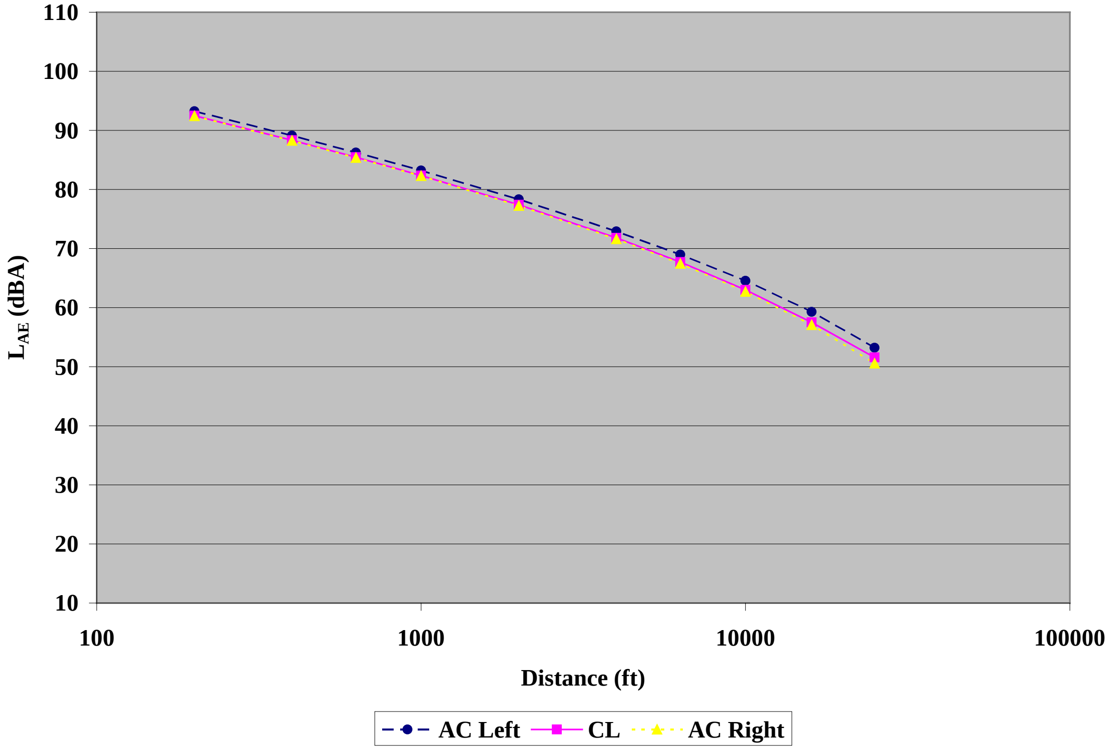

Figure 51. Piper PA-42 200 Series L_{AE} Data (Ref. Spd. = 160 kts)

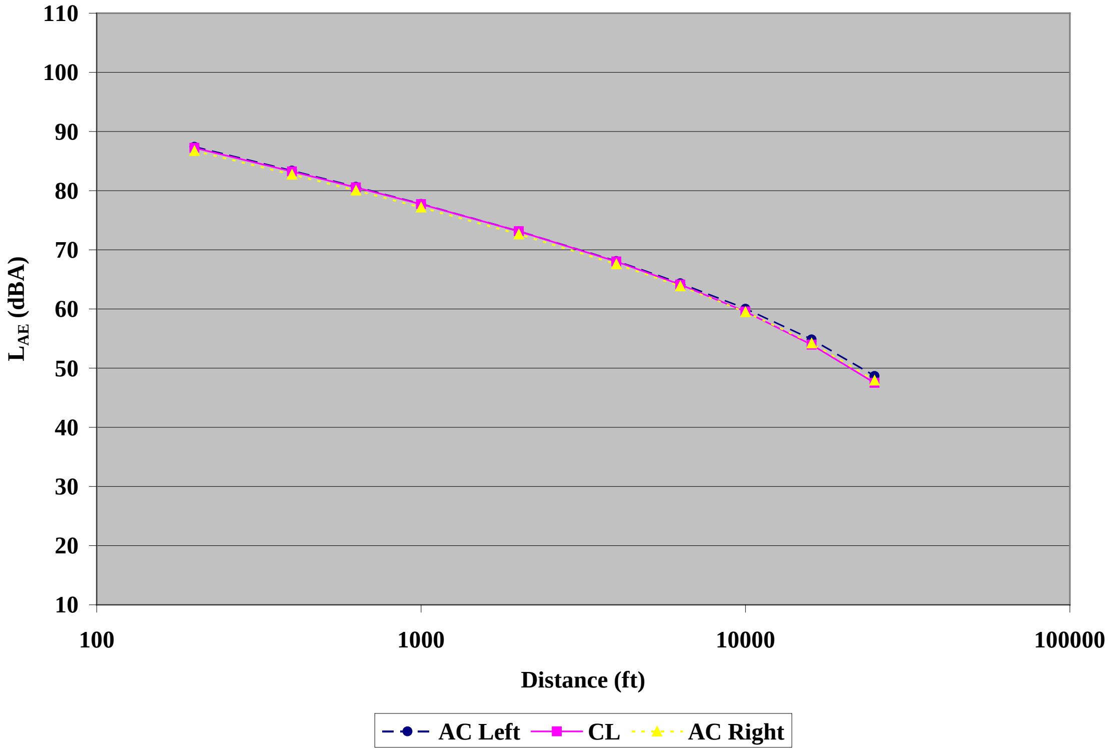

Figure 52. Piper PA-42 300 Series L_{AE} Data (Ref. Spd. = 160 kts)

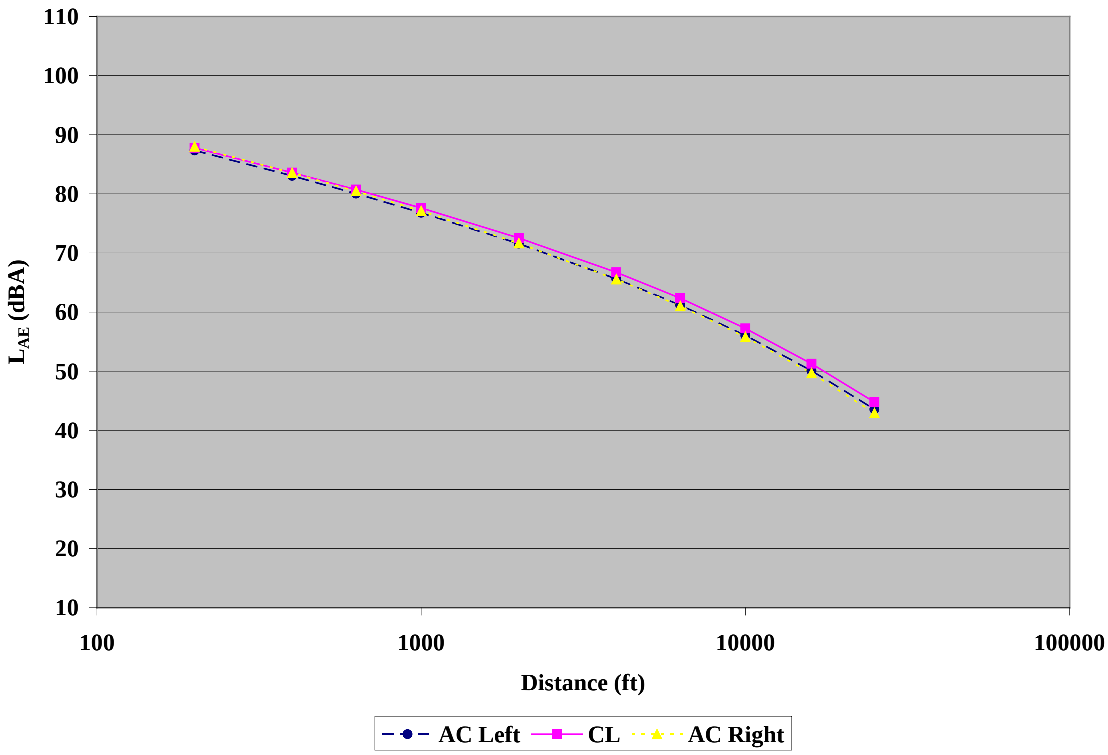

Figure 53. Piper PA-42 600 Series L_{AE} Data (Ref. Spd. = 160 kts)

E.2.6 Bell 407

Due to time constraints, data for Series 600 were not collected.

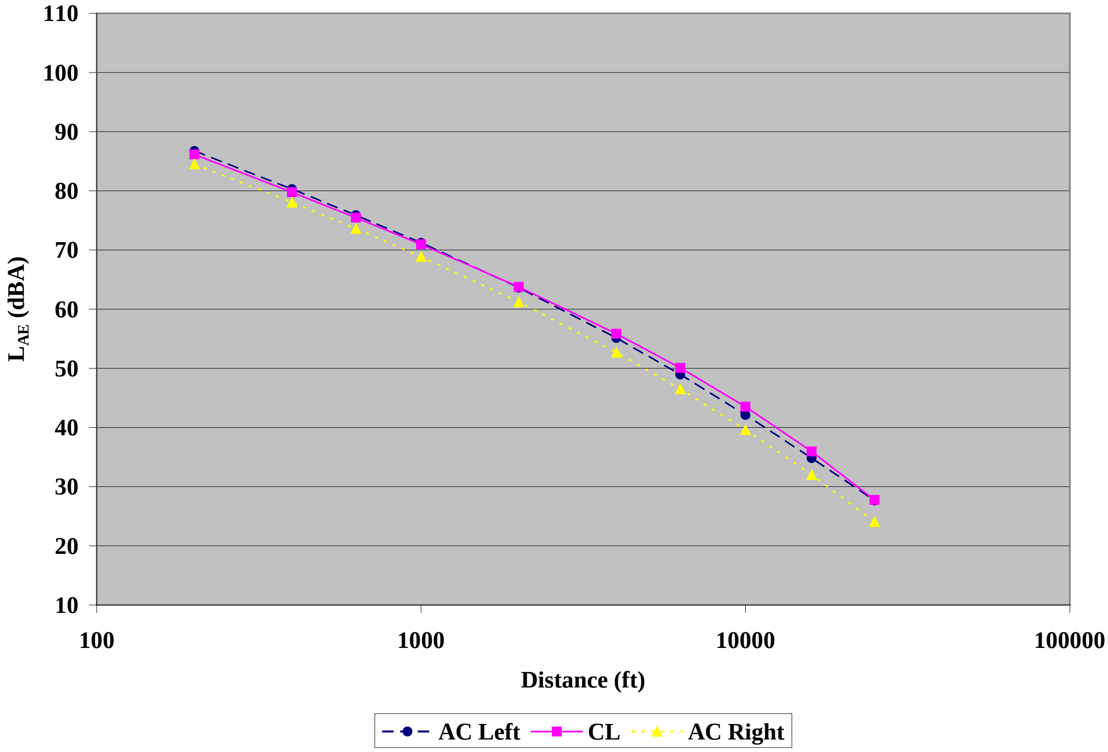

Figure 54. Bell 407 100 Series L_{AE} Data (Ref. Spd. = 94 kts)

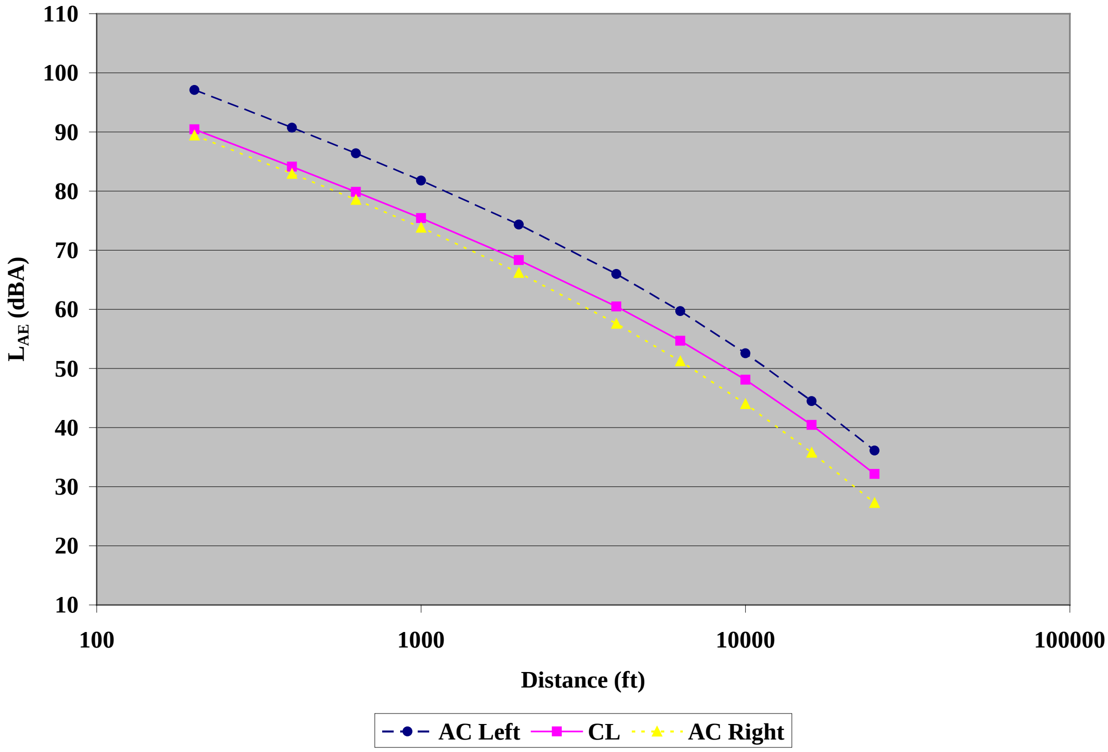

Figure 55. Bell 407 200 Series L_{AE} Data (Ref. Spd. = 133 kts)

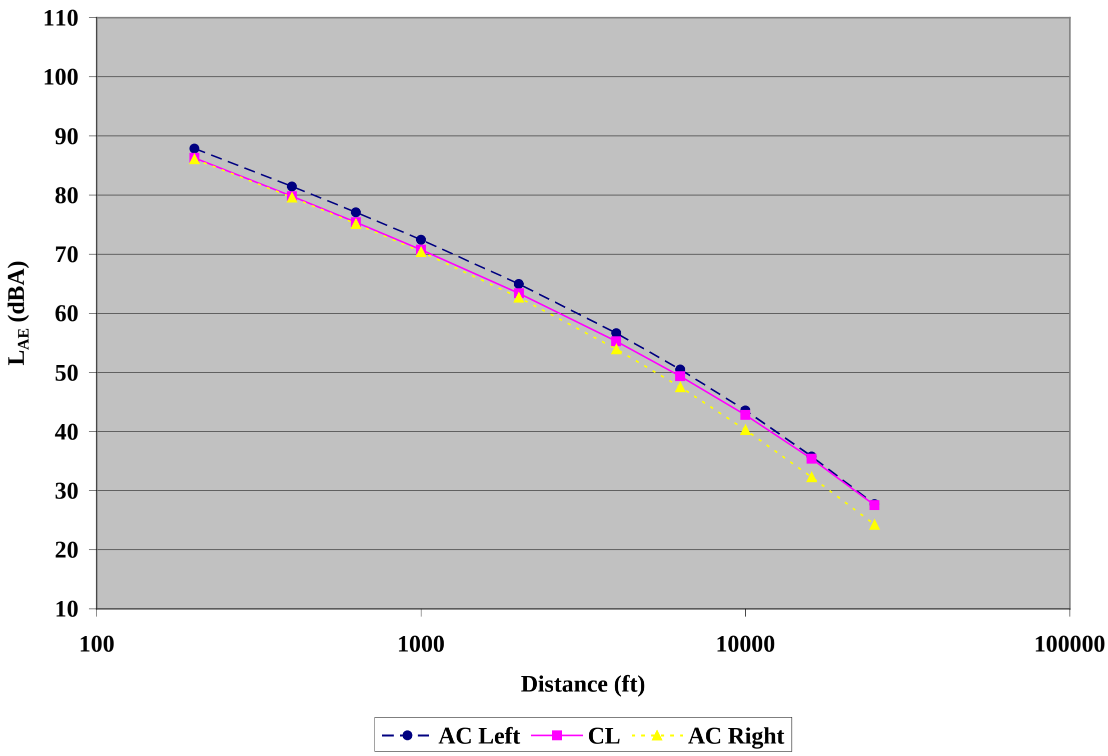

Figure 56. Bell 407 300 Series L_{AE} Data (Ref. Spd. = 80 kts)

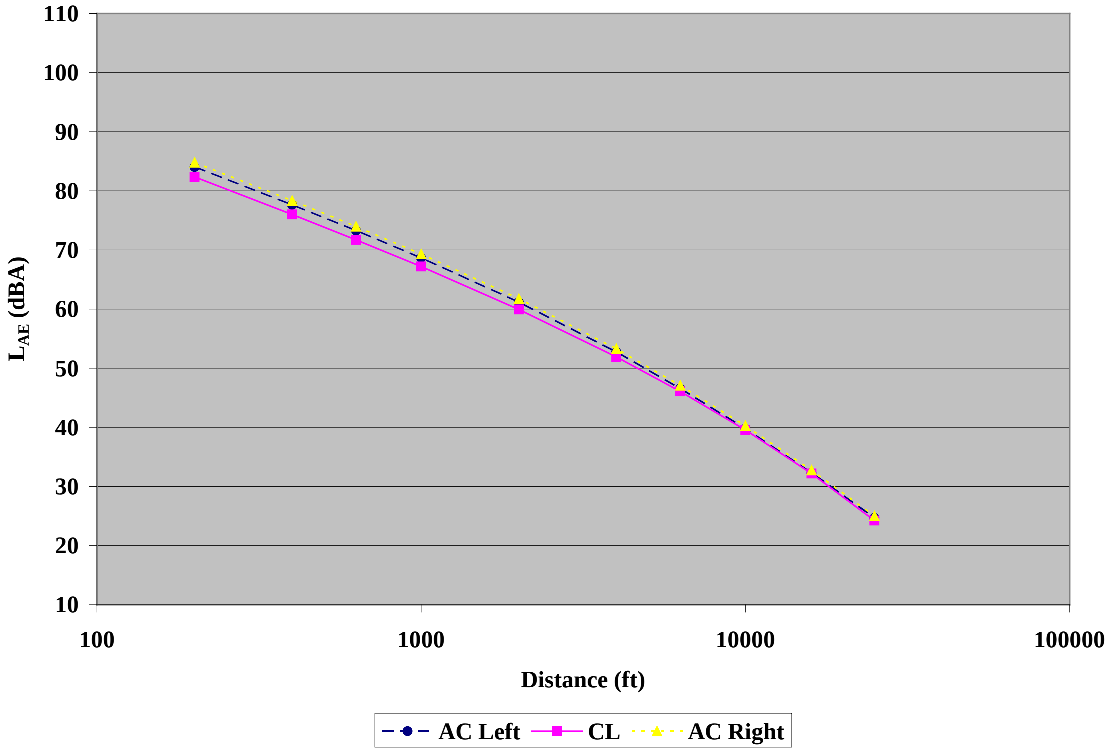

Figure 57. Bell 407 400 Series L_{AE} Data (Ref. Spd. = 76 kts)

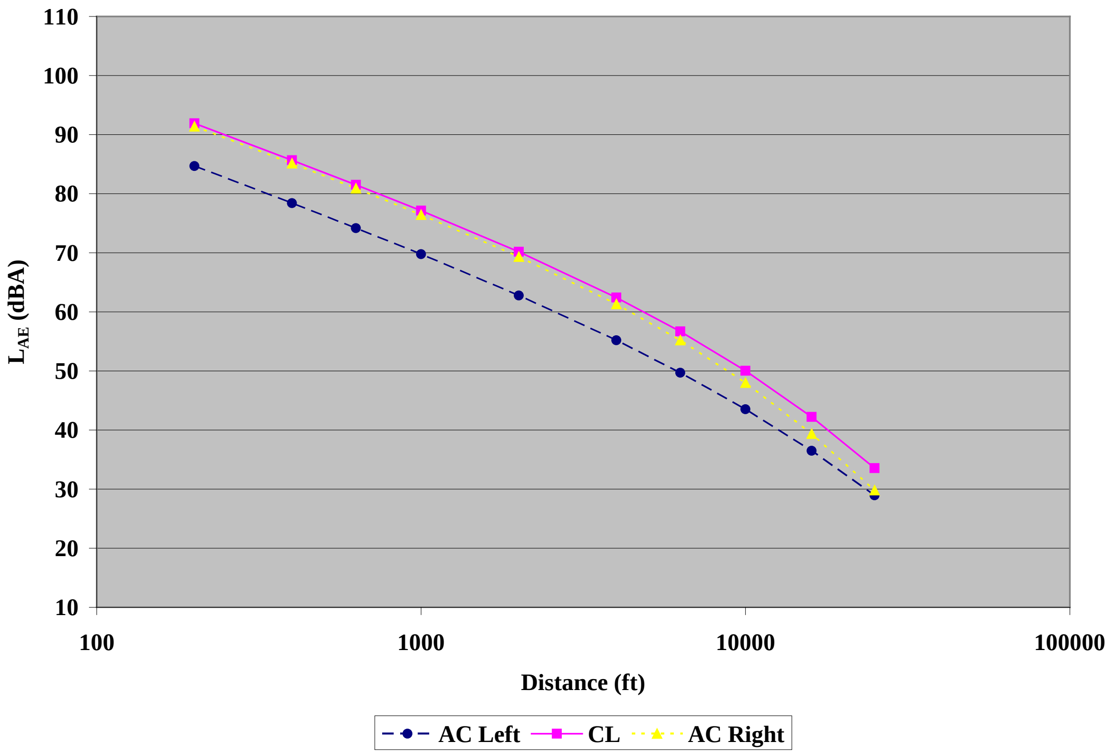

Figure 58. Bell 407 500 Series L_{AE} Data (Ref. Spd. = 65 kts)

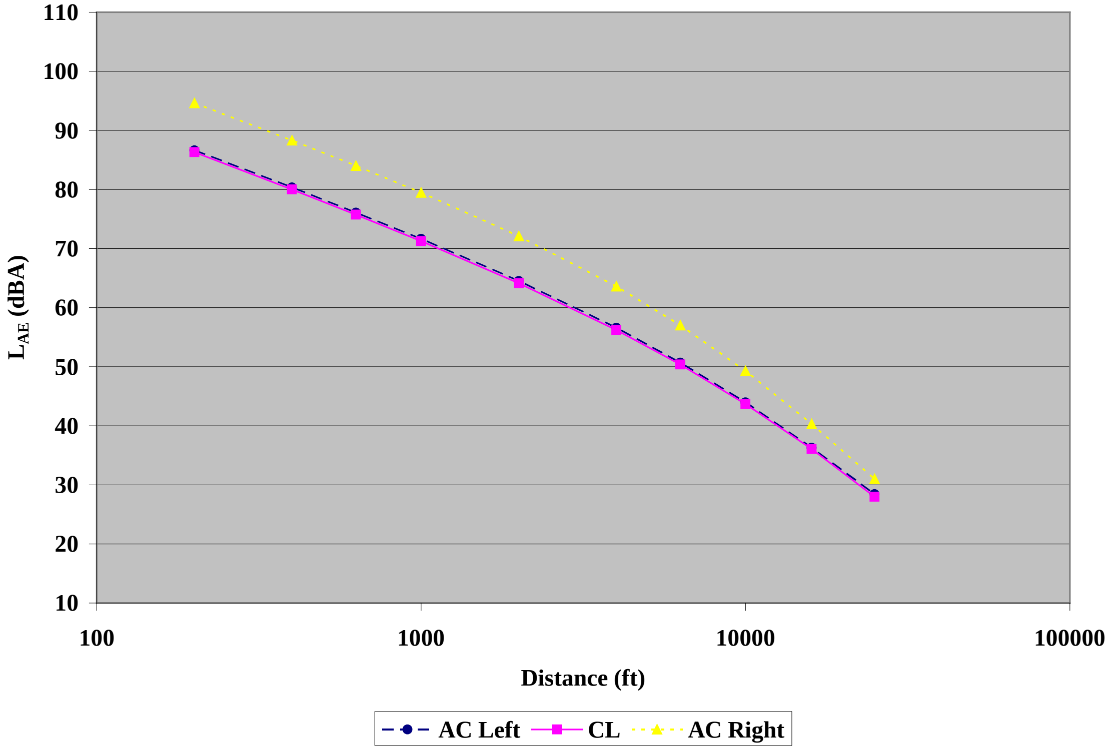

Figure 59. Bell 407 700 Series L_{AE} Data (Ref. Spd. = 61 kts)

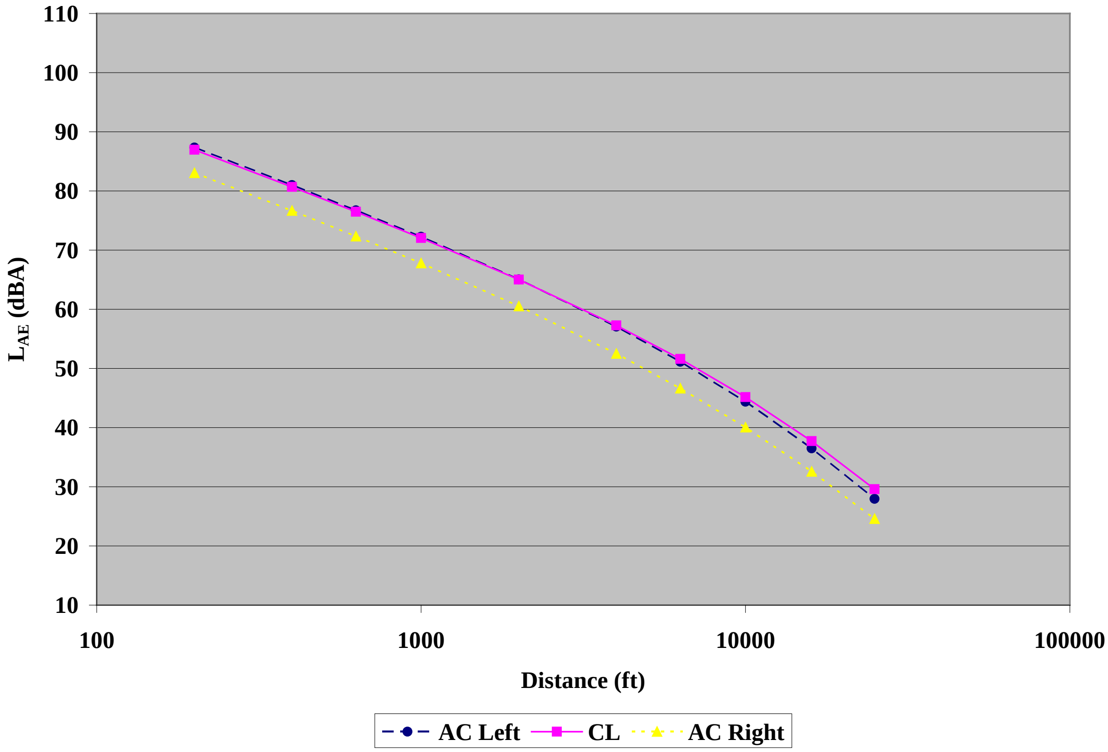

Figure 60. Bell 407 800 Series L_{AE} Data (Ref. Spd. = 36 kts)

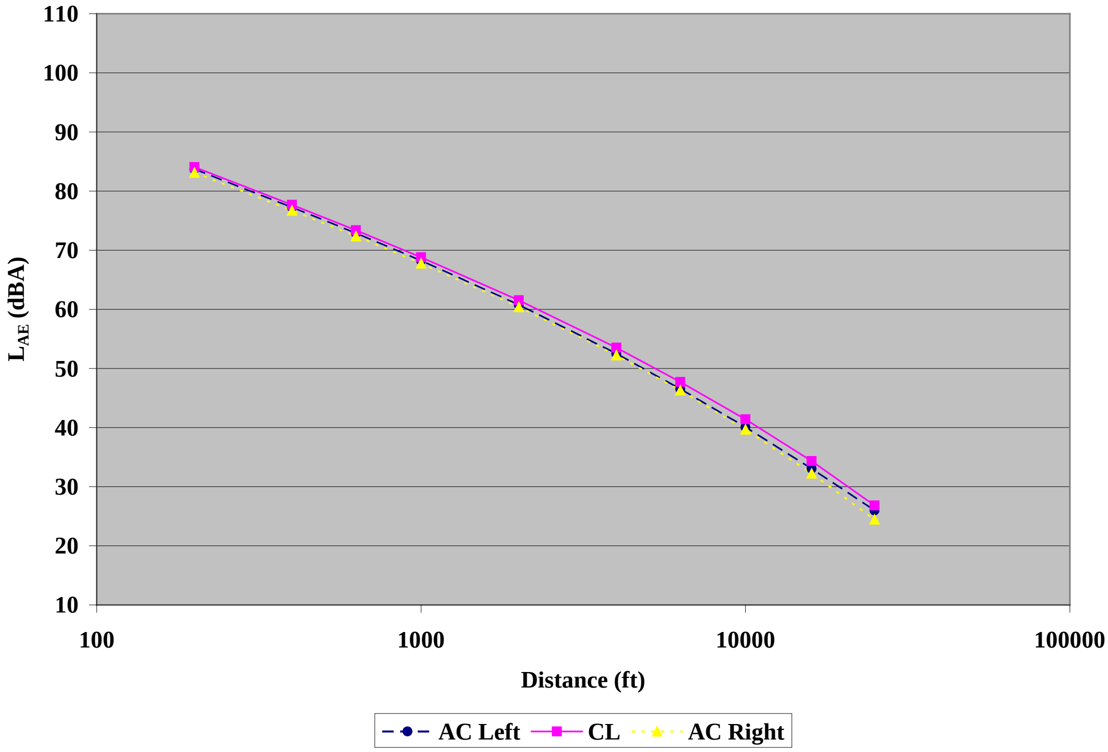

Figure 61. Bell 407 900 Series L_{AE} Data (Ref. Spd. = 21 kts)

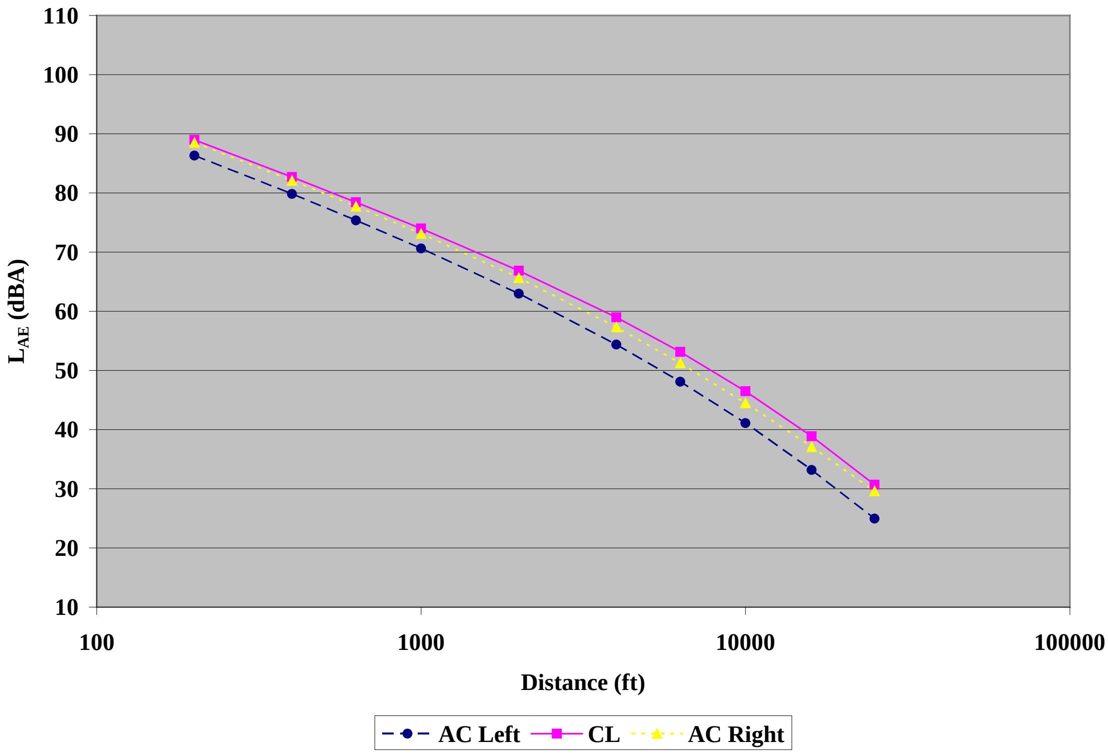

Figure 62. Bell 407 1000 Series L_{AE} Data (Ref. Spd. = 109 kts)

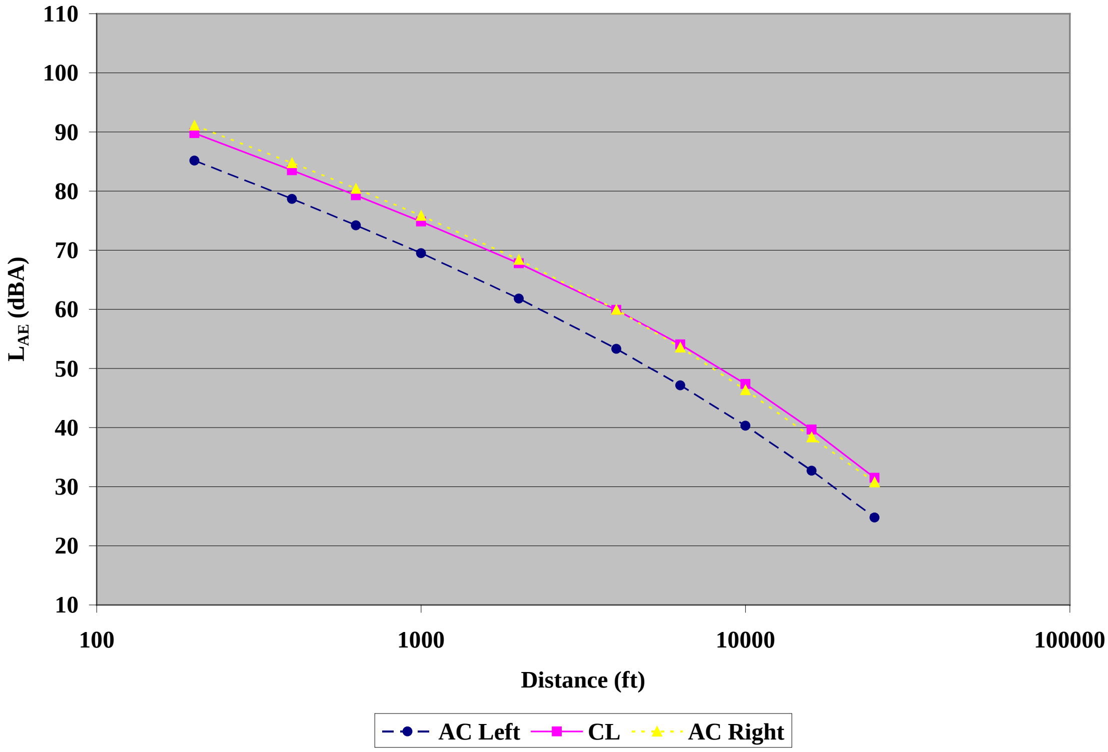

Figure 63. Bell 407 1100 Series L_{AE} Data (Ref. Spd. = 98 kts)

E.2.7 Robinson R44

Note that the R44 did not have a 400 Series. Helicopters typically have one set of departure NPDs (Series 300 for the R44) and supplemental variations of departures were measured only if time permitted.

