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SOUND MEASUREMENTS ON A 4000-POUND-THRUST HIGH-BYPASS-RATIO TURBOFAN ENGINE

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • MARCH 1970

1. Report No. NASA TM X-1950	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle SOUND MEASUREMENTS ON A 4000-POUND-THRUST HIGH-BYPASS-RATIO TURBOFAN ENGINE		5. Report Date March 1970 6. Performing Organization Code
7. Author(s) Loren W. Acker, Joseph R. Balombin, and James W. Coats		8. Performing Organization Report No. E-5330
9. Performing Organization Name and Address Lewis Research Center National Aeronautics and Space Administration Cleveland, Ohio 44135		10. Work Unit No. 126-61 11. Contract or Grant No. 13. Type of Report and Period Covered Technical Memorandum
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D. C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Sound measurements were made on a 4000-pound-thrust, high-bypass-ratio turbofan engine. Sound data were obtained at various engine speeds as the fan and core engine nozzle areas were changed. The overall engine noise was dominated by a pronounced discrete tone corresponding to the fan blade passage frequency. The calculated perceived noise levels were about 15 decibels higher than overall sound pressure levels.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Acoustics Turbofan-engines Aircraft-noise	Unclassified - unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price *
Unclassified	Unclassified	32	$3.00

*For sale by the Clearinghouse for Federal Scientific and Technical Information Springfield, Virginia 22151

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SUMMARY

Sound measurements were made on a 4000-pound-thrust, high-bypass-ratio turbofan aircraft engine having a bypass ratio of 6. This engine, though smaller than those used on commercial transports, should exhibit noise characteristics like the advanced high-bypass transport engines. Various fan and core engine exhaust nozzles were used to study the effect of back pressure or blade loading on the noise output. This report presents the sound data obtained at various engine operating speeds. Correlations of the sound data with engine or fan performance parameters are not presented because no internal aerodynamic data were obtained.

The overall engine noise output is dominated by a pronounced discrete tone which corresponds in frequency to that of the number of fan blades passing a fixed point on the cowl each second. At takeoff speed this frequency is 4260 hertz. Because this discrete tone at the blade passage frequency is in the most annoying region of the audible spectrum, calculated perceived noise levels are about 15 decibels higher than the overall sound pressure levels.

INTRODUCTION

The community noise level of advanced commercial transport aircraft is expected to be less than current models because high-bypass-ratio turbofan engines will be used. High-bypass-ratio engines for future subsonic aircraft are being designed with a flow bypass ratio between 5 and 8.

Sound measurements were made on a high-bypass-ratio 4000-pound-thrust turbofan engine having a bypass ratio of 6. The engine was manufactured by the Lycoming Division of AVCO Corporation. Although it is smaller in diameter and thrust than engines

built for current commerical transports (4000-lb thrust compared to 18 000 lb), the internal aerodynamic design is generally similar to current commercial engine design practice. The design of the engine, however, emphasized only performance and reliability with little attention given to its noise generation characteristics.

This report presents all of the sound data taken during a three-part test program, which was conducted in an outdoor free-field research facility here at Lewis. First, baseline sound measurements with the manufacturer's delivered configuration were obtained. Second, the effect of fan blade loading or pressure ratio on the noise output was investigated. The third part was a study of the effect on noise level of reducing the turbine back pressure or core engine exhaust velocity. Only acoustic results are discussed since aerodynamic measurements were not made.

ENGINE DESCRIPTION

A sectioned schematic drawing of the turbofan engine is shown in figure 1. The engine consists of two turbine-driven rotor spools: a high pressure spool produces the hot

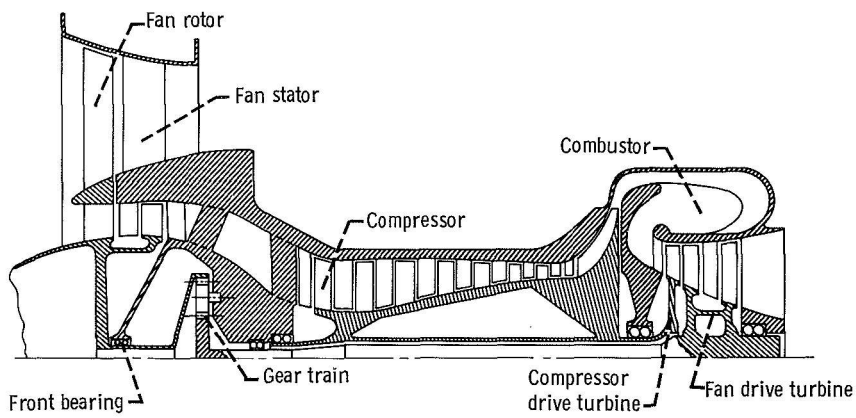
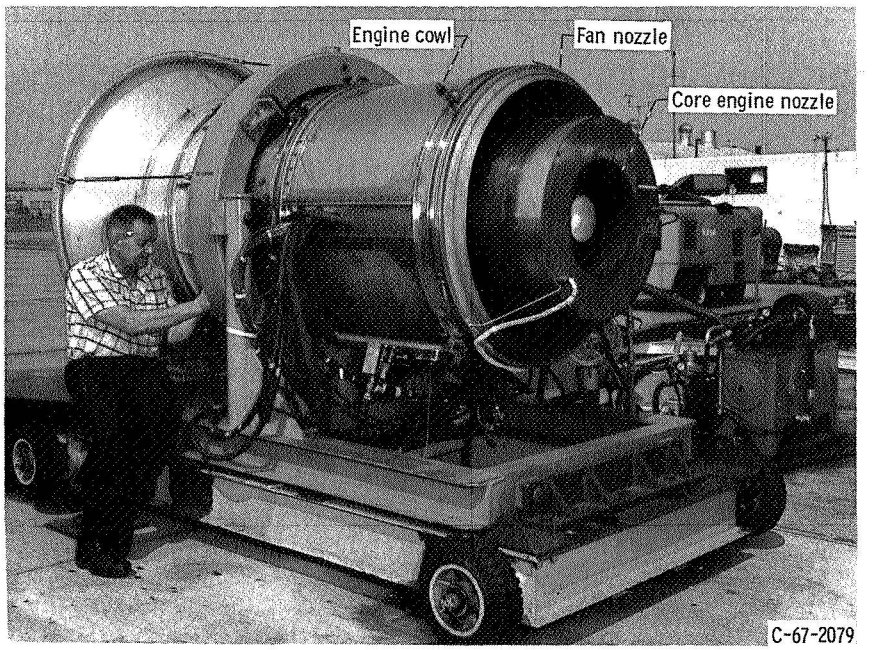


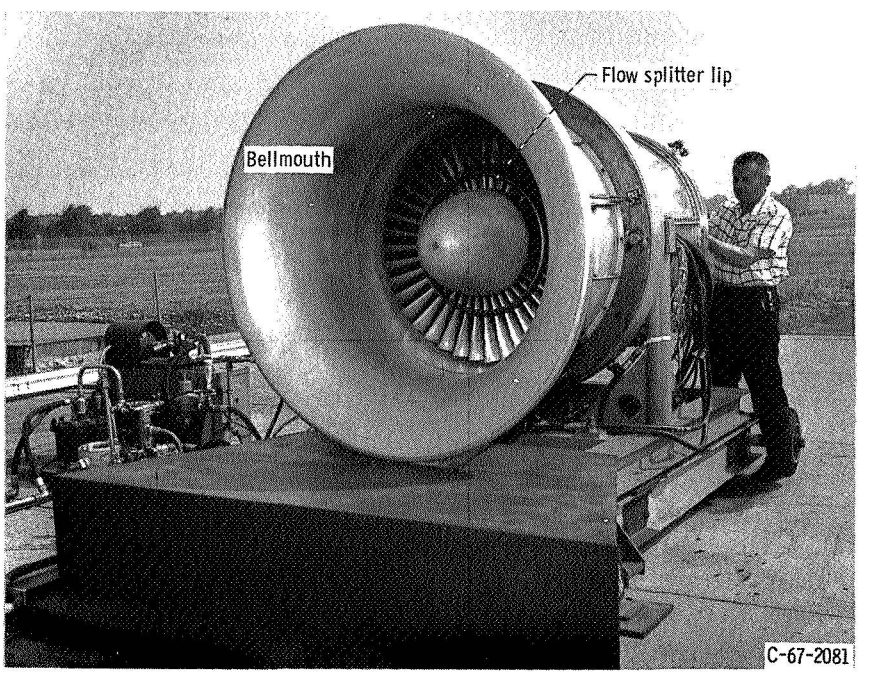
Figure 1. - Schematic sketch of turbofan engine.

gas which in turn drives the fan spool or low pressure spool. The turbofan configuration was an adaptation by the manufacturer around a production high-speed-turboshaft gas turbine engine. Therefore, a gear box was used to match the speed torque characteristics of the fan and the fan drive turbine.

The air for the core engine is immediately separated from the fan bypass air by a splitter lip machined integrally with the fan blade. The core engine air is first compressed by two axial flow stages on the fan wheel prior to entering the main compressor



(a) Rear view.



(b) Front view.

Figure 2. - Turbofan engine.

which is driven by a single-stage turbine. The hot gas, after leaving the two-stage fan drive turbine, passes through an exhaust nozzle to yield some thrust.

The bypass part of the total air flow is compressed in a single-stage fan. It then passes through an exhaust nozzle to produce thrust. The ratio of the thrust produced by the bypass flow to that produced by the core engine flow is approximately 5.5 to 1. The engine and fan characteristics are listed in table I.

INSTRUMENTATION AND OPERATION

The engine (fig. 2), which was mounted on a portable operating stand during noise testing, was operated in an open area which provided a free nonreverberant sound field where building reflections affected the data by no more than 1/2 decibel. Sound measurements were made with condenser microphones located in a horizontal plane which passed through the engine centerline. The microphones were located on a 100-foot radius around the engine at 10° angular increments. The angle 0° was directly in front of the engine. The survey included only a 160° traverse from the engine front because of possible damage to the microphones by the exhaust wake.

Five spectral records were taken at each microphone location for each engine condition to average out the effect of run to run atmospheric variations. Sound data were acquired on magnetic tape and played back through a 1/3 octave band spectrum analyzer. The analyzer read out sound pressure level units in decibels referenced to 0.0002 microbar. Each microphone had a variation of less than ±2 decibels in normal incidence free field response from 100 hertz to 10 kilohertz. An increment of 1 to 3 decibels was added to the data above 3 kilohertz to compensate for the microphone roll-off and cable losses. Because each microphone was calibrated with a standard 121.5-decibel tone before each run and redundant data runs were averaged, it is believed that the data are reproducible to less than 1 decibel. The absolute sound levels may, however, be accurate to only ±2 decibels.

DISCUSSION OF RESULTS

The noise studies on the engine were conducted in three parts: baseline measurements, variable fan blade loading, and two core engine exhaust areas. The various nozzle area combinations used in each of the three series are shown in table II. The baseline tests were made with a fan nozzle of 512 square inches and a core engine exhaust nozzle area of 143 square inches. Variations in pressure ratio across the fan (fan blade loading) were accomplished by using three other fan nozzles having areas of

429, 487 and 659 square inches. To change the pressure ratio across the core engine, a 384-square-inch exhaust area diffuser was installed at the core engine discharge. The diffuser was operated with only the 429- and 659-square-inch fan nozzles. Sound measurements were obtained for each configuration over a range of fan speeds up to 99 percent of 6440 rpm. The maximum permissible fan speed was 6440 rpm. All the sound measurements are listed in table III.

The measurements listed in table III are sound pressure levels (SPL) in decibels for each 1/3 octave band from 50 hertz to 10 kilohertz at each microphone location from 0^{o} to 160^{o} for each engine speed and for each engine configuration (A to F in table II). The sound pressure levels have been corrected for cable losses and microphone rolloff as discussed in the INSTRUMENTATION AND OPERATION section. Overall broad band sound pressure levels (OASPL) are also listed. These were obtained not by a single measurement but by summing the 1/3 octave band readings from 50 hertz to 10 kilohertz.

The sound pressure data were integrated over a spherical surface 100 feet in radius to obtain calculated sound power levels (PWL) which collapse the spatial sound distribution into single values. The sound power levels in decibels reference to 10^{-13} watt are listed in table IV for each 1/3 octave band and the overall broad band sound power level (OAPWL).

The 1/3 octave band data of table III were also used to compute perceived noise levels (PNDB). The calculation procedure used is outlined in reference 1. The perceived noise levels presented in table V are calculated for both on a 100-foot radius around the engine and on a parallel sideline 100 feet from the engine axis. Some discussion of the data follows.

The radiation pattern of the sound pressure levels measured in only the 4-kilohertz band at 99 percent fan speed shows the distribution and magnitude of the characteristic whine or blade passage tone produced by the fan. At 99 percent of maximum fan speed the discrete blade passage tone was 4260 hertz. It can be seen from the curve figure 3 that with 10^{o} increments between microphone stations four peaks of increasing amplitude were resolved as the survey progressed from the front to the rear of the engine. A very intense peak of 112 decibels occurred at an angle of 130^{o}. This was nearly 20 decibels above the lowest level measured, which was directly in front of the engine. As the survey progressed past the 130^{o} angle, the level of the blade passage tone diminished rapidly to a value of 98 decibels on the 160^{o} azimuth angle.

The radiation pattern of the overall or broad band sound pressure level (OASPL table III) is shown by the middle curve. These sound pressure levels represent those which would be measured by ideal equipment having an absolutely flat frequency response from 50 hertz to 10 kilohertz. The data indicate a nearly uniform sound pressure field of about 110 decibels between 30^{o} and 110^{o}. In this region and also in the front, the broad band noise apparently dominates the noise at the blade passage frequency.

