

F-35 Noise Measurement Executive Summary

- Introduction:**

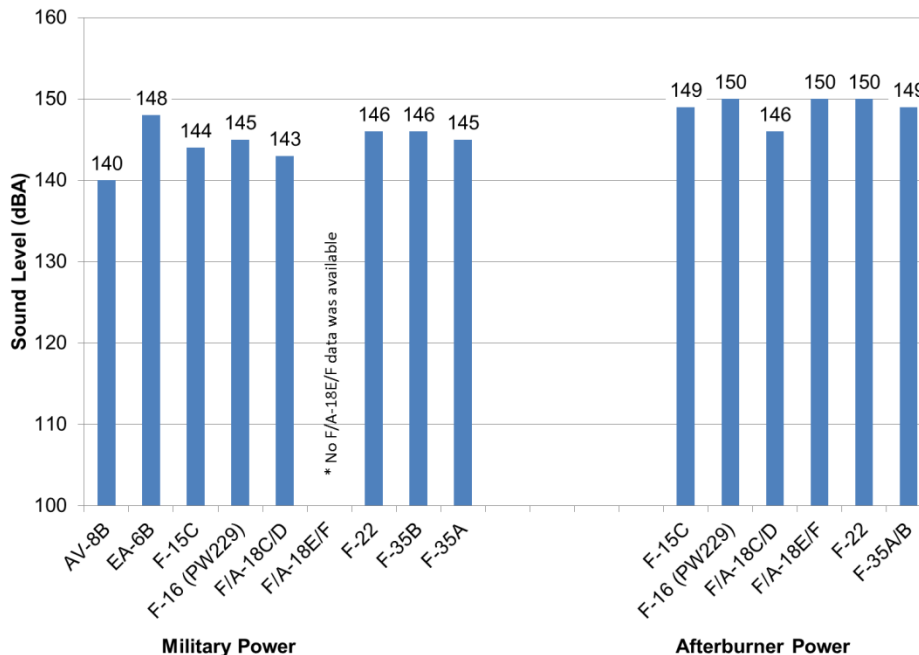
- The F-35 Lightning II is a 5th generation fighter aircraft with three variants: the F-35A conventional takeoff and landing (CTOL); the F-35B short take-off and vertical landing (STOVL); and the F-35C aircraft carrier takeoff and landing (CV).
- The F-35A and F-35C engines are only different in that the F-35C has special salt corrosion prevention materials for aircraft carrier operations. The F-35B engine includes a swivel nozzle and lift fan for short takeoffs and vertical landings. All three variant engines have a maximum thrust of 43,000 lbs.

- Background:**

- The F-35 program has been proactive in collecting aircraft noise data.
- Oct 2008: F-35AA1, a pre-production prototype aircraft, was used to collect ground run-up and flyover noise data for environmental assessments and impact statements.
- Sep 2013: F-35A and F-35B aircraft were used to collect production representative ground run-up and flyover noise data and provide the best available noise data for environmental assessments and impact statements. In the analysis, the F-35A serves as a surrogate for the F-35C.
- The 2013 measurements generally corroborated the prior 2008 results.
- To better understand the data the following explanation is provided:
 - Listeners may perceive noises differently, even though sound levels in decibels (dB) are equal.
 - The average listener would barely notice a change in the “loudness” between two sounds that are 3 dB apart
 - The average listener would perceive a sound that is 10 dB higher than the original sound as “twice as loud”.
 - The F-35 sounds different than current legacy aircraft in terms of its tone.

- Comparison of Noise Results:**

**Aircraft Ground Noise
Figure 1**



- Notes:

1. AV-B, EA-6B, F/A-18C/D, F/A-18E/F data from various technical reports (Aug 2002)
2. F-16, F-15, and F-22 data from AFRL Noise Data Handbook
3. F-35A and F-35B data from tests at Edwards AFB (Sep 2013)
4. Military power – the maximum continuous power of the engine without afterburner
5. Noise data is typically measured 135° off nose or 45° off the aircraft tail

**Takeoff and Flyover Noise
Table 1**

Condition	F-35A Comparisons				F-35B Comparisons			
	F-35AA1 ⁽¹⁾	F-35A ⁽²⁾	F-16C/D (PW220)	F-16C/D (PW229)	F-35B ⁽²⁾	F/A-18C/D ⁽³⁾	F/A-18E/F ⁽⁴⁾	AV-8B ⁽⁵⁾
	L _{max} (dB)	L _{max} (dB)	L _{max} (dB)	L _{max} (dB)	L _{max} (dB)	L _{max} (dB)	L _{max} (dB)	L _{max} (dB)
Mil Takeoff (1000 ft AGL)	112	111	103	110	110	108	113	105
Arrival (non-break, thru 1000 ft AGL, gear down (F-16 data with gear up))	95	93	79	90	92	103	108	90
Low Approach and Go, downwind leg, 1500 ft AGL, gear down; (F-16 data with gear up)	91	89	79	103	87	97	104	85
Radar Pattern (downwind leg, 2000 ft AGL, gear up)	79	79	75	89	77	81	91	85

Footnotes:

- (1) F-35AA1 data from tests at Edwards AFB (Oct 2008, Sep 2009)
- (2) F-35A and F-35B data from tests at Edwards AFB (Sep 2013)
- (3) F/A-18C/D comparison data was derived from F/A-18C/D acoustic data applied to the Table 1 conditions
- (4) F/A-18E/F profile settings from NAS Lemoore
- (5) AV-8B profiles settings from MCAS Yuma

Notes:

- a) Until 2012 there was not a standard measurement procedure
- b) Specific community noise levels depend on location, weather, local course rules, and flying technique
- c) L_{max} = Maximum instantaneous (1 sec) sound level

• **Comparisons:**

- On the ground (Figure 1)
 - F-35 is comparable with most legacy fighter aircraft
- In the air (Table 1)
 - During takeoff, the F-35A (111 dB) is almost equal in noise level to the F-16 with the latest generation PW229 engine (110 dB), and it is at least 10 dB lower on two of the three low altitude flight conditions. However, the F-35A is generally louder for all conditions when compared to the F-16 with the earlier PW220 engine.
 - The F-35B noise level is comparable to the AV-8B on approach and is 5 dB louder on takeoff. The F-35B is quieter than the legacy F/A-18C/D during all approaches and is slightly louder (2 dB) than the F/A-18 C/D on takeoff.
 - The F-35A (as a surrogate for the F-35C) is slightly louder (3 dB) than the F/A-18 C/D on takeoff but has lower noise levels on approach. The F-35A is slightly quieter (2 dB) than the F/A-18E/F on takeoff and much quieter (>10 dB) on all three approach flight profiles.

• **Summary:**

- All F-35 US Services and Partners are using the same noise data. However, the F-35 community noise contours will be different at many US and overseas installations due to differing regulations determining the calculation method, local takeoff and arrival profiles, terrain, and local environments.
- The community noise contours computed using the Sep 2013 production representative F-35A and F-35B noise data are essentially equal to or slightly smaller than the contours in recent F-35 Environmental Impact Statements developed using the 2008 F-35AA1 noise data.
- F-35C noise data is expected to be essentially equal to F-35A noise data except for low power approach conditions and high speed (>450 knots) conditions, where it is estimated to be slightly louder.
- The F-35 Joint Program Office is releasing noise data to our US Services, International Partners, and Foreign Military Sales customers to perform their Environmental Impact Assessments.