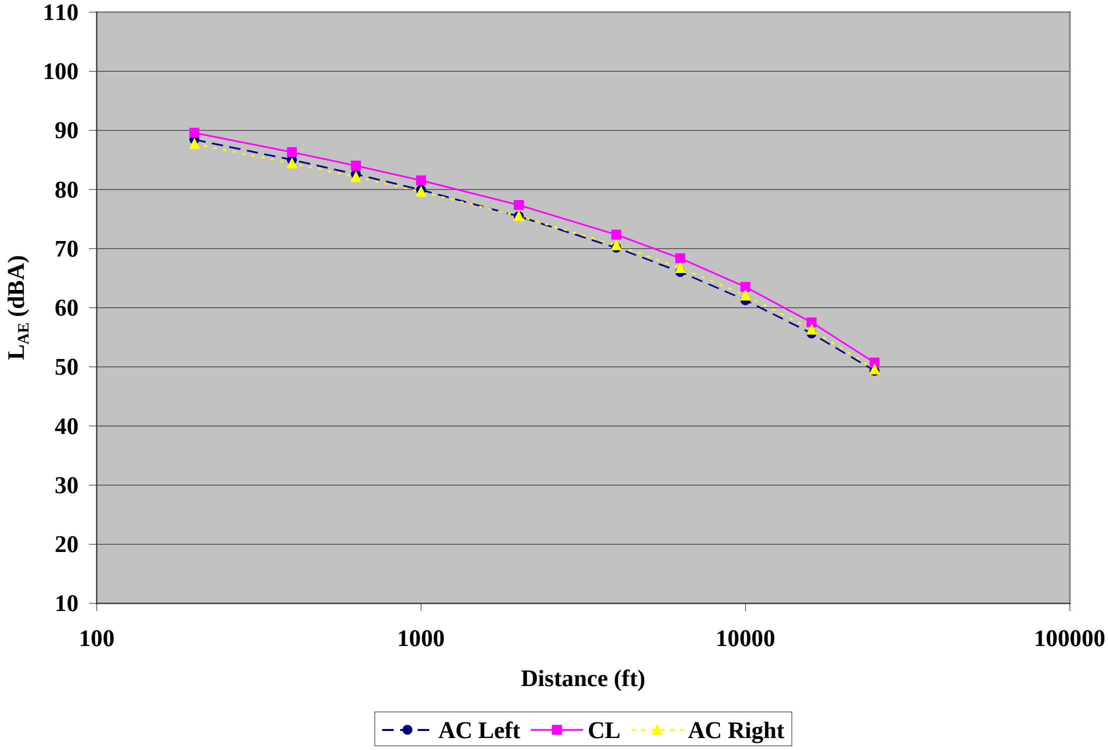

Figure 64. Robinson R44 100 Series L_{AE} Data (Ref. Spd. = 83 kts)

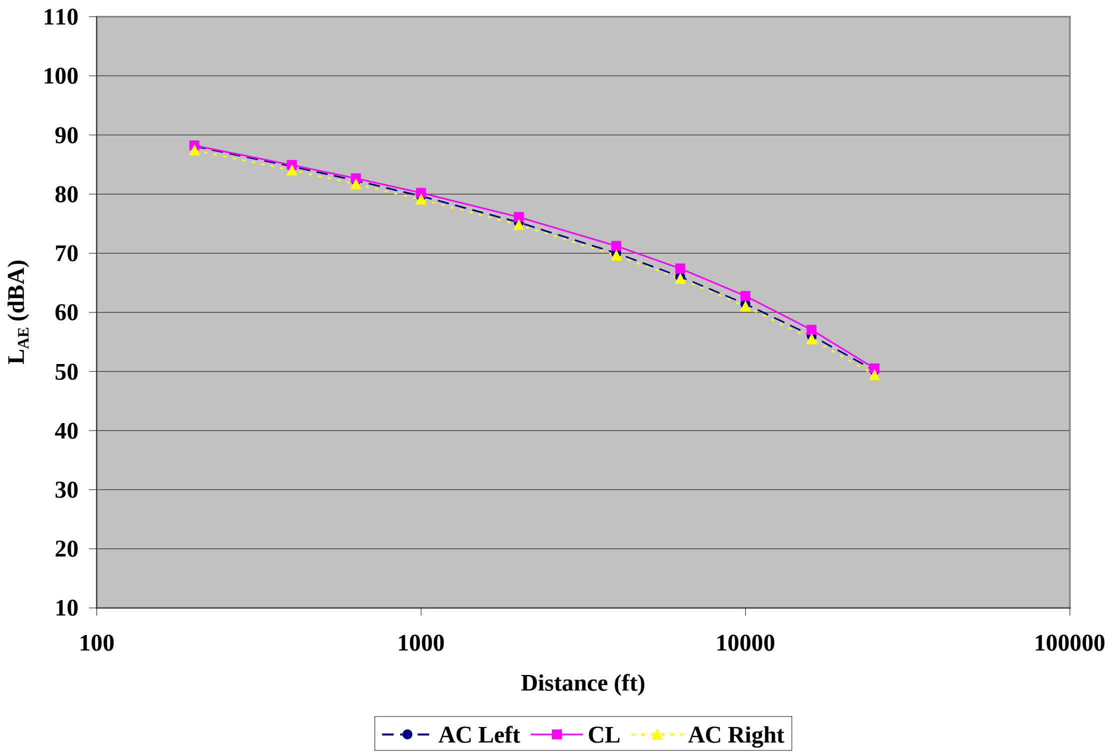

Figure 65. Robinson R44 200 Series L_{AE} Data (Ref. Spd. = 104 kts)

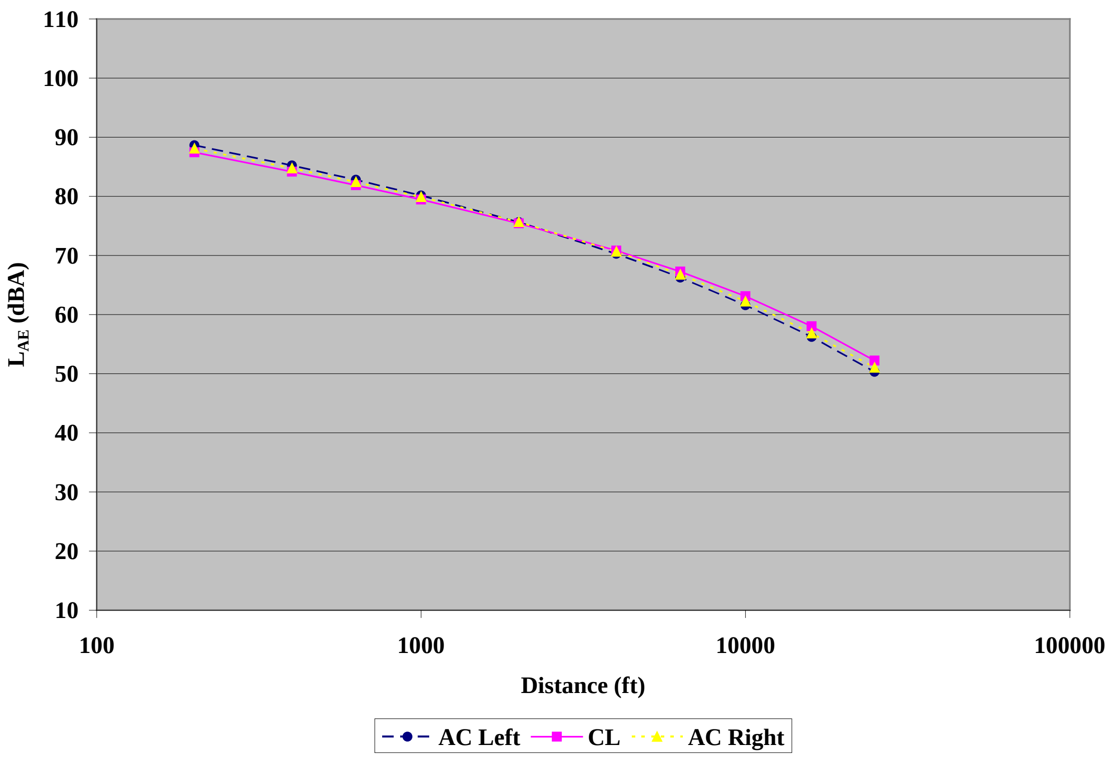

Figure 66. Robinson R44 300 Series L_{AE} Data (Ref. Spd. = 67 kts)

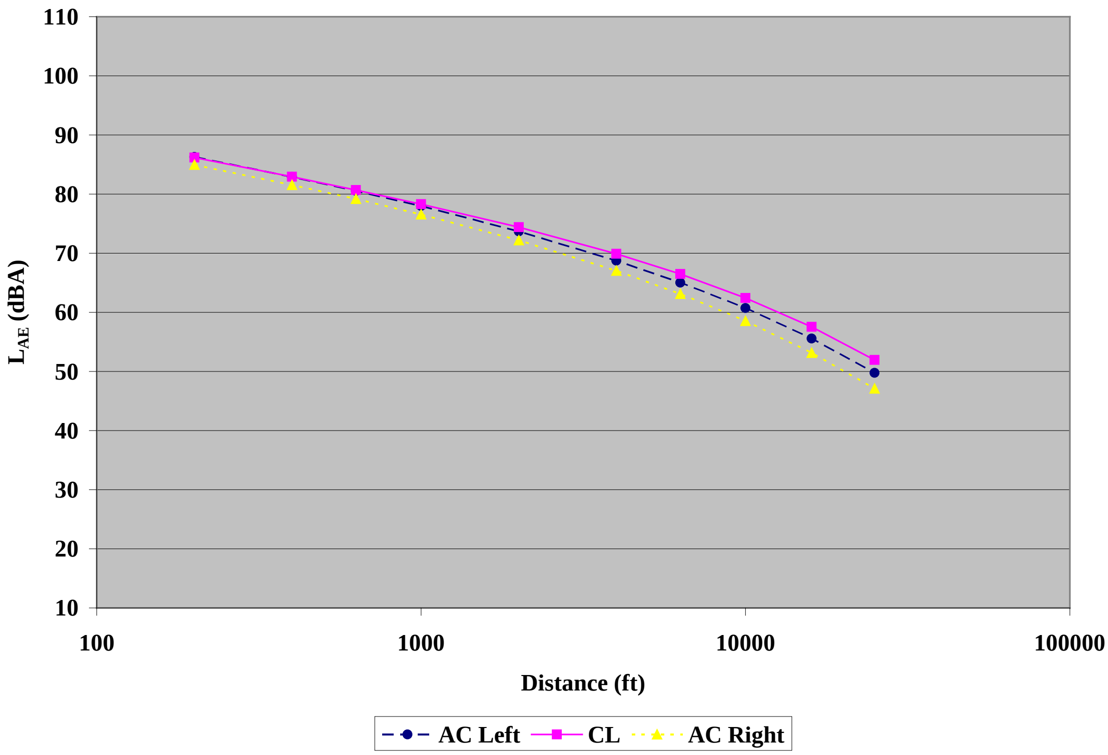

Figure 67. Robinson R44 500 Series L_{AE} Data (Ref. Spd. = 66 kts)

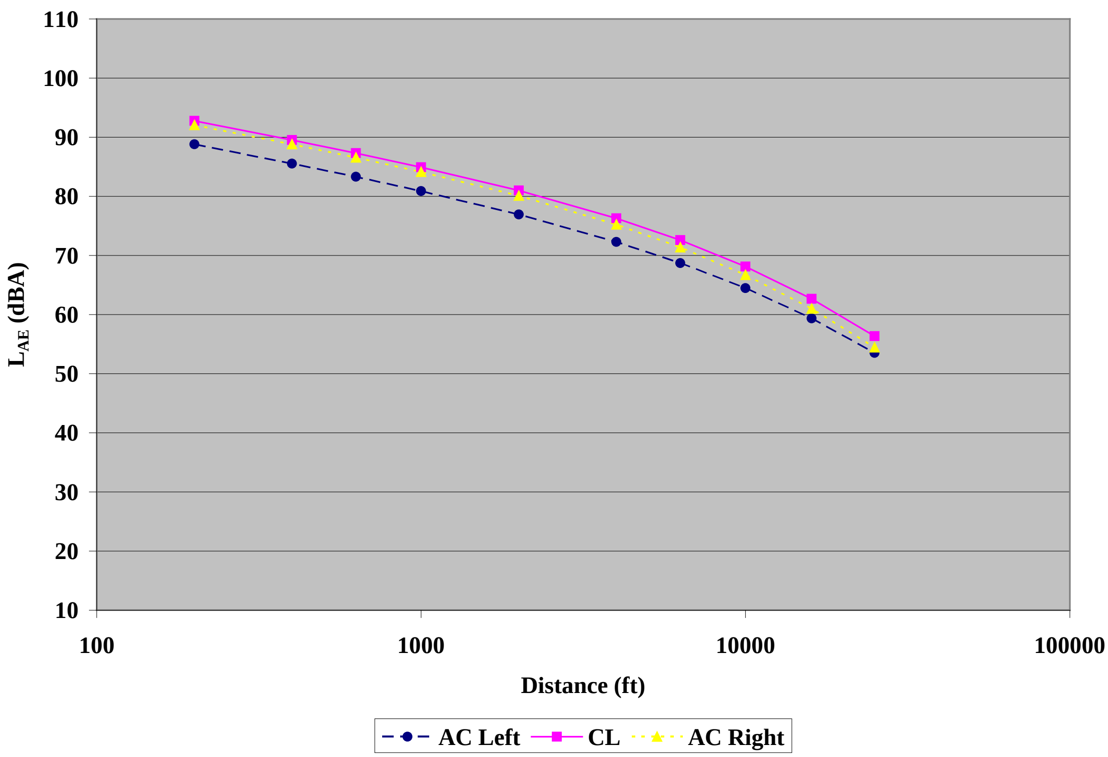

Figure 68. Robinson R44 600 Series L_{AE} Data (Ref. Spd. = 47 kts)

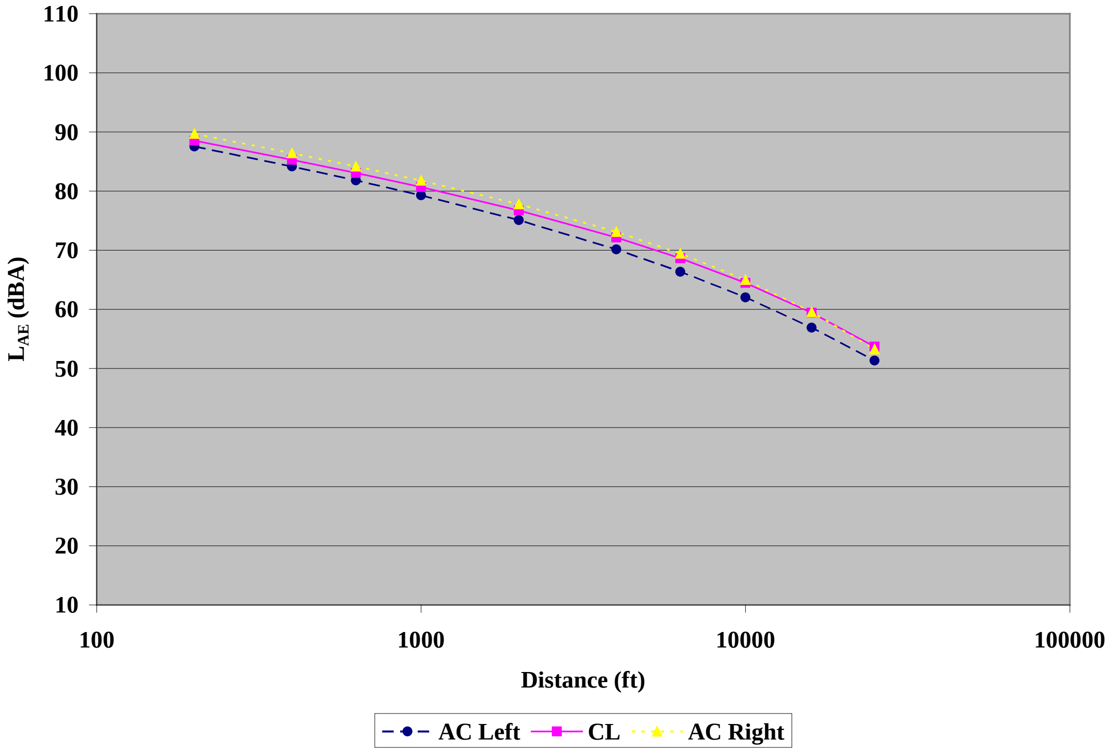

Figure 69. Robinson R44 700 Series L_{AE} Data (Ref. Spd. = 68 kts)

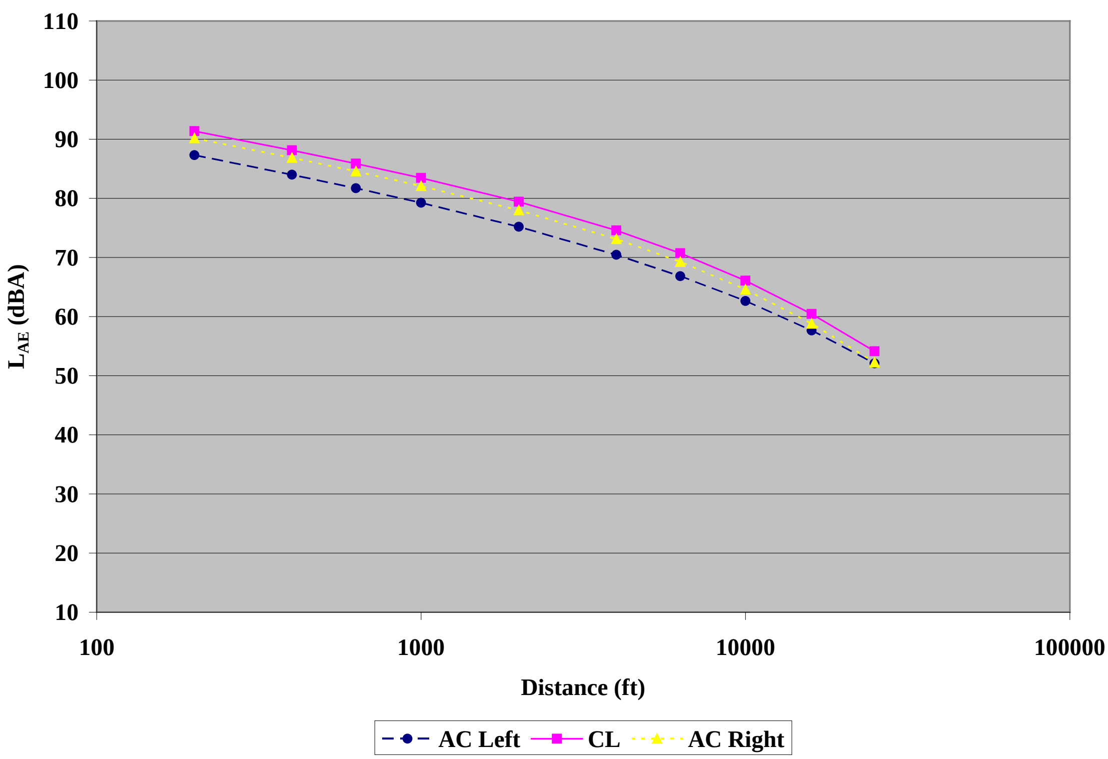

Figure 70. Robinson R44 800 Series L_{AE} Data (Ref. Spd. = 64 kts)

E.2.7 Schweizer 300C

Due to time constraints, data for Series 900 were not collected for the Schweizer 300C.

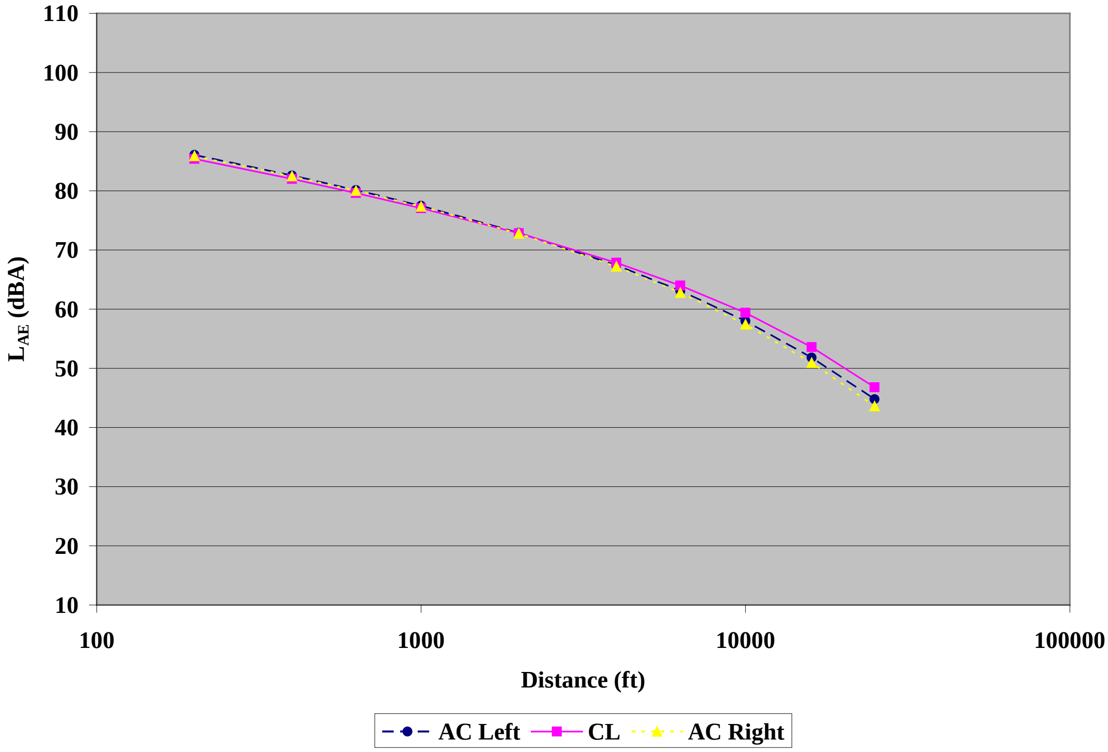

Figure 71. Schweizer 300C 100 Series L_{AE} Data (Ref. Spd. = 55 kts)

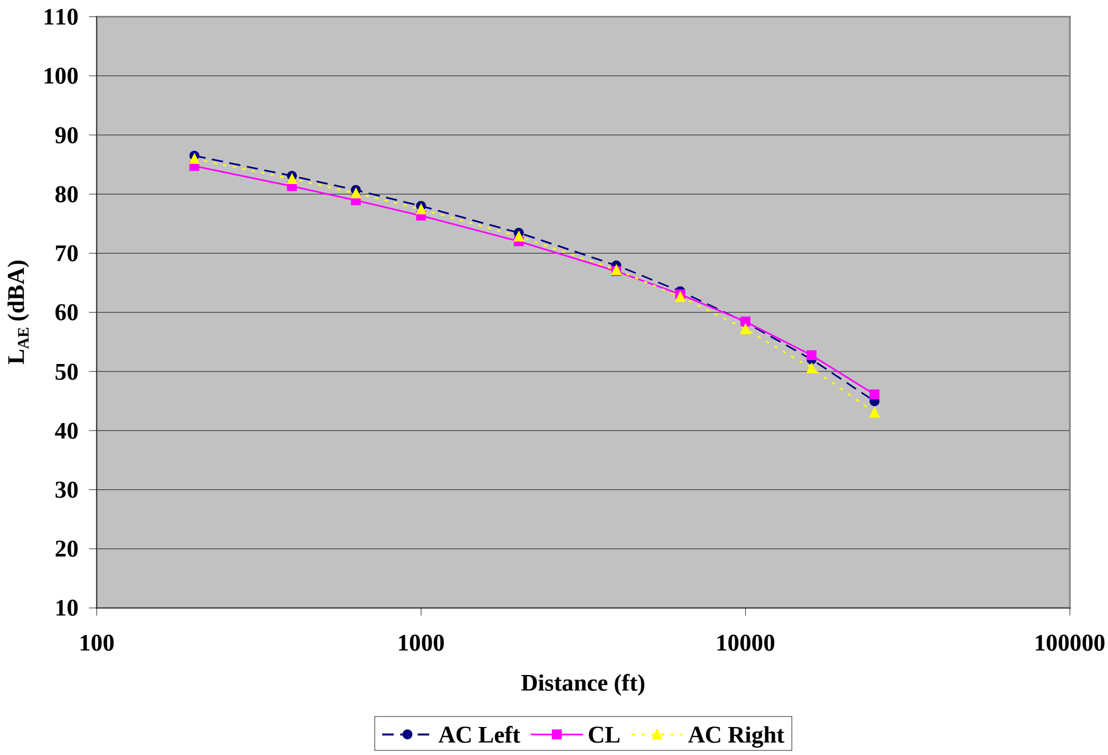

Figure 72. Schweizer 300C 200 Series L_{AE} Data (Ref. Spd. = 73 kts)

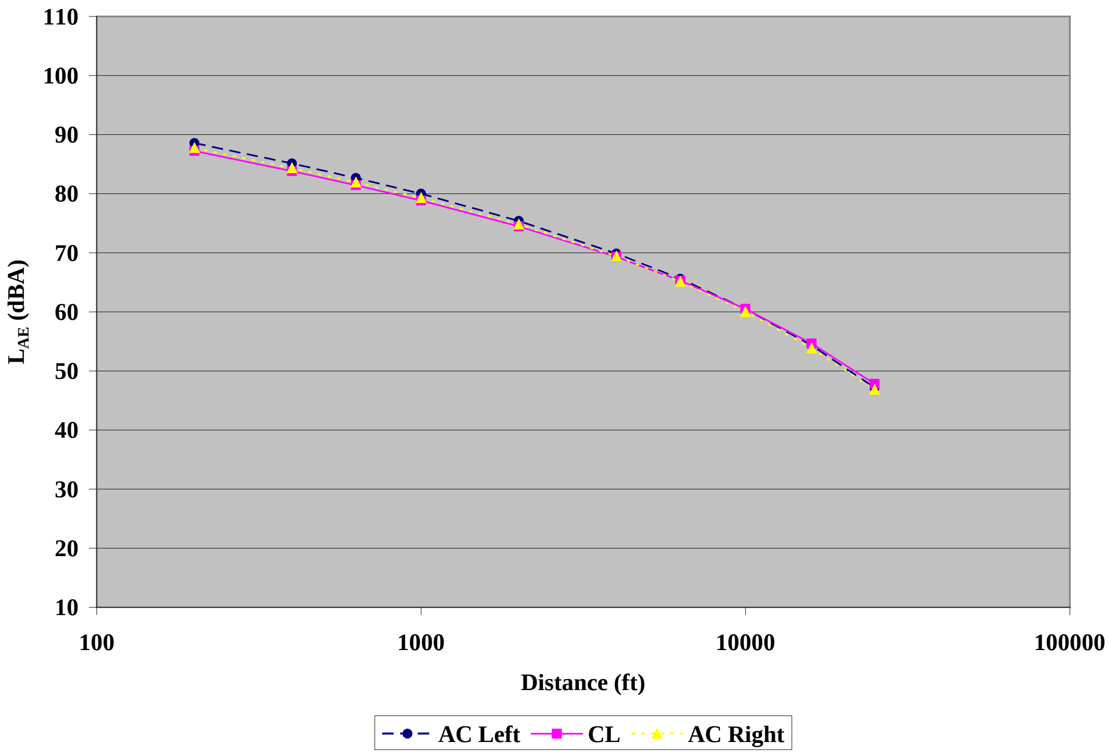

Figure 73. Schweizer 300C 300 Series L_{AE} Data (Ref. Spd. = 39 kts)

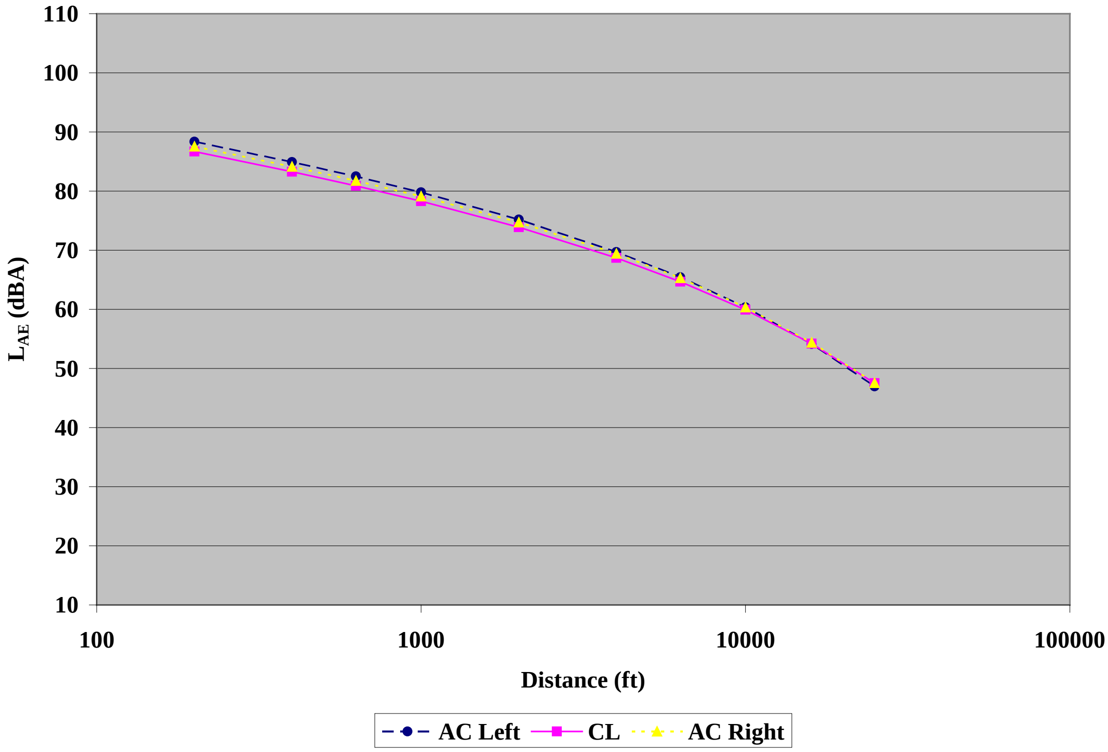

Figure 74. Schweizer 300C 400 Series L_{AE} Data (Ref. Spd. = 42 kts)