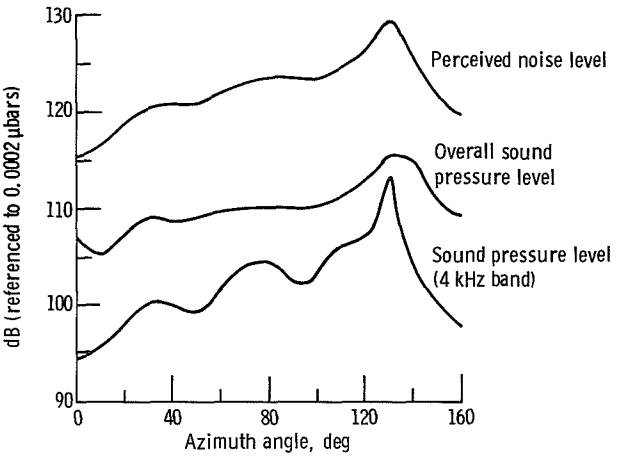


Figure 3. - Sound field around turbofan engine. Core engine nozzle, 143 square inches; fan nozzle, 512 square inches; radius, 100 feet; 99 percent rpm.

However, the blade passage tone at the 130° angle was dominant, as evidenced by a peak of 115 decibels, which is only 3 decibels above the 4-kilohertz level. Observers standing on the 130° azimuth found the intense sound annoying and unpleasant to their ears. The same observers stood about 200 feet directly behind the engine and comfortably communicated at a normal level of speech.

The calculated sound power levels in table IV of both the overall and the 4-kilohertz patterns show that the overall level was about 6 decibels higher than the 4-kilohertz level at 99 percent rpm. Therefore, the sound from the blade passage tone must contribute about 25 percent of the total radiated sound power.

The top curve shows the psycho-acoustic perceived noise level. The data were calculated similar to the overall curve except weighting factors of annoyance degree were applied to each band of the spectrum. The general shape of this pattern is similar to the 4-kilohertz pattern and the general level is about 12 to 15 decibels higher than the overall level. This result is caused by the high weighting applied to the 4-kilohertz band. The human ear is most sensitive to sound pressures in the 2400 to 4800 hertz band, and the spectrum at the 130° angle (fig. 4) shows the sound pressure levels in this band to be very high, about 12 to 13 decibels higher than the broad band level.

It is believed the characteristic tone of a fan is caused by the rotor blades either cutting wakes from inlet guide vanes or generating wakes which are encountered by stationary struts or exit guide vanes downstream from the rotor. This fan does not have inlet guide vanes but it does have a set of exit guide vanes (stators) very close to the rotor (0.3 in.). This arrangement may cause the tone to be stronger from the rear than the front.

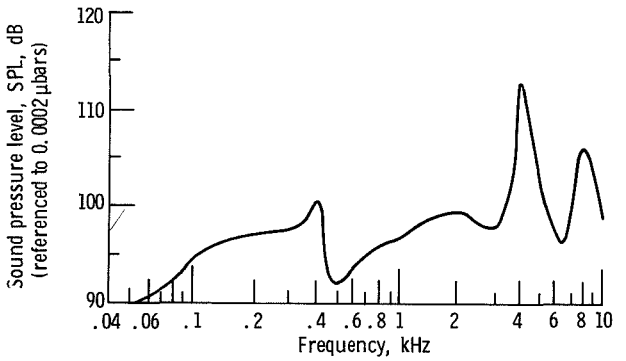


Figure 4. - One-third octave band sound pressure level spectrum. Azimuth angle, 130°; core engine nozzle, 143 square inches; fan nozzle, 512 square inches; 99 percent rpm.

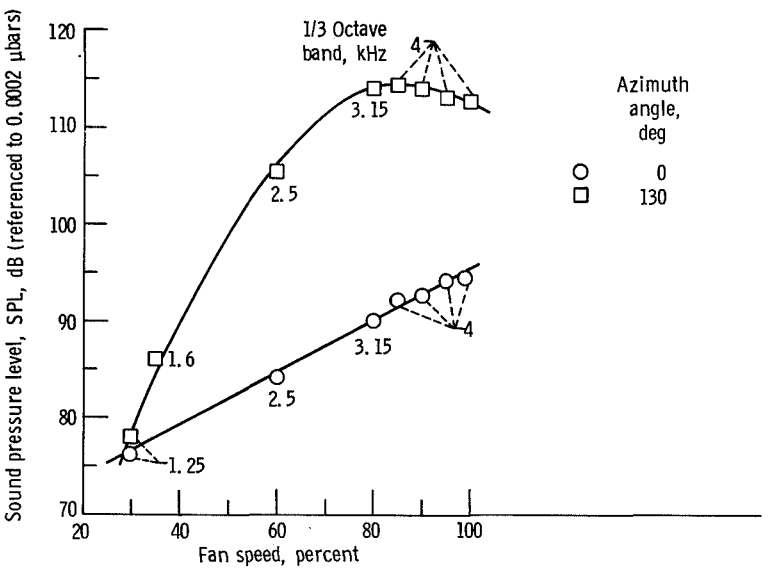


Figure 5. - Effect of fan speed on sound pressure level in 1/3 octave band containing blade passage frequency. Core engine nozzle, 143 square inches; fan nozzle, 512 square inches; radius, 100 feet.

The sound pressure levels measured in the 1/3 octave band containing the fundamental blade passage tone are given in figure 5 as a function of fan speed. A comparison is shown between the sound level directly in front of the engine (0° azimuth) to that in back of the engine (130° azimuth). The discrete tone emanating from the front appears to vary linearly with fan speed and increases only about 18 decibels from idle speed to takeoff speed. The tone from the rear, however, varied about 40 decibels from idle to 85 percent rpm where a peak of about 115 decibels occurred.

Sideline noise patterns are usually used to show how the noise level of a vehicle varies as it approaches and passes a stationary observer. If the vehicle is an airplane,

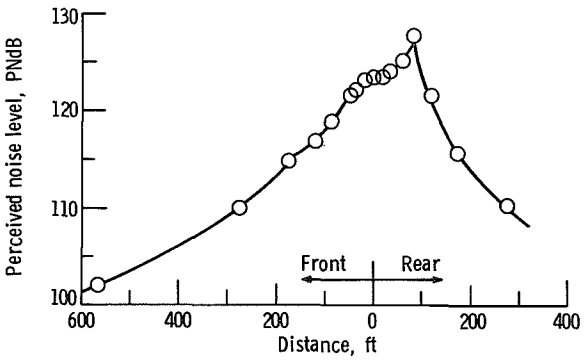


Figure 6. - Sideline noise pattern 100 feet from engine centerline. Core engine nozzle, 143 square inches; fan nozzle, 512 square inches; 99 percent rpm.

the pattern shows the noise created during takeoff, landing, and flyover. The sideline sound calculated in PNDB on a line parallel to and 100 feet from the engine centerline is shown in figure 6. The data contain no correction factors for Doppler shift, viscous dissipation of high frequencies, and humidity. The raw SPL data listed in table III may be extrapolated, and perceived noise levels may be calculated to any sideline distance desired. The engine appears to be loudest after it has passed the observer; however, the noise level falls off very sharply as the engine leaves the observer.

Many investigators have correlated the wide band sound energy from fans and compressors with the rotor tip speed. Smith and House (ref. 2) obtained a sixth power relation with airflow lumped into the correlation. In figure 7 the wideband radiated power level (OAPWL, table III) is plotted against rotor mechanical tip speed in feet per second using the 512-square-inch fan nozzle. A line fitting the equation

$$\text{PWL} = 141 + 34.5 \log \frac{\text{Tip speed}}{325}$$

was faired through the data points. The slope of 3.45 is somewhat lower than the sixth

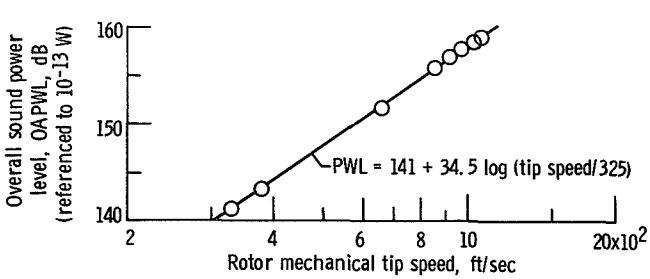


Figure 7. - Total power level radiated by turbofan engine. Core engine nozzle, 143 square inches; fan nozzle, 512 square inches.

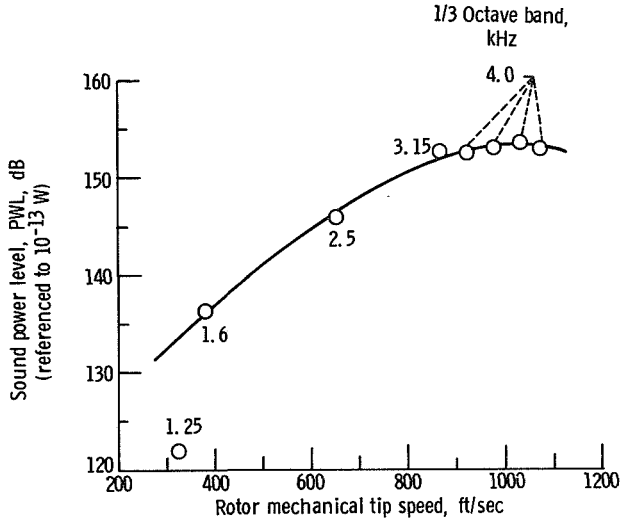


Figure 8. - Power level in 1/3 octave band containing blade passage frequency radiated by turbofan engine. Fan nozzle, 512 square inches.

power slope quoted previously. The data, however, also included the sound produced by the core engine operating with a 143 square inch exhaust nozzle.

The sound power level in the 1/3 octave band containing the fundamental blade passage frequency is related to the fan tip speed in figure 8. The data indicate a peak of 153 decibels at a rotor tip speed of 1050 feet per second which is at or near the local sonic relative tip velocity.

Although the noise of the fan could not be studied completely independently from the core engine, some control over the noise from the two sources was obtained by altering their respective pressure ratios. This was done by independently varying the exhaust areas of both the core engine and the fan.

The effect of changing the fan exhaust restriction is shown in figure 9. The data show the overall sound power levels for each nozzle over a range of fan speeds. Although the data do not indicate a large effect (only 2.5 to 3 dB) of nozzle area on the noise output, a trend of increased sound power with increased blade loading is still indicated.

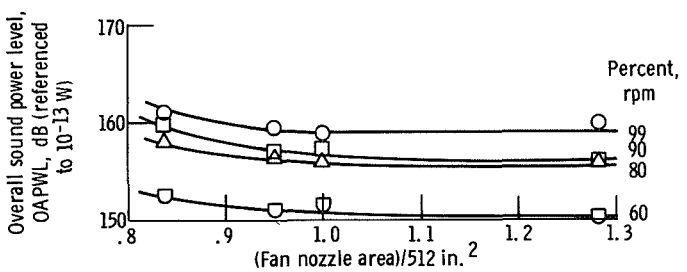


Figure 9. - Effect of fan nozzle area on overall sound power level. Core engine nozzle, 143 square inches.

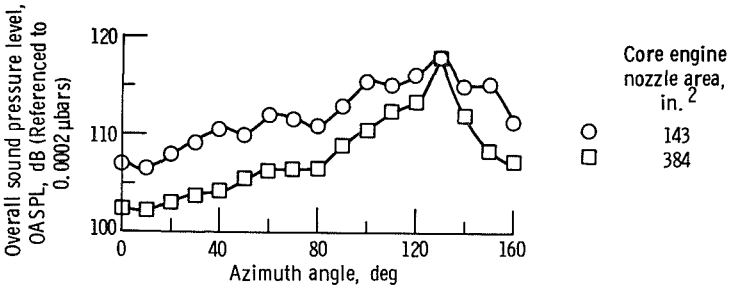


Figure 10. - Effect of core engine nozzle area on sound pattern. Fan nozzle, 429 square inches; 99 percent rpm.

Increasing the nozzle to larger than 512 square inches caused no significant change in noise level.

Figure 10 shows the effect on the sound radiation pattern caused by replacing the core engine exhaust nozzle with a diffuser having an area of 384 square inches. The diffuser on the turbine relieved the back pressure caused by the core engine nozzle and reduced the exhaust velocity to a very low value. The reduction in overall sound pressure at both front and rear of the engine appeared to be significant (about 5 dB), and a sound power reduction of 3 decibels occurred. However, at the 130° angle no significant difference in sound pressure levels was measured. These data indicate that the fan with its blade-passage tone produces the highest sound levels measured.

The plot of the 1/3 octave band power level spectrum given in figure 11 further shows the fan discrete tone to be the dominant sound from the engine. Simply reducing the core engine pressure ratio level reduced all the low frequency tones and significantly reduced the broad band noise; for example, the 630-hertz band dropped 11 decibels. The peak which occurred at 400 hertz and then disappeared when the diffuser was employed remains unexplained. An examination of the data table shows this low fre-

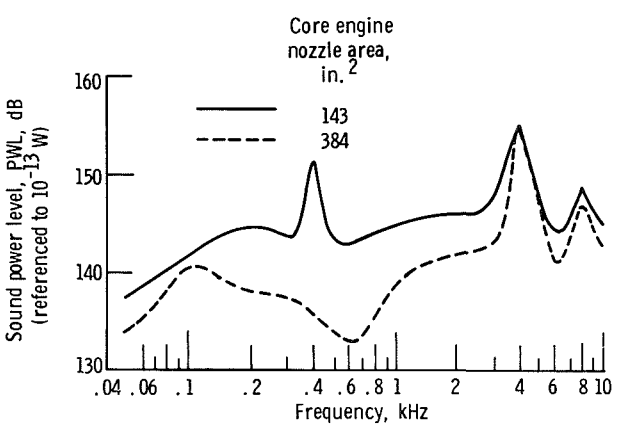


Figure 11. - One-third octave band power level spectra for turbofan engine. Fan nozzle, 429 square inches; 99 percent rpm.

quency spike to vary in frequency with engine speed. A 10-hertz narrow band analysis indicated this spike to be a single discrete tone.

CONCLUDING REMARKS

The sound measurements made on a high-bypass-flow turbofan engine indicated a pronounced discrete tone which was 10 to 12 decibels above the broad band sound levels. This tone was believed to be caused by the aerodynamic interaction between rotating and stationary fan blades. Its frequency corresponds to the frequency of rotor blades passing a stationary point on the engine cowl, the blade passage frequency. At takeoff (100 percent rpm) and landing (65 to 70 percent rpm) speeds this tone has a fundamental frequency in the range of 2 to 4 kilohertz. Since this frequency band is weighted heavily in the calculation of perceived noise levels, the turbofan sound is characterized by a perceived noise level about 12 to 15 decibels above the overall sound pressure level measured.