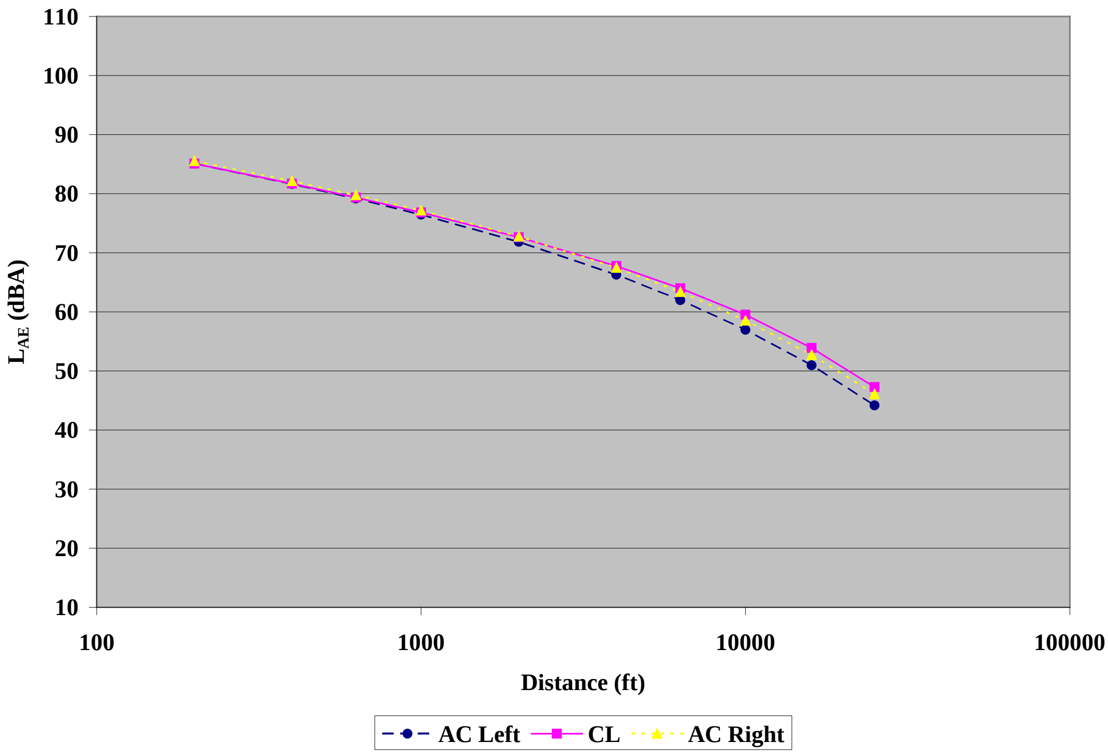

Figure 75. Schweizer 300C 500 Series L_{AE} Data (Ref. Spd. = 67 kts)

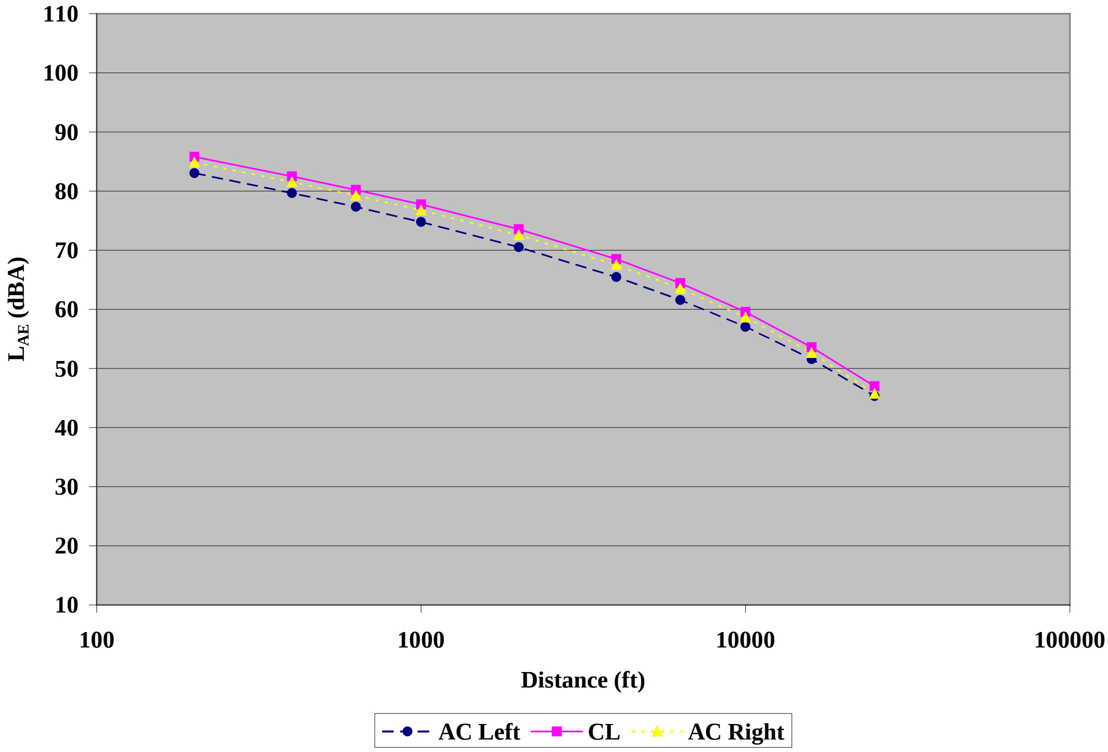

Figure 76. Schweizer 300C 600 Series L_{AE} Data (Ref. Spd. = 52 kts)

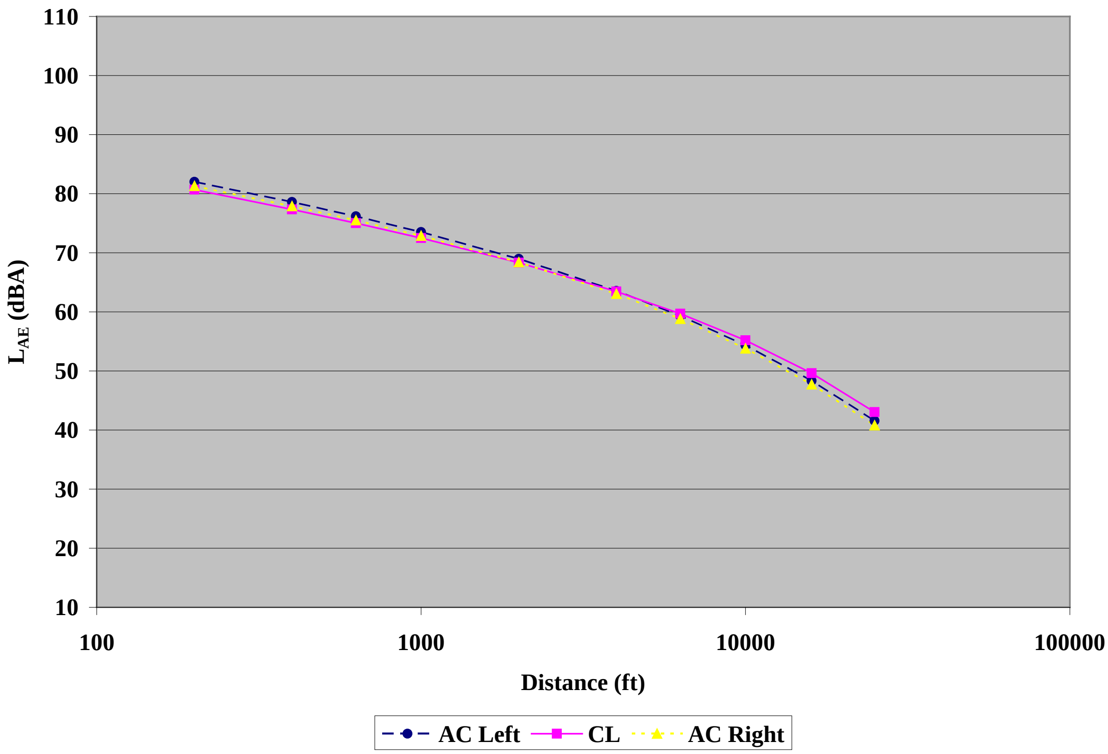

Figure 77. Schweizer 300C 700 Series L_{AE} Data (Ref. Spd. = 64 kts)

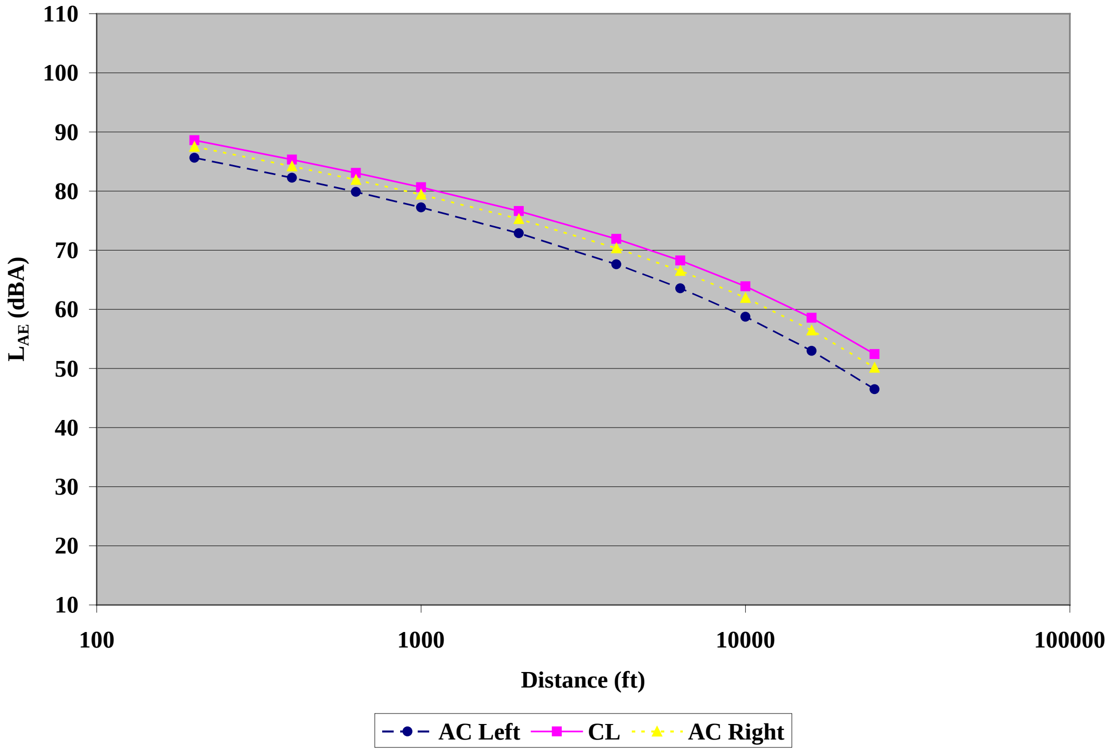

Figure 78. Schweizer 300C 800 Series L_{AE} Data (Ref. Spd. = 61 kts)

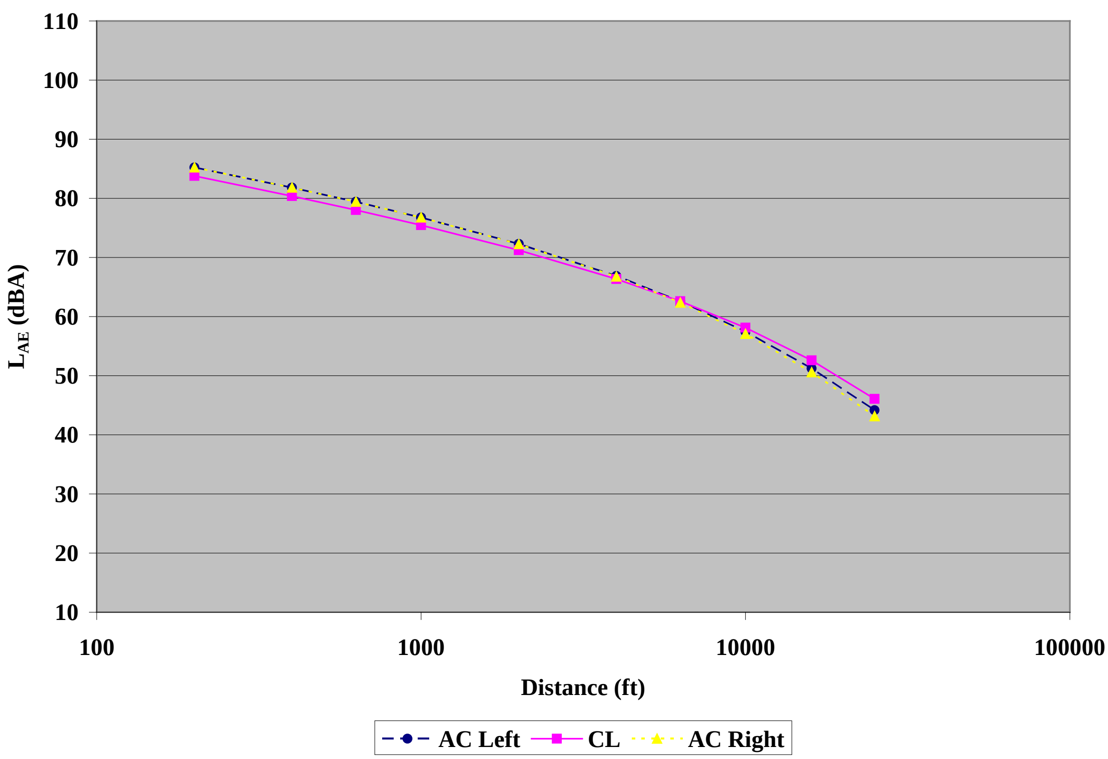

Figure 79. Schweizer 300C 1000 Series L_{AE} Data (Ref. Spd. = 70 kts)

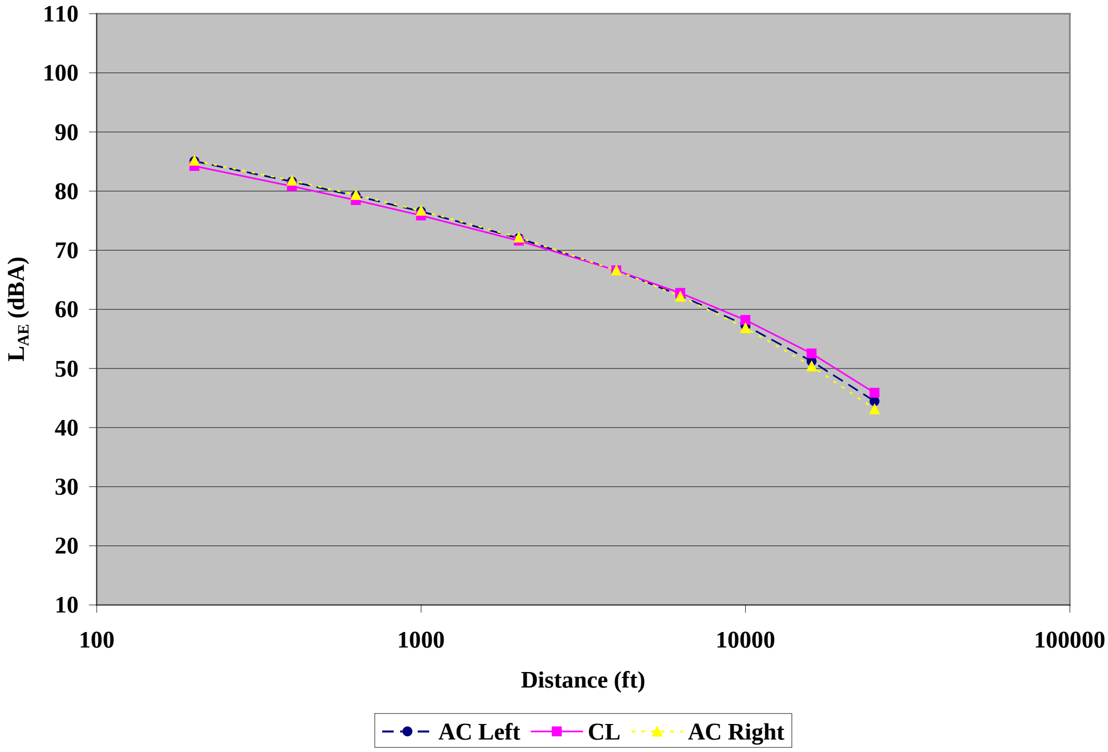

Figure 80. Schweizer 300C 1100 Series L_{AE} Data (Ref. Spd. = 63 kts)

E.3 Helicopter Hover Sound Level Data Tables

Helicopter static operations included HIGE, HOGE, ground and flight idle events. NPD data are presented for the helicopter hover noise at the initial L_0 position (see Figure 20 in Section 7.1.2 for a diagram of the helicopter sweep positions). For the HIGE and HOGE events, the time-period (t) is thirty seconds.

E.3.1 Hover In-Ground Effect Data

In Table 147 through 149, NPD data is presented for the Bell 407, Robinson R44 and Schweizer 300C HIGE helicopter noise at the initial L_0 position (see Figure 20 for a diagram of the helicopter sweep positions).

E.3.1.1 Hover Noise-Power-Distance Curves

The HIGE reference altitude for the Bell 407, Robinson R44, and Schweizer 300C helicopters was five feet, measured from the bottom of the helicopter skids.

Table 147. Bell 407 HIGE Longitudinal Axis NPDs (Ref. Alt. = 5 ft)

Reference orientation L_0		
Distance (ft)	L_{Aeq30s}	L_{PNT30s}
200	84.7	93.9
400	78.1	86.8
630	73.5	81.9
1000	68.5	76.5
2000	60.2	67.3
4000	50.3	56.9
6300	42.5	48.9
10000	33.1	39.7
16000	21.7	26.1
25000	9.2	5.6

Table 148. Robinson R44 HIGE Longitudinal Axis NPDs (Ref. Alt. = 5 ft)

Reference orientation L_0		
Distance (ft)	L_{Aeq30s}	L_{PNT30s}
200	80.1	92.6
400	73.5	85.7
630	69.0	81.0
1000	64.2	75.9
2000	56.2	67.8
4000	46.8	59.1
6300	39.7	53.0
10000	31.4	45.0
16000	22.3	32.0
25000	13.4	12.5

Table 149. Schweizer 300C HIGE Longitudinal Axis NPDs (Ref. Alt. = 5 ft)

Reference orientation L_0		
Distance (ft)	L_{Aeq30s}	L_{PNT30s}
200	76.3	89.0
400	69.6	81.8
630	64.8	76.7
1000	59.6	71.2
2000	50.7	62.2
4000	39.9	51.9
6300	31.5	43.7
10000	21.8	31.1
16000	11.7	10.7
25000	3.1	-19.9

E.3.1.2 Directivity Data

The A-weighted directivity adjustments to be applied to the above Bell 407, Robinson R-44 and Schweizer 300C HIGE data for off-reference orientations are presented in Table 150, along with the perceived level directivity adjustments, denoted by the symbols ΔL_{Aeqt} and ΔL_{PNTt}. These directivity adjustments may be added to the L_{Aeqt} and L_{PNTt} NPDs in Tables 147 through 149 to develop directivity adjusted NPDs for HIGE.

Polar plots of the helicopter directivity for HIGE noise data are presented in Figures 81 through 83. Solid points on the graph represent measured data, whereas the hollow represent interpolated points. Average wind direction and wind speed are noted on each plot. Average wind direction is measured in degrees from north (i.e., a wind direction of zero degrees indicates a wind blowing *from* the north).

Table 150. HIGE 360-Degree Directivity NPD Adjustments

180 L	165 L	150 L	135 L	120 L	105 L	90 L	75 L	60 L	45 L	30 L	15 L	L 0	15 R	30 R	45 R	60 R	75 R	90 R	105 R	120 R	135 R	150 R	165 R	180 R
Bell 407 ΔL_{Aeq30s} (dBA)																								
6.6	5.9	5.1	4.4	2.8	1.1	1.8	2.5	3.2	1.7	0.3	-1.2	0.0	1.2	2.4	3.6	4.6	5.7	5.3	4.9	4.5	5.5	6.4	7.4	6.6
Robinson R44 ΔL_{Aeq30s} (dBA)																								
5.2	6.1	7.0	7.9	7.7	7.5	7.3	5.7	4.1	2.5	1.6	0.8	0.0	1.1	2.2	3.3	4.8	6.3	7.8	8.2	8.6	8.9	7.7	6.4	5.2
Schweizer 300C ΔL_{Aeq30s} (dBA)																								
-0.2	0.0	0.2	0.3	0.5	0.6	0.8	0.4	0.0	-0.5	-0.3	-0.2	0.0	1.5	2.9	3.1	3.3	3.5	3.8	2.8	1.8	0.8	0.5	0.1	-0.2
Bell 407 ΔL_{PNT30s} (dB)																								
7.2	6.4	5.5	4.7	2.7	0.7	1.5	2.2	2.9	1.5	0.1	-1.3	0.0	1.3	2.6	3.9	4.4	4.9	4.9	4.9	4.9	5.9	7.0	8.1	7.2
Robinson R44 ΔL_{PNT30s} (dB)																								
7.5	7.9	8.3	8.7	8.5	8.2	7.9	6.5	5.0	3.5	2.3	1.2	0.0	0.8	1.7	2.5	3.3	4.1	4.9	6.5	8.1	9.7	9.0	8.2	7.5
Schweizer 300C ΔL_{PNT30s} (dB)																								
-0.5	0.0	0.2	0.4	0.2	-0.1	-0.2	-0.3	-0.5	-0.3	-0.2	0.0	0.0	0.4	0.9	1.2	1.5	1.9	2.2	1.4	0.6	-0.2	-0.3	-0.4	-0.5

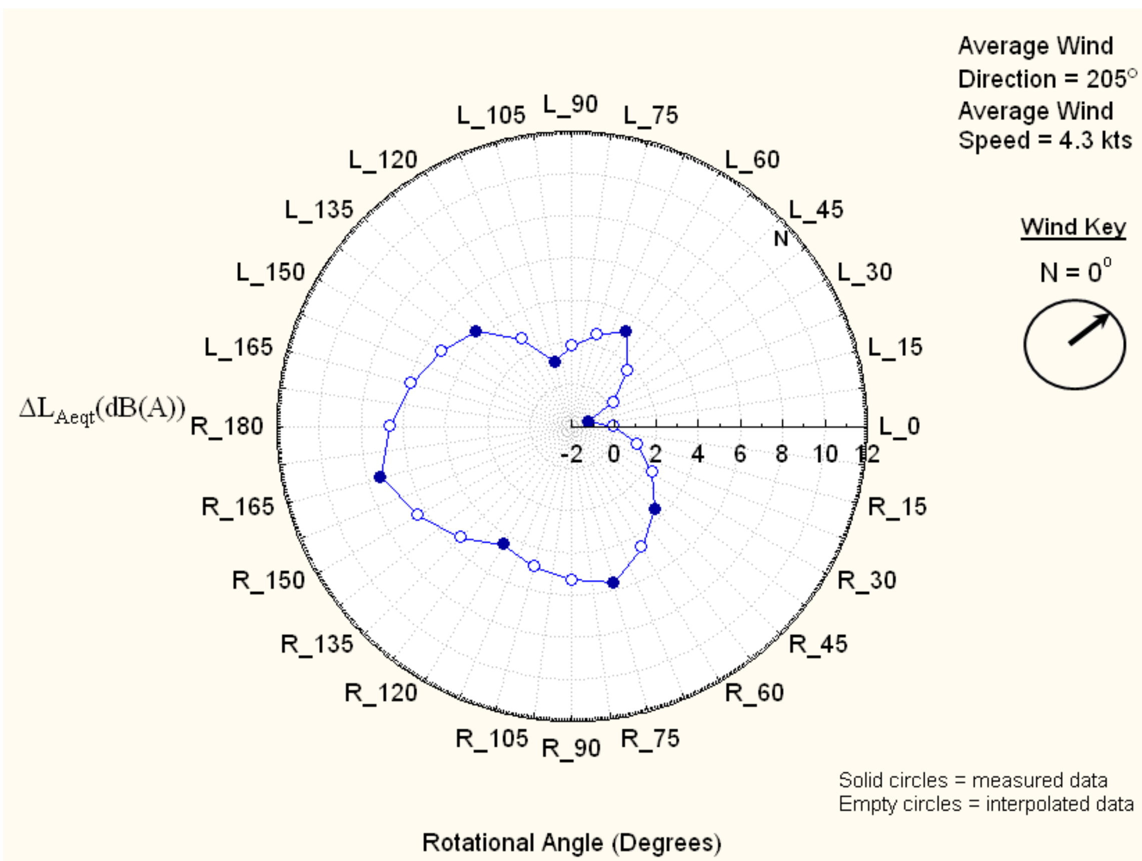

Figure 81. Bell 407 HIGE Directivity

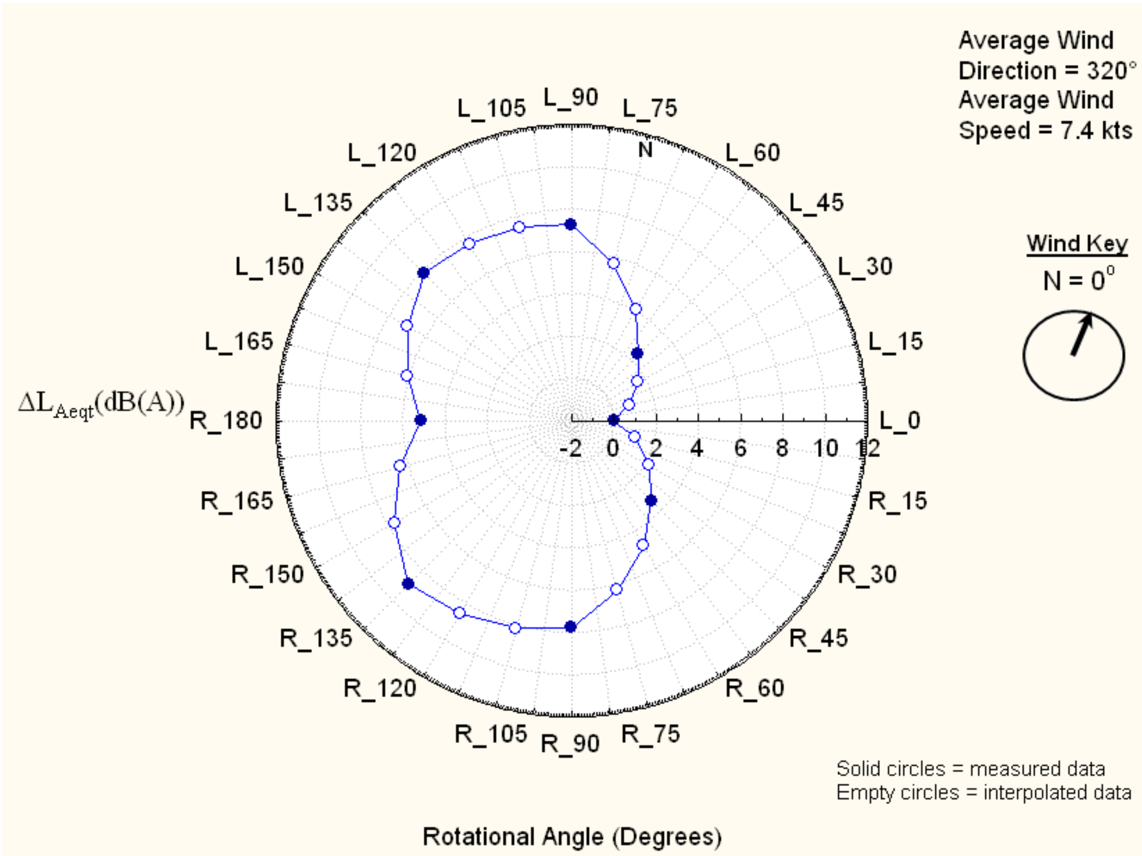

Figure 82. Robinson R44 HIGE Directivity

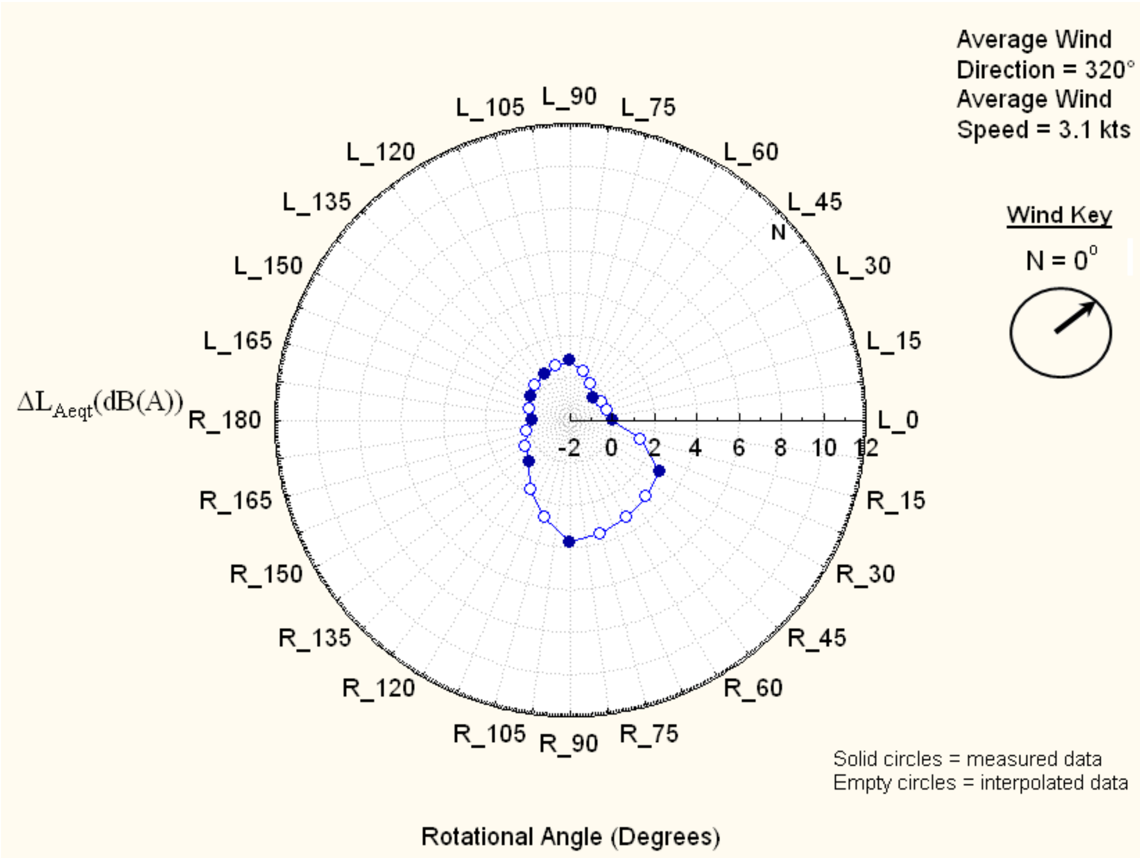

Figure 83. Schweizer 300C HIGE Directivity

E.3.2 Hover Out-of-Ground Effect Data

In Tables 151 through 153 NPD data is presented for the Bell 407, Robinson R44, and Schweizer 300C HOGE helicopter noise at the initial L_0 position (see Figure 20 for a diagram of the helicopter sweep positions).

E.3.2.1 Hover Noise-Power-Distance Curves

The HOGE reference altitude for the helicopters was the main rotor diameter multiplied by 2.5. This resulted in reference altitudes of 88 feet for the Bell 407, 83 feet for the Robinson R44, and 67 feet for the Schweizer 300C measured from the bottom of the helicopter skids.

Table 151. Be11 407 HOGE Longitudinal Axis NPDs (Ref. Alt. = 88 ft)

Reference orientation L_0		
Distance (ft)	L_{Aeq30s}	L_{PNT30s}
200	87.4	100.0
400	80.7	93.2
630	76.2	88.5
1000	71.3	83.5
2000	63.3	75.4
4000	54.1	66.9
6300	47.2	61.2
10000	39.2	54.0
16000	30.1	42.3
25000	20.5	24.9

Table 152. Robinson R44 HOGE Longitudinal Axis NPDs (Ref. Alt. = 83 ft)

Reference orientation L_0		
Distance (ft)	L_{Aeq30s}	L_{PNT30s}
200	77.3	90.8
400	70.8	83.9
630	66.3	79.1
1000	61.6	74.0
2000	53.8	65.7
4000	44.8	56.4
6300	37.9	49.5
10000	29.8	40.6
16000	20.0	26.2
25000	9.3	4.7

Table 153. Schweizer 300C HOGE Longitudinal Axis NPDs (Ref. Alt. = 67 ft)

Reference orientation L_0		
Distance (ft)	L_{Aeq30s}	L_{PNT30s}
200	77.8	89.0
400	71.3	82.2
630	66.9	77.5
1000	62.1	72.5
2000	54.2	64.3
4000	45.1	55.0
6300	38.2	48.6
10000	30.2	38.7
16000	20.8	22.7
25000	10.5	-1.3

E.3.2.2 Directivity Data

The A-weighted directivity adjustments to be applied to the above Bell 407, Robinson R-44 and Schweizer 300C HOGE data for off-reference orientations are presented in Table 154, along with the perceived level directivity adjustments, denoted by the symbols ΔL_{Aeqt} and ΔL_{PNTt}. These directivity adjustments may be added to the L_{Aeqt} and L_{PNTt} NPDs in Table 151 through Table 153 to develop directivity adjusted NPDs for HOGE.

Polar plots of the helicopter directivity noise data for HOGE are presented in Figures 84 through 86. Solid points on the graph represent measured data where as the hollow represent interpolated points. Average wind direction and wind speed are noted on each plot. Average wind direction is measured in degrees from north (i.e., a wind direction of zero degrees indicates a wind blowing *from* the north).

Table 154. HOGE 360-Degree Directivity NPD Adjustments

180 L	165 L	150 L	135 L	120 L	105 L	90 L	75 L	60 L	45 L	30 L	15 L	L 0	15 R	30 R	45 R	60 R	75 R	90 R	105 R	120 R	135 R	150 R	165 R	180 R
Bell 407 ΔL_{Aeq30s} (dBA)																								
10.9	7.3	3.8	4.1	4.4	4.8	4.1	3.5	2.9	2.3	1.5	0.8	0.0	3.6	7.1	6.5	5.8	5.1	6.1	7.2	8.2	9.2	9.8	10.3	10.9
Robinson R44 ΔL_{Aeq30s} (dBA)																								
9.0	9.1	9.2	9.3	9.4	9.4	9.5	7.5	5.4	3.3	2.2	1.1	0.0	2.0	4.1	6.1	7.3	8.4	9.5	10.1	10.7	11.3	10.6	9.8	9.0
Schweizer 300C ΔL_{Aeq30s} (dBA)																								
5.3	4.1	2.9	1.7	1.7	1.7	1.7	1.1	0.5	0.0	0.0	0.0	0.0	1.2	2.4	2.4	2.4	2.4	3.1	3.8	4.5	5.2	5.2	5.3	5.3
Bell 407 ΔL_{PNT30s} (dB)																								
9.0	6.0	3.1	3.2	3.3	3.5	2.8	2.2	1.5	0.9	0.6	0.3	0.0	2.6	5.2	4.8	4.3	3.9	4.2	4.4	4.7	5.0	6.3	7.7	9.0
Robinson R44 ΔL_{PNT30s} (dB)																								
9.3	9.5	9.7	9.9	9.4	9.0	8.5	7.7	6.8	5.9	3.9	2.0	0.0	1.6	3.1	4.7	5.8	6.8	7.8	9.2	10.6	12.0	11.1	10.2	9.3
Schweizer 300C ΔL_{PNT30s} (dB)																								
3.7	2.1	0.6	-0.9	0.1	1.1	0.5	-0.2	-0.8	-0.6	-0.4	-0.2	0.0	0.2	0.4	0.7	1.2	1.8	2.5	3.3	4.1	4.4	4.8	5.2	3.7

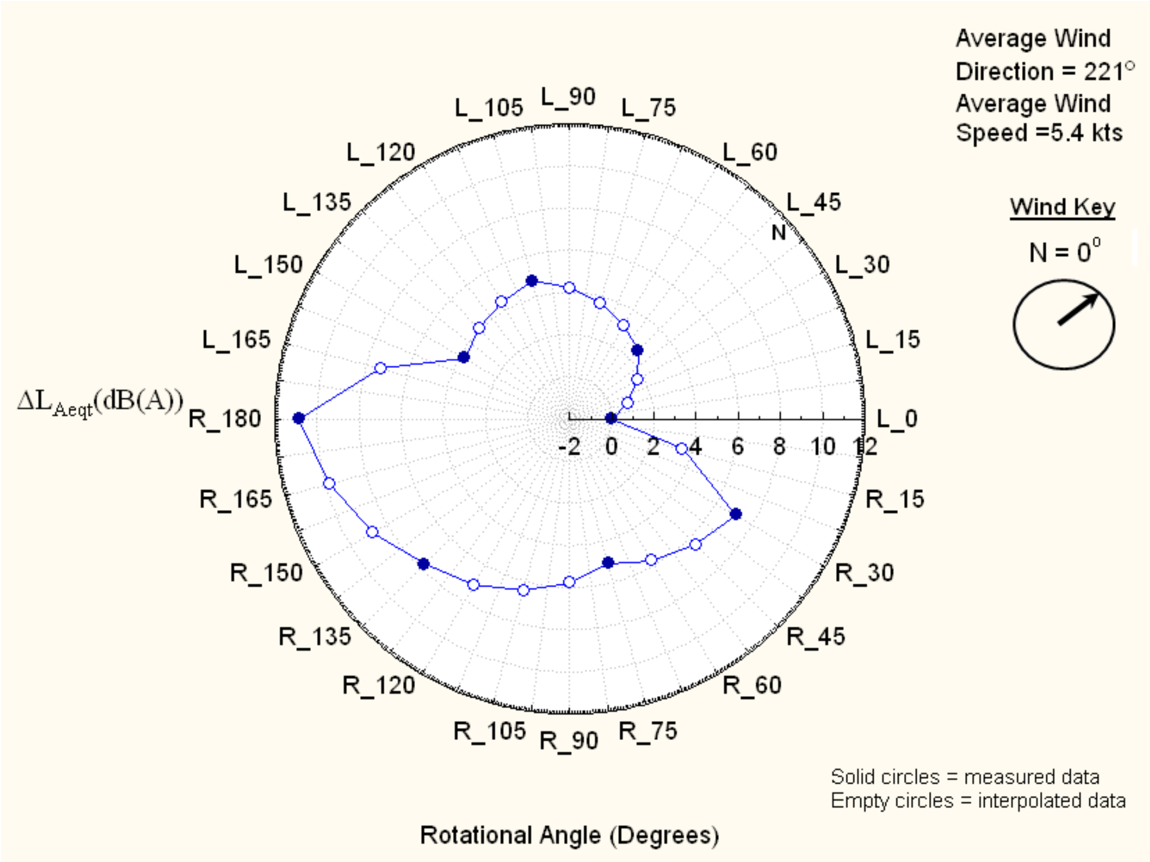

Figure 84. Bell 407 HOGE Directivity

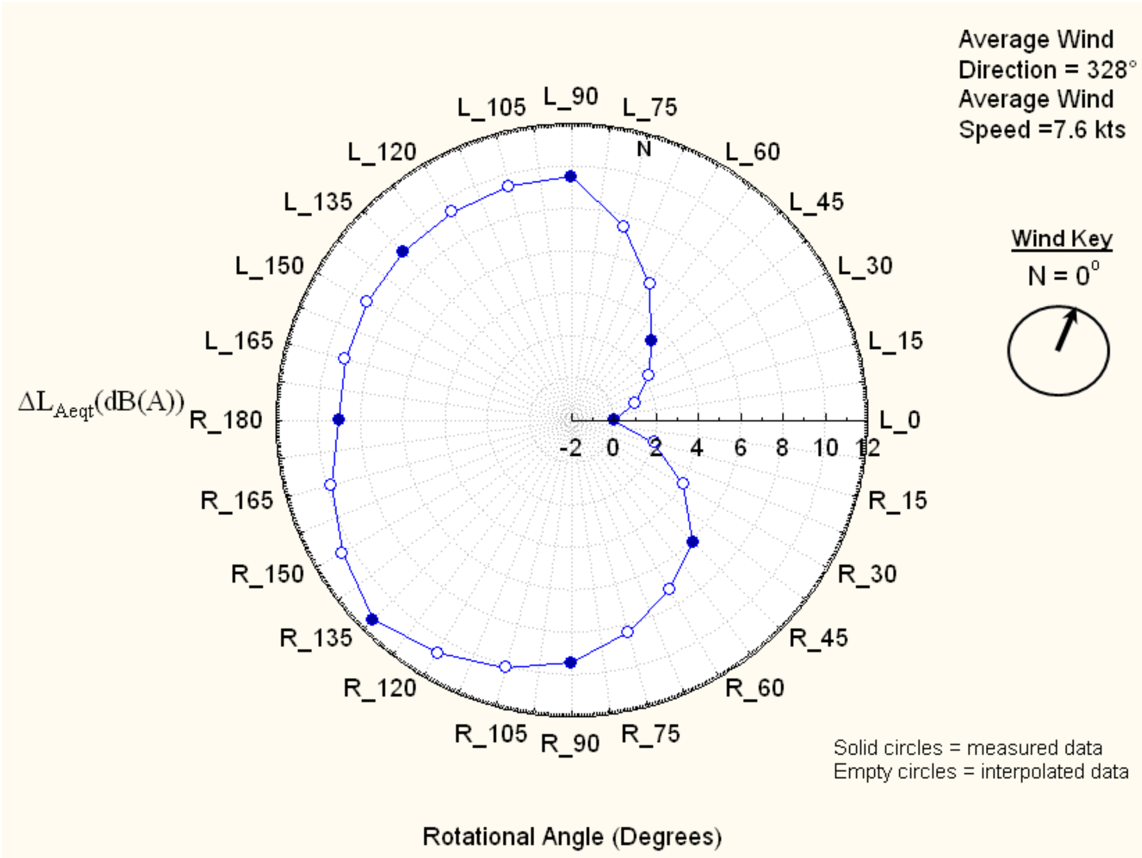

Figure 85. Robinson R44 HOGE Directivity

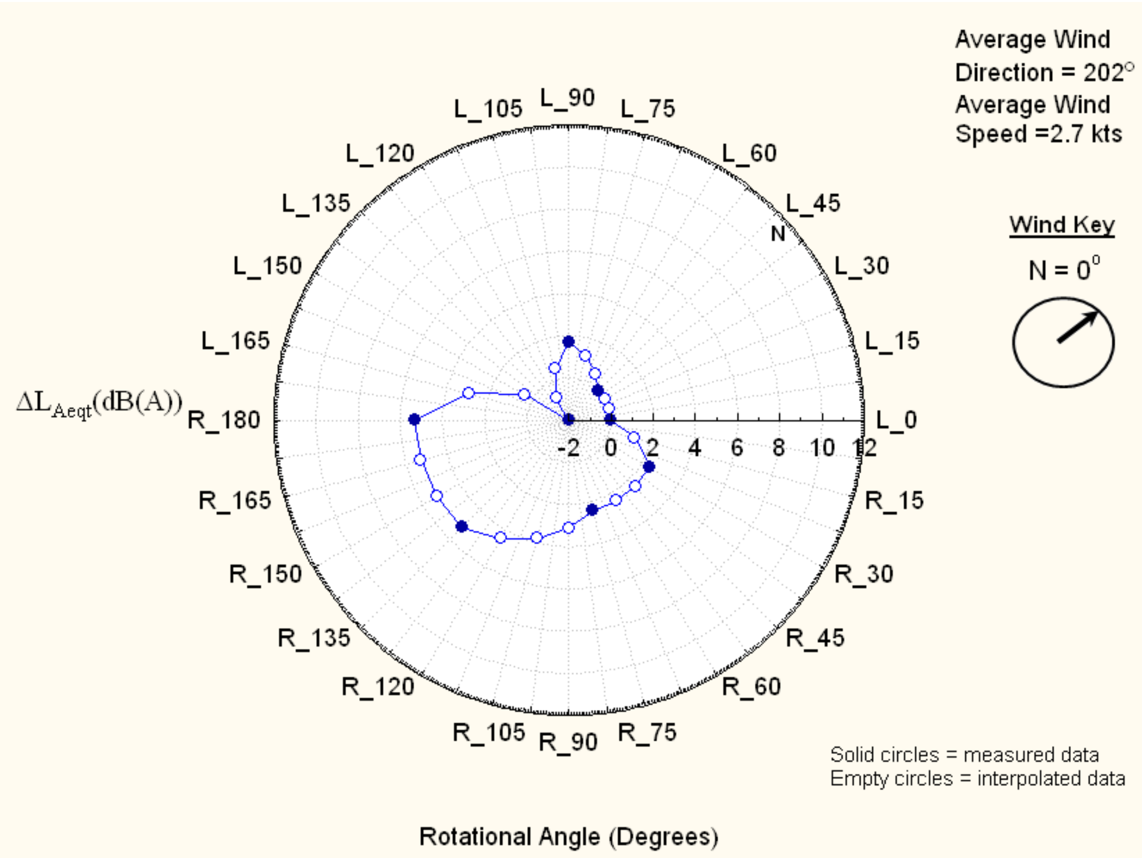

Figure 86. Schweizer 300C HOGE Directivity

E.4 Helicopter Idle Data

In Table 155 NPD data is presented for the Bell 407, Robinson R44, and Schweizer 300C Ground Idle and Flight Idle helicopter noise at the initial L_0 position (see Figure 20 for a diagram of the helicopter sweep positions). The NPDs presented in Table 155 were constructed using 30-second equivalent continuous A-weighted and perceived sound pressure levels, L_{Aeq30s} and L_{PNT30s}.

Table 155. Helicopter Idle Longitudinal Axis NPDs (Ref. Alt. = 0 ft)

	B407 Ground	B407 Flight	R44 Ground	R44 Flight	300C Ground	300C Flight
L_{Aeq30s}						
Dist. (ft)	**dBA**	**dBA**	**dBA**	**dBA**	**dBA**	**dBA**
200	73.1	83.1	71.8	75.6	56.2	70.3
400	65.4	76.3	65.3	69.0	49.6	63.6
630	59.8	71.5	60.8	64.4	45.1	59.0
1000	53.6	66.2	56.1	59.5	40.2	53.9
2000	43.4	57.5	48.6	51.4	32.0	45.4
4000	31.7	47.2	40.4	42.3	22.6	35.5
6300	22.6	39.3	34.7	35.9	15.5	27.8
10000	12.0	30.1	28.5	28.9	7.9	19.1
16000	0.1	19.1	21.4	21.0	0.3	9.8
25000	-10.6	7.6	13.6	12.4	-6.4	1.2

L_{PNT30s}

Dist. (ft)	dB	dB	dB	dB	dB	dB
200	84.6	94.9	89.4	89.8	73.2	85.9
400	76.7	87.6	82.6	82.9	65.8	78.5
630	70.5	82.6	78.0	78.2	60.5	73.4
1000	63.4	77.2	73.0	73.2	54.7	68.0
2000	50.9	68.2	65.1	65.1	44.3	59.0
4000	31.9	58.3	56.2	55.8	29.3	48.7
6300	10.6	50.9	49.7	49.4	12.2	39.1
10000	-23.8	41.4	39.3	39.4	-15.4	23.7
16000	-79.6	26.1	22.4	23.2	-60.1	-1.3
25000	-163.2	3.0	-2.9	-1.2	-127.2	-38.8

E.4.2.2 Directivity Data

The A-weighted directivity adjustments to be applied to the above Bell 407, Robinson R-44 and Schweizer 300C Ground Idle and Flight Idle data for off-reference orientations are presented inTables 156 and 157, along with the perceived level directivity adjustments, denoted by the symbols ΔL_{Aeqt} and ΔL_{PNTt}. These directivity adjustments may be added to the NPDs in Table 155 to develop directivity-adjusted NPDs for Flight Idle and Ground Idle.

Polar plots of the helicopter directivity noise data for Ground and Flight Idle are presented in Figures 87 through 92. Solid points on the graph represent measured data where as the hollow represent interpolated points. Average wind direction and wind speed are noted on each plot. Average wind direction is measured in degrees from north (i.e., a wind direction of zero degrees indicates a wind blowing *from* the north).

Table 156. Ground Idle 360-Degree Directivity NPD Adjustments

180 L	165 L	150 L	135 L	120 L	105 L	90 L	75 L	60 L	45 L	30 L	15 L	L 0	15 R	30 R	45 R	60 R	75 R	90 R	105 R	120 R	135 R	150 R	165 R	180 R
Bell 407 ΔL_{Aeq30s} (dBA)																								
-1.9	0.8	3.4	6.0	5.0	3.9	2.9	3.2	3.5	3.8	4.1	2.1	0.0	-0.2	-0.4	-0.5	-1.2	-1.8	-2.4	-1.2	0.0	1.2	2.4	0.3	-1.9
Robinson R44 ΔL_{Aeq30s} (dBA)																								
4.3	5.3	6.4	7.4	6.6	5.8	5.0	4.4	3.9	3.3	2.2	1.1	0.0	1.3	2.5	3.8	4.6	5.5	6.3	7.5	8.7	9.9	8.0	6.2	4.3
Schweizer 300C ΔL_{Aeq30s} (dBA)																								
-0.7	3.1	6.8	7.1	7.3	7.5	6.6	5.7	4.8	3.9	2.9	1.5	0.0	-2.8	-5.5	-5.1	-4.7	-4.3	-4.2	-4.1	-3.9	-3.8	-3.7	-2.2	-0.7
Bell 407 ΔL_{PNT30s} (dB)																								
-2.2	0.0	2.2	4.4	4.1	3.7	3.4	3.4	3.5	3.5	3.6	1.8	0.0	-0.2	-0.5	-0.7	-0.9	-1.2	-1.4	-0.5	0.3	1.2	2.0	-0.1	-2.2
Robinson R44 ΔL_{PNT30s} (dB)																								
5.9	6.1	6.2	6.4	6.2	6.0	5.8	5.2	4.6	3.9	2.6	1.3	0.0	0.8	1.5	2.3	3.1	3.9	4.7	6.1	7.5	8.9	7.9	6.9	5.9
Schweizer 300C ΔL_{PNT30s} (dB)																								
2.3	3.6	4.8	4.3	3.7	3.1	2.7	2.4	2.0	1.6	1.3	0.5	0.0	-0.6	-1.2	-0.7	-0.3	0.1	-0.3	-0.7	-1.1	-1.5	-1.9	0.2	2.3

Table 157. Flight Idle 360-Degree Directivity NPD Adjustments

180 L	165 L	150 L	135 L	120 L	105 L	90 L	75 L	60 L	45 L	30 L	15 L	L 0	15 R	30 R	45 R	60 R	75 R	90 R	105 R	120 R	135 R	150 R	165 R	180 R
Bell 407 ΔL_{Aeq30s} (dBA)																								
3.1	3.6	3.0	2.4	1.8	1.1	0.5	-0.1	-0.8	-0.6	-0.4	-0.3	0.0	0.3	0.8	1.4	2.0	2.6	2.7	2.9	3.1	2.9	2.8	2.6	3.1
Robinson R44 ΔL_{Aeq30s} (dBA)																								
8.5	8.1	7.7	7.3	6.3	5.2	4.2	3.3	2.4	1.6	1.0	0.5	0.0	-0.4	-0.8	-1.2	-0.5	0.2	0.9	3.3	5.6	7.9	8.1	8.3	8.5
Schweizer 300C ΔL_{Aeq30s} (dBA)																								
0.0	0.7	1.3	1.9	1.9	1.9	1.9	2.4	3.0	3.6	2.4	1.2	0.0	-1.0	-1.9	-2.9	-1.9	-0.8	0.2	-0.6	-1.3	-2.1	-1.4	-0.7	0.0
Bell 407 ΔL_{PNT30s} (dB)																								
2.4	2.1	1.6	1.2	0.8	0.3	0.1	-0.1	-0.3	-0.2	-0.1	-0.1	0.0	0.1	0.5	0.9	1.4	1.8	2.1	2.3	2.6	2.7	2.7	2.8	2.4
Robinson R44 ΔL_{PNT30s} (dB)																								
8.5	8.1	7.8	7.5	6.8	6.2	5.6	4.4	3.1	1.8	1.2	0.6	0.0	0.0	-0.1	-0.1	2.0	4.2	6.3	7.2	8.1	9.0	8.8	8.6	8.5
Schweizer 300C ΔL_{PNT30s} (dB)																								
2.4	1.1	-0.2	-1.5	-1.0	-0.5	0.0	0.4	0.7	1.0	0.7	0.3	0.0	-1.1	-2.2	-3.3	-2.5	-1.6	-0.7	-1.1	-1.6	-2.0	-0.5	0.9	2.4

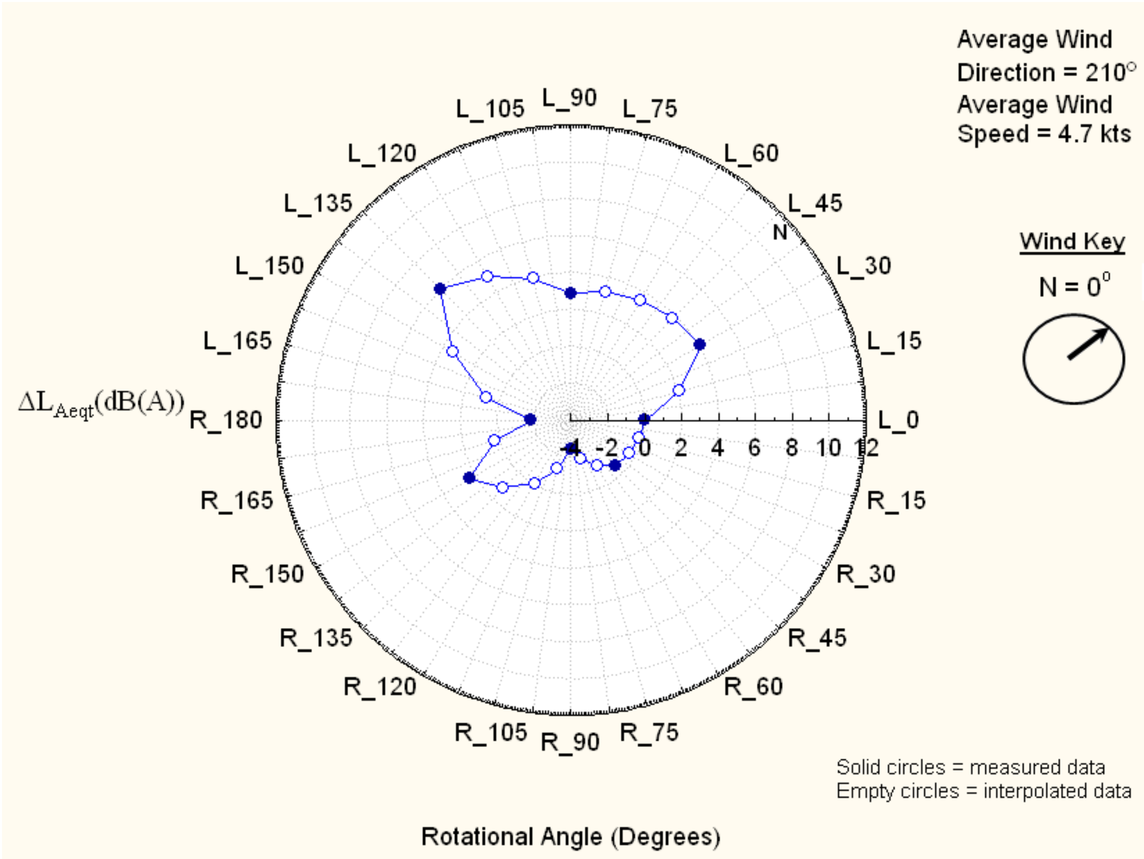

Figure 87. Bell 407 Ground Idle Directivity

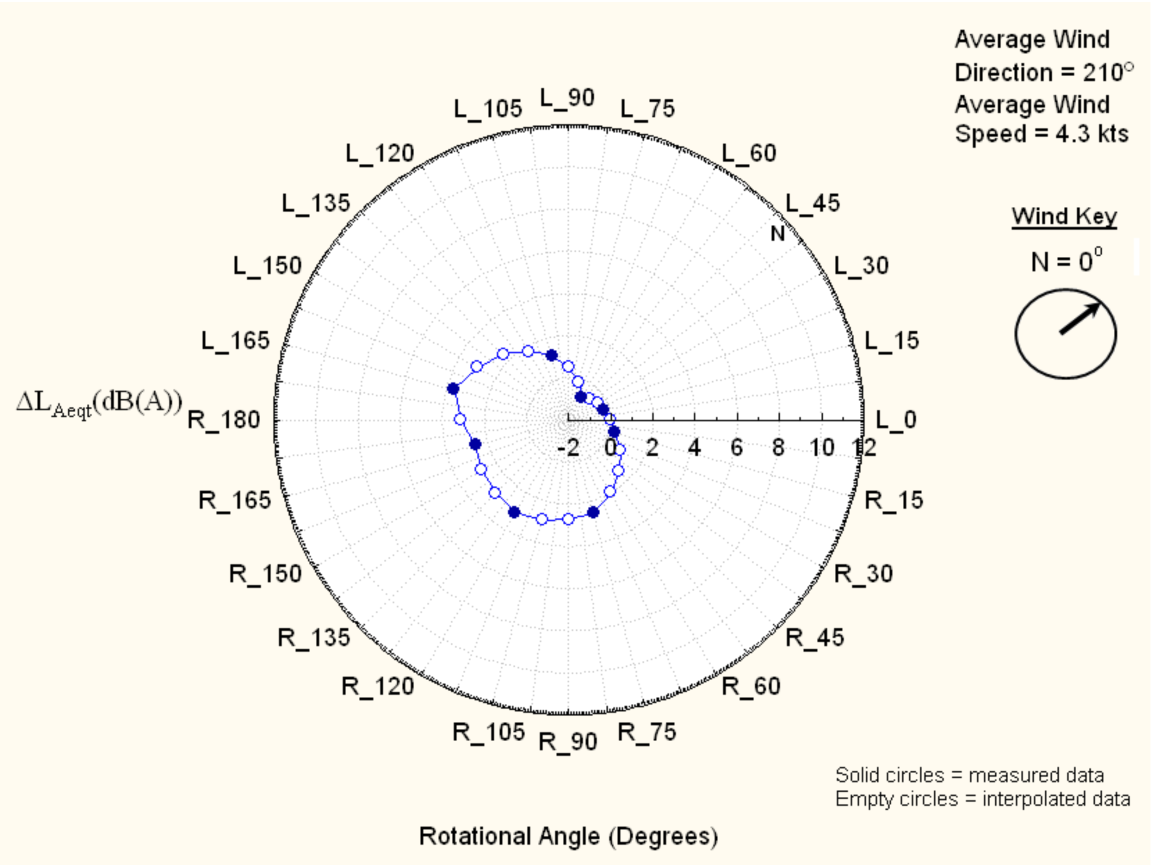

Figure 88. Bell 407 Flight Idle Directivity

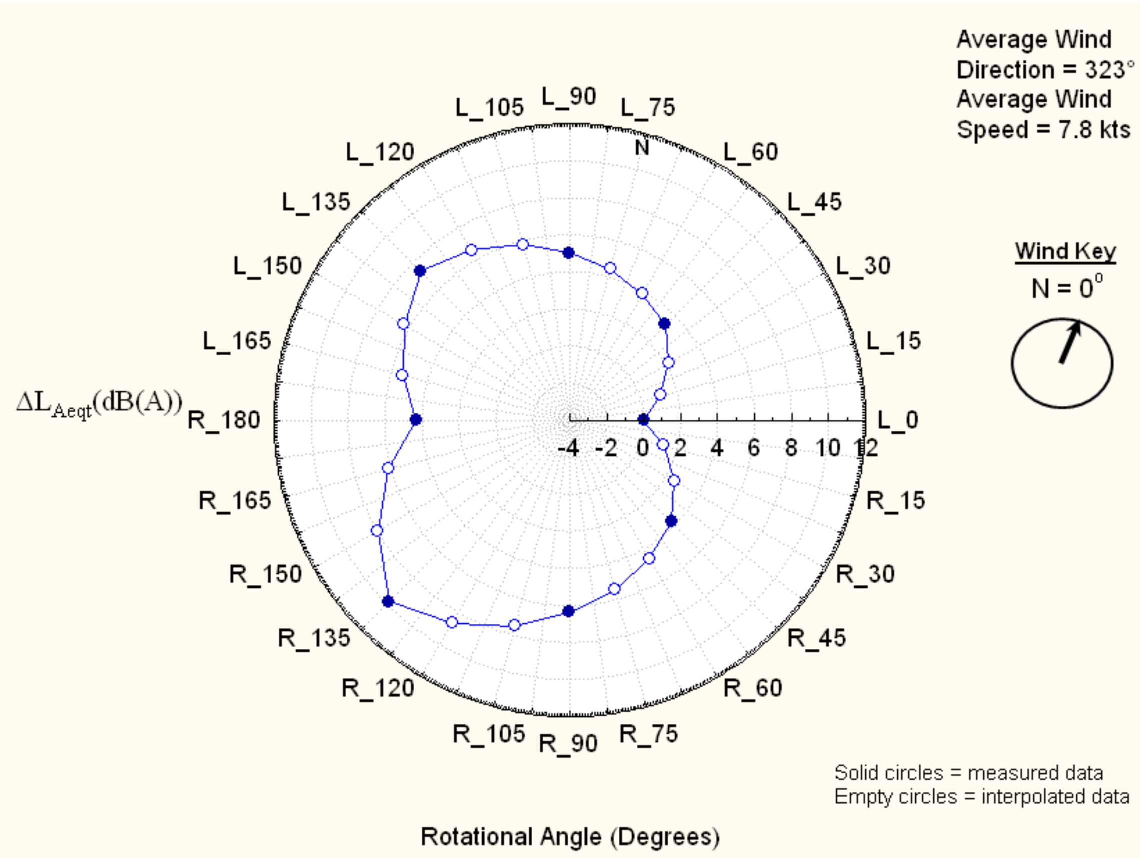

Figure 89. Robinson R44 Ground Idle Directivity

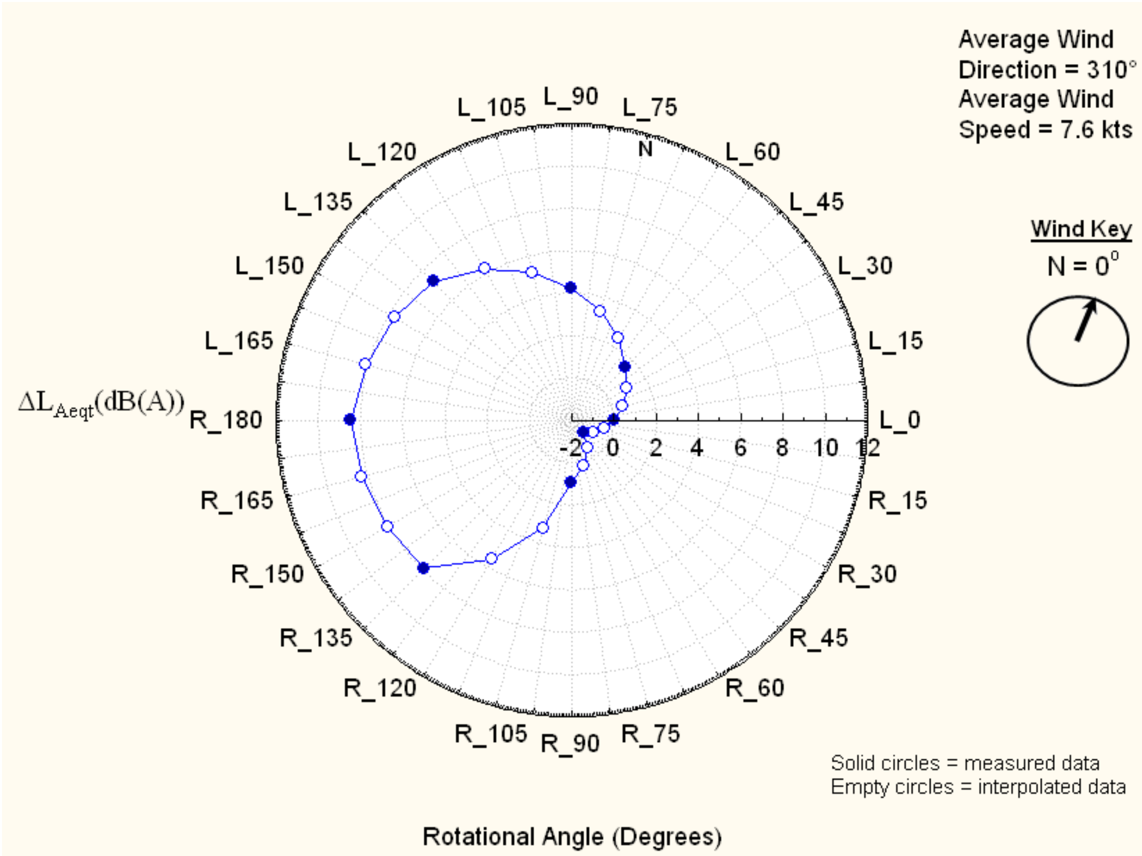

Figure 90. Robinson R44 Flight Idle Directivity

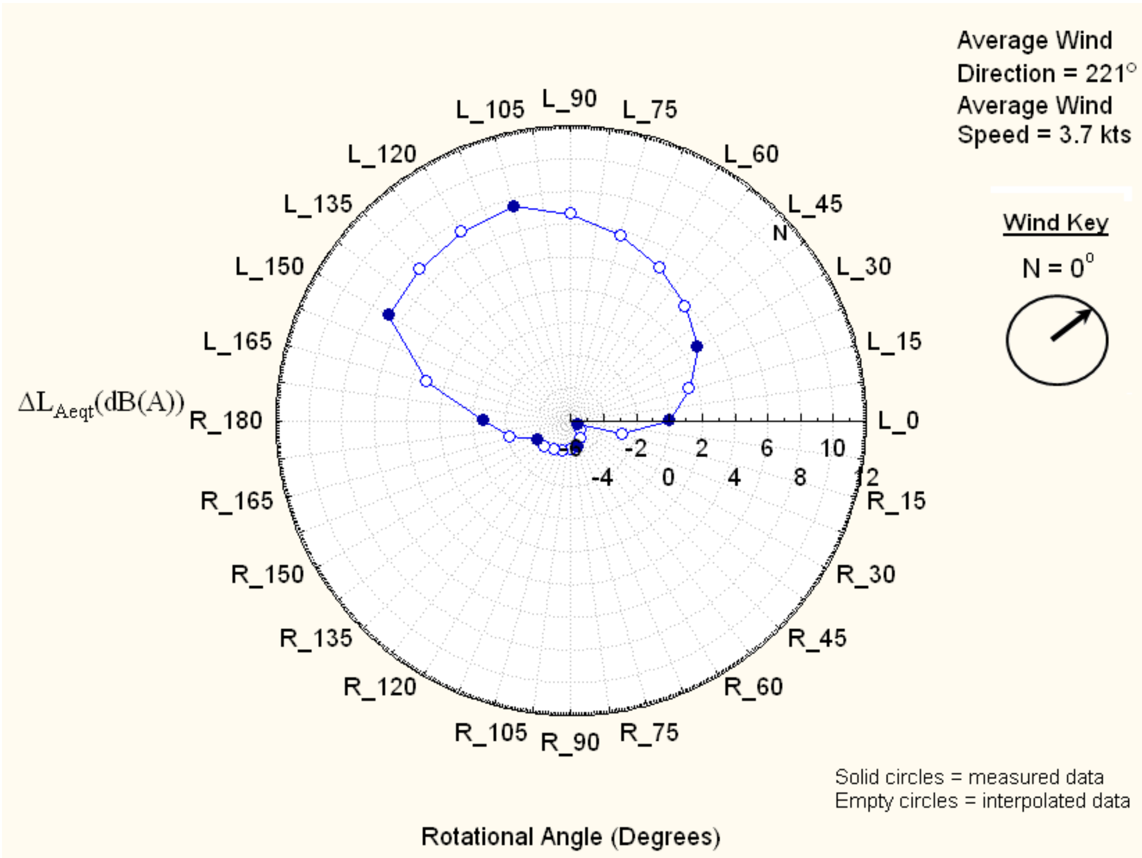

Figure 91. Schweizer 300C Ground Idle Directivity

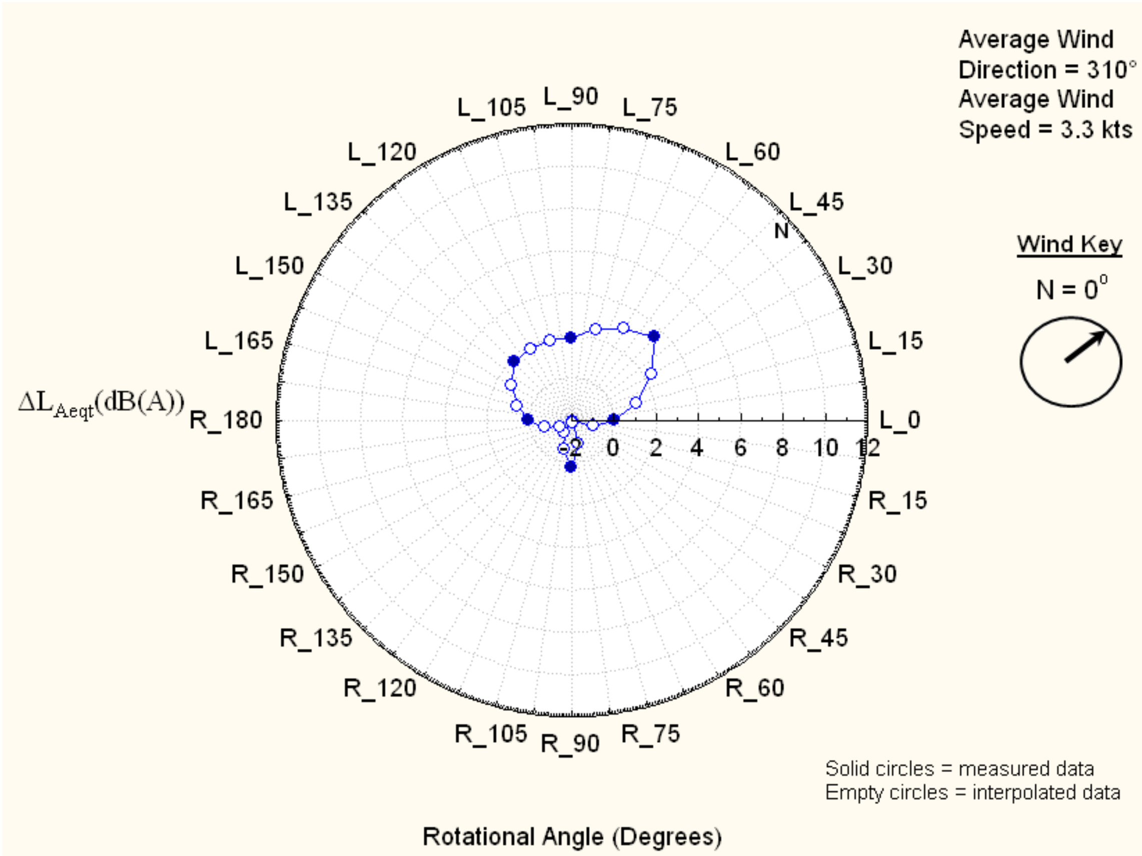

Figure 92. Schweizer 300C Flight Idle Directivity

This page intentionally left blank.