The sound levels of both the fan and core engine increase with the increased pressure ratios produced by reducing their respective exhaust nozzle areas. Reducing the size of the exhaust nozzles caused the fan or compressor blades to operate at increased angles of attack and higher aerodynamic loading.

Lewis Research Center,
National Aeronautics and Space Administration,
Cleveland, Ohio, October 28, 1969,
126-61.

REFERENCES

1. Anon.: Definitions and Procedures for Computing Perceived Noise Levels of Aircraft Noise. ARP 865, SAE, 1964.

2. Smith, M. J. T.; and House, M. E.: Internally Generated Noise from Gas Turbine Engines. Measurement and Prediction. Paper 66-GT/N-43, ASME, Mar. 1966.

TABLE I. - TURBOFAN ENGINE CHARACTERISTICS

Engine	
Sea level static thrust, lb	4320
Sea level fan speed (100 percent rpm), rpm	6440
Sea level power shaft speed, rpm	15 330
Sea level core engine shaft speed, rpm	18 720
Bypass ratio	6:1
Gear box speed ratio	2.38:1
Fan	
Diameter (leading edge tip), in.	38.5
Number of rotor blades	40
Aspect ratio (bypass section)	2:1
Solidity at rotor tip (bypass section)	1.4
Hub to tip radius ratio (bypass section)	0.61
Pressure rise ratio	1.3
Blade passage frequency (100 percent rpm), Hz	4295
Number of stator blades	51
Solidity of stators (mean radius)	1.67
Aspect ratio of stators	2:1
Spacing between rotor and stators, in.	0.3

TABLE II. - EXHAUST NOZZLE CONFIGURATIONS

Test series	Data table series	Exhaust fan	Core engine nozzle area, $in.^2$
Baseline	A	512	143
Fan pressure ratio	B	487	143
	C	429	143
	D	659	143
Core engine pressure ratio	E	659	384
	F	429	384

TABLE III. - AVERAGE SOUND PRESSURE LEVEL DATA

(a) Series A; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan, rpm, 30 percent of maximum																
50	68.4	69.4	69.4	70.2	69.2	69.2	71.0	70.4	71.8	69.4	72.0	71.0	71.2	72.0	72.2	71.2	71.8
63	70.6	71.2	71.0	71.2	71.6	71.2	72.2	70.8	71.8	71.0	73.6	72.4	72.0	72.2	71.8	72.4	74.0
80	70.8	71.6	72.4	72.6	71.0	70.0	73.8	74.2	71.8	69.4	72.6	73.4	73.0	74.0	74.0	72.8	74.6
100	76.8	76.2	76.0	76.2	76.6	74.2	76.4	75.0	75.8	75.4	78.2	79.6	82.2	84.2	84.6	86.0	86.6
125	76.6	76.6	77.4	76.4	76.2	76.2	75.6	73.6	75.2	76.4	79.2	79.2	81.6	84.0	84.8	86.0	87.2
160	74.2	75.2	75.2	74.8	73.0	73.0	71.4	72.0	75.2	76.0	77.0	77.4	78.4	79.0	79.4	79.4	80.0
200	75.4	76.6	75.6	73.4	72.0	73.2	76.4	76.2	77.6	75.0	75.4	76.4	76.8	77.2	78.2	76.8	79.4
250	75.8	77.4	79.0	80.4	81.0	78.2	76.6	76.2	78.2	72.0	73.4	73.8	74.2	74.4	75.8	70.0	73.2
315	75.2	74.6	72.2	70.6	70.4	70.0	71.6	71.0	71.8	69.0	69.0	69.2	70.2	71.0	73.4	68.2	66.4
400	72.8	72.4	69.6	68.8	70.0	70.2	68.2	67.2	68.0	66.2	64.4	65.4	66.8	66.4	69.4	67.4	65.0
500	73.4	72.6	69.0	68.8	68.8	68.0	68.0	67.2	67.8	64.0	63.2	64.2	65.6	66.4	68.0	65.6	64.4
630	73.6	72.0	69.2	69.8	69.6	69.0	69.2	67.2	66.6	65.2	64.2	65.4	67.2	70.0	68.0	62.4	61.0
800	73.8	70.2	70.2	69.8	69.0	69.2	67.6	65.2	63.6	65.0	66.2	67.4	69.6	71.2	69.2	64.4	61.0
1.00K	70.2	72.2	72.6	71.4	71.4	69.2	69.2	65.2	63.2	66.0	68.2	69.6	71.6	73.0	69.8	64.4	62.8
1.25K	76.2	78.4	78.6	78.0	75.4	75.0	75.0	70.4	68.0	69.2	73.2	74.0	76.0	77.0	74.6	70.6	67.0
1.60K	84.0	85.0	84.6	83.8	82.0	78.2	75.4	71.2	70.8	71.2	75.4	77.6	78.4	78.4	76.8	71.4	69.4
2.00K	79.4	81.4	81.8	81.0	77.8	76.0	75.0	71.6	69.0	73.0	76.0	78.0	79.4	80.4	75.6	69.8	70.0
2.50K	81.2	82.6	82.2	80.2	77.8	74.2	74.0	70.0	68.6	74.0	76.0	78.6	78.4	80.2	75.4	70.4	69.4
3.15K	82.8	84.2	84.2	83.6	80.0	80.0	75.8	71.4	69.2	72.0	74.2	76.6	76.8	78.0	75.0	69.8	68.0
4.00K	90.6	94.6	94.4	95.8	93.4	91.2	87.0	82.6	80.6	82.0	83.0	83.0	82.8	86.4	85.6	81.0	76.8
5.00K	95.2	98.4	92.6	93.0	89.8	87.2	84.6	78.6	77.6	78.4	82.2	86.6	87.2	90.0	87.6	84.6	76.4
6.30K	95.6	96.4	91.6	92.2	87.8	87.2	83.0	76.0	73.8	74.0	77.0	79.8	79.6	79.2	80.4	77.4	75.0
8.00K	86.2	87.4	86.0	84.4	81.6	80.0	78.6	72.4	69.2	71.4	75.0	78.2	77.8	78.4	76.4	73.6	69.2
10.0K	79.8	81.0	81.0	81.0	77.2	77.0	75.0	70.4	68.2	72.4	75.2	78.4	77.4	78.0	76.6	71.4	66.4
OASPL	99.8	102.1	98.9	99.5	96.7	94.8	91.9	87.9	87.5	87.7	89.9	91.9	92.5	94.5	93.6	92.0	91.6
	Fan, rpm, 35 percent of maximum																
50	65.4	68.0	68.2	67.6	67.6	68.0	68.8	68.8	69.4	70.4	69.6	70.4	69.4	70.2	70.2	70.0	71.8
63	67.8	69.0	69.4	68.6	69.0	72.2	71.0	69.4	71.6	72.4	72.2	71.8	72.6	73.0	72.6	72.2	73.2
80	69.6	70.0	71.4	70.8	70.4	71.0	71.2	69.4	70.4	71.8	72.4	72.4	73.4	73.4	74.8	74.6	76.0
100	71.8	72.2	72.4	72.4	72.2	72.0	72.0	70.2	71.4	72.4	74.2	73.6	76.0	77.0	78.0	78.2	79.0
125	82.2	83.0	84.0	83.2	83.0	81.0	82.0	79.8	82.6	84.6	86.4	86.6	88.4	90.0	91.8	92.8	93.2
160	75.0	76.0	76.2	76.0	74.0	73.0	72.6	73.4	75.8	79.8	79.0	77.4	79.0	80.4	81.4	82.4	82.4
200	75.4	75.6	75.0	72.8	71.2	74.2	77.0	76.0	77.2	76.0	76.2	77.4	78.2	79.0	80.4	79.0	80.4
250	76.0	76.0	73.4	71.4	73.2	75.0	73.8	72.4	74.0	72.6	73.0	73.4	75.0	75.4	75.6	72.2	76.8
315	76.0	75.2	72.2	69.8	70.8	71.2	72.0	71.2	72.2	71.0	70.4	70.2	71.2	72.0	74.2	68.6	68.4
400	73.8	72.6	69.0	69.0	71.2	71.0	70.2	69.4	70.2	69.2	66.6	67.0	68.4	68.0	71.8	69.2	67.8
500	73.2	72.0	69.0	69.0	68.8	68.2	69.2	69.0	69.2	64.2	64.4	65.4	66.8	68.2	69.4	66.6	65.4
630	72.6	71.0	70.0	70.6	69.6	70.0	70.2	69.6	68.4	63.4	65.8	66.4	68.4	70.2	69.8	63.0	62.2
800	69.2	69.6	71.4	70.2	70.0	70.0	68.4	67.4	65.8	65.0	68.4	69.0	71.4	73.0	71.0	65.4	61.4
1.00K	67.6	70.2	71.0	69.6	69.0	68.2	67.8	66.2	64.8	66.0	70.2	71.6	73.2	74.4	71.6	64.2	63.6
1.25K	73.2	74.0	74.2	76.2	76.6	77.2	78.6	75.4	75.2	79.4	80.4	80.6	79.0	78.0	75.8	71.4	70.0
1.60K	83.8	80.6	83.0	88.4	87.6	88.2	87.0	85.8	87.0	91.2	93.0	92.2	88.2	86.2	82.6	81.2	81.0
2.00K	81.2	78.0	78.6	86.0	78.2	82.0	81.8	77.4	72.6	76.2	80.2	80.8	80.2	82.4	77.2	71.4	71.2
2.50K	75.6	78.0	76.0	76.0	74.6	74.2	75.4	72.8	73.0	74.4	78.6	80.2	79.4	80.4	76.8	72.0	70.6
3.15K	79.4	82.0	81.6	83.6	82.8	85.0	85.0	83.6	83.6	84.0	87.0	86.2	83.4	83.2	84.4	78.4	78.0
4.00K	82.2	83.0	83.4	87.0	82.2	82.2	80.8	77.6	76.0	74.2	78.2	82.4	82.2	83.2	82.2	78.4	72.8
5.00K	90.6	96.0	91.4	93.8	88.8	90.0	88.0	83.0	79.6	81.2	85.4	88.4	86.6	87.2	85.8	83.0	78.8
6.30K	96.8	102.0	95.2	94.8	91.0	89.0	83.0	80.4	77.2	80.2	83.6	87.6	89.6	92.0	89.4	85.2	77.0
8.00K	86.0	86.2	84.6	85.0	82.6	82.0	79.4	75.8	72.2	75.4	78.6	80.8	80.6	81.0	79.4	77.6	73.0
10.0K	80.4	83.0	81.2	83.6	78.8	79.0	77.0	73.2	70.8	73.4	77.4	80.0	79.4	81.0	78.8	73.2	67.8
OASPL	98.8	103.3	98.0	99.2	95.7	95.7	94.0	91.5	91.5	94.1	96.3	96.8	95.9	97.0	96.2	95.1	94.8