APPENDIX F: SPECTRAL CLASS PROCESSING INFORMATION

The INM utilizes spectral data for some of its calculations, e.g., atmospheric absorption. Accordingly, representative spectral data are presented for each Dynamic Operations measurement series for which data were collected. Provided below is the 1,000 feet LFO, APP, and DEP adjusted spectral information used to determine each aircraft's LFO, APP, and DEP spectral classes. Each spectrum was generated from Dynamic Operations noise data collected during LFO, APP, and DEP events. These data were adjusted to 1,000 feet in Volpe Center's LCorrect processing software, grouped by configuration and power settings, and arithmetically averaged together. Each spectrum has been normalized to 70.0 dB at 1,000 Hz per the methodology employed in Reference 25, and is described in Section 8.5. The INM spectral class assignments determined for these aircraft are listed in Table 158.

Table 158. INM Spectral Class Assignments

Aircraft	Operation	Spectral Class Assignment
Cessna 182	DEP	113
	APP	215
	LFO*	109
Cessna 208B	DEP	109
	APP	210
	LFO	109
Dornier 228	DEP	110
	APP	216
	LFO	113
Dornier 328	DEP	109
	APP	214
	LFO	113
Piper PA-42	DEP	109
	APP	213
	LFO	213
Bell 407	DEP	116
	APP	217
	LFO	301
Robinson R44	DEP	114
	APP	219
	LFO	305
Schweizer 300C	DEP	116
	APP	217
	LFO	305

* For fixed-wing aircraft in INM, only departure and approach spectral class assignments are used. Additional spectral class assignments are provided for use with research and non-standard modeling in INM.

F.1 Cessna 182

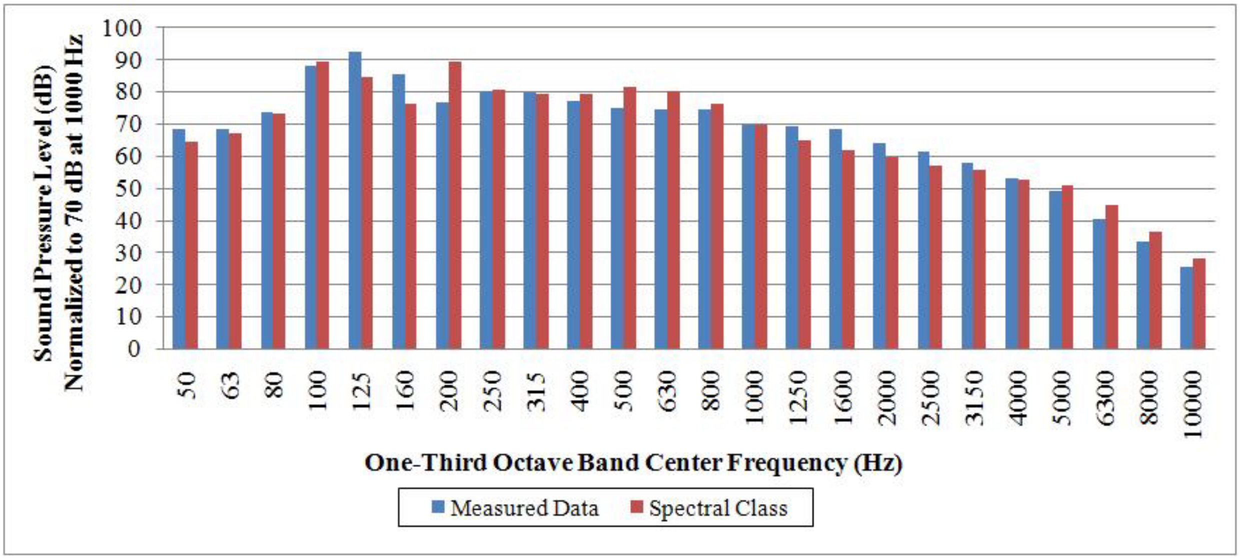

Figure 93. Cessna 182 Average 1000-ft 100 Series LFO Spectrum (normalized)

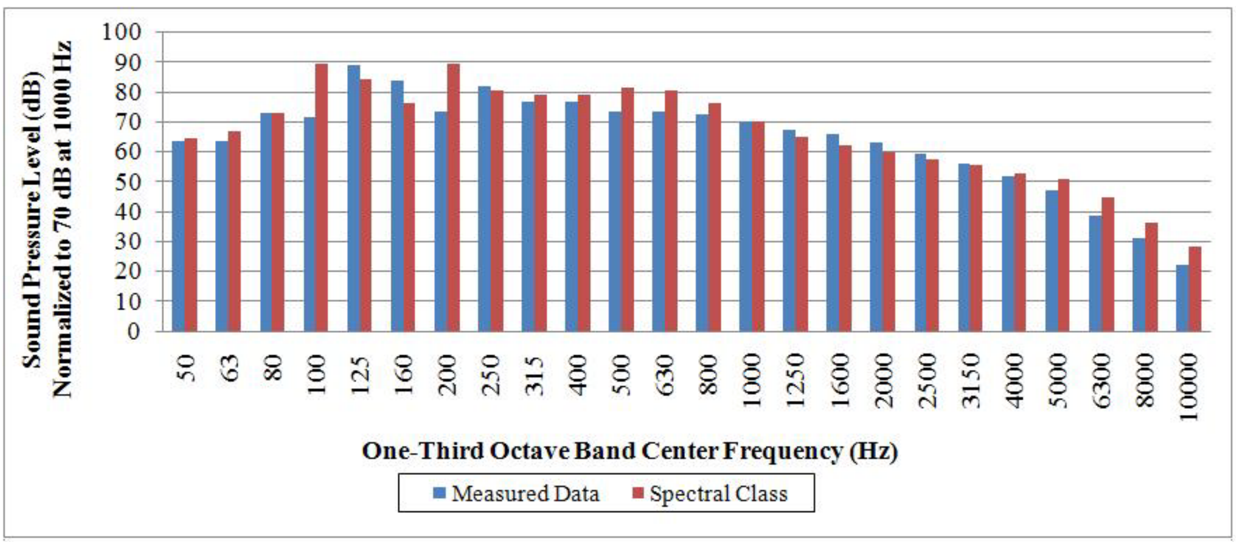

Figure 94. Cessna 182 Average 1000-ft 200 Series LFO Spectrum (normalized)

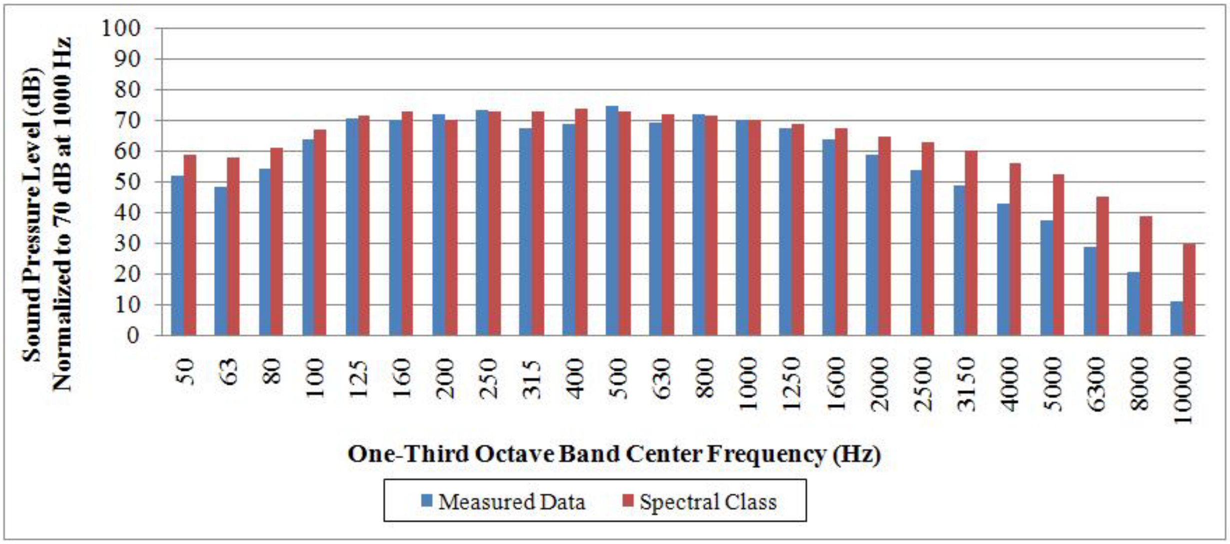

Figure 95. Cessna 182 Average 1000-ft 300 Series DEP Spectrum (normalized)

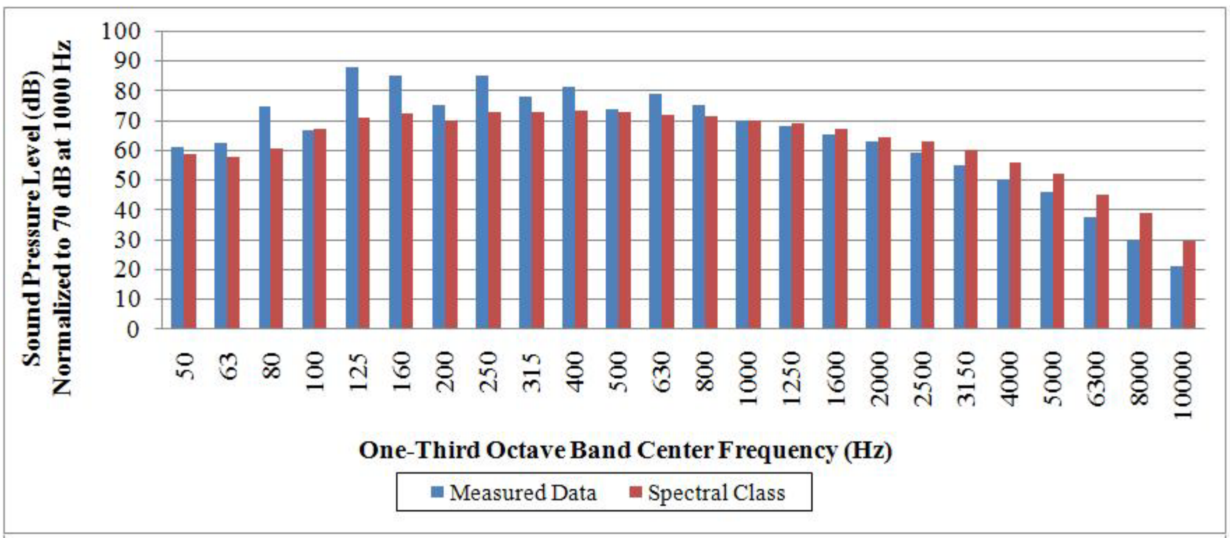

Figure 96. Cessna 182 Average 1000-ft 400 Series DEP Spectrum (normalized)

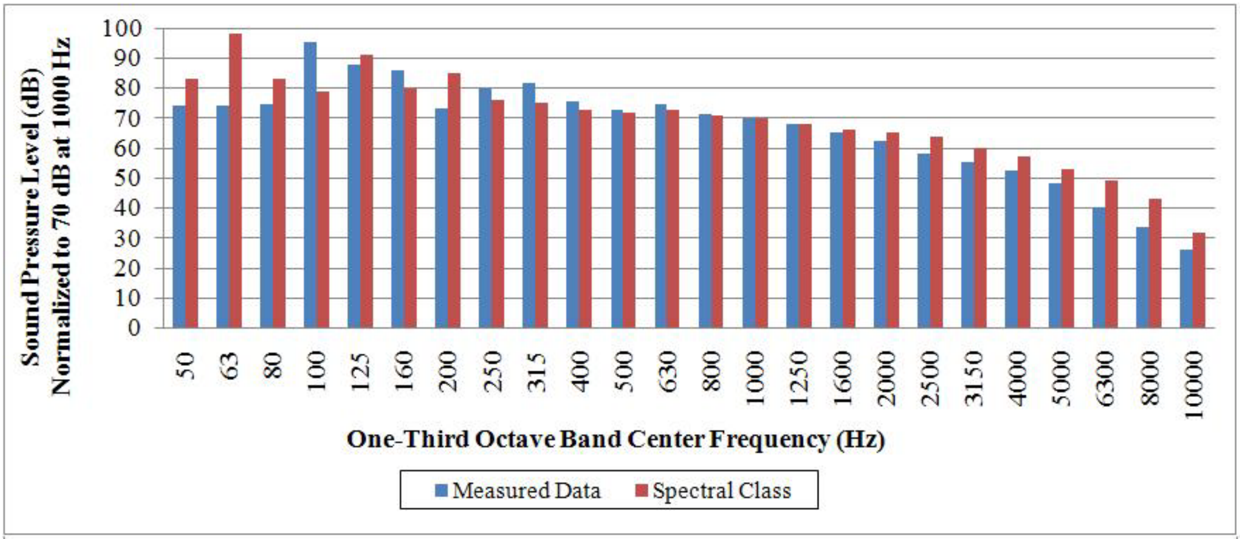

Figure 97. Cessna 182 Average 1000-ft 500 Series APP Spectrum (normalized)

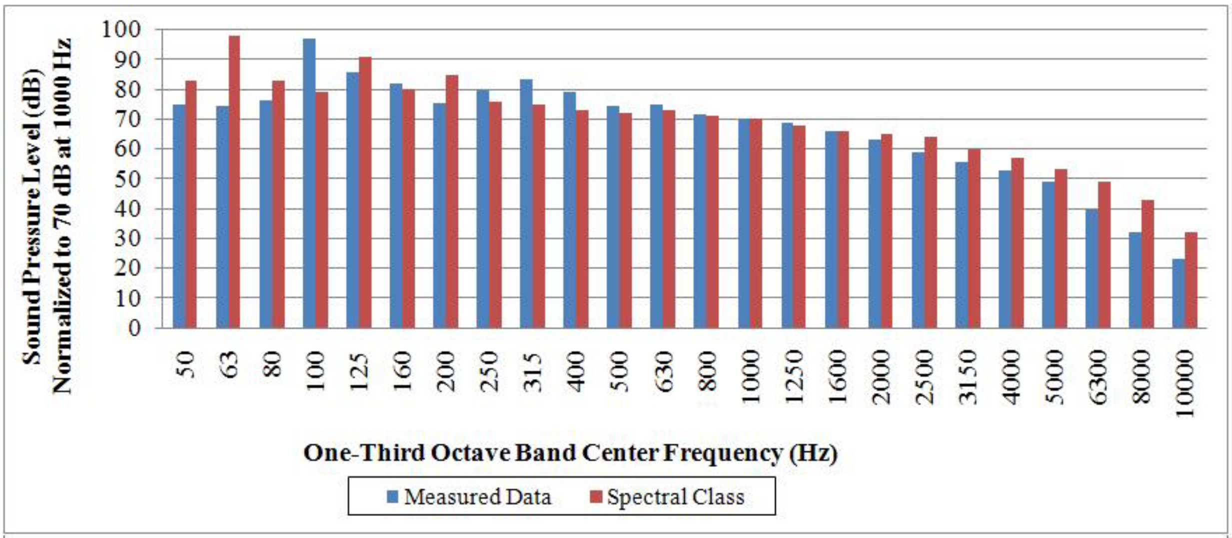

Figure 98. Cessna 182 Average 1000-ft 600 Series APP Spectrum (normalized)

F.2 Cessna 208B

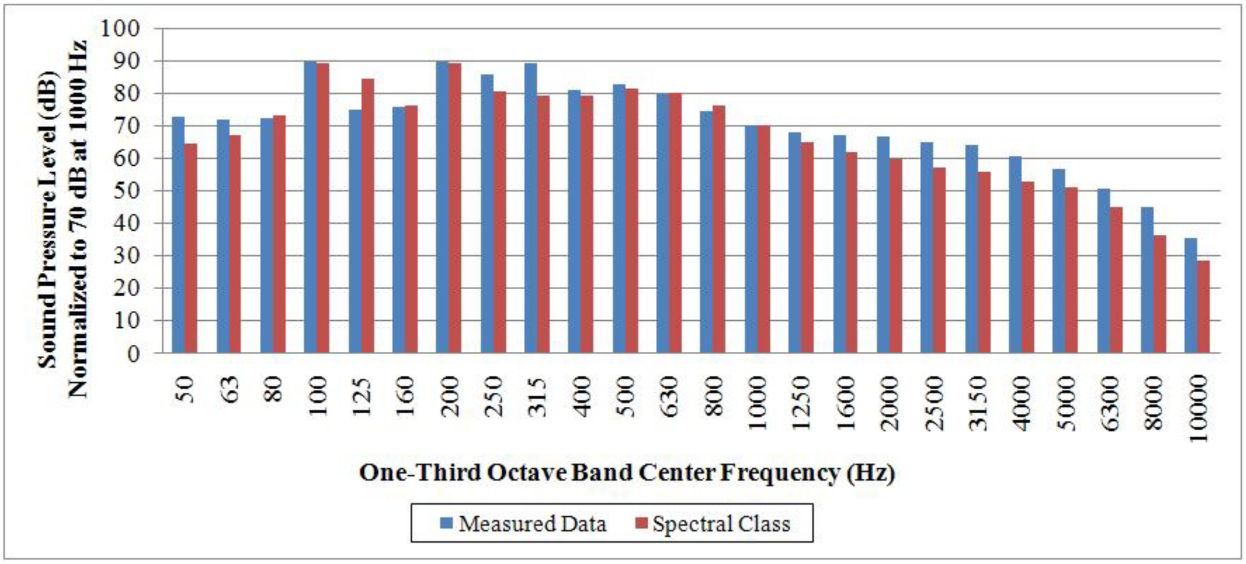

Figure 99. Cessna 208B Average 1000-ft 100 Series LFO Spectrum (normalized)

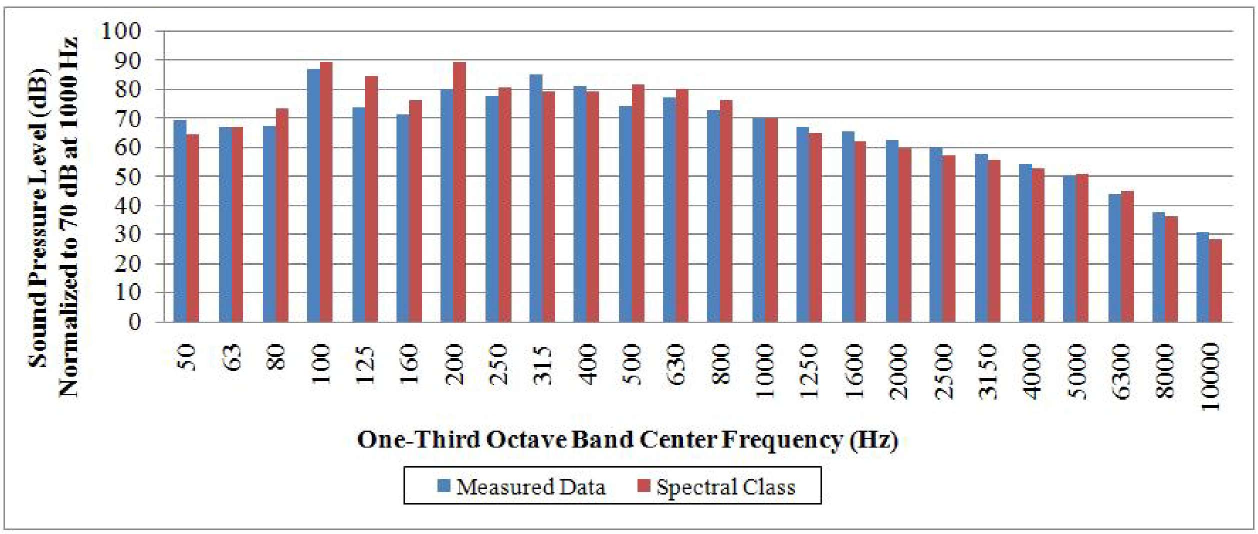

Figure 100. Cessna 208B Average 1000-ft 200 Series LFO Spectrum (normalized)

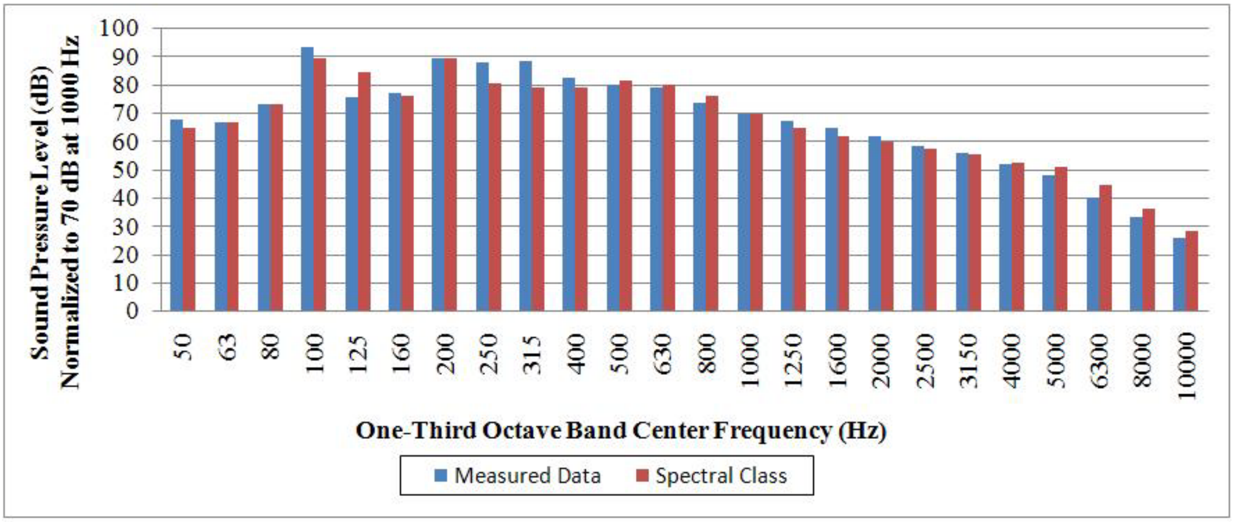

Figure 101. Cessna 208B Average 1000-ft 300 Series DEP Spectrum (normalized)

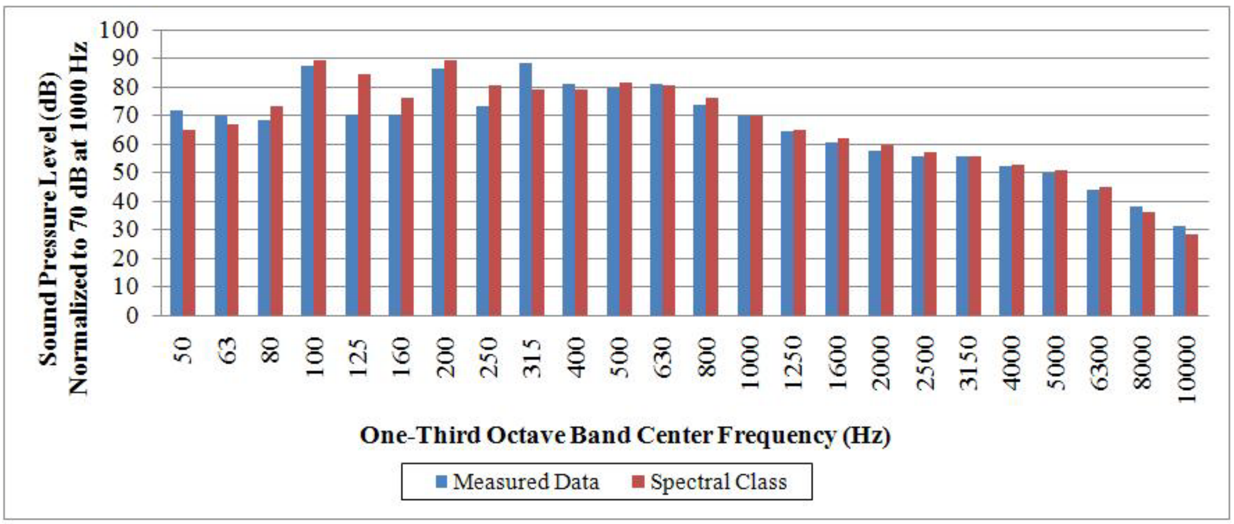

Figure 102. Cessna 208B Average 1000-ft 400 Series DEP Spectrum (normalized)

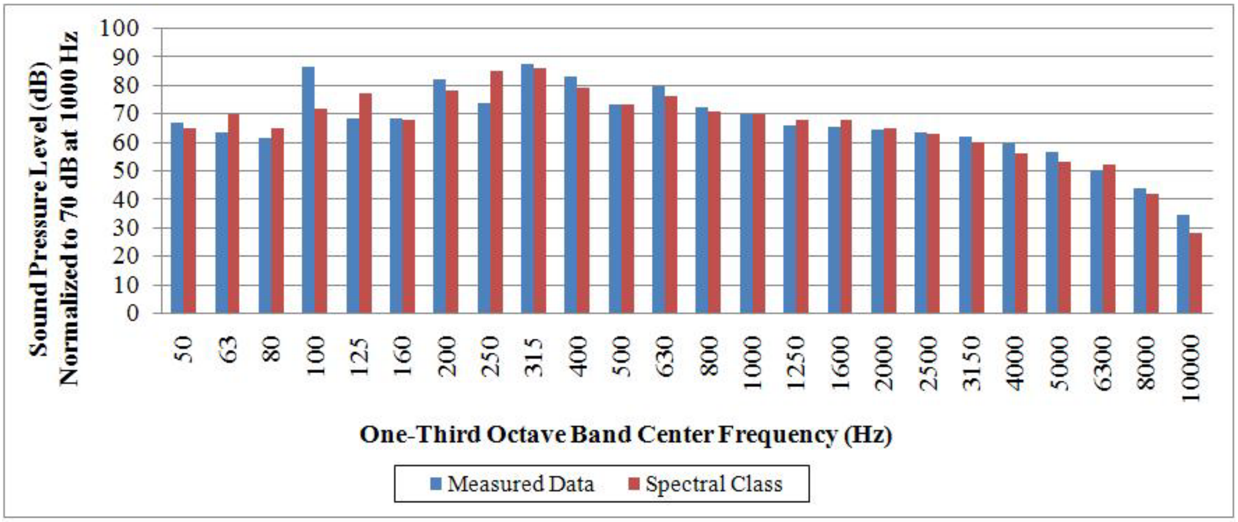

Figure 103. Cessna 208B Average 1000-ft 500 Series APP Spectrum (normalized)

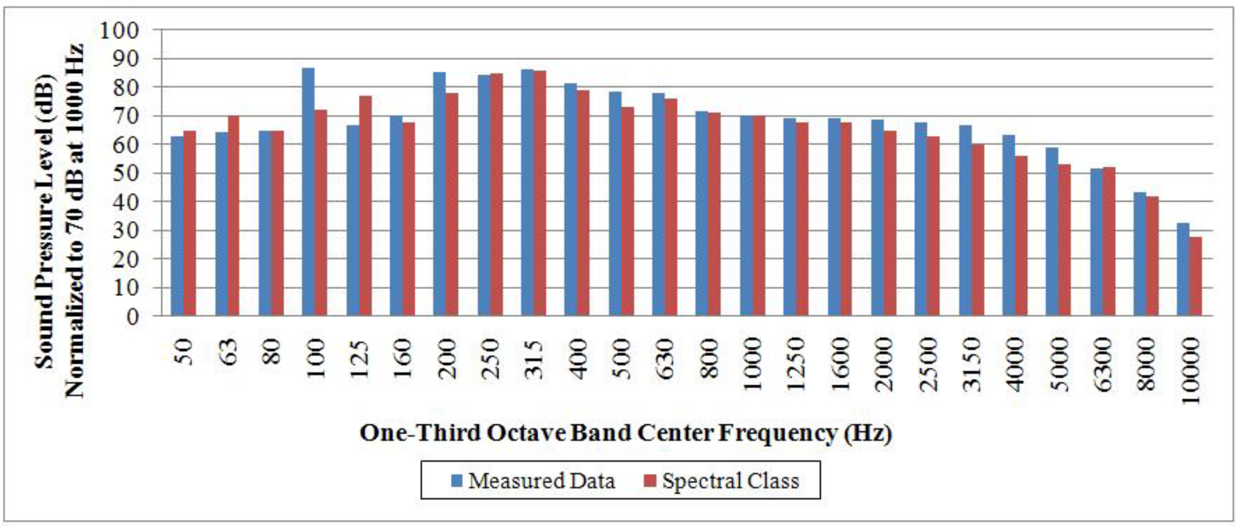

Figure 104. Cessna 208B Average 1000-ft 600 Series APP Spectrum (normalized)

F.3 Dornier 228

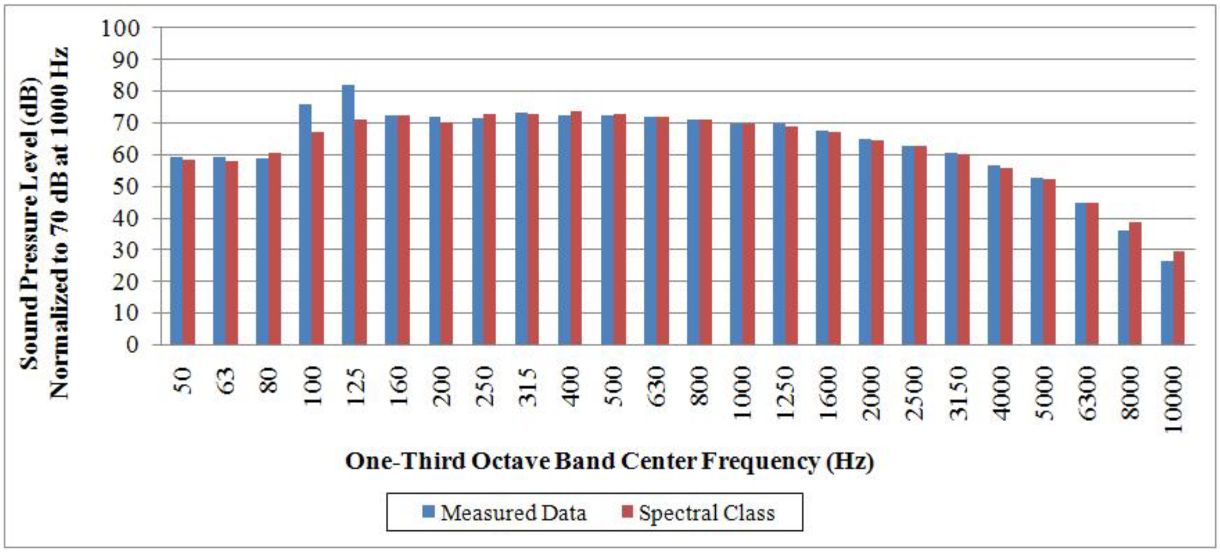

Figure 105. Dornier 228 Average 1000-ft 100 Series LFO Spectrum (normalized)

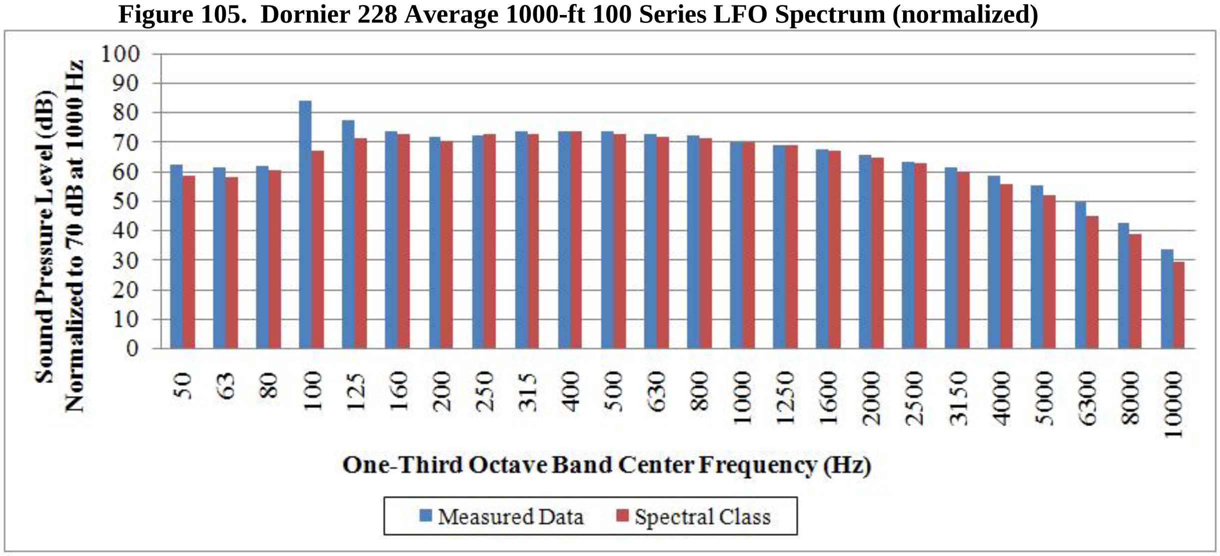

Figure 106. Dornier 228 Average 1000-ft 200 Series LFO Spectrum (normalized)

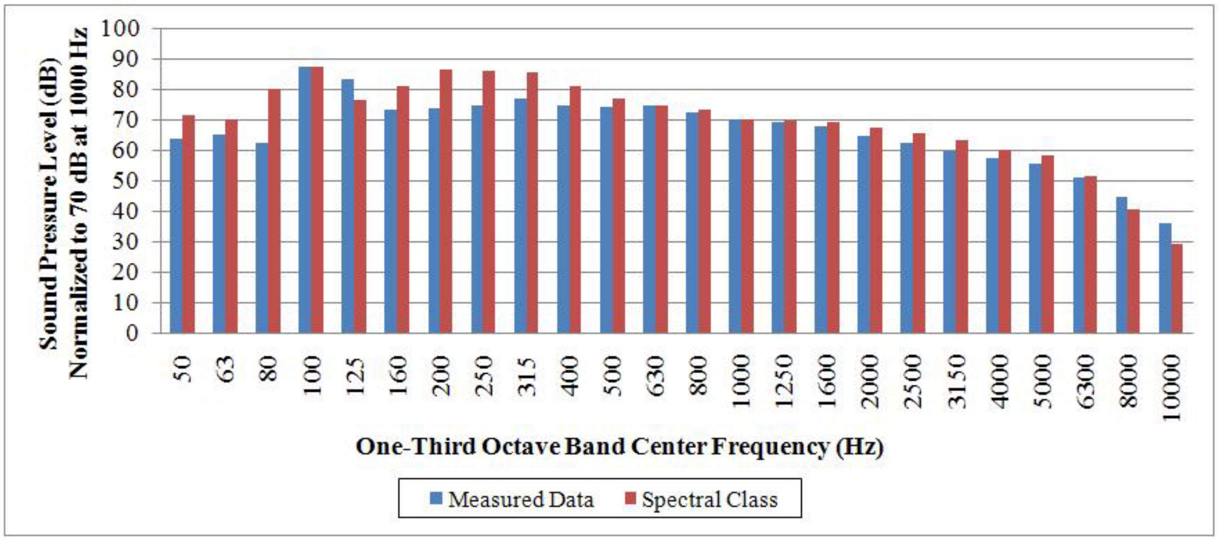

Figure 107. Dornier 228 Average 1000-ft 300 Series DEP Spectrum (normalized)

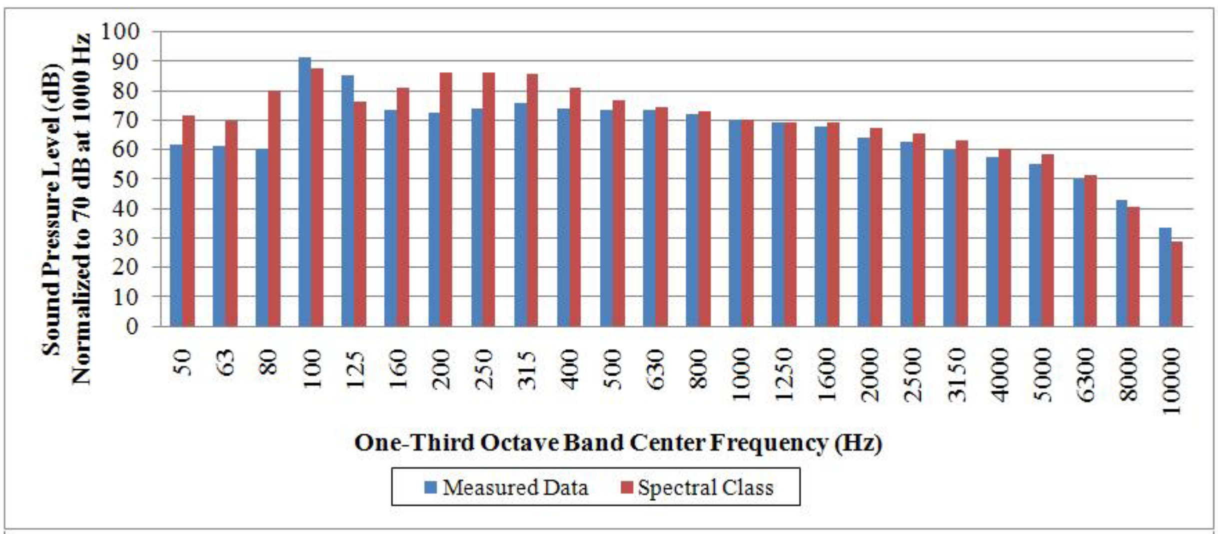

Figure 108. Dornier 228 Average 1000-ft 400 Series DEP Spectrum (normalized)

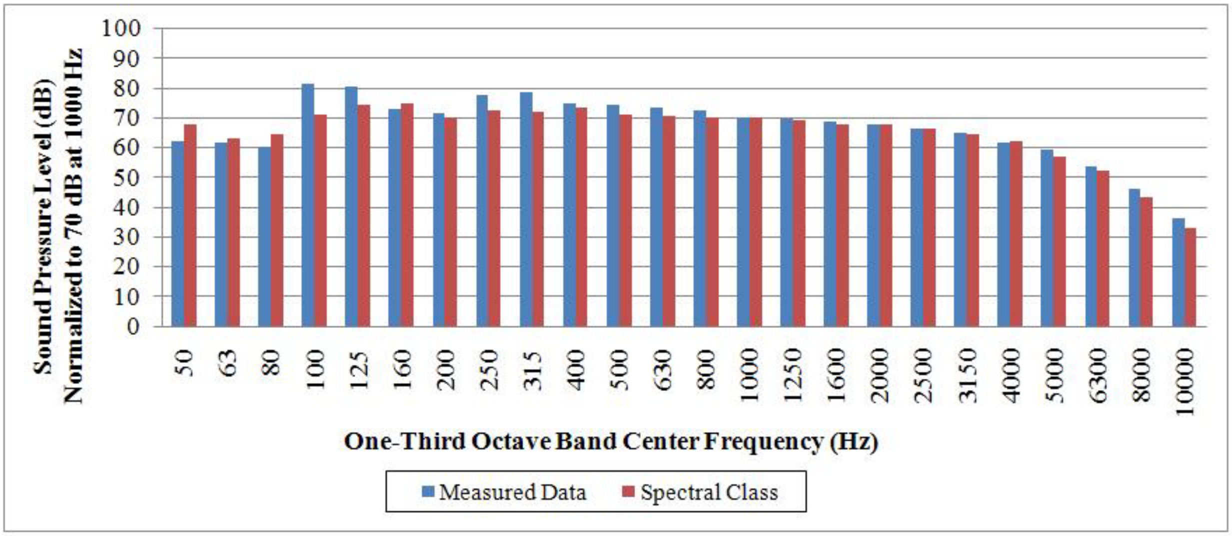

Figure 109. Dornier 228 Average 1000-ft 500 Series APP Spectrum (normalized)

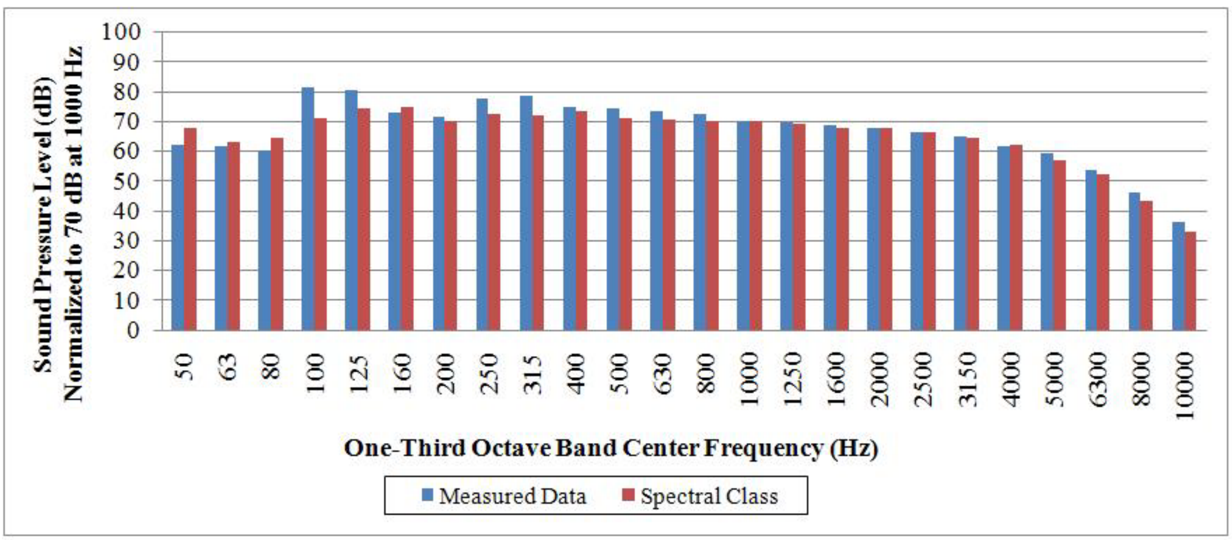

Figure 110. Dornier 228 Average 1000-ft 600 Series APP Spectrum (normalized)

F.4 Dornier 328

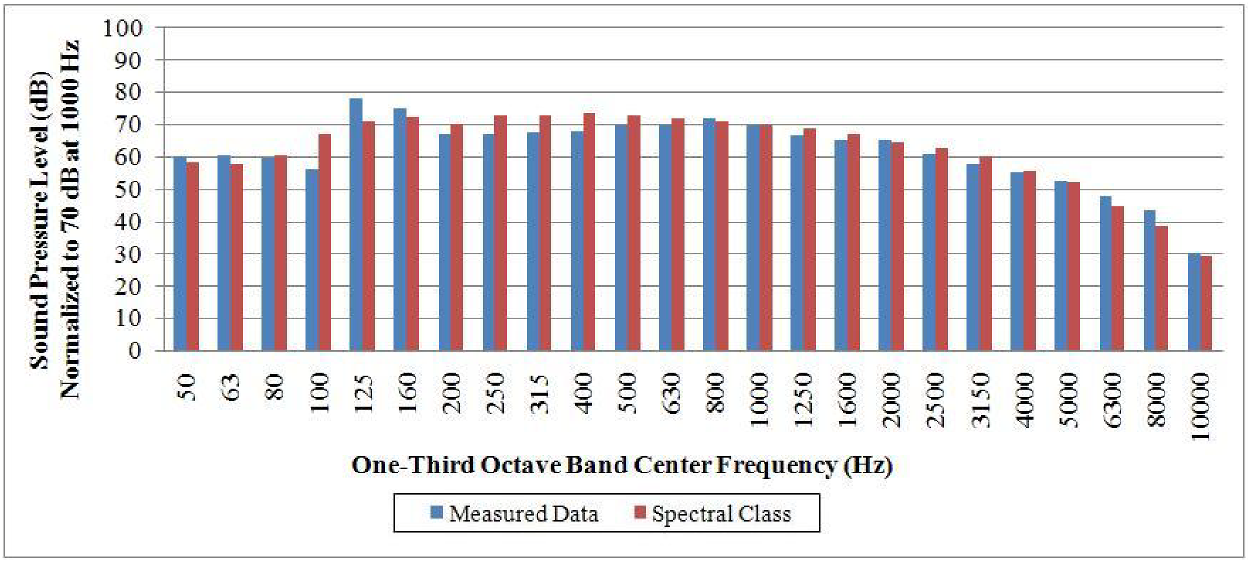

Figure 111. Dornier 328 Average 1000-ft 100 Series LFO Spectrum (normalized)

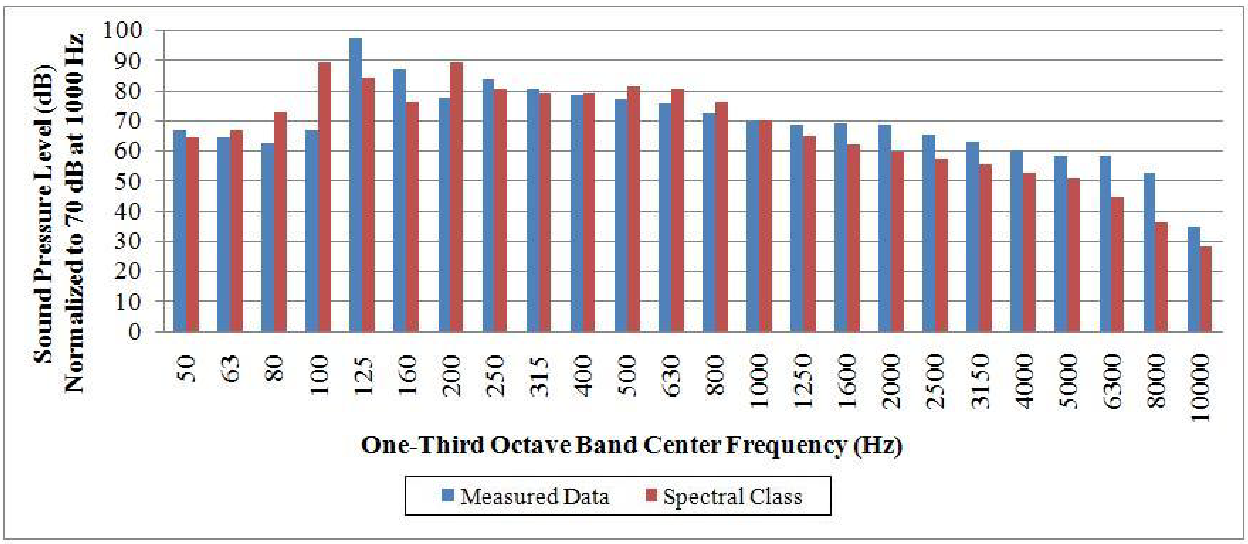

Figure 112. Dornier 328 Average 1000-ft 300 Series DEP Spectrum (normalized)

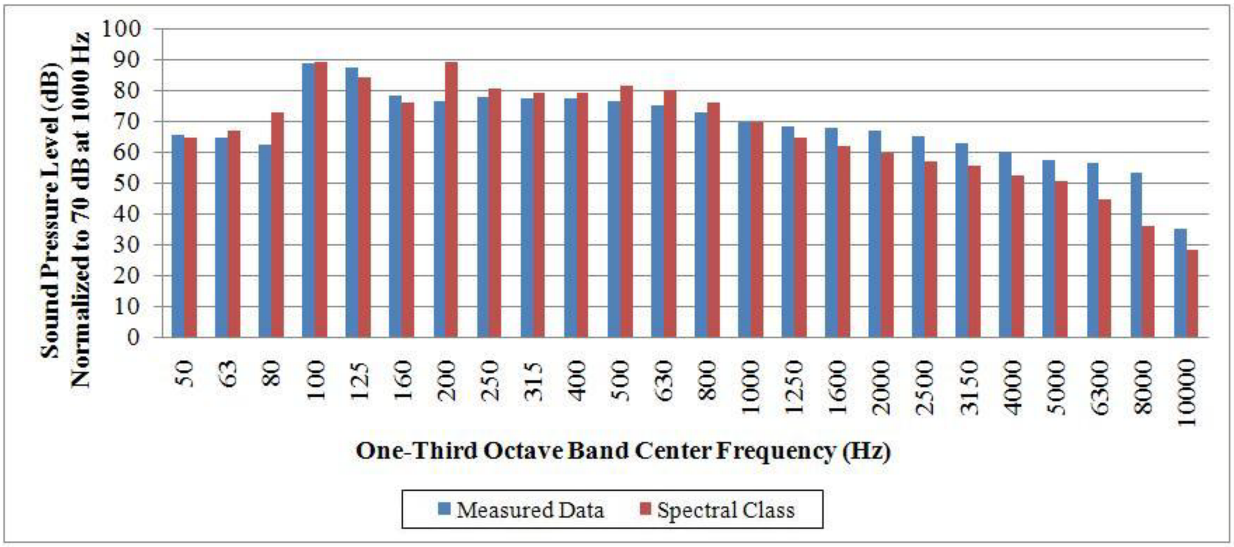

Figure 113. Dornier 328 Average 1000-ft 400 Series DEP Spectrum (normalized)

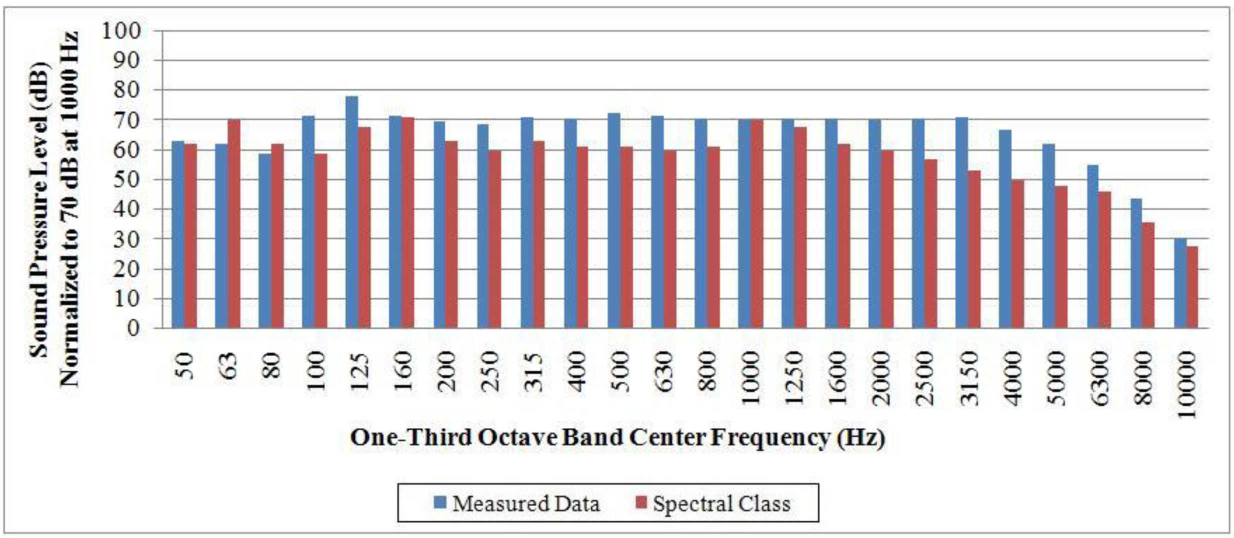

Figure 114. Dornier 328 Average 1000-ft 500 Series APP Spectrum (normalized)

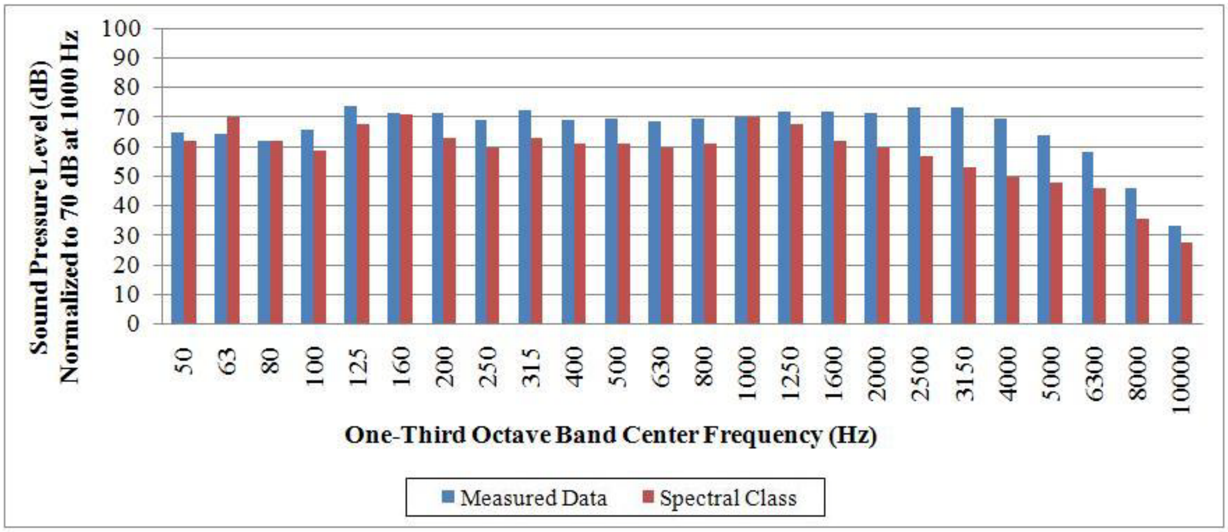

Figure 115. Dornier Do 328 Average 1000-ft 600 Series APP Spectrum (normalized)

F.5 Piper PA-42

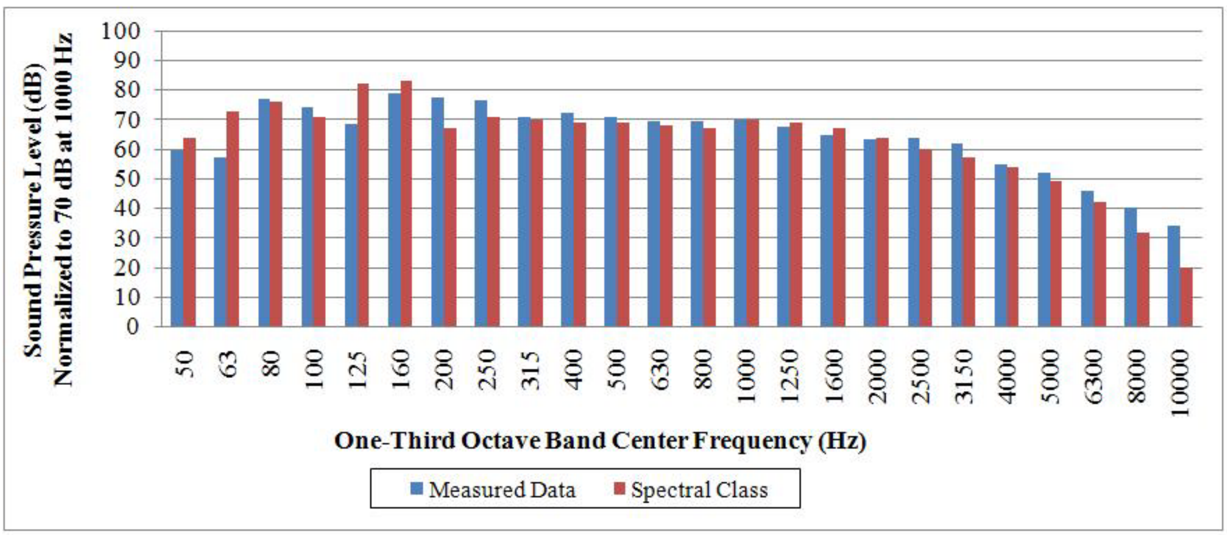

Figure 116. Piper PA-42 Average 1000-ft 100 Series LFO Spectrum (normalized)

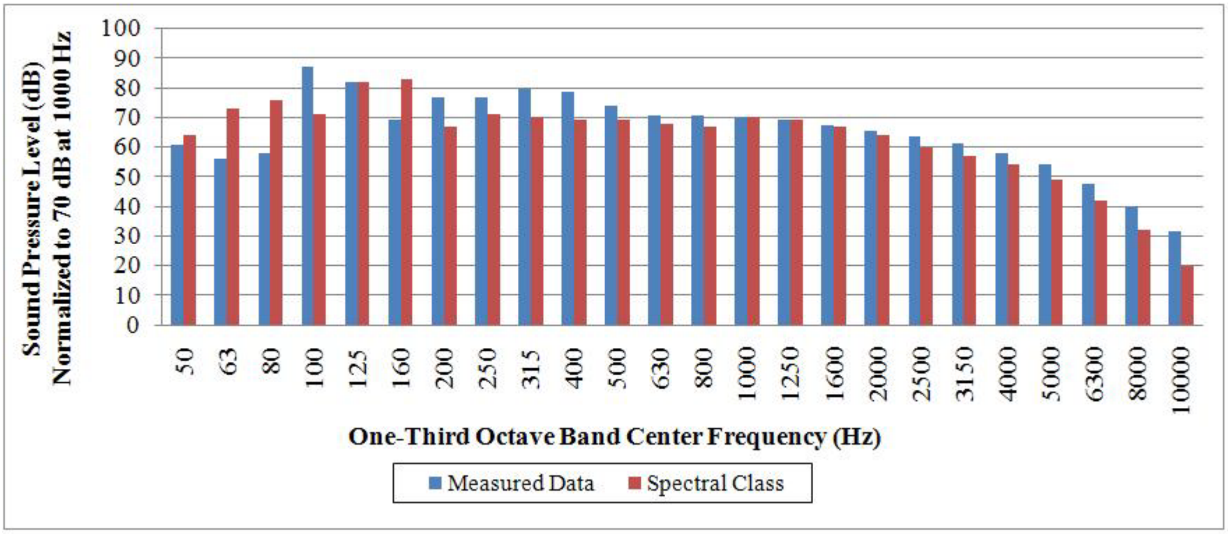

Figure 117. Piper PA-42 Average 1000-ft 200 Series LFO Spectrum (normalized)

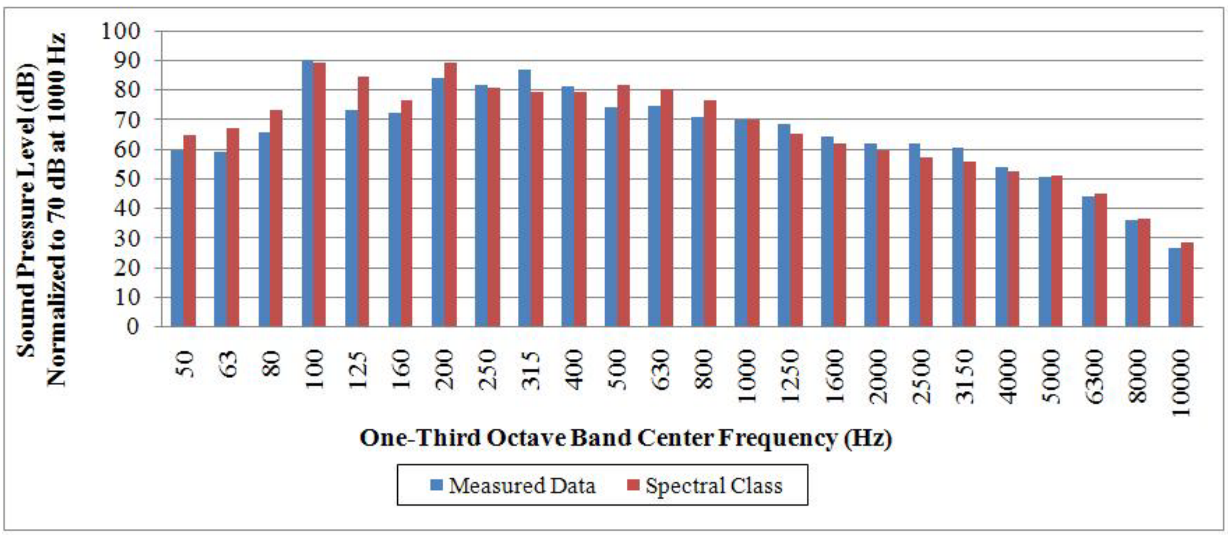

Figure 118. Piper PA-42 Average 1000-ft 300 Series DEP Spectrum (normalized)

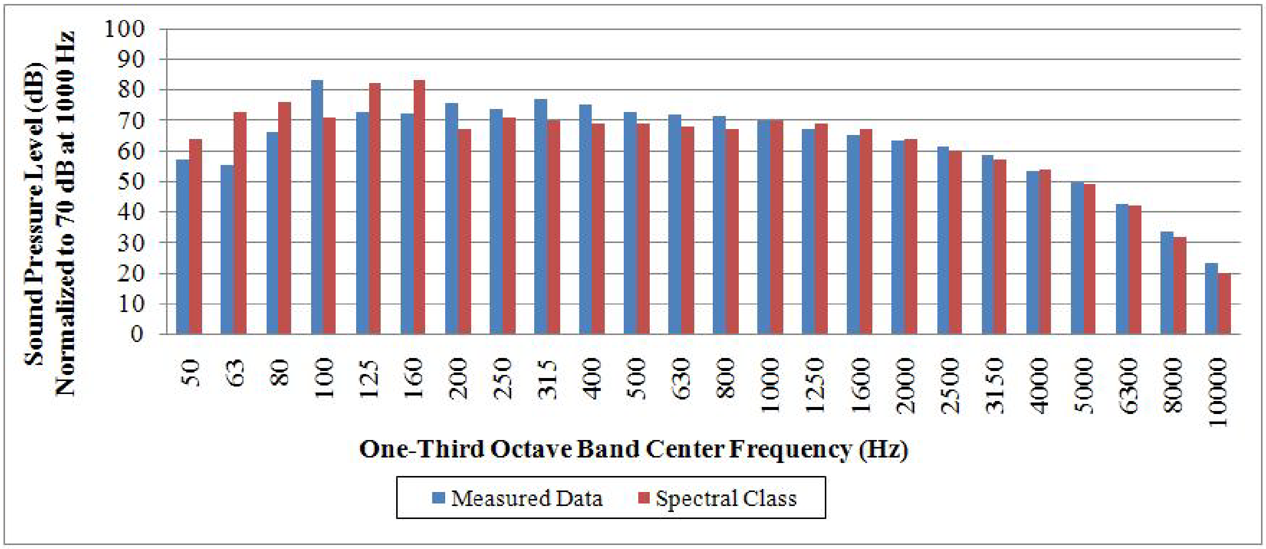

Figure 119. Piper PA-42 Average 1000-ft 600 Series APP Spectrum (normalized)