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(a) Continued. Series A; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 60 percent of maximum																
50	72.2	73.0	73.4	72.4	72.2	72.0	72.4	73.2	75.6	73.2	74.4	75.6	76.8	76.4	78.6	77.8	79.0
63	74.2	74.2	76.2	75.2	74.8	74.0	75.6	76.0	76.6	75.4	77.4	77.2	77.8	79.2	80.8	80.4	82.2
80	73.8	74.6	76.4	76.0	75.0	76.2	76.8	77.0	78.0	77.0	78.4	78.0	79.4	81.2	82.6	82.2	83.4
100	75.2	76.0	76.4	75.6	76.0	75.2	76.8	78.0	78.4	79.0	80.2	80.4	82.6	84.2	84.8	85.8	86.0
125	77.6	78.6	79.4	77.2	77.8	77.0	77.8	79.0	80.0	79.4	81.0	81.6	83.2	86.0	87.2	88.2	88.8
160	81.2	82.0	81.2	79.6	79.2	80.2	81.6	82.6	82.0	80.2	81.4	82.2	83.6	85.0	85.6	86.4	87.2
200	98.8	97.6	94.2	94.0	98.6	103.2	102.4	98.8	99.0	97.4	98.2	96.2	96.6	97.4	96.4	94.4	98.8
250	92.2	90.4	88.0	89.2	92.6	98.2	95.2	93.4	92.4	90.2	89.6	88.4	89.2	90.2	90.0	87.4	91.4
315	81.2	81.0	79.4	81.0	81.6	82.0	81.4	82.2	81.4	78.2	78.4	78.4	79.4	81.2	83.0	77.8	79.8
400	78.8	77.2	80.2	83.6	82.8	82.2	83.4	83.2	83.2	79.4	78.0	77.6	78.2	78.4	80.4	78.2	78.2
500	77.4	77.4	81.4	81.6	80.8	82.0	81.6	81.4	81.4	76.0	75.0	74.8	75.4	77.2	76.8	75.6	76.2
630	80.4	80.0	80.0	80.4	81.4	81.2	81.2	80.8	78.6	73.4	76.0	76.0	77.6	79.2	77.4	74.2	74.4
800	79.6	79.0	79.0	80.6	81.0	80.2	80.2	79.0	76.6	74.4	79.2	78.2	79.4	81.2	78.0	75.6	74.2
1.00K	75.4	77.2	79.4	79.2	79.2	79.2	78.8	78.2	76.2	76.2	80.2	81.0	81.2	83.2	79.2	74.6	73.2
1.25K	74.8	76.4	78.0	78.6	78.0	79.0	77.4	77.0	76.2	78.4	82.4	83.2	83.4	84.4	80.2	75.0	74.2
1.60K	74.0	75.2	76.2	76.0	76.2	77.0	76.4	76.0	76.4	80.2	83.4	84.4	84.0	85.0	80.8	74.4	74.2
2.00K	74.8	76.4	78.0	77.2	76.6	77.0	77.6	77.0	77.6	83.0	85.6	86.4	86.6	88.2	84.0	76.4	76.6
2.50K	84.2	88.0	91.2	92.8	91.8	90.0	87.2	93.6	90.4	94.4	101.4	100.8	100.8	105.4	99.6	90.8	91.4
3.15K	90.4	96.0	97.4	98.0	97.2	98.0	91.2	85.4	86.8	87.0	88.4	88.4	88.2	92.2	87.6	83.8	81.8
4.00K	82.6	85.0	85.2	85.6	85.6	84.0	82.6	79.0	77.8	80.0	81.6	81.8	82.0	82.4	80.0	74.6	73.6
5.00K	87.0	90.0	90.0	89.6	97.6	95.2	89.2	87.0	87.4	92.0	91.0	94.6	95.2	95.2	91.2	87.4	84.0
6.30K	85.8	89.2	91.2	89.4	87.6	90.2	86.8	84.2	82.8	85.0	84.4	85.4	85.6	86.2	85.2	79.2	76.4
8.00K	88.2	85.4	90.2	93.0	88.2	89.0	86.6	89.0	89.6	94.0	95.4	95.4	94.8	95.0	91.2	86.4	83.4
10.0K	85.2	84.2	84.2	85.8	92.0	90.2	85.0	84.4	84.6	89.2	92.4	95.8	95.4	97.0	93.4	85.2	80.8
OASPL	101.3	101.8	101.8	102.4	104.1	106.3	104.2	102.0	101.6	102.1	104.9	104.8	104.9	107.6	103.6	99.2	101.4
	Fan rpm, 80 percent of maximum																
50	75.0	77.0	75.6	76.0	75.6	77.0	76.4	77.0	77.6	79.0	79.6	80.4	81.4	82.2	84.4	85.6	86.8
63	76.6	77.4	78.4	77.4	77.2	79.0	78.4	78.6	80.4	80.4	81.2	82.2	83.0	84.0	86.0	86.8	88.6
80	77.8	79.2	80.0	78.8	78.4	80.0	80.6	81.4	82.8	83.2	83.4	84.2	85.0	86.4	88.0	89.2	89.2
100	80.0	81.6	80.6	80.6	81.2	82.0	82.8	83.0	83.8	84.0	85.6	85.2	87.2	89.0	90.2	91.6	91.0
125	80.8	82.2	82.0	81.4	81.8	83.0	83.4	84.6	84.8	85.2	87.2	87.4	88.8	91.0	92.2	93.2	93.0
160	81.4	82.6	82.2	82.2	82.0	84.0	84.6	85.4	86.0	86.0	87.6	88.4	89.8	92.0	92.6	94.4	93.8
200	81.6	82.2	82.6	83.6	84.2	86.0	86.0	86.4	86.4	85.4	86.6	88.0	89.2	91.2	92.0	92.2	92.4
250	94.2	93.0	90.0	95.2	95.6	93.2	93.4	94.4	94.2	91.4	91.6	90.4	89.2	93.2	97.8	92.8	97.0
315	100.2	97.0	94.6	101.2	99.8	98.2	99.2	100.8	99.8	96.4	95.6	93.2	89.8	97.2	103.2	97.0	101.6
400	84.8	86.2	87.2	87.6	87.6	88.0	89.0	88.0	87.2	83.4	82.2	82.6	83.2	85.0	88.6	83.4	84.2
500	87.2	88.2	87.2	87.2	87.6	88.0	87.8	87.8	86.6	81.4	81.6	82.6	82.6	84.2	83.8	81.6	81.6
630	84.0	86.2	88.4	89.4	89.4	90.0	88.8	88.6	86.6	82.4	84.0	84.0	84.4	86.2	84.4	81.4	81.6
800	85.6	86.2	86.4	88.6	89.2	89.0	88.2	87.2	84.2	83.2	85.4	85.8	86.2	87.2	84.6	81.8	79.8
1.00K	83.2	85.0	86.6	88.0	87.8	88.2	87.2	87.8	84.4	85.4	88.4	88.8	88.8	89.4	86.2	81.6	80.4
1.25K	80.4	82.2	85.2	86.4	86.6	88.0	86.2	85.2	84.0	87.4	90.2	90.8	91.2	90.4	87.6	82.2	80.6
1.60K	78.6	80.6	83.2	84.2	84.2	85.2	84.8	84.4	84.0	89.0	91.0	92.2	92.4	92.0	88.0	81.6	80.6
2.00K	78.6	79.6	80.6	82.0	82.0	83.2	84.4	83.8	85.0	89.2	91.2	92.4	92.4	92.0	88.2	82.0	81.4
2.50K	78.6	80.6	81.4	82.4	83.6	85.2	85.4	85.2	88.0	91.2	91.0	91.2	91.4	91.2	85.8	82.0	82.0
3.15K	90.0	90.0	92.6	94.6	96.8	99.0	97.8	100.0	98.0	105.0	101.0	105.0	105.4	114.0	105.8	102.4	97.8
4.00K	95.0	92.4	94.0	93.6	91.6	95.0	91.2	91.6	89.6	94.4	90.4	97.8	95.8	103.8	95.8	93.6	87.6
5.00K	100.8	94.2	89.6	89.0	86.0	88.0	86.4	84.8	83.2	86.2	86.2	88.4	87.4	88.4	85.0	80.0	79.0
6.30K	87.6	89.2	91.0	95.2	97.0	95.2	96.6	93.4	92.6	95.0	97.2	99.2	101.0	99.0	95.8	90.4	87.8
8.00K	91.2	94.2	94.2	101.0	98.8	98.2	102.0	96.6	92.4	93.0	91.6	93.6	94.2	94.2	94.2	88.6	86.2
10.0K	90.0	89.2	91.0	91.6	90.8	92.2	94.0	94.0	94.6	99.0	100.0	100.4	99.2	99.0	95.6	90.6	87.4
OASPL	105.4	103.1	102.7	106.5	105.9	105.9	106.7	106.2	104.9	107.8	106.5	108.7	108.8	115.0	113.1	106.1	105.8

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(a) Continued. Series A; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 85 percent of maximum																
50	77.2	77.0	77.2	77.2	77.0	78.2	78.8	77.4	79.0	78.4	80.2	81.6	82.6	84.4	86.8	87.2	89.6
63	77.6	78.2	79.4	79.0	78.6	80.2	80.0	79.8	81.0	82.0	82.4	83.0	83.8	86.0	88.4	88.6	90.2
80	78.8	79.4	79.4	79.8	80.0	81.0	81.4	81.8	83.0	83.4	84.0	85.2	86.6	88.0	89.8	90.2	91.2
100	81.0	81.6	81.6	81.4	82.4	83.2	83.8	84.0	84.8	85.4	86.2	86.8	88.6	90.2	92.2	92.8	92.8
125	82.6	83.0	83.4	82.8	83.2	85.0	85.2	85.6	86.4	87.2	88.4	88.6	90.0	92.4	94.0	95.0	93.8
160	82.6	83.2	83.0	83.2	83.6	85.2	85.8	86.8	87.6	87.2	88.4	89.6	91.2	93.2	95.0	95.6	94.8
200	83.2	83.4	84.0	84.4	85.8	87.0	87.4	88.0	88.4	87.4	88.4	89.6	91.2	93.2	94.4	94.2	93.6
250	90.2	89.4	88.4	91.4	92.0	92.0	90.8	91.0	90.8	88.0	89.0	88.4	90.0	93.2	95.6	91.8	94.0
315	101.2	99.2	98.6	101.6	101.8	99.2	102.2	102.0	101.4	98.2	96.0	91.6	91.4	99.4	107.2	99.0	105.4
400	88.4	89.2	90.0	90.8	90.8	91.0	91.6	90.4	90.0	85.4	84.2	84.6	85.8	87.4	92.4	86.4	89.2
500	86.6	88.0	88.4	89.0	89.2	90.0	89.8	89.6	88.4	83.2	83.2	83.8	84.4	86.2	85.6	83.4	83.8
630	87.0	88.0	89.6	91.2	91.4	92.0	90.6	90.8	88.8	85.4	87.0	86.4	86.6	88.2	86.0	83.2	84.4
800	87.2	87.6	88.0	90.2	90.8	91.0	90.0	88.8	85.8	85.0	87.0	87.2	88.0	89.2	85.8	83.8	82.8
1.00K	84.0	85.4	88.0	89.4	89.6	91.0	89.2	89.0	85.8	87.2	90.0	90.2	91.0	91.2	87.2	83.0	82.0
1.25K	82.0	84.2	87.4	88.4	88.4	89.2	88.0	87.6	86.0	89.4	92.0	92.4	92.8	93.0	88.4	83.6	83.0
1.60K	79.8	82.0	85.0	86.0	86.0	87.0	86.2	86.4	86.4	90.4	92.6	93.6	93.8	93.4	89.0	84.0	83.2
2.00K	79.2	81.0	82.6	84.0	84.4	84.2	86.6	86.0	87.0	91.4	93.4	94.2	94.6	93.2	88.8	83.4	83.0
2.50K	81.0	82.4	84.4	85.4	86.8	87.2	89.2	88.8	89.6	91.2	92.6	93.0	93.4	93.4	88.0	84.4	85.8
3.15K	87.0	88.6	92.4	93.2	93.6	94.2	94.2	94.2	96.0	97.4	101.6	104.6	104.6	111.4	98.0	93.2	90.6
4.00K	92.2	93.6	98.0	98.2	98.2	97.2	97.4	98.0	98.2	97.2	102.4	106.0	107.0	114.2	103.2	97.4	93.6
5.00K	92.2	89.4	88.6	89.4	88.4	87.0	86.6	86.6	85.2	87.4	89.2	91.0	90.6	92.4	86.8	82.6	80.8
6.30K	85.8	85.6	90.0	91.8	92.4	93.2	91.0	91.2	89.4	93.4	94.2	96.4	98.4	95.4	92.0	87.8	85.0
8.00K	90.0	91.2	96.4	97.8	98.2	99.0	98.4	97.4	94.2	95.2	96.0	97.2	100.2	99.4	96.0	92.0	88.0
10.0K	87.4	90.4	89.4	91.8	94.0	97.2	94.8	95.4	95.2	98.2	99.4	100.2	97.8	99.4	94.8	91.2	88.2
OASPL	103.8	103.1	104.6	106.3	106.6	106.4	106.7	106.6	106.1	106.0	108.2	110.3	110.9	116.6	110.4	105.6	107.6
	Fan rpm, 90 percent of maximum																
50	78.8	79.2	79.4	78.6	78.8	79.0	79.6	80.4	80.4	81.2	81.6	82.6	83.4	86.2	88.4	90.2	91.4
63	78.4	79.0	81.0	79.8	79.8	81.0	81.8	81.4	82.4	83.4	84.0	83.8	85.4	87.4	89.6	90.6	91.4
80	79.6	80.6	82.0	80.6	80.6	82.2	83.4	82.2	84.8	85.2	85.6	86.2	87.4	89.4	91.6	92.4	93.2
100	82.0	83.8	83.6	83.2	83.6	85.0	85.2	84.4	87.2	86.4	87.6	88.6	89.6	92.2	93.8	94.6	94.2
125	84.4	84.8	85.8	84.4	85.0	86.0	87.0	86.8	88.2	88.4	89.4	90.0	91.2	94.0	95.6	96.6	95.4
160	84.0	85.6	85.4	85.4	85.6	87.2	87.2	88.6	89.8	89.0	90.2	90.8	92.4	94.4	95.8	96.8	95.2
200	84.0	84.6	85.2	86.0	87.0	88.0	88.8	89.6	89.8	89.0	90.4	92.0	93.0	95.2	96.2	96.6	95.4
250	88.4	88.6	87.6	89.8	90.6	91.0	90.0	90.6	90.6	88.4	89.0	90.0	91.4	94.2	95.4	92.4	93.8
315	103.2	100.0	101.4	102.8	100.6	103.0	102.6	103.8	102.6	98.0	96.0	93.0	92.0	103.0	109.8	102.6	107.0
400	93.8	92.6	93.4	94.2	93.4	95.2	94.6	94.6	94.0	89.4	87.4	87.0	88.6	93.4	98.8	92.4	95.2
500	86.6	88.4	90.2	91.4	90.8	92.0	91.2	91.2	90.0	84.4	85.0	85.4	85.8	88.2	88.0	86.8	85.2
630	89.6	89.4	91.2	92.2	92.2	93.0	92.8	92.4	90.6	88.0	89.4	88.4	88.6	91.0	88.0	86.6	86.2
800	88.0	88.6	90.2	91.6	92.2	92.0	91.6	91.0	88.2	86.4	89.4	89.4	89.8	91.2	88.2	86.6	84.2
1.00K	85.2	86.6	89.6	91.8	91.8	92.2	91.8	91.8	88.6	89.4	92.2	92.6	92.4	93.2	89.6	86.0	84.2
1.25K	82.8	85.2	89.0	91.2	91.0	91.2	91.0	89.8	88.4	92.0	94.6	95.0	95.2	95.0	91.0	86.2	85.2
1.60K	81.0	84.0	87.2	88.8	88.0	88.2	89.8	88.8	88.6	93.2	95.2	96.0	96.6	96.0	90.8	86.6	84.4
2.00K	80.4	82.2	85.0	86.6	87.2	87.2	89.8	88.8	89.4	94.0	95.4	96.4	96.4	96.2	91.0	86.2	82.2
2.50K	80.6	83.2	85.4	86.8	88.4	89.0	90.8	89.6	90.8	93.4	94.0	95.0	95.2	94.4	90.2	87.2	85.6
3.15K	84.0	86.4	88.4	90.4	90.6	92.0	93.4	93.6	95.6	100.0	101.2	101.8	100.4	102.0	94.0	89.6	90.2
4.00K	92.6	94.2	97.6	99.6	99.6	100.0	100.8	101.0	99.0	103.8	104.4	104.6	106.4	114.4	104.4	99.0	99.0
5.00K	93.6	92.2	89.8	90.8	88.2	88.2	90.2	90.2	88.2	91.0	90.6	92.0	92.6	95.2	90.6	87.4	84.6
6.30K	82.8	85.6	88.4	90.6	88.0	88.2	89.2	89.6	90.0	92.4	93.0	95.2	94.6	94.2	89.4	85.2	82.4
8.00K	91.0	89.6	99.2	101.8	96.6	98.2	99.2	99.2	96.6	97.2	96.6	99.8	102.0	105.2	98.8	93.4	90.4
10.0K	85.6	86.6	89.0	92.2	93.2	93.2	94.6	95.2	95.4	96.2	96.2	97.2	95.8	95.0	91.6	87.2	83.8
OASPL	105.3	103.8	106.2	108.0	106.4	107.7	108.0	108.4	107.3	108.3	108.9	109.6	110.4	115.9	112.4	107.7	109.4

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(a) Concluded. Series A; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 95 percent of maximum																
50	79.0	80.4	80.6	80.2	79.8	81.0	81.2	81.2	81.8	82.2	83.6	84.0	85.6	88.2	90.2	91.6	93.6
63	79.6	80.2	81.2	81.0	80.8	81.2	82.6	83.4	83.8	85.4	86.4	86.4	87.4	89.2	91.8	93.2	94.4
80	80.8	82.0	82.2	82.8	82.8	84.2	84.2	84.2	85.8	86.2	87.2	88.0	88.4	91.0	93.2	94.2	95.0
100	83.4	84.6	85.0	84.8	84.6	86.0	86.6	87.0	87.6	88.0	89.6	89.8	91.0	92.2	95.8	96.4	95.8
125	85.8	86.2	86.2	86.0	86.6	88.0	88.2	88.2	89.8	90.0	91.0	91.6	92.4	95.2	97.0	97.6	96.2
160	85.4	86.6	86.4	87.0	87.0	88.2	89.0	89.6	90.6	90.4	92.2	92.6	93.4	96.2	97.4	98.4	95.6
200	85.4	86.0	87.0	87.6	88.8	90.0	90.8	90.6	91.6	91.2	92.6	93.4	94.4	96.4	97.6	97.6	95.4
250	88.2	88.2	88.0	89.8	90.6	91.0	91.0	90.8	91.6	89.4	91.2	91.8	93.4	96.2	97.0	95.0	94.0
315	102.4	98.6	97.4	100.8	99.0	102.2	102.0	100.6	98.8	97.2	94.0	92.4	95.6	100.4	109.0	103.4	104.4
400	101.0	97.0	97.0	100.2	98.4	103.0	100.8	100.4	98.4	96.0	92.0	90.8	95.2	99.0	108.4	102.4	102.6
500	87.8	90.2	92.0	93.4	93.2	94.0	93.2	92.6	92.2	87.0	86.4	87.2	88.0	91.0	93.4	89.0	87.2
630	90.2	91.4	92.2	93.6	93.8	94.2	93.8	92.6	92.2	89.0	90.0	89.8	90.0	93.0	93.6	88.6	87.8
800	88.0	89.0	91.6	93.6	93.8	95.0	94.4	93.0	92.2	90.0	91.4	91.8	92.8	94.0	93.6	88.6	87.4
1.00K	87.2	88.2	92.2	94.2	94.2	95.0	94.2	93.2	91.2	92.2	94.2	94.6	94.8	96.0	92.0	88.0	86.4
1.25K	84.8	87.0	91.4	92.8	93.0	93.2	92.8	91.8	91.4	94.0	96.4	96.4	96.8	97.4	92.4	88.2	86.4
1.60K	82.8	86.0	90.0	90.6	90.8	90.2	92.0	91.0	91.2	95.2	97.2	98.0	98.4	98.0	92.6	88.4	86.6
2.00K	81.4	84.6	87.6	89.4	89.6	90.2	92.6	90.8	91.4	96.0	98.2	98.4	99.0	98.0	92.6	88.0	86.8
2.50K	82.8	85.4	89.0	90.2	92.4	92.2	93.8	92.0	93.4	94.4	96.6	97.2	97.8	97.2	92.0	89.4	89.0
3.15K	84.4	87.6	89.6	92.2	93.8	93.2	96.2	97.6	100.0	104.0	98.2	98.8	98.4	99.0	93.4	90.8	91.4
4.00K	94.2	95.0	98.4	103.0	98.6	100.0	100.2	101.4	106.0	103.0	107.6	107.0	107.6	113.0	106.4	100.8	100.2
5.00K	88.8	90.2	90.4	91.2	92.2	92.2	92.6	92.0	91.6	91.4	94.6	95.4	97.6	100.4	95.6	92.6	88.0
6.30K	87.2	86.6	88.4	89.8	88.2	89.2	90.8	90.8	92.0	92.4	94.0	95.0	94.0	94.4	89.0	87.0	84.0
8.00K	88.4	89.4	98.0	95.8	95.6	98.2	98.8	97.2	96.4	97.4	99.2	102.0	101.8	108.2	100.6	94.2	91.0
10.0K	84.4	87.4	91.0	94.4	93.6	96.0	97.6	96.8	95.2	95.0	94.4	96.2	95.4	98.0	91.6	89.2	85.8
OASPL	106.1	104.3	106.1	108.5	107.1	109.2	109.1	108.6	109.7	109.5	110.8	111.0	111.5	115.6	114.1	109.8	109.6
	Fan rpm, 99 percent of maximum																
50	81.8	83.0	82.4	82.6	82.0	82.0	81.8	81.4	83.6	83.2	85.0	85.8	86.8	90.0	92.4	94.4	96.6
63	82.2	83.2	82.6	83.2	83.0	83.0	84.0	84.2	85.6	85.4	86.4	87.6	88.2	91.2	94.0	94.4	96.6
80	82.4	84.4	83.4	84.4	84.4	85.2	86.0	85.6	87.0	88.0	88.4	89.8	90.0	92.4	95.2	95.8	96.4
100	85.0	86.0	85.4	86.2	86.8	87.0	87.8	89.0	89.6	89.2	90.6	91.4	92.8	95.0	96.8	97.2	97.0
125	87.4	88.0	88.2	87.4	88.4	89.4	89.6	90.6	91.6	91.0	92.2	92.6	94.0	96.2	98.6	98.8	95.8
160	87.2	88.4	88.2	88.8	89.2	91.0	90.8	92.2	92.4	92.0	93.0	93.2	94.4	96.4	98.4	99.0	95.2
200	87.2	87.6	88.4	89.6	90.2	91.2	92.0	93.2	93.4	92.2	93.6	94.6	95.8	97.2	98.0	98.6	95.0
250	89.2	90.0	89.2	91.0	92.0	93.0	92.2	93.0	93.2	91.4	93.2	93.2	94.8	97.4	98.0	96.2	94.6
315	99.2	97.0	97.0	97.8	97.2	98.0	98.4	98.2	97.8	95.2	92.4	92.4	95.4	100.2	106.2	99.0	100.0
400	104.0	99.0	102.6	104.0	102.2	103.2	102.0	102.2	103.0	101.0	94.6	92.0	100.0	103.2	112.2	107.0	104.2
500	90.6	93.0	94.4	95.4	95.0	96.0	95.2	95.0	93.6	88.2	88.0	88.6	89.8	92.2	92.6	90.6	88.4
630	90.6	92.4	93.0	95.6	95.4	95.2	94.8	95.0	93.0	89.4	90.2	90.6	92.0	94.2	91.6	90.0	87.6
800	89.6	90.6	93.0	95.4	96.4	97.0	96.2	95.8	93.6	93.2	94.2	94.4	94.8	96.2	92.2	90.6	89.4
1.00K	87.8	89.4	94.4	96.2	96.0	96.2	95.8	95.8	92.4	93.4	96.0	96.2	96.6	96.4	92.8	89.6	87.0
1.25K	85.4	88.6	92.6	95.0	94.4	95.0	94.8	94.0	92.8	95.4	98.2	98.4	98.6	98.4	94.0	89.8	88.4
1.60K	84.8	87.6	91.0	92.8	92.0	92.0	93.8	93.4	93.2	97.2	99.4	99.6	100.2	99.0	94.2	89.8	89.0
2.00K	83.6	86.6	89.4	90.6	90.8	91.0	94.0	93.0	94.0	98.0	99.6	100.8	100.4	99.4	94.6	89.8	88.5
2.50K	84.0	87.0	90.0	92.2	94.2	92.2	94.8	93.4	94.8	97.0	98.4	99.0	99.2	98.0	93.8	91.0	91.2
3.15K	85.8	88.4	90.6	93.4	94.8	95.0	98.2	98.4	101.2	101.8	100.2	98.4	98.2	98.0	94.8	92.2	91.8
4.00K	94.4	95.6	97.2	100.4	99.8	99.2	102.4	104.0	104.4	102.6	103.4	106.2	107.2	112.8	104.4	100.6	98.0
5.00K	88.0	91.2	93.4	93.2	92.8	95.0	95.4	95.4	95.4	95.4	95.4	98.0	102.8	103.2	100.8	97.4	93.4
6.30K	90.8	90.4	89.4	90.2	89.6	91.2	91.8	92.8	93.8	94.4	95.0	96.2	95.6	96.2	91.6	88.2	85.2
8.00K	88.0	88.4	94.4	95.4	94.8	96.0	97.2	96.6	97.4	98.2	99.6	101.0	104.0	106.2	100.6	95.4	90.5
10.0K	86.4	88.4	95.4	95.4	94.2	97.2	98.0	95.6	95.6	96.4	96.2	97.2	97.8	99.0	94.6	90.6	87.2
OASPL	106.8	105.2	107.6	109.1	108.5	109.2	109.8	110.0	110.4	110.0	110.3	111.4	112.8	115.7	115.1	111.2	109.4

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(b) Series B; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 60 percent of maximum																
50	71.8	71.0	71.2	71.8	71.2	71.4	72.4	74.0	72.6	74.0	74.0	74.6	74.8	76.2	77.6	78.2	79.8
63	72.6	72.4	73.0	72.8	72.8	74.0	74.0	75.6	75.6	75.6	76.0	77.0	77.0	78.6	79.8	80.0	82.2
80	74.6	74.4	74.6	74.2	74.2	75.8	76.4	75.4	77.0	77.6	77.6	78.8	80.6	81.6	83.0	83.0	84.4
100	76.6	76.4	75.8	75.2	76.6	76.0	77.8	77.2	78.0	79.4	80.0	80.6	81.8	83.6	84.8	85.4	86.6
125	78.6	77.6	77.6	77.0	78.2	76.8	77.8	77.6	78.8	80.0	80.8	81.8	83.2	85.6	87.0	88.2	88.4
160	80.4	80.6	79.6	78.2	78.0	78.8	79.6	81.4	80.6	80.6	81.2	82.4	83.0	85.0	85.8	86.2	87.8
200	95.2	93.6	90.8	91.6	96.2	97.6	95.8	92.6	94.0	94.8	94.2	93.2	92.6	93.2	92.8	91.6	97.6
250	92.6	90.6	87.0	88.6	93.6	95.0	92.8	88.8	91.2	91.6	90.0	89.0	89.4	89.8	90.6	88.8	94.8
315	81.4	80.4	78.4	79.4	80.0	80.2	81.0	82.2	81.2	78.6	78.4	79.2	78.8	80.8	83.2	77.8	80.6
400	77.6	76.8	78.4	80.8	80.4	80.6	82.2	81.2	81.8	78.4	76.8	77.2	76.8	77.6	80.0	76.8	78.2
500	77.6	77.2	80.4	80.6	80.2	81.0	82.0	82.4	81.2	75.6	74.8	75.0	74.4	76.8	76.4	74.8	77.4
630	80.8	79.0	78.6	79.6	80.6	80.8	80.8	80.4	78.4	75.0	74.6	74.6	75.4	77.8	77.0	73.4	74.0
800	80.0	78.4	78.0	80.0	80.6	80.2	80.0	78.6	76.4	75.2	76.4	76.8	78.2	79.6	77.0	74.4	71.4
1.00K	77.2	77.2	78.8	79.0	79.0	79.2	78.8	77.8	74.8	76.8	78.8	80.0	80.6	81.4	77.8	73.0	72.2
1.25K	77.0	76.4	76.4	78.6	78.4	78.6	78.6	77.0	75.2	79.2	81.6	82.8	83.4	83.4	79.8	74.2	73.8
1.60K	75.4	76.0	77.0	77.4	77.2	76.6	77.6	75.4	75.6	80.8	83.8	85.0	85.0	85.0	80.8	74.8	74.6
2.00K	77.0	76.8	76.8	77.2	77.0	76.8	77.6	76.8	77.6	83.6	86.2	87.0	87.2	88.4	85.0	77.4	77.0
2.50K	85.0	87.0	92.0	94.2	91.6	89.0	91.6	92.6	92.0	98.4	101.0	100.8	101.4	105.4	102.4	93.2	91.6
3.15K	88.8	95.8	95.2	99.0	96.0	92.8	89.0	85.6	88.0	86.8	89.0	90.0	88.6	92.2	88.6	85.4	82.0
4.00K	84.8	85.0	83.8	86.2	86.0	87.2	84.0	79.6	78.6	81.4	80.8	81.6	82.6	82.8	80.8	75.8	74.8
5.00K	89.8	90.8	91.6	94.0	97.6	97.6	92.4	90.8	88.2	90.4	90.6	92.2	97.6	98.2	91.2	88.4	85.0
6.30K	87.2	90.0	89.6	90.0	87.4	88.8	88.2	84.4	82.8	84.4	85.0	86.0	86.4	87.4	86.2	79.6	77.8
8.00K	88.4	86.6	90.0	94.0	89.6	90.0	89.6	87.8	89.4	94.6	95.6	95.2	96.2	94.8	94.4	86.4	82.2
10.0K	87.0	83.6	86.4	86.2	89.8	90.0	88.6	84.6	84.6	90.0	92.0	95.2	96.0	95.6	93.2	84.8	81.4
OASPL	100.1	100.7	100.6	103.1	103.4	103.4	101.3	99.2	99.6	102.6	104.0	104.3	105.3	107.5	104.8	99.2	101.4
	Fan rpm, 80 percent of maximum																
50	77.2	76.8	77.0	76.8	76.0	76.6	77.4	76.6	77.6	79.2	79.2	80.4	81.6	83.0	85.0	86.2	87.8
63	78.0	78.2	77.6	78.6	78.6	78.6	79.8	79.0	80.4	81.0	81.2	82.6	83.0	84.8	87.2	87.6	89.4
80	80.2	80.0	79.4	79.2	80.2	80.6	81.4	80.8	82.2	83.0	83.8	84.6	85.2	87.2	89.0	89.8	90.8
100	81.8	81.4	81.6	80.8	81.0	82.4	83.2	82.6	84.2	84.4	85.8	86.4	87.6	89.4	91.2	92.0	92.0
125	83.2	83.0	82.4	81.6	82.2	83.4	83.8	84.2	85.8	87.2	88.0	88.4	89.0	91.2	93.0	94.2	93.6
160	83.2	83.0	82.4	82.0	82.4	83.8	84.8	85.0	86.8	87.0	88.2	89.6	90.6	92.4	94.0	95.0	94.6
200	83.2	82.8	82.8	83.6	84.2	85.0	86.6	85.8	86.8	86.8	87.8	88.6	89.8	91.4	93.4	93.4	93.2
250	93.2	90.4	88.0	91.8	92.4	91.2	91.6	91.4	91.6	90.0	90.4	89.8	89.4	93.4	96.4	92.6	97.6
315	101.2	97.2	95.4	99.6	98.8	97.4	100.0	100.6	99.6	96.6	95.6	93.2	91.4	98.2	104.8	98.0	103.8
400	86.6	86.4	86.6	88.0	88.0	88.6	89.4	87.8	88.2	84.6	83.4	83.4	83.8	85.6	89.6	84.6	86.2
500	89.0	88.2	87.2	87.4	88.2	88.8	88.8	87.2	87.0	82.2	82.4	83.0	82.4	84.4	83.8	82.2	82.6
630	85.8	86.6	88.2	89.6	89.8	90.2	89.6	88.6	87.6	83.8	83.6	84.0	83.8	85.8	83.6	81.6	82.4
800	87.0	85.0	86.8	88.4	89.8	89.8	88.6	87.0	84.8	84.0	84.6	84.8	85.2	86.2	83.8	81.4	80.8
1.00K	84.4	84.2	86.2	88.0	88.2	89.0	88.0	87.6	84.8	85.8	87.8	88.4	88.2	89.0	85.6	81.6	80.4
1.25K	82.0	82.6	84.6	86.4	87.0	88.0	86.8	85.6	84.6	88.2	89.8	90.4	90.8	90.4	86.8	82.4	81.2
1.60K	80.0	80.4	82.8	84.0	84.6	85.0	85.6	84.2	84.8	89.6	91.2	91.6	91.6	91.6	87.6	82.2	81.4
2.00K	79.0	79.8	80.8	81.6	83.2	83.2	84.6	83.0	85.0	90.2	91.2	92.4	92.4	91.6	88.0	82.6	81.6
2.50K	80.0	80.6	81.2	83.0	84.0	84.4	85.8	86.0	88.2	92.0	91.4	91.8	91.6	91.6	87.4	83.4	82.8
3.15K	89.8	92.6	91.8	95.2	95.4	96.8	100.0	99.2	101.4	101.8	105.8	106.8	104.2	114.4	103.6	99.6	96.8
4.00K	94.6	90.0	89.4	93.4	90.6	94.0	93.6	92.2	93.2	94.0	96.0	99.2	99.4	106.0	97.4	93.6	89.2
5.00K	99.0	89.8	90.2	89.0	86.0	87.6	87.0	84.4	84.4	86.4	87.2	88.0	87.4	88.6	85.0	81.0	79.8
6.30K	86.6	88.8	91.8	96.6	94.6	93.8	98.6	93.2	94.6	96.8	96.6	96.4	100.2	100.6	95.8	90.6	89.6
8.00K	93.4	91.8	95.2	103.0	99.2	96.8	103.6	99.6	96.2	94.2	93.4	93.0	94.0	95.6	92.6	88.4	88.4
10.0K	93.2	90.6	92.2	92.2	92.0	94.2	95.2	93.6	95.6	99.4	100.4	100.2	99.0	101.0	95.4	89.4	88.6
OASPL	105.5	102.3	102.6	106.8	105.2	105.0	108.1	106.2	106.4	106.8	108.7	109.4	108.5	115.6	109.4	105.5	107.1