F.6 Bell 407

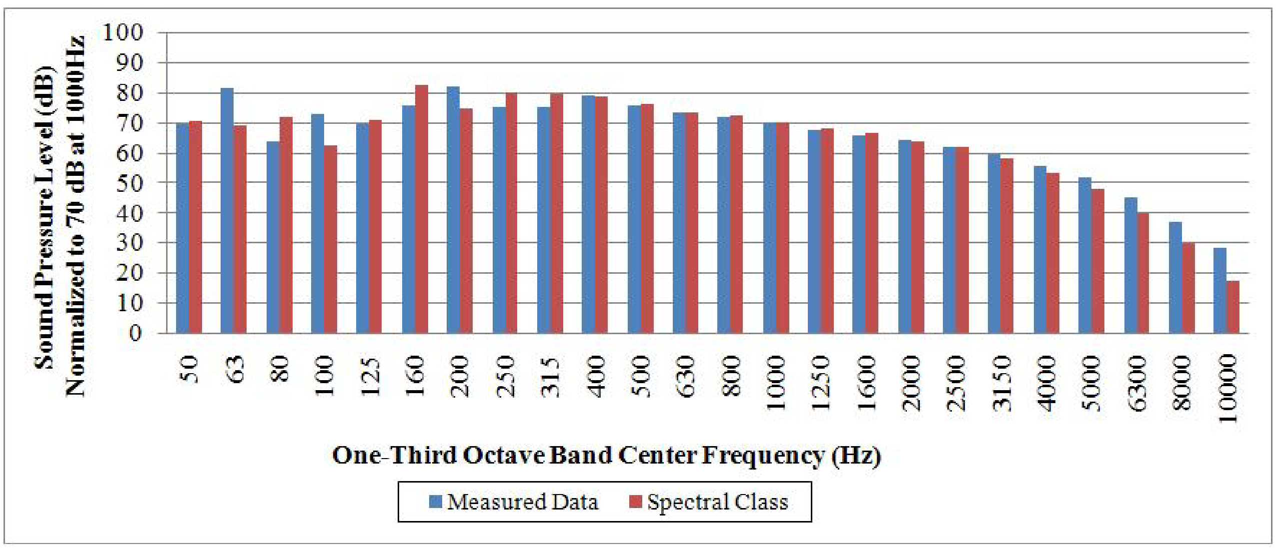

Figure 120. Bell 407 Average 1000-ft 100 Series LFO Spectrum (normalized)

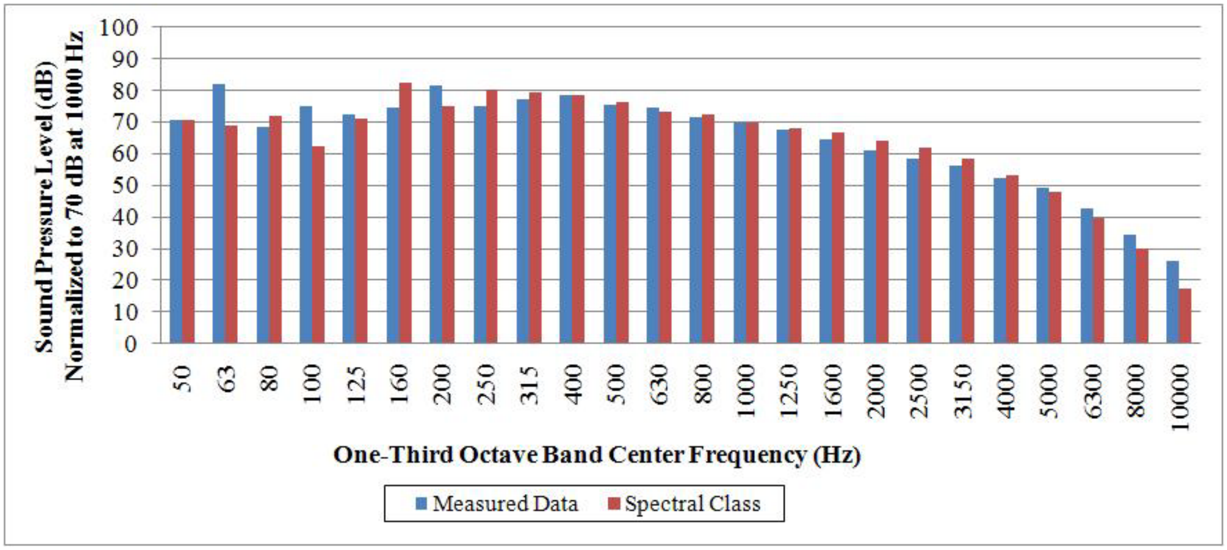

Figure 121. Bell 407 Average 1000-ft 200 Series LFO Spectrum (normalized)

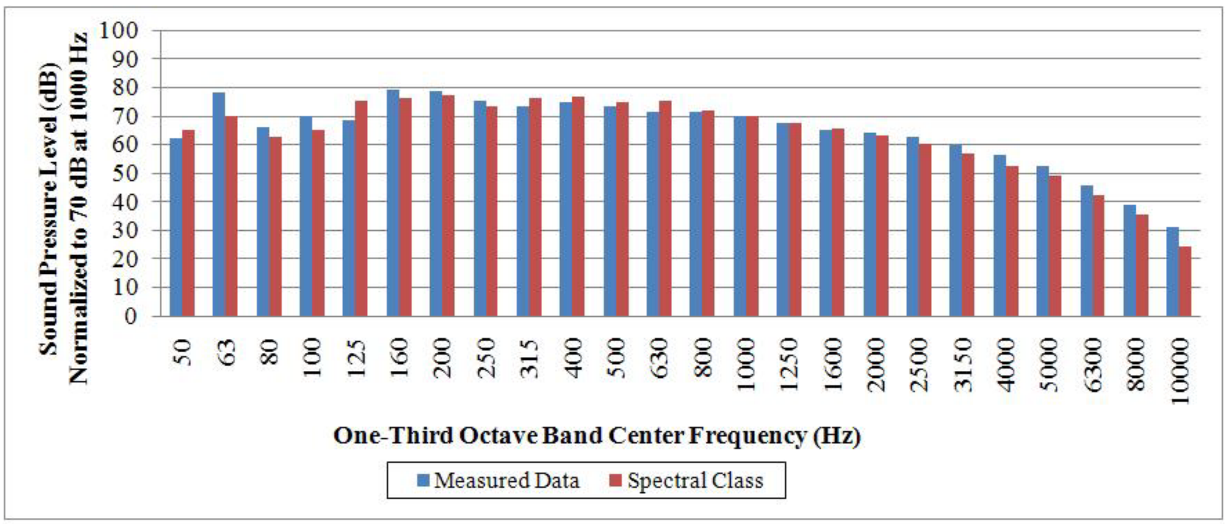

Figure 122. Bell 407 Average 1000-ft 300 Series DEP Spectrum (normalized)

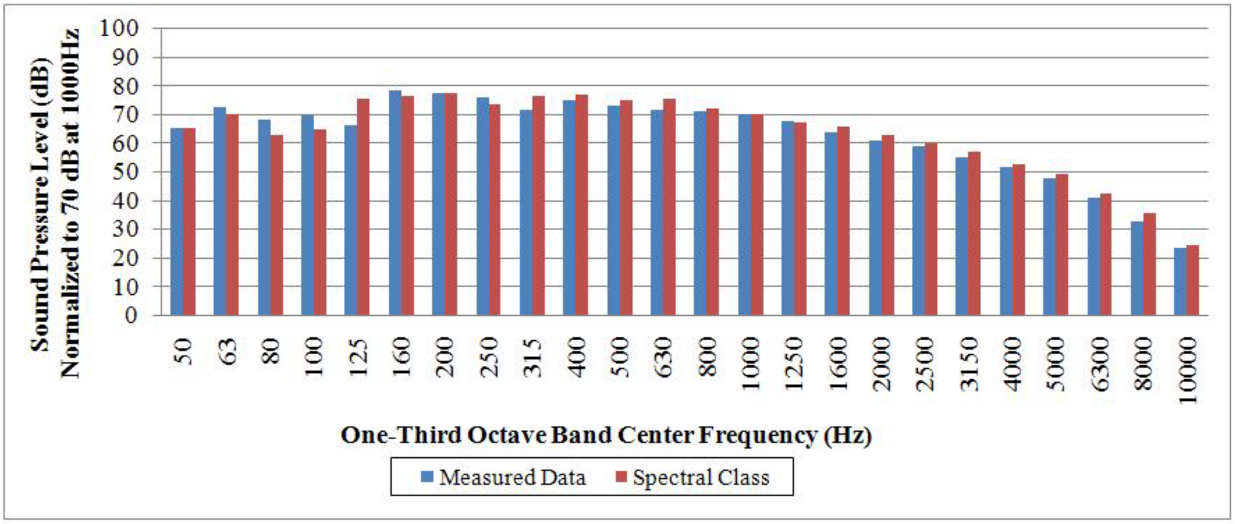

Figure 123. Bell 407 Average 1000-ft 400 Series DEP Spectrum (normalized)

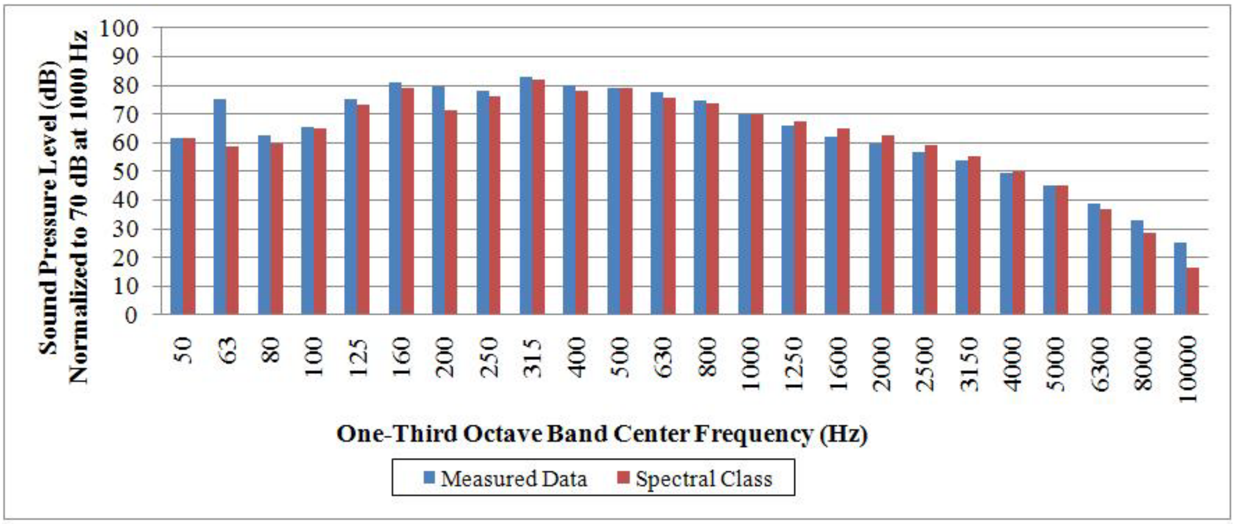

Figure 124. Bell 407 Average 1000-ft 500 Series APP Spectrum (normalized)

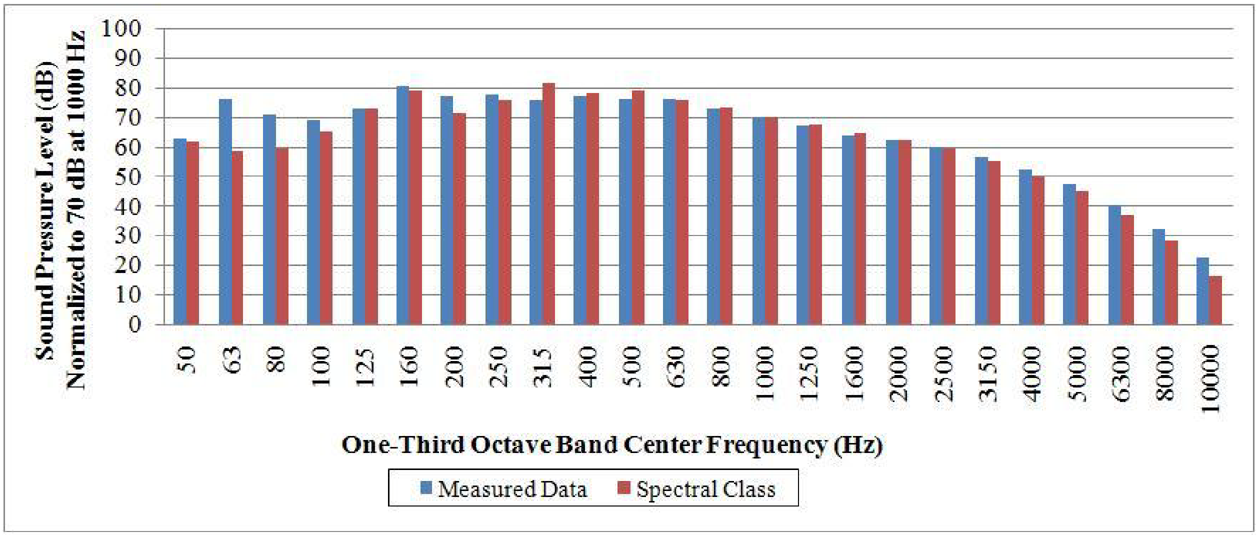

Figure 125. Bell 407 Average 1000-ft 700 Series APP Spectrum (normalized)

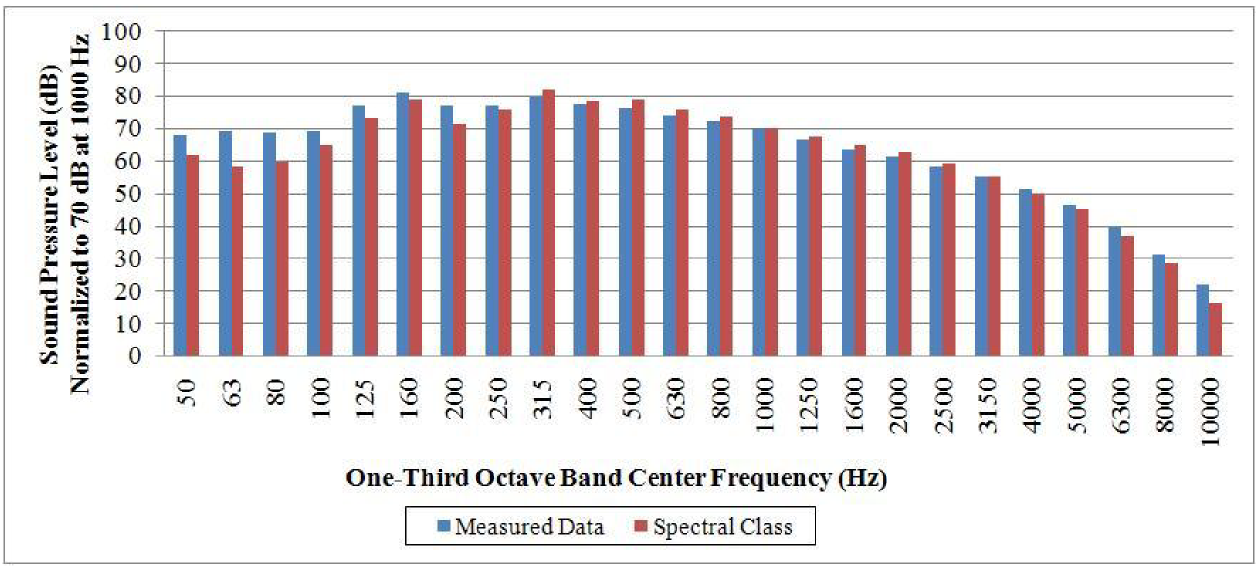

Figure 126. Bell 407 Average 1000-ft 800 Series APP Spectrum (normalized)

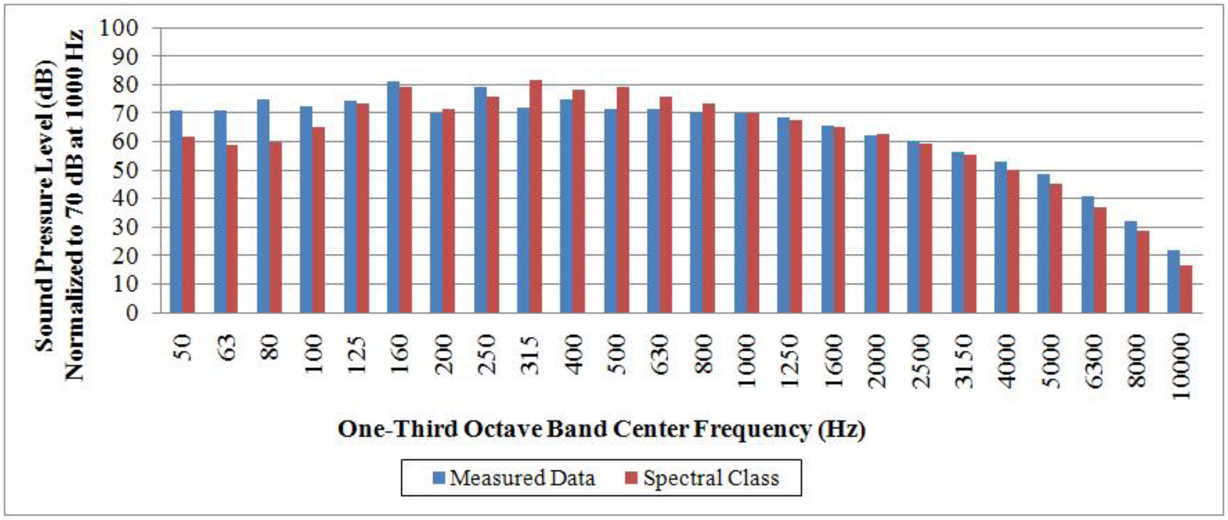

Figure 127. Bell 407 Average 1000-ft 900 Series APP Spectrum (normalized)

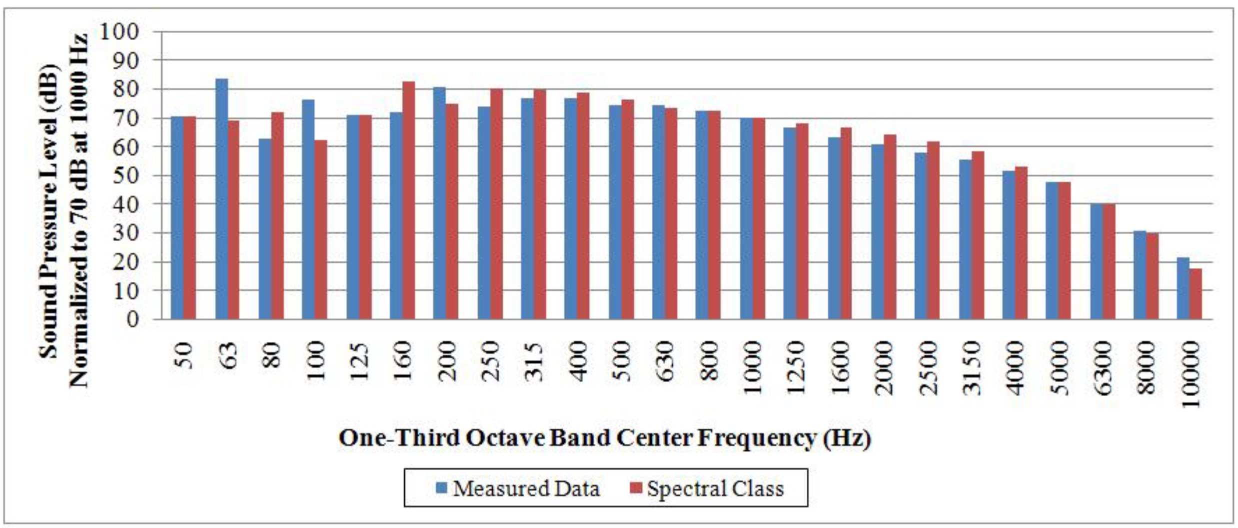

Figure 128. Bell 407 Average 1000-ft 1000 Series LFO Spectrum (normalized)

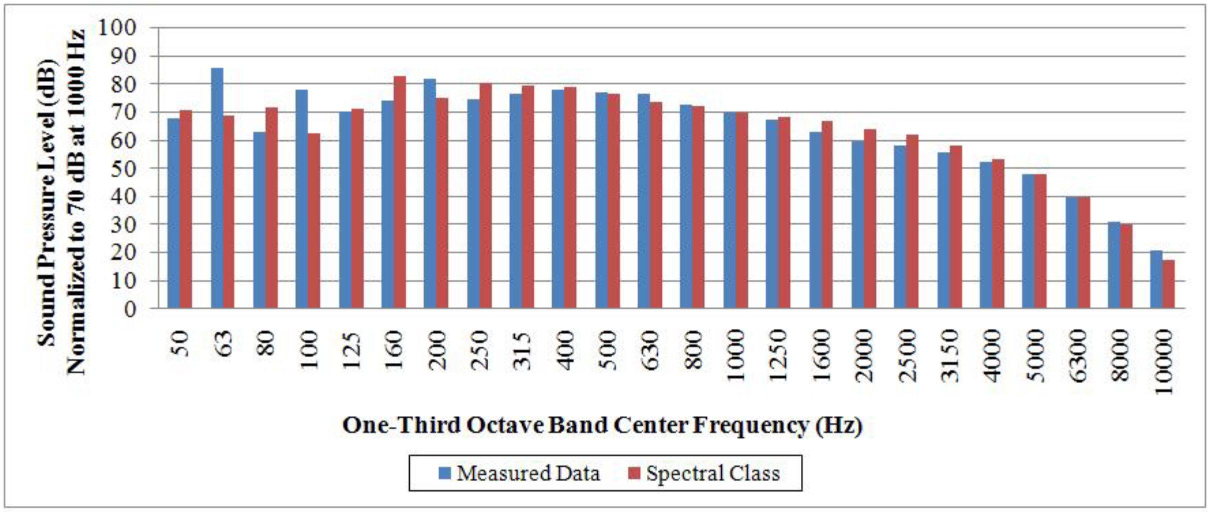

Figure 129. Bell 407 Average 1000-ft 1100 Series LFO Spectrum (normalized)

F.7 Robinson R44

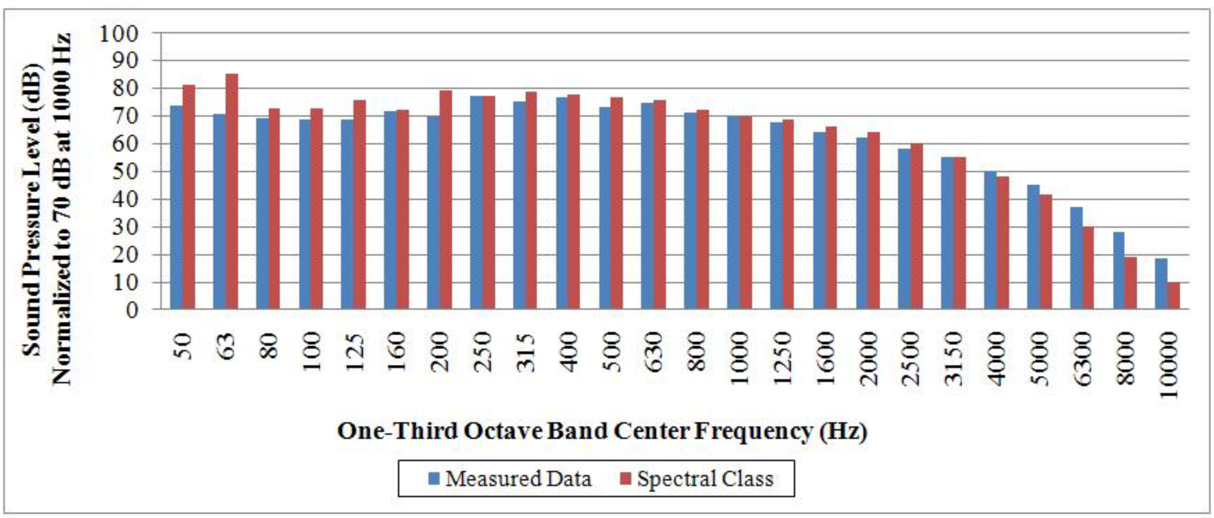

Figure 130. Robinson R44 Average 1000-ft 100 Series LFO Spectrum (normalized)

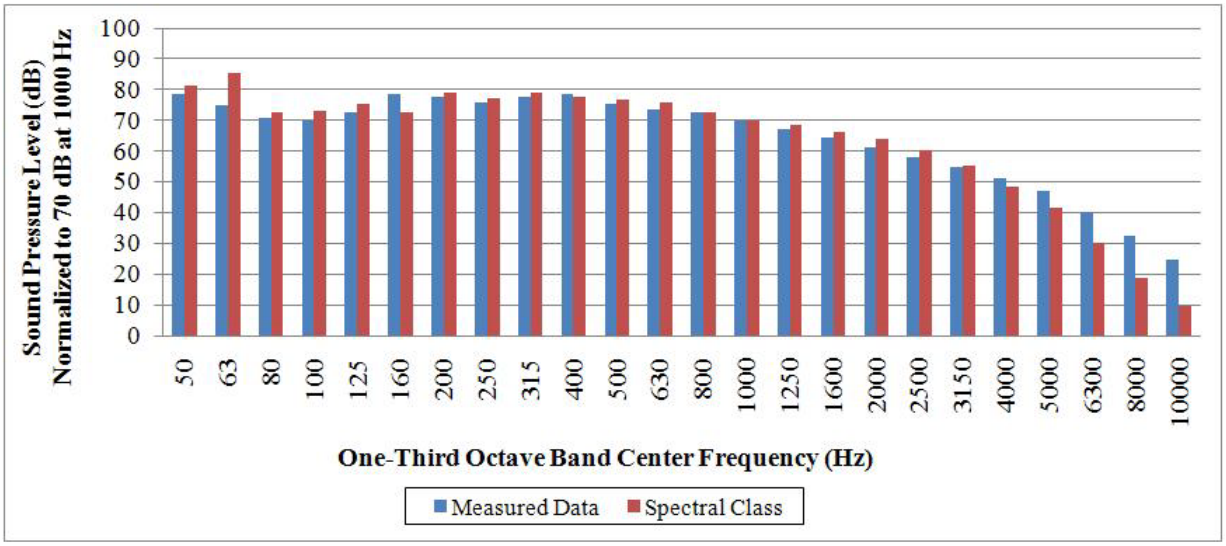

Figure 131. Robinson R44 Average 1000-ft 200 Series LFO Spectrum (normalized)

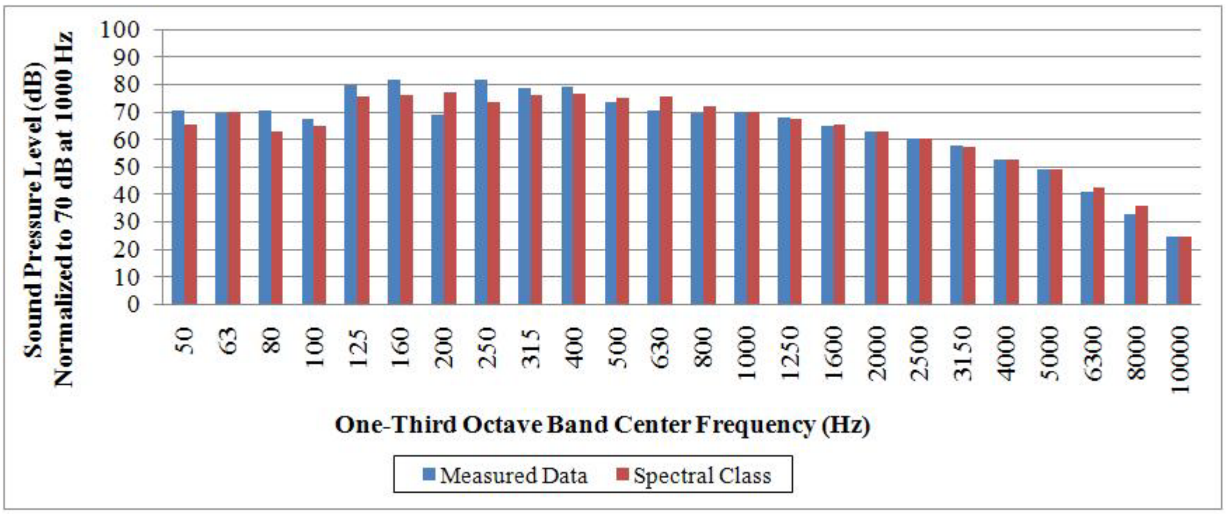

Figure 132. Robinson R44 Average 1000-ft 300 Series DEP Spectrum (normalized)

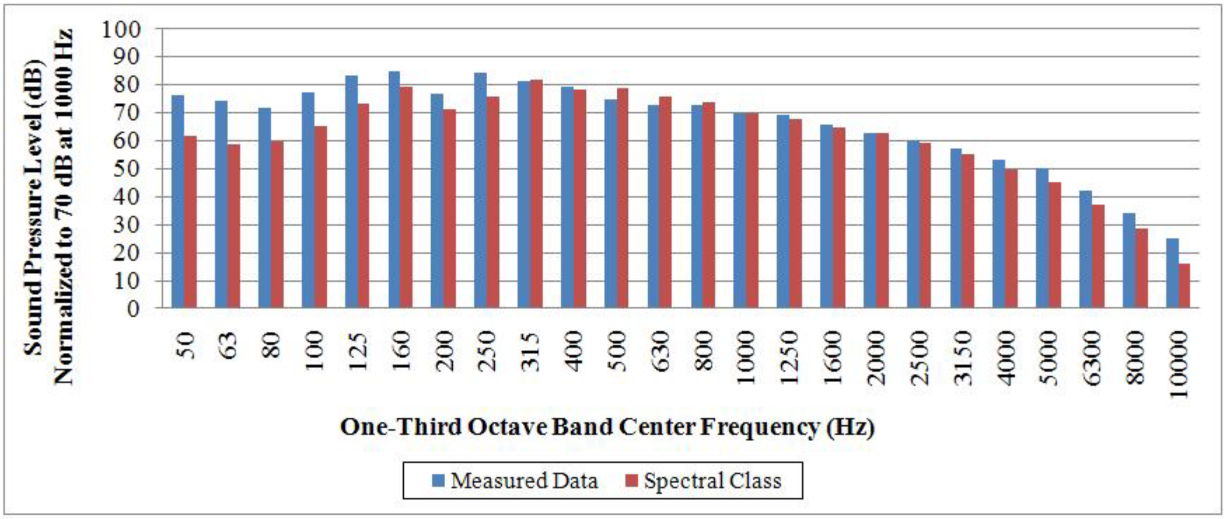

Figure 133. Robinson R44 Average 1000-ft 500 Series APP Spectrum (normalized)

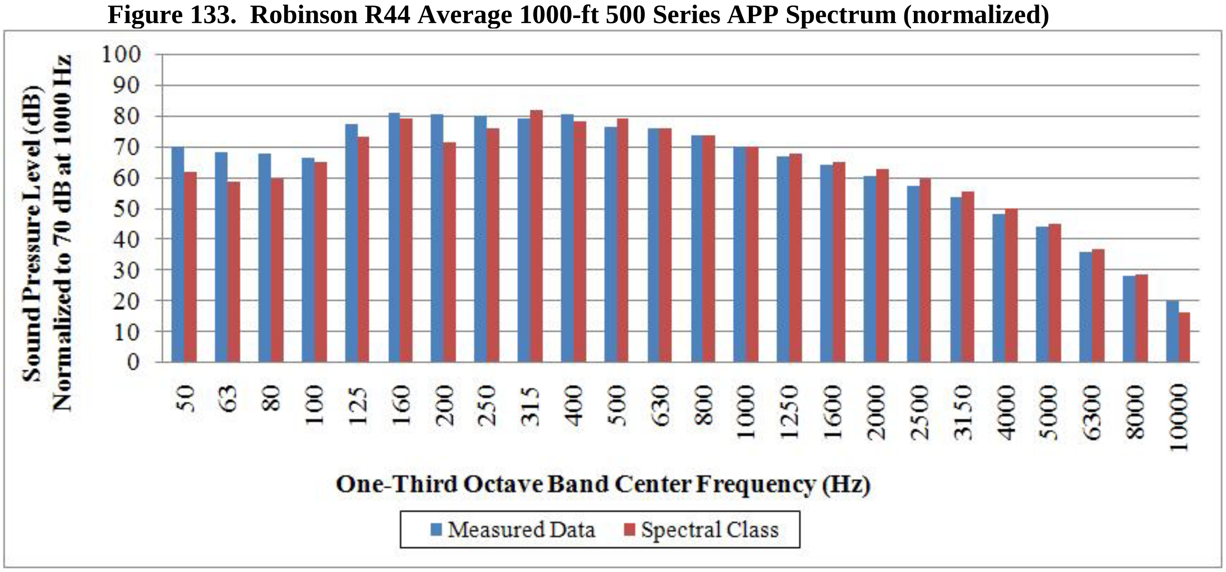

Figure 134. Robinson R44 Average 1000-ft 600 Series APP Spectrum (normalized)