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(b) Concluded. Series B; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 90 percent of maximum																
50	79.4	78.8	79.2	79.2	80.0	79.0	80.0	78.6	80.2	81.8	83.0	83.4	85.4	86.8	89.4	91.2	93.4
63	80.8	79.6	79.8	80.0	80.6	80.8	81.8	80.4	82.2	83.8	83.8	85.6	86.8	88.4	91.4	92.2	94.4
80	81.8	81.0	81.4	80.8	81.4	82.2	83.6	82.6	83.8	86.0	86.2	87.6	89.0	90.6	92.8	93.8	94.8
100	84.4	83.4	83.4	83.0	83.6	84.8	86.0	84.8	86.0	87.8	89.2	89.4	90.4	92.8	95.0	95.4	95.4
125	86.8	85.8	85.4	84.8	85.4	86.4	87.6	87.0	88.2	89.2	89.8	91.0	92.2	94.4	96.2	97.6	96.2
160	85.8	85.4	85.6	85.4	86.0	87.4	88.8	87.6	89.6	89.8	91.0	92.0	93.4	95.2	96.8	98.0	96.2
200	85.6	84.8	85.2	86.2	87.0	88.6	89.6	89.0	90.2	90.2	91.6	92.8	94.0	95.6	97.4	97.4	96.0
250	88.4	87.0	87.0	88.8	89.6	90.0	89.8	89.0	90.2	88.8	90.0	91.4	92.2	94.8	96.6	93.8	94.2
315	100.2	99.0	99.8	100.4	99.8	100.0	101.8	100.8	99.2	97.4	94.6	92.8	95.6	102.0	109.4	103.4	106.4
400	95.0	94.2	95.0	95.4	95.6	96.6	97.8	95.8	95.0	91.8	88.6	88.6	92.4	95.6	102.2	96.2	98.4
500	88.2	89.0	89.8	91.0	91.2	91.8	91.8	90.2	90.0	85.6	85.4	86.2	86.6	88.8	88.8	86.0	85.6
630	91.6	89.2	90.8	92.2	92.8	93.0	92.6	91.2	90.0	88.2	88.4	88.2	88.2	91.0	88.4	85.6	85.4
800	89.8	88.2	89.8	92.4	92.8	93.0	92.4	91.4	88.6	87.6	88.4	89.0	89.2	90.8	88.4	85.8	84.6
1.00K	86.4	86.8	89.2	92.0	92.6	92.8	92.4	92.0	88.0	89.8	91.2	92.0	92.2	92.6	89.6	85.4	83.6
1.25K	84.2	84.6	88.0	90.8	91.2	92.2	91.0	90.2	87.6	91.8	94.0	94.8	94.6	94.2	91.0	86.4	84.8
1.60K	82.0	83.0	86.0	87.8	88.8	90.0	89.8	89.4	88.4	93.4	95.2	96.4	95.8	95.2	91.2	86.6	84.8
2.00K	82.0	82.2	84.0	85.8	87.6	89.0	90.0	89.0	89.0	94.4	95.8	96.8	96.6	95.6	91.6	86.0	85.0
2.50K	82.8	82.6	85.0	86.6	89.4	89.4	91.4	90.6	90.8	93.4	94.4	95.6	95.8	95.0	91.0	86.8	87.2
3.15K	85.6	85.2	87.4	89.4	90.2	90.4	92.8	93.6	95.6	101.4	102.4	102.2	99.4	99.8	94.0	91.2	90.6
4.00K	93.4	92.4	93.6	101.4	98.0	98.4	100.6	100.8	102.0	103.2	103.6	105.2	107.0	114.4	104.4	101.0	100.8
5.00K	91.0	90.8	87.8	96.0	90.8	90.8	90.8	89.2	88.8	91.2	91.4	93.2	93.4	95.4	91.2	87.2	85.8
6.30K	84.0	85.6	88.2	90.4	88.2	88.4	89.0	88.2	89.6	93.4	93.4	95.0	94.2	95.6	89.8	85.4	85.0
8.00K	92.8	91.4	98.0	101.0	96.4	98.6	98.2	99.2	96.0	100.2	99.4	99.6	101.2	106.4	99.0	94.6	91.4
10.0K	86.2	85.8	89.4	92.4	92.4	92.4	94.2	93.8	94.6	96.8	95.6	96.2	96.0	97.4	91.8	87.6	86.4
OASPL	104.3	103.3	105.0	107.8	106.2	106.9	107.9	107.4	107.0	108.8	109.1	109.9	110.6	116.0	112.6	108.8	109.8
	Fan rpm, 99 percent of maximum																
50	82.8	81.6	82.6	82.2	82.0	82.2	83.2	82.6	82.4	84.8	85.2	86.2	87.8	90.2	93.2	94.8	97.4
63	84.4	83.8	83.4	83.0	82.8	83.4	84.6	84.6	84.6	87.2	87.4	88.0	89.0	91.6	94.6	96.2	98.8
80	84.0	84.4	84.4	84.2	84.6	85.2	87.0	87.4	87.2	88.2	89.2	89.6	91.2	93.6	95.4	97.0	97.8
100	86.8	86.4	86.2	86.4	87.0	88.0	88.8	88.8	89.2	90.0	91.4	92.0	92.8	95.2	97.4	98.2	98.0
125	89.6	88.2	88.4	88.6	88.6	89.8	91.0	91.2	91.0	91.8	92.8	92.8	94.2	97.2	98.8	99.6	98.0
160	89.2	88.8	88.8	89.6	89.6	90.8	92.2	92.2	92.6	93.0	93.8	94.2	95.0	97.4	99.0	100.2	97.6
200	89.2	89.0	89.2	90.0	91.0	92.0	93.4	93.6	93.8	94.0	95.4	96.2	97.0	98.0	99.2	99.6	96.8
250	90.8	89.6	89.6	90.8	92.2	92.8	93.0	93.2	93.8	92.8	94.0	94.8	96.2	98.6	99.0	96.4	96.2
315	96.2	95.0	94.8	94.8	95.2	95.4	96.8	96.8	95.8	92.8	91.8	93.2	94.8	98.6	102.2	96.4	98.0
400	101.6	98.6	103.8	101.6	103.4	103.4	104.6	104.4	102.2	98.6	95.2	94.6	100.0	104.6	110.2	105.8	103.4
500	92.4	93.2	95.0	96.0	96.0	96.4	96.6	95.8	94.4	89.2	89.0	90.2	90.6	93.8	93.4	91.0	89.6
630	93.2	93.4	93.6	96.0	96.0	96.2	95.6	95.4	93.2	90.0	90.0	90.6	91.4	93.2	91.6	89.0	88.2
800	91.2	91.0	93.2	96.0	97.4	97.4	97.0	96.8	94.6	93.2	93.4	94.0	95.0	95.6	92.6	90.0	89.4
1.00K	90.0	90.8	94.0	97.0	97.2	97.4	97.4	96.4	92.4	94.0	95.2	96.2	96.4	97.0	93.0	89.6	88.2
1.25K	87.8	88.6	92.4	94.6	95.2	95.6	95.6	94.6	92.8	96.2	98.2	99.2	99.0	98.6	94.8	90.4	89.0
1.60K	86.2	88.0	91.0	92.8	93.2	93.4	94.4	94.2	93.0	97.6	99.8	100.6	100.4	99.8	95.2	90.6	89.6
2.00K	85.2	86.6	88.2	90.6	92.4	93.2	94.2	93.6	93.6	98.0	100.4	101.2	101.0	99.4	95.2	90.6	89.8
2.50K	86.2	85.0	89.8	92.6	94.6	94.0	94.6	93.8	94.6	98.0	98.8	100.0	100.0	98.2	94.0	91.0	91.6
3.15K	87.2	88.2	90.4	92.4	94.8	94.6	98.0	98.4	100.2	105.0	101.0	101.2	100.0	99.8	94.4	92.8	93.4
4.00K	97.0	95.6	101.0	98.2	97.6	99.0	106.6	104.4	101.8	105.4	106.6	108.2	106.8	115.0	106.6	99.0	97.8
5.00K	89.4	92.2	97.0	92.4	92.6	95.0	97.0	96.0	94.0	95.6	97.2	100.4	102.0	105.4	102.2	96.6	93.6
6.30K	97.2	91.0	91.0	90.4	90.0	91.2	92.8	93.0	93.0	95.4	96.2	97.6	96.6	96.4	92.0	88.2	87.6
8.00K	89.8	89.8	96.4	95.2	96.2	94.6	96.4	97.6	102.0	102.2	102.8	102.2	102.2	106.2	99.0	92.8	91.2
10.0K	88.8	89.6	98.0	95.2	94.2	96.4	97.0	95.2	96.2	97.2	97.6	97.8	97.6	99.4	96.0	90.8	88.4
OASPL	106.5	105.1	108.8	108.1	108.9	109.3	111.5	110.7	109.9	111.6	111.8	112.8	112.7	117.2	114.2	110.8	109.8

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(c) Series C; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 60 percent of maximum																
50	75.6	75.4	76.2	76.0	76.6	76.8	76.0	76.8	77.4	74.4	74.6	75.8	76.8	78.0	79.4	82.8	81.0
63	77.2	77.8	77.8	77.4	77.8	77.8	78.2	78.0	77.4	76.6	77.0	77.8	78.4	80.6	80.8	84.2	83.2
80	77.4	78.2	77.8	77.0	78.0	79.8	78.6	78.8	78.8	78.0	79.0	79.6	80.8	81.8	83.2	86.8	84.6
100	77.4	77.4	77.4	77.2	77.8	78.2	78.8	79.0	79.4	79.8	80.6	81.0	83.2	84.2	85.4	88.0	87.2
125	78.8	78.4	78.2	77.6	78.4	78.0	79.0	79.8	80.4	80.8	81.6	81.8	83.8	86.0	88.0	90.6	89.6
160	79.8	79.2	79.4	79.0	79.2	79.2	80.6	80.6	81.2	80.6	81.4	82.0	83.4	85.0	86.6	89.0	88.8
200	87.0	86.4	84.2	84.8	88.8	90.0	89.2	87.4	88.0	89.4	89.0	88.6	89.2	89.2	90.2	91.4	94.0
250	93.4	93.2	89.2	91.2	95.6	96.2	95.6	92.6	94.6	91.6	90.6	90.8	92.0	91.0	94.4	95.0	97.4
315	81.8	80.8	80.4	80.8	82.0	81.0	81.8	81.6	82.4	77.6	77.4	79.0	79.8	80.2	84.2	82.8	81.4
400	77.6	76.8	78.6	80.8	81.2	80.8	81.6	80.8	81.6	76.6	75.4	75.8	76.4	76.8	79.4	79.8	76.0
500	77.8	77.4	81.2	81.6	81.8	81.8	82.8	82.8	81.4	75.8	75.0	75.0	75.4	76.6	76.8	78.0	74.8
630	79.0	79.0	79.4	79.8	81.6	81.6	81.6	80.8	79.0	74.8	75.2	75.4	76.6	78.2	76.2	77.0	72.8
800	80.0	79.2	79.0	80.2	81.4	81.6	81.4	80.4	77.6	75.8	77.0	78.0	79.4	80.4	77.4	77.2	72.6
1.00K	77.8	78.4	79.2	80.0	80.4	79.6	79.8	79.0	77.6	78.0	79.8	80.8	82.8	82.2	78.4	78.6	73.8
1.25K	76.8	77.2	77.4	79.4	79.2	79.4	78.8	78.8	78.2	79.6	82.4	83.4	85.2	84.2	80.8	79.8	75.2
1.60K	75.6	76.4	77.2	78.2	78.6	78.0	78.2	78.2	78.0	81.0	83.8	85.2	86.4	85.2	82.6	80.0	76.2
2.00K	78.2	77.8	78.2	80.0	80.6	79.4	79.0	78.6	79.4	85.8	87.4	87.8	89.2	88.8	86.6	82.8	78.6
2.50K	86.2	89.2	94.6	97.6	100.0	100.0	98.0	92.0	97.2	103.8	104.0	104.0	105.0	104.8	103.0	98.8	92.6
3.15K	90.6	94.6	97.2	95.0	94.0	92.6	90.8	85.8	89.2	90.8	91.0	91.4	93.2	92.8	90.8	88.2	84.0
4.00K	92.4	86.8	86.2	86.4	87.6	86.2	85.0	82.4	81.6	83.2	83.2	86.8	84.6	84.4	82.8	80.2	77.4
5.00K	90.0	88.8	92.6	94.4	98.2	101.8	90.6	86.6	94.0	92.6	94.8	101.2	100.2	98.6	95.0	90.2	87.0
6.30K	88.6	90.4	91.4	90.8	89.0	91.2	88.4	85.2	85.0	85.6	87.0	89.6	89.0	88.0	86.6	82.2	79.2
8.00K	88.6	86.6	91.8	92.2	92.4	90.6	93.0	89.2	91.0	93.4	97.2	96.8	96.8	95.8	91.4	86.2	82.4
10.0K	85.2	85.2	87.0	89.4	88.8	87.6	87.8	85.0	85.0	89.0	92.6	95.0	95.8	96.2	93.4	86.8	81.8
OASPL	99.9	100.1	102.0	102.7	104.6	105.7	102.6	99.0	101.9	105.3	106.1	107.3	107.7	107.3	105.5	102.9	101.5
	Fan rpm, 80 percent of maximum																
50	77.8	77.6	77.0	76.6	77.4	77.4	77.6	78.4	79.4	80.6	81.0	81.2	83.4	85.6	87.4	90.6	90.6
63	77.6	78.2	78.4	78.6	78.8	79.8	80.4	80.8	81.4	82.0	81.8	83.4	85.0	87.0	89.0	91.8	91.6
80	79.6	79.6	79.6	79.8	80.8	81.2	82.0	82.6	83.0	83.4	84.8	85.6	87.2	88.6	90.6	93.2	92.8
100	82.0	82.2	82.0	81.8	82.4	82.4	84.0	84.4	85.0	85.2	86.0	86.6	89.2	90.6	92.8	95.0	94.6
125	83.4	83.0	83.4	83.2	83.6	84.8	85.8	86.8	87.2	87.4	88.2	88.2	90.6	92.8	94.4	96.4	95.4
160	83.4	83.4	83.4	83.0	84.4	85.4	86.4	87.0	88.0	87.2	89.0	90.0	91.2	93.4	95.4	98.6	96.4
200	83.8	83.2	83.4	83.6	85.4	86.4	86.8	87.6	87.6	86.6	88.2	88.8	90.8	92.8	94.8	96.8	95.6
250	89.0	87.2	86.6	88.4	89.8	89.2	89.0	89.4	89.6	86.8	87.6	88.4	89.8	92.6	94.8	93.6	96.2
315	97.4	94.6	96.2	97.2	98.2	97.2	99.0	99.8	99.4	95.2	93.4	92.2	93.4	99.2	106.0	102.6	106.2
400	85.8	86.2	87.6	88.6	89.4	89.4	90.8	89.8	89.6	84.8	83.4	84.0	86.0	87.8	92.6	89.4	89.4
500	88.2	88.2	87.0	87.2	88.4	89.0	90.0	88.4	87.4	81.6	82.0	83.2	84.0	86.2	85.2	85.8	82.6
630	88.0	87.2	87.8	89.8	90.2	90.6	90.8	89.6	88.2	84.2	84.6	83.8	85.4	87.2	85.4	85.4	83.2
800	84.8	86.4	87.4	88.8	90.4	90.0	90.8	88.6	86.2	85.0	85.4	86.0	87.0	87.8	85.4	85.2	82.0
1.00K	84.2	85.4	86.6	88.4	89.2	89.0	89.4	88.8	86.6	86.6	87.8	88.6	89.6	90.0	87.0	85.8	81.6
1.25K	82.4	83.2	85.4	87.2	88.4	88.6	88.8	87.4	86.4	87.8	90.2	90.8	91.8	91.2	88.2	86.0	82.4
1.60K	80.2	81.0	83.2	85.2	86.4	86.4	87.2	87.0	86.6	89.2	91.4	92.2	93.0	92.0	88.6	86.4	83.2
2.00K	80.8	80.6	82.0	84.2	85.6	85.4	87.0	87.2	86.6	90.6	91.8	92.6	93.6	92.6	89.6	87.0	83.2
2.50K	82.2	82.8	84.4	85.8	88.0	87.4	89.0	88.6	90.6	93.2	92.8	93.2	93.4	93.4	90.2	88.0	84.6
3.15K	92.2	90.8	97.6	98.2	99.2	102.4	107.0	97.4	101.4	103.6	108.0	105.6	107.4	115.8	109.0	101.4	96.0
4.00K	95.2	89.8	92.6	95.0	93.6	96.0	96.2	91.8	92.0	96.4	99.2	101.0	101.8	109.6	103.4	97.2	90.2
5.00K	97.4	89.2	90.8	90.2	88.2	89.0	89.6	87.2	87.0	90.4	92.4	93.6	91.4	92.6	88.4	85.2	82.8
6.30K	90.2	89.0	94.4	102.2	95.2	96.8	98.4	94.8	95.0	97.6	103.0	104.8	100.0	96.8	96.0	92.4	90.2
8.00K	91.6	90.0	92.8	107.0	100.4	101.0	104.0	102.6	98.8	95.4	96.4	97.6	96.0	96.0	93.4	90.2	87.8
10.0K	90.8	89.8	89.0	91.8	93.2	97.0	94.0	93.8	96.2	101.2	102.2	101.4	95.6	99.0	97.2	90.8	88.6
OASPL	103.9	101.2	103.7	109.6	106.3	107.7	110.4	107.0	106.8	108.0	111.1	110.6	110.6	117.2	112.5	108.6	108.7

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(c) Concluded. Series C; core engine nozzle area, 143 square inches; fan nozzle area, 512 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 90 percent of maximum																
50	80.2	80.4	80.4	80.0	80.8	80.6	81.6	82.4	82.8	82.8	83.0	84.4	86.2	88.0	91.0	92.6	95.6
63	80.8	81.0	81.2	81.2	82.2	82.0	84.0	83.8	85.2	84.8	85.6	86.2	88.0	90.0	92.8	94.6	96.0
80	82.8	82.2	82.2	82.2	82.8	84.0	84.8	85.2	86.2	86.4	87.4	88.0	90.2	91.8	94.4	95.6	96.8
100	85.0	85.0	84.4	84.4	85.4	86.4	87.2	87.2	88.8	87.6	89.2	90.8	92.4	94.0	96.2	97.0	97.2
125	87.2	86.8	86.6	86.6	87.2	87.6	90.2	89.8	90.6	90.0	90.8	91.4	93.6	95.8	97.8	99.0	98.2
160	87.2	87.0	87.2	86.8	88.4	89.0	90.0	90.6	92.0	90.8	92.0	92.8	94.2	96.0	97.8	100.0	98.0
200	86.4	86.6	87.0	87.4	89.2	90.0	90.8	91.2	92.2	91.0	92.8	93.4	95.0	96.4	98.4	100.2	97.6
250	87.8	87.2	87.2	88.8	90.2	90.4	91.0	90.8	91.8	89.4	90.6	91.4	93.6	95.8	97.2	95.6	96.4
315	93.2	94.2	93.4	94.6	96.4	95.2	96.8	96.6	95.8	94.2	90.6	92.4	95.0	99.2	105.2	103.2	101.6
400	95.2	97.4	97.8	98.6	101.0	100.4	102.0	100.4	101.0	96.8	92.0	90.8	97.4	101.2	107.6	105.4	101.2
500	90.0	90.4	90.6	91.6	92.8	93.0	93.0	92.0	91.6	85.6	86.2	87.2	88.4	90.2	89.8	90.4	85.8
630	88.4	89.4	91.4	92.8	93.8	93.6	93.0	92.0	90.8	87.4	87.8	88.4	90.2	91.2	89.2	89.6	85.8
800	90.0	89.4	90.4	93.2	94.6	94.0	93.8	92.8	91.0	89.6	90.2	90.0	91.8	92.4	89.6	90.0	86.5
1.00K	87.4	87.8	90.4	92.8	93.8	93.8	93.8	93.2	90.4	90.6	91.8	92.8	93.4	93.6	90.8	89.4	86.0
1.25K	87.2	85.8	88.6	91.2	92.6	92.8	93.0	92.2	90.4	92.8	94.0	95.4	96.0	95.0	92.0	90.2	86.6
1.60K	83.2	84.0	87.4	89.6	90.2	90.6	91.8	91.2	91.2	93.6	95.8	96.2	97.2	96.0	92.8	90.4	87.0
2.00K	83.6	83.2	85.4	88.8	89.8	90.2	91.8	91.8	90.8	95.2	96.4	97.2	97.4	96.2	93.2	91.0	87.4
2.50K	84.0	83.6	87.2	90.4	91.6	91.4	93.4	93.8	92.8	95.2	95.8	97.0	97.2	96.2	93.0	91.2	88.8
3.15K	87.0	87.4	89.8	92.2	93.6	92.8	94.8	96.8	98.6	103.2	105.4	104.2	102.8	106.4	97.0	97.2	92.2
4.00K	94.4	93.8	97.2	100.2	101.6	100.6	105.6	108.4	108.0	105.8	105.0	111.6	113.2	116.0	108.8	108.4	104.0
5.00K	92.4	88.6	92.6	92.4	91.2	90.2	92.4	92.8	92.2	93.0	93.2	95.8	97.4	99.6	94.2	93.0	88.6
6.30K	86.4	87.0	90.2	91.2	91.0	90.2	92.6	91.8	93.0	94.6	96.2	96.8	96.8	96.2	91.2	89.8	86.2
8.00K	90.6	90.2	100.8	100.2	100.4	98.8	100.8	98.4	99.4	102.6	103.6	103.6	105.4	105.2	98.8	95.8	93.0
10.0K	86.4	85.4	90.4	93.2	93.2	93.0	95.2	94.6	96.0	98.0	97.8	98.0	96.8	96.2	92.6	88.8	86.8
OASPL	102.9	103.2	106.0	107.2	108.3	107.7	110.0	110.9	110.8	110.6	111.1	113.9	115.1	117.5	113.6	112.9	110.1
	Fan rpm, 99 percent of maximum																
50	83.2	82.6	82.4	82.4	82.6	82.8	83.0	84.2	84.8	84.6	86.2	87.2	88.8	91.0	94.4	97.6	98.8
63	84.0	83.8	83.6	83.6	84.2	84.6	85.8	86.4	87.6	87.0	88.4	89.4	90.8	93.2	96.2	95.6	100.0
80	85.2	85.0	85.2	84.8	85.4	85.6	87.2	87.8	89.0	89.2	90.0	90.8	92.8	94.6	97.6	100.4	100.0
100	87.2	87.2	87.2	86.6	87.4	88.2	89.6	89.6	90.6	90.6	91.6	92.8	94.4	96.4	98.8	102.2	100.0
125	89.6	89.2	89.6	88.8	90.2	90.6	91.4	92.0	92.6	92.4	93.2	93.6	96.0	98.4	100.6	102.0	99.8
160	90.8	90.8	90.8	90.8	92.0	92.2	93.4	93.6	94.8	93.8	95.0	95.2	96.8	98.8	100.6	104.6	99.2
200	90.2	90.6	91.6	91.8	93.6	94.2	94.6	95.4	95.8	94.8	96.4	96.4	97.8	99.6	100.4	102.8	98.6
250	91.2	91.0	91.2	93.0	93.8	94.6	94.4	95.0	95.8	93.8	94.6	95.8	97.6	99.6	100.6	99.4	97.8
315	94.4	93.4	93.0	94.4	95.6	94.8	96.2	96.4	95.8	93.0	92.6	93.8	95.4	98.6	100.8	98.8	97.2
400	100.6	99.4	100.6	100.6	102.4	100.4	104.6	101.0	100.6	96.4	94.4	93.8	99.2	106.2	110.6	111.0	102.6
500	94.4	95.0	96.2	97.0	98.0	97.8	98.0	97.4	95.8	90.8	91.4	92.0	94.4	97.4	97.8	98.2	92.0
630	94.4	94.4	96.0	97.6	98.8	98.2	97.0	97.2	95.2	91.8	92.8	93.4	94.6	96.2	94.6	94.6	90.4
800	94.0	94.2	95.0	97.6	99.4	98.8	98.8	98.4	95.4	95.0	95.6	96.4	97.6	98.0	94.8	95.4	92.0
1.00K	91.8	92.8	95.2	98.6	99.6	99.0	99.6	98.4	95.0	96.2	97.2	97.2	98.6	98.2	95.4	94.8	90.6
1.25K	88.4	89.4	93.2	95.4	97.4	97.0	97.4	97.4	95.8	98.0	99.4	100.0	101.0	99.8	96.6	94.8	91.0
1.60K	86.4	88.0	91.6	94.2	95.4	94.8	96.2	96.4	96.2	99.0	101.2	101.4	101.8	100.4	96.8	94.8	91.2
2.00K	86.0	86.4	89.2	92.4	94.2	94.0	96.0	96.0	95.6	99.8	101.6	102.0	102.4	101.0	97.4	94.8	91.2
2.50K	87.8	87.6	91.2	94.2	96.4	96.0	96.6	96.4	97.4	99.4	101.2	101.8	101.8	100.6	96.8	95.8	93.4
3.15K	88.8	89.4	92.4	95.4	97.8	98.0	101.0	100.6	102.0	106.8	104.2	104.4	103.8	103.0	97.6	96.6	95.2
4.00K	98.4	95.8	96.4	100.6	103.2	100.4	105.0	104.8	103.8	107.4	113.2	111.2	113.2	115.0	106.4	104.6	104.2
5.00K	93.0	93.4	100.4	96.8	95.6	95.2	98.4	97.6	96.2	100.8	102.2	103.2	105.2	109.0	104.4	101.6	96.8
6.30K	96.6	93.0	92.2	93.4	93.0	92.8	94.8	95.6	95.0	97.4	98.4	99.8	95.8	99.8	95.6	92.8	90.0
8.00K	90.0	89.2	94.8	96.0	97.4	96.6	98.0	97.8	99.2	100.8	103.2	104.8	104.0	107.4	100.2	96.8	94.8
10.0K	87.6	88.8	93.6	94.6	95.0	95.0	97.6	95.6	96.6	97.2	98.2	99.8	99.2	102.2	96.8	93.4	89.6
OASPL	106.8	106.0	108.1	109.2	110.7	109.9	112.0	111.2	110.8	113.0	115.7	115.1	116.3	118.2	115.1	115.2	111.6