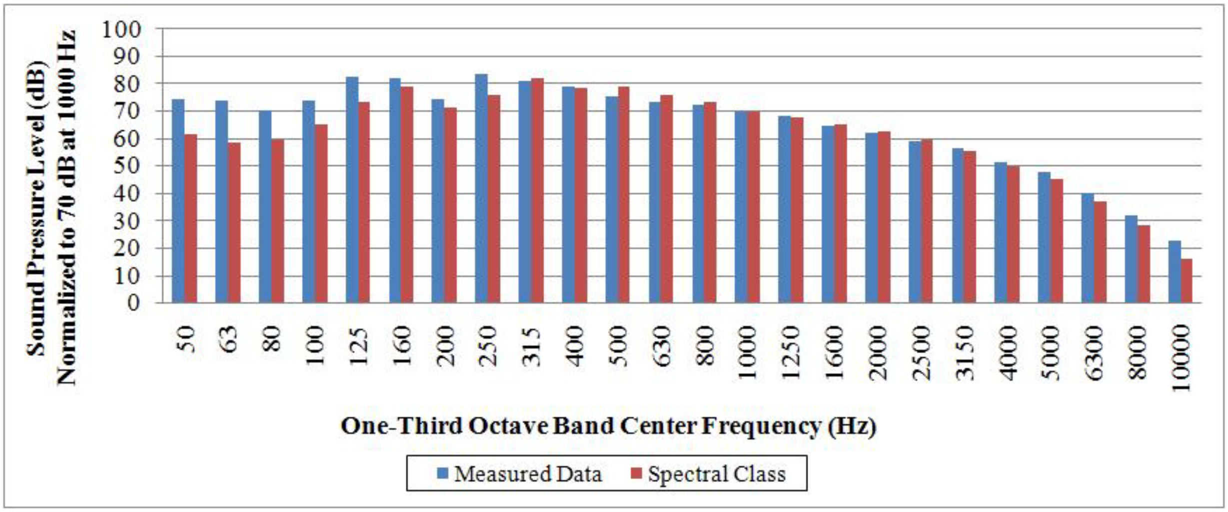

Figure 135. Robinson R44 Average 1000-ft 700 Series APP Spectrum (normalized)

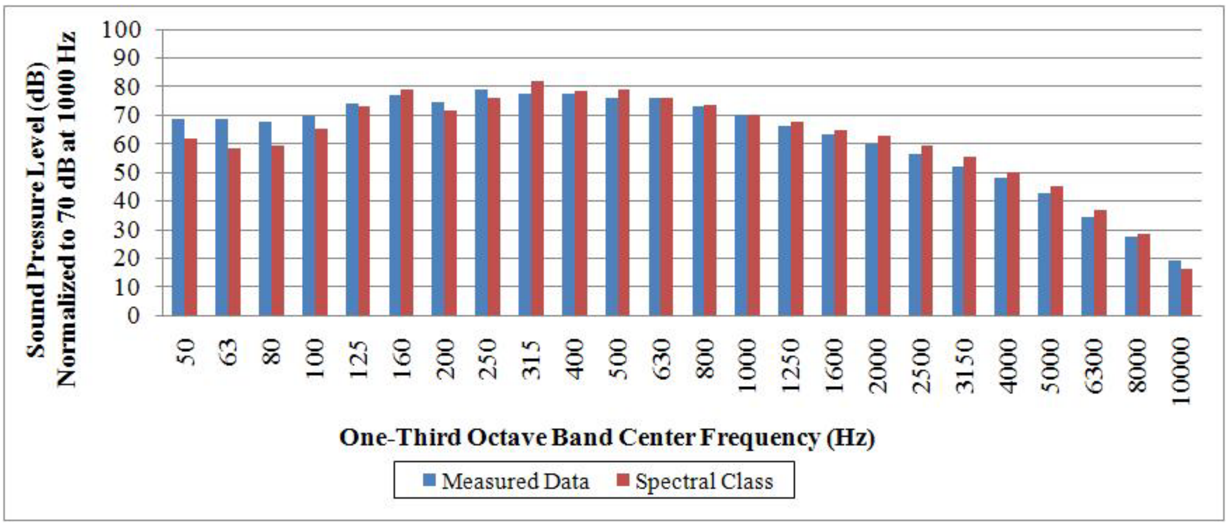

Figure 136. Robinson R44 Average 1000-ft 800 Series APP Spectrum (normalized)

F.8 Schweizer 300C

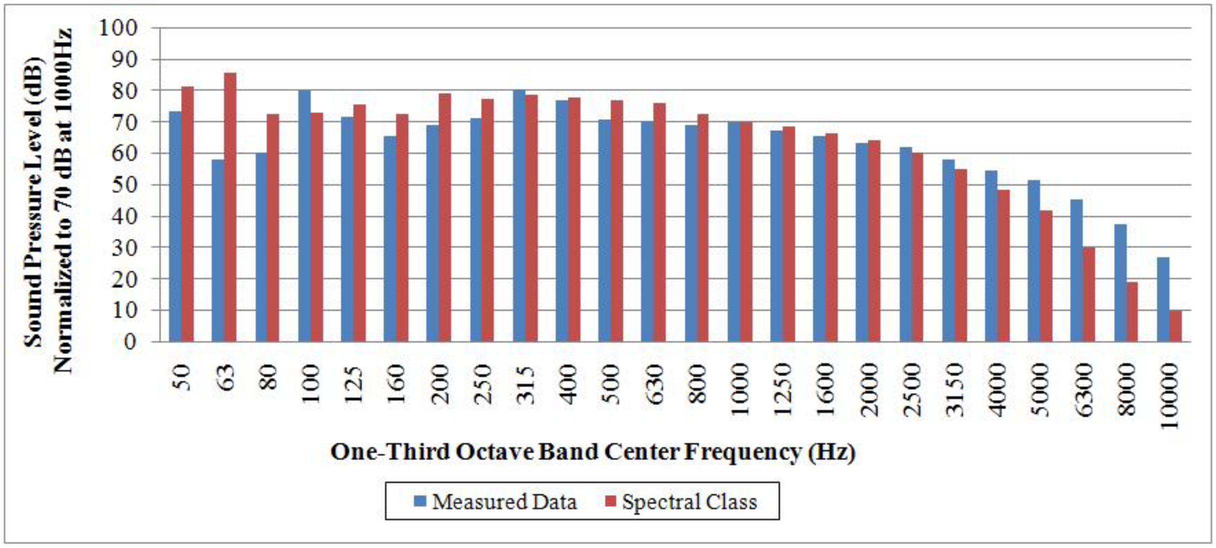

Figure 137. Schweizer 300C Average 1000-ft 100 Series LFO Spectrum (normalized)

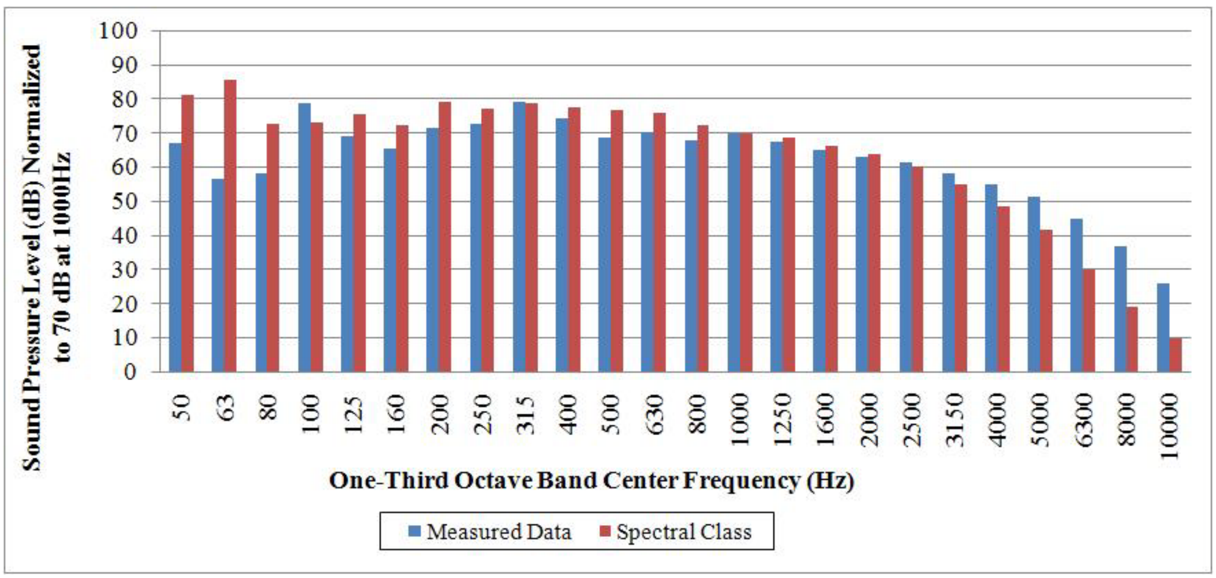

Figure 138. Schweizer 300C Average 1000-ft 200 Series LFO Spectrum (normalized)

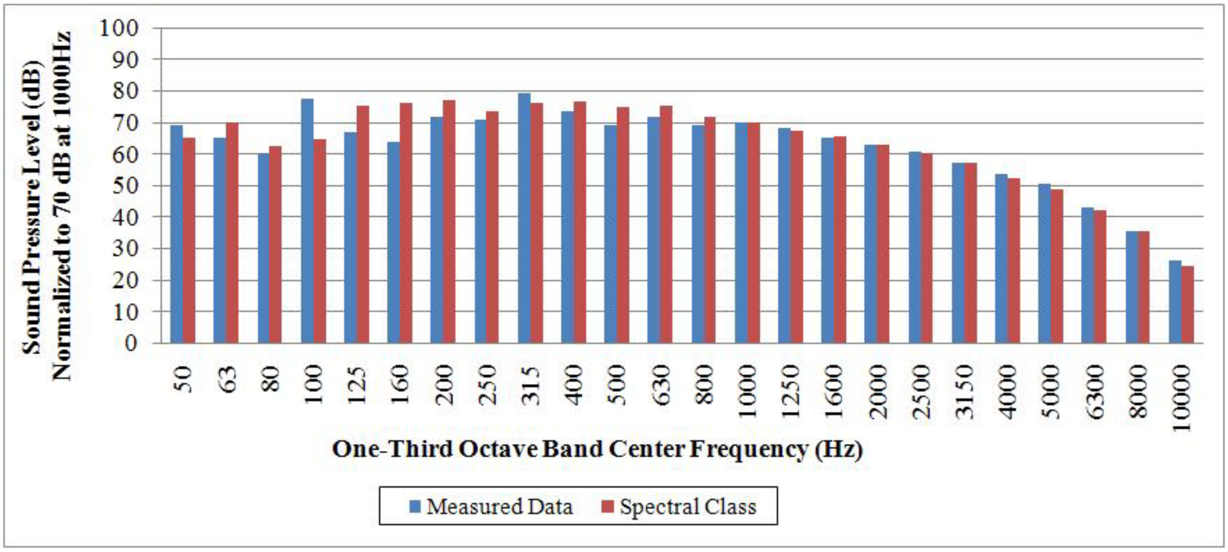

Figure 139. Schweizer 300C Average 1000-ft 300 Series DEP Spectrum (normalized)

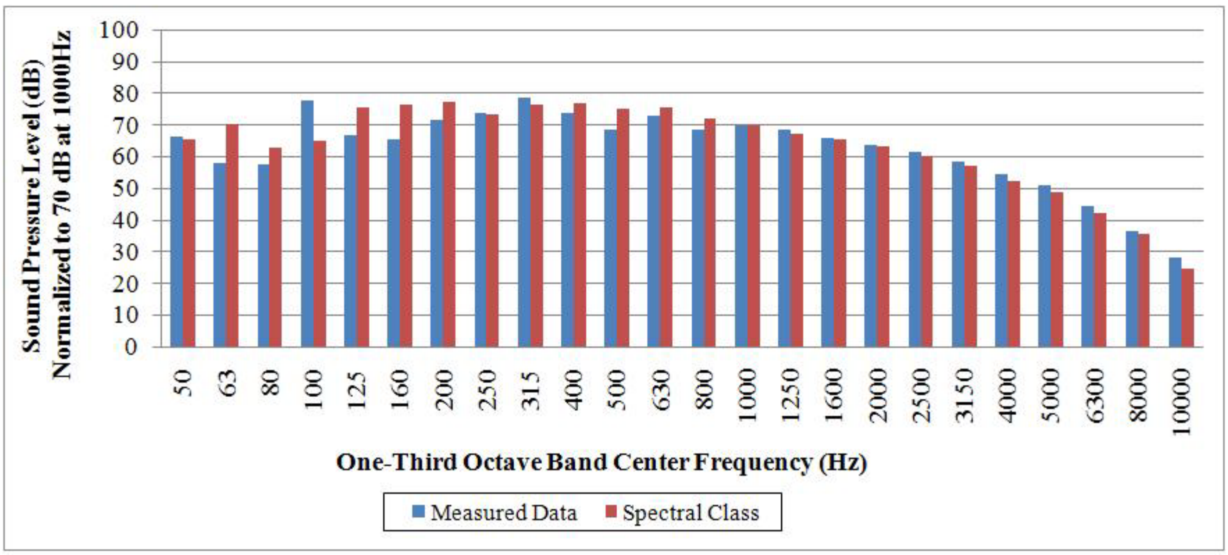

Figure 140. Schweizer 300C Average 1000-ft 400 Series DEP Spectrum (normalized)

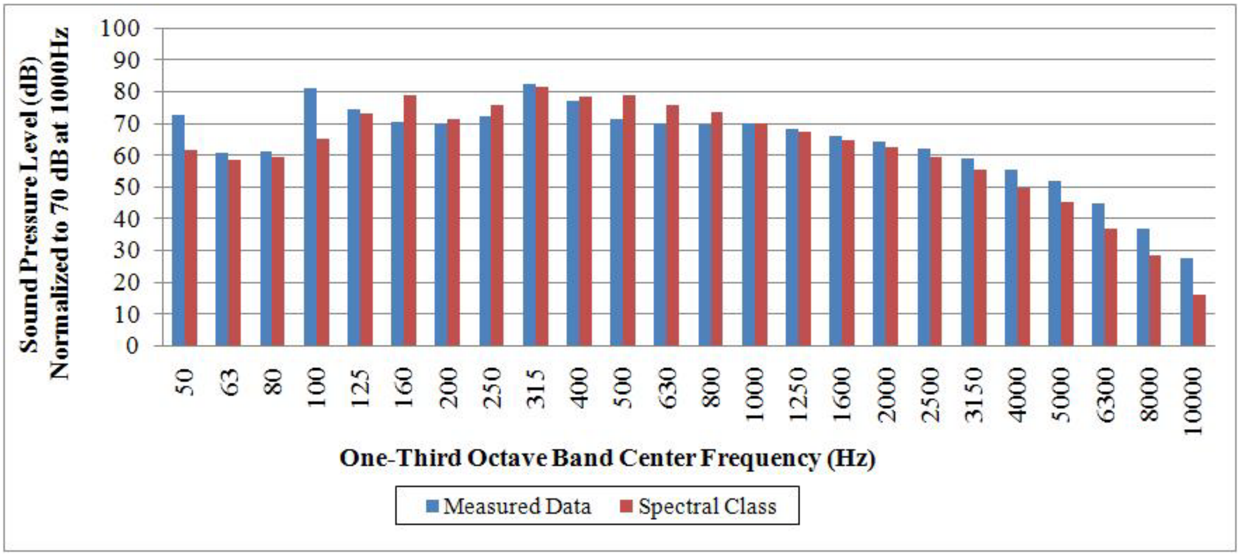

Figure 141. Schweizer 300C Average 1000-ft 500 Series APP Spectrum (normalized)

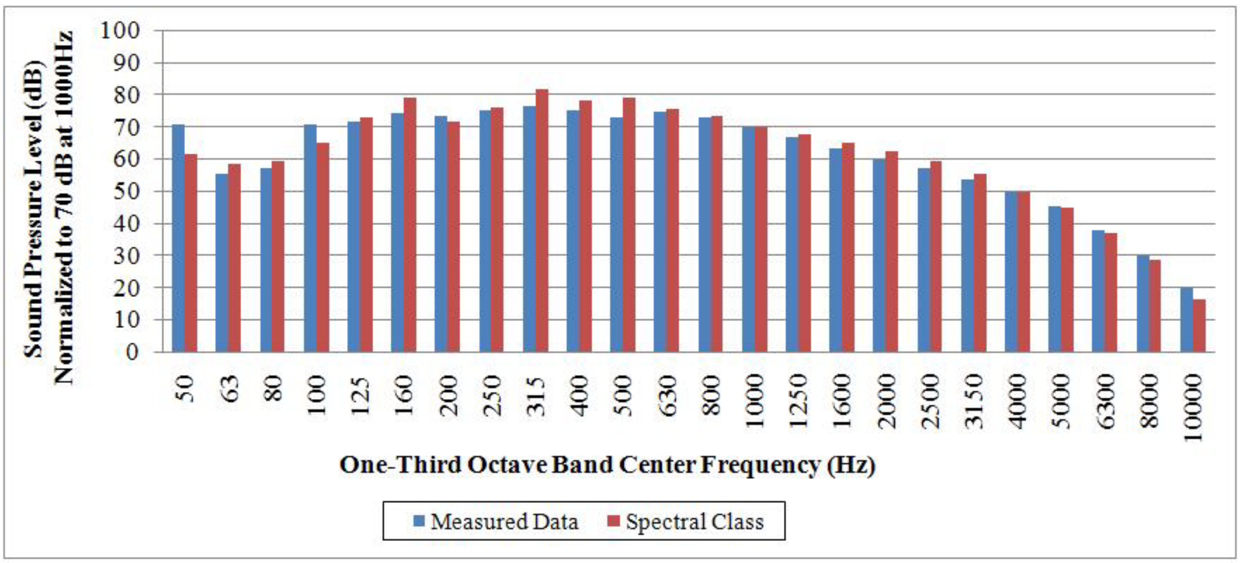

Figure 142. Schweizer 300C Average 1000-ft 600 Series APP Spectrum (normalized)

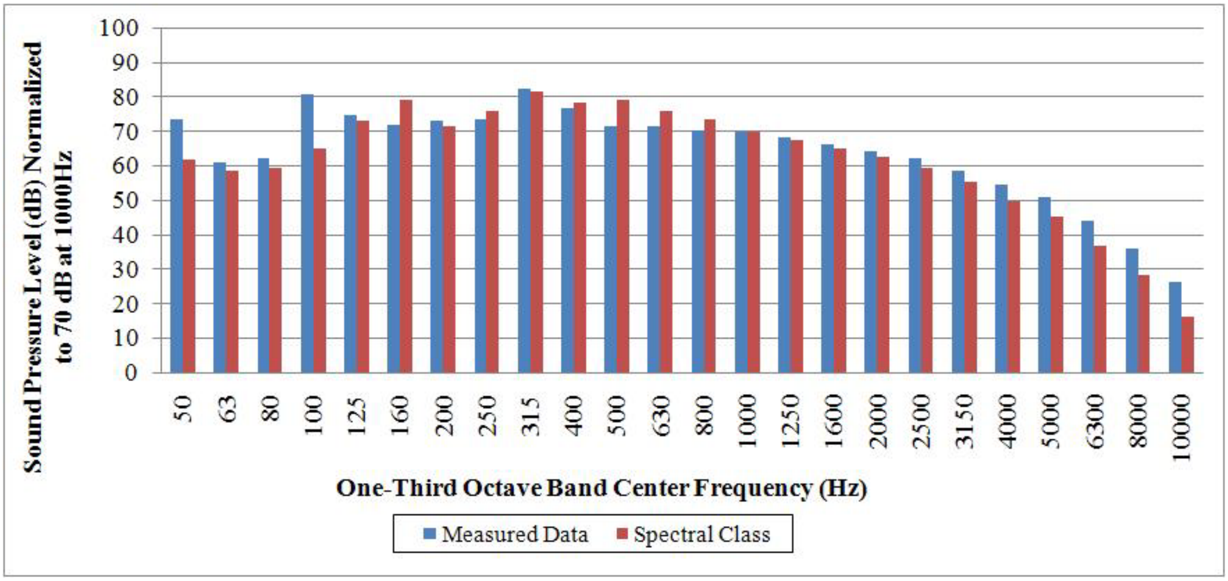

Figure 143. Schweizer 300C Average 1000-ft 700 Series APP Spectrum (normalized)

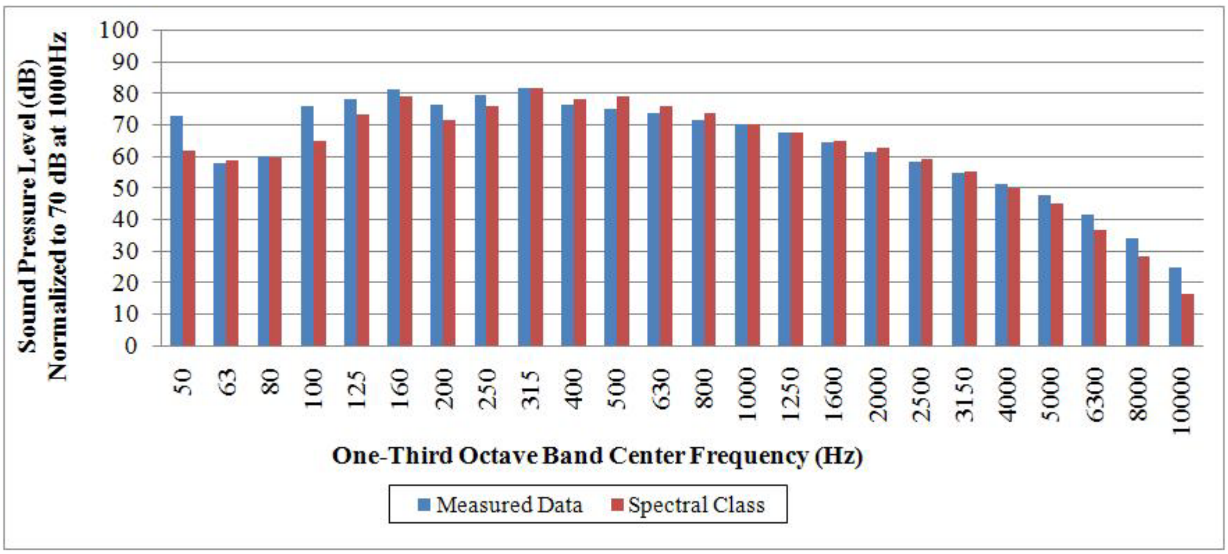

Figure 144. Schweizer 300C Average 1000-ft 800 Series APP Spectrum (normalized)

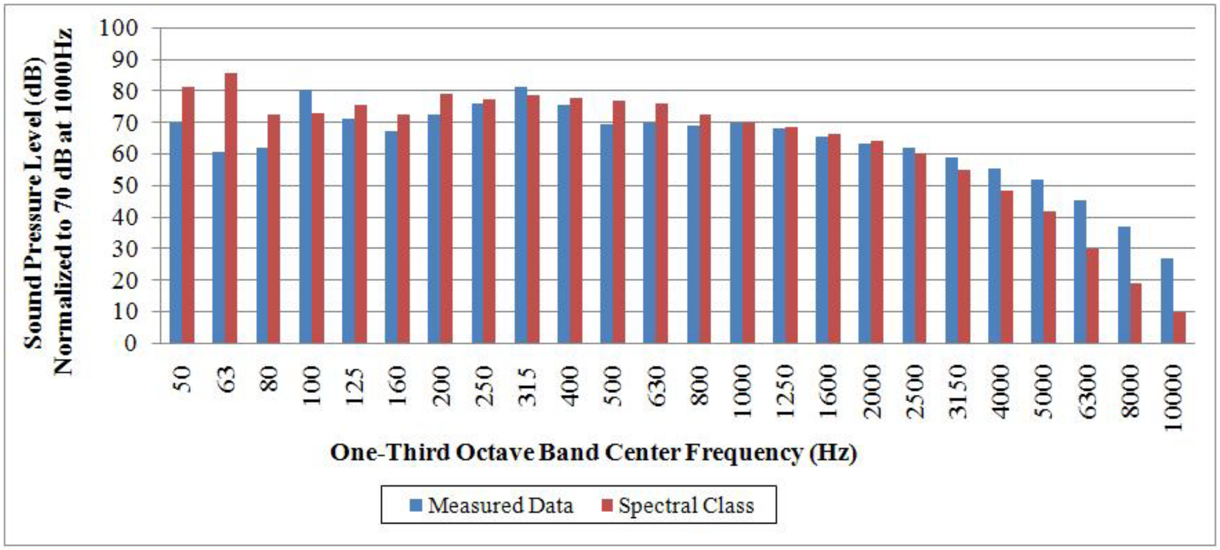

Figure 145. Schweizer 300C Average 1000-ft 1000 Series APP Spectrum (normalized)

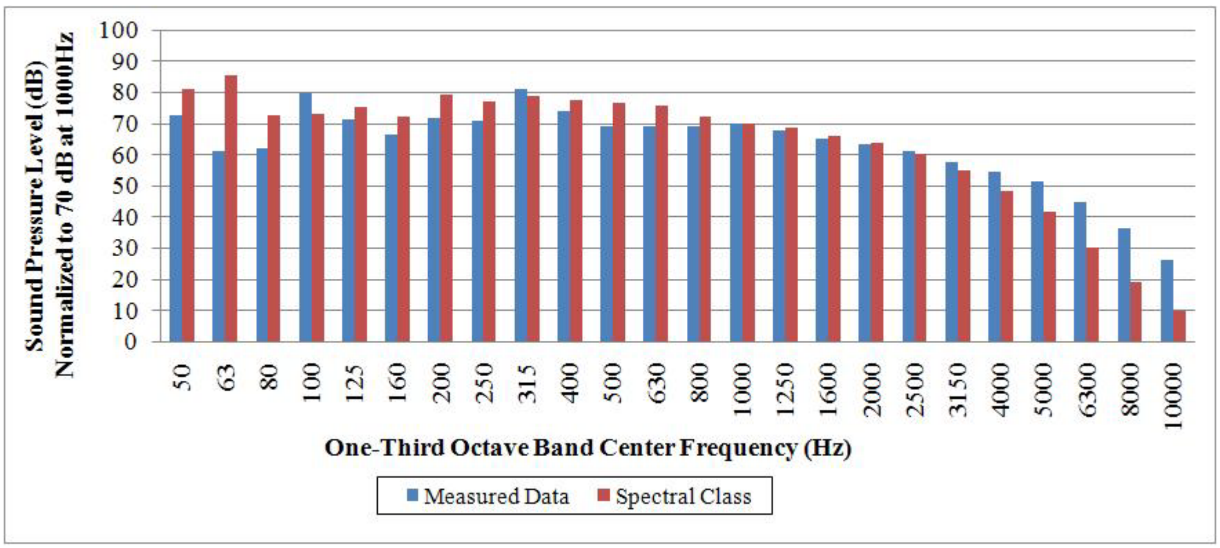

Figure 146. Schweizer 300C Average 1000-ft 1100 Series APP Spectrum (normalized)

This page intentionally left blank.

APPENDIX G: ACRONYMS AND ABBREVIATIONS

AFE	Airport Field Elevation
AGL	Above Ground Level
APP	Approach
ASCII	American Standard Code for Information Interchange
DAT	Digital Audio Tape
dB	Decibel, a unit of noise level or noise exposure level
dB(A)	Decibel with A-weighting applied
DBF	dBase IV database file format
DEP	Departure
EPR	Engine Pressure Ratio
FAA	Federal Aviation Administration
FIT	Fitchburg Municipal Airport
FPM	Feet Per Minute
ft	Feet
GLB	GLB Electronics, Inc. (Buffalo, New York)
HNM	Heliport Noise Model
hp	Horsepower
hr	Hour
IAS	Indicated Airspeed
IFR	Instrument Flight Rules
in-Hg	Inches of Mercury
INM	Integrated Noise Model
ISA	International Standard Atmosphere
KCAS	Knots Calibrated Airspeed
KIAS	Knots Indicated Airspeed
KTAS	Knots True Airspeed
kts	Knot(s)
$\mathbf{L_{AE}}$	Sound exposure level
$\mathbf{L_{Aeqt}}$	Time-period, equivalent, continuous, A-weighted sound pressure level
$\mathbf{L_{ASmx}}$	Maximum, slow-scale, A-weighted sound level
lb	Pound(s) force or weight
$\mathbf{L_{EPN}}$	Effective perceived noise level
LFO	Level Flight
$\mathbf{L_{PNTSmx}}$	Tone-adjusted, maximum, slow-scale, perceived noise level
$\mathbf{L_{PNTt}}$	Time-period, equivalent, continuous, perceived noise level
MAP	Manifold Pressure
MGTW	Maximum Gross Takeoff Weight
mm	Millimeter
MSL	Mean Sea Level
N1	Low pressure rotor speed as a percentage of a reference speed
nmi	Nautical Miles
NPD	Noise-Power-Distance
NPS	National Park Service
ROC	Rate of Climb

RPM	Revolutions Per Minute
RWY	Runway
s	Second
TAMS	Transportable Automated Meteorological Station
TSPI	Time-Space-Position Information
VCAF	Volpe Center Acoustics Facility
VFR	Visual Flight Rules
$\mathbf{V_H}$	Maximum speed in level flight with maximum continuous power (kts)
$\mathbf{V_{NE}}$	Velocity Not to Exceed
Volpe	John A. Volpe National Transportation Systems Center
$\mathbf{V_Y}$	Speed for best rate of climb (kts)

REFERENCES

1 National Parks Air Tour Management Act of 2000. Public Law 106-181, 114 Stat. 61, Title VIII, Section 801, April 2000.

2 FICAN Findings and Recommendations on Tools for Modeling Aircraft Noise in National Parks, Federal Interagency Committee on Aviation Noise: Washington, D.C., February 2005.

3 Fleming, Gregg G., Plotkin, Kenneth J., Roof, Christopher J., Ikelheimer, Bruce J., Senzig, David A., FICAN Assessment of Tools for Modeling Aircraft Noise in the National Parks, John A. Volpe National Transportation Systems Center: Cambridge, MA, Wyle Laboratories: Arlington, VA, Senzig Engineering: Winchester, MA, March 2005.

4 Fleming, et al., Integrated Noise Model (INM) Version 6.0 Technical Manual, Report No. FAA-AEE-02-01, John A. Volpe National Transportation System Center: Cambridge, MA, January 2002.

5 Environmental Impacts: Policies and Procedures, FAA Order 1050.1E, June 2004.

6 Airport Noise Compatibility Planning, Federal Aviation Regulations (FAR) Part 150, January 1985.

7 Reherman, Clay, Samiljan, Robert, Scarpone, Christopher, Boeker, Eric, Roof, Christopher, Ruggiero, Joseph, Lau, Michael, Fleming, Gregg, Volpe Center Acoustics Facility Time-Space-Position-Information System User's Guide, Version 5.0, Volpe Center Report No. RVT-41-FA94TC1-LR1, John A. Volpe National Transportation System Center: Cambridge, MA, July 2008.

8 Federal Aviation Regulations, Part 36, Noise Standards: Aircraft Type and Airworthiness Certification, Federal Aviation Administration: Washington, D.C., September 1992.

9 Annex 16, Environmental Protection, Volume I, Aircraft Noise, Third Edition, International Civil Aviation Organization (ICAO), July 1993.

10 Society of Automotive Engineers, Committee A-21, Aircraft Noise, Procedure for the Calculation of Airplane Noise in the Vicinity of Airports, Aerospace Information Report No. 1845, Society of Automotive Engineers, Inc.: Warrendale, PA, March 1986.

11 Report on Standard Method of Computing Noise Contours around Civil Airports Volume 1: Applications Guide; Volume 2: Technical Guide, European Civil Aviation Conference (ECAC) Doc 29 (3rd Edition), July 2005.

12 Recommended Method for Computing Noise Contours Around Airports (Doc 9911), First Edition, International Civil Aviation Organization (ICAO), January 2009.

13 Fleming, Gregg G., Rickley, Edward J., HNM, Heliport Noise Model Version 2.2, User's Guide, DOT Report No. DOT-VNTSC-FAA-94-3, John A. Volpe National Transportation System Center: Cambridge, MA, February 1994.

14 Acoustical Terminology, American National Standard, ANSI S1.1-1994 (R2004), American National Standards Institute: New York, New York, 2004.

15 Noise Measurement Flight Test for Aerospatiale SA 354N Dauphin 2 Twin Jet Helicopter: Data and Analyses, FAA Report No. FAA-EE-84-2, Federal Aviation Administration: Washington, D.C., April 1984.

16 Cessna Model 182 Skylane Owner's Manual, 1965.

17 Pilot's Flight Manual for Schweizer 300C helicopter Model 269C, September 1988.

18 Procedure for Calculation of Airplane Noise in the Vicinity of Airports, Aerospace Information Report 1845, Society of Automotive Engineers: Warrendale, Pennsylvania, March 1986.

19 Reherman, Clay N., Roof, Christopher J., Fleming, Gregg G., Senzig, David A., Read, David R., Lee, Cynthia S.Y., Fitchburg Municipal Airport Noise Measurement Study: Summary of Measurements, Data and Analysis, DOT Report No. DOT-VNTSC-FAA-03-09, John A. Volpe National Transportation System Center: Cambridge, MA, November 2005.

20 Cessna Model 182P Skylane Pilot's Operating Handbook and Airplane Flight Manual, 1976.

21 Continental Aircraft Engine Series IO-470 Operator's Manual, 1973.

22 Hartzell Map Interpolator Version 1.2, 2008.

23 Gunston, Bill, World Encyclopedia of Aero Engines, 2nd Ed., Sterling Publishing Co.,: New York, NY, 1989.

24 Dornier 328 Airplane Flight Manual, AM-AFM-050893 (Mod 20), July 1999.

23 Spectral Classes for FAA's Integrated Noise Model Version 6.0, John A. Volpe National Transportation Systems Center Acoustics Facility: Cambridge, MA, December 1999.