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(d) Series D; core engine nozzle area, 143 square inches; fan nozzle area, 659 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 60 percent of maximum																
50	71.4	71.4	72.6	72.8	70.2	71.6	70.8	72.0	72.4	74.0	73.0	72.4	73.0	74.6	76.2	79.8	80.0
63	74.6	73.8	73.6	74.2	73.4	73.6	73.4	73.8	74.2	75.0	75.2	74.8	75.0	77.0	78.4	82.6	81.2
80	75.4	75.6	76.2	76.2	74.2	75.4	75.2	74.8	75.0	76.0	76.2	77.0	77.2	79.0	81.0	84.2	82.4
100	76.4	76.0	76.4	76.0	74.4	74.2	73.6	75.8	76.6	77.2	78.8	79.4	80.0	81.2	83.4	85.0	84.4
125	79.2	79.0	78.4	78.0	77.6	78.8	79.4	79.8	79.8	78.8	79.6	80.2	80.8	83.2	84.2	85.8	86.4
160	92.6	91.4	90.4	89.8	85.8	89.0	90.0	91.4	91.4	87.0	87.6	87.6	87.2	89.2	90.4	90.0	92.6
200	97.6	98.0	97.2	94.6	93.6	94.4	95.6	97.6	97.6	95.0	94.4	93.4	94.6	96.8	97.6	98.0	99.0
250	80.2	78.8	78.2	80.4	81.4	81.4	80.0	81.6	81.4	78.6	79.8	79.8	80.2	81.6	82.2	80.4	81.0
315	79.0	78.0	77.8	79.2	79.2	79.2	79.4	80.8	80.8	77.8	76.8	76.6	76.8	77.8	80.8	76.4	77.8
400	76.8	77.2	78.4	80.4	79.6	80.6	80.4	80.6	81.4	76.2	75.2	75.2	75.2	75.4	79.0	75.0	74.8
500	79.4	78.6	78.2	78.8	79.4	80.4	79.0	80.2	80.0	72.8	72.0	72.2	72.6	74.6	72.4	73.4	73.4
630	80.4	78.2	78.0	79.8	80.4	80.8	80.8	81.4	80.0	74.0	72.8	75.2	73.8	76.0	74.8	73.6	70.8
800	76.8	77.6	79.0	79.6	80.2	80.8	80.8	81.0	78.4	75.8	75.8	77.8	78.8	79.2	77.6	75.6	71.4
1.00K	76.8	77.4	78.2	78.6	79.4	80.0	79.4	79.0	75.2	76.8	79.2	80.8	81.2	81.6	77.8	74.4	72.2
1.25K	74.6	76.8	78.2	78.2	78.0	79.0	78.2	78.0	75.4	78.6	81.6	83.0	83.6	83.4	81.6	76.0	74.2
1.60K	73.2	75.4	76.8	76.8	76.6	76.6	76.8	76.4	76.0	79.6	83.2	84.0	84.6	84.2	80.8	77.2	74.8
2.00K	74.0	78.8	78.2	77.2	77.6	77.2	76.8	76.2	77.8	82.0	84.4	85.8	85.8	88.2	83.8	78.2	76.4
2.50K	85.4	89.0	91.0	89.8	90.0	90.8	90.4	86.4	88.8	92.6	97.2	98.6	97.4	104.6	99.8	88.8	86.0
3.15K	91.4	97.0	100.8	97.2	100.6	101.4	90.8	88.2	87.4	85.8	86.6	87.6	86.6	91.0	89.0	87.0	80.6
4.00K	86.4	84.8	84.4	85.4	85.4	85.0	82.6	80.8	79.2	80.8	82.0	83.0	85.0	85.0	84.4	78.8	75.0
5.00K	86.0	87.2	85.6	90.0	96.4	90.6	91.6	92.0	89.4	87.8	91.0	95.8	102.0	102.6	99.4	93.2	88.2
6.30K	87.6	91.4	91.4	90.6	85.2	86.8	87.0	84.2	82.6	82.4	83.4	86.2	88.2	89.0	87.0	82.2	77.8
8.00K	84.8	85.6	90.2	90.4	87.6	88.4	89.0	88.0	89.2	90.2	92.0	93.0	94.8	96.2	94.0	86.2	81.6
10.0K	82.0	82.2	83.8	85.0	86.0	86.8	84.6	83.2	84.2	87.2	90.6	93.2	93.0	93.8	90.6	85.8	79.8
OASPL	100.8	102.3	103.8	101.7	103.5	103.6	100.5	100.9	100.7	99.6	101.7	103.1	105.2	108.0	105.1	101.3	101.1
	Fan rpm, 80 percent of maximum																
50	74.8	76.8	73.8	74.6	74.0	74.8	73.4	76.0	76.6	78.0	77.6	76.8	76.6	79.8	81.6	84.4	84.2
63	77.4	78.4	77.4	77.2	76.8	77.4	77.6	78.2	79.8	79.4	79.2	79.6	79.8	81.6	83.2	86.0	85.0
80	78.4	78.2	78.2	78.6	78.2	80.4	81.8	81.0	81.2	81.4	81.2	80.6	81.4	84.0	86.2	88.6	87.2
100	78.8	79.0	78.2	80.4	79.0	80.8	80.8	82.4	83.2	82.0	83.6	83.4	85.2	86.8	88.0	90.0	89.2
125	80.4	80.0	79.6	79.2	79.8	80.2	81.0	82.8	83.2	83.4	85.2	85.6	86.4	89.0	90.2	91.0	90.6
160	84.0	82.4	82.0	81.2	81.0	82.2	82.6	84.0	84.6	84.2	85.6	85.8	87.4	88.8	90.0	92.0	90.8
200	87.8	86.4	86.0	87.6	88.8	90.4	88.6	90.0	88.8	85.8	86.2	86.4	87.0	88.6	90.2	91.0	91.2
250	101.4	100.4	99.6	100.4	103.4	104.4	100.4	99.4	102.4	95.0	95.6	96.4	91.6	97.8	100.2	96.4	97.0
315	89.2	88.4	86.6	88.0	88.6	88.8	86.8	88.0	88.2	83.6	83.2	84.0	82.6	85.0	86.6	85.2	85.6
400	83.2	83.6	84.2	85.2	85.2	86.0	85.6	86.2	86.2	81.0	80.0	79.6	79.2	79.6	82.2	79.2	79.6
500	85.8	85.2	85.6	86.4	86.2	86.6	86.0	86.8	86.4	79.6	79.0	79.6	78.6	80.8	78.8	78.8	77.6
630	85.8	84.6	84.6	86.6	87.0	87.2	86.0	86.8	85.0	78.6	78.6	79.0	80.0	81.2	79.4	78.8	76.6
800	82.8	83.6	84.8	87.0	87.2	87.8	86.8	87.0	83.6	81.4	83.4	84.0	84.8	84.6	81.6	80.2	77.8
1.00K	82.0	82.2	84.6	87.6	87.8	89.6	89.4	88.8	84.8	86.0	89.0	88.8	88.8	89.2	85.4	82.2	80.0
1.25K	80.2	81.4	83.6	85.2	86.0	86.6	85.2	85.0	84.6	87.4	90.2	90.4	90.4	90.2	86.6	82.8	81.8
1.60K	79.2	79.0	79.6	80.8	81.2	81.0	80.6	82.6	85.0	87.8	90.4	90.8	90.4	90.4	86.6	82.2	82.0
2.00K	77.6	77.8	79.0	81.0	80.8	81.2	82.0	83.2	85.4	87.8	89.8	89.6	90.0	89.6	85.8	82.2	81.4
2.50K	79.4	79.8	80.8	82.6	83.0	84.2	82.4	85.6	87.2	88.2	87.4	87.8	88.4	89.2	85.2	82.6	81.2
3.15K	93.0	92.8	95.6	99.6	97.8	100.2	99.0	103.0	97.6	100.6	101.8	102.0	104.0	113.6	107.8	104.0	95.2
4.00K	95.6	93.2	93.6	97.4	95.0	94.0	93.4	90.8	90.4	92.8	93.6	93.0	95.8	104.2	99.8	97.2	90.0
5.00K	100.0	91.4	90.2	88.6	87.2	87.2	86.2	86.4	85.4	87.4	88.0	88.8	88.6	90.2	87.6	83.0	80.2
6.30K	87.4	88.6	93.0	94.6	92.6	92.6	92.8	93.0	91.8	92.4	94.2	97.4	103.8	108.4	99.0	93.0	87.0
8.00K	93.2	94.0	98.0	103.2	99.2	99.6	101.0	97.4	92.8	91.4	91.8	92.8	94.0	98.0	95.2	89.2	85.8
10.0K	90.6	88.8	89.2	90.2	89.6	91.8	92.6	93.0	93.4	93.6	94.8	97.0	97.6	99.2	96.6	89.6	86.2
OASPL	105.7	103.7	104.6	107.5	106.8	107.8	106.3	106.6	105.5	104.4	105.5	106.3	108.5	115.5	113.2	106.7	102.5

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(d) Concluded. Series D; core engine nozzle area, 143 square inches; fan nozzle area, 659 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 90 percent of maximum																
50	75.8	75.4	74.4	76.0	74.6	76.0	74.4	77.6	78.8	80.6	80.2	80.6	80.4	83.2	85.4	88.2	88.8
63	78.4	79.0	78.0	78.4	78.6	78.6	77.8	80.2	81.6	81.8	81.6	82.6	83.6	85.2	87.8	88.6	89.0
80	79.2	79.4	79.0	79.6	79.2	80.2	78.8	82.0	83.6	82.8	83.6	85.6	85.4	86.6	88.8	90.8	89.6
100	81.4	80.6	80.4	80.8	81.4	82.6	80.6	84.2	84.4	84.6	86.0	87.2	88.4	90.8	91.4	92.8	91.8
125	83.2	82.4	81.2	81.8	82.0	82.8	83.0	85.6	85.6	85.6	87.4	88.2	89.4	91.8	92.0	93.8	92.4
160	84.8	83.2	83.0	83.0	83.4	84.4	83.8	86.0	86.8	86.2	88.4	88.6	89.8	91.2	92.2	94.6	92.6
200	85.0	84.6	84.4	85.0	85.0	86.8	86.8	88.0	87.4	86.4	88.0	88.6	89.2	90.8	91.8	92.8	91.8
250	99.4	97.4	96.6	97.8	97.6	96.6	94.8	97.6	97.4	94.8	93.8	90.4	92.4	96.4	95.8	95.6	98.6
315	102.0	100.2	98.4	99.8	100.0	98.4	97.4	100.6	99.8	97.0	95.0	91.2	92.6	96.8	99.8	96.2	98.6
400	86.2	86.0	86.8	87.6	88.4	88.4	88.8	88.8	88.6	84.2	83.2	83.0	82.2	82.4	84.0	82.6	82.8
500	86.8	86.4	87.4	88.6	88.2	89.0	87.6	89.2	87.8	82.2	81.8	82.0	81.2	83.2	80.8	80.8	80.8
630	87.0	85.8	87.4	89.2	89.4	89.2	89.0	90.2	88.0	82.2	82.4	82.6	84.0	85.2	81.8	80.2	80.0
800	84.6	84.4	86.4	88.8	89.4	89.8	89.4	90.2	86.6	84.2	85.8	86.2	86.6	86.6	82.8	82.8	81.0
1.00K	82.4	82.8	86.6	90.0	90.0	91.4	87.4	91.4	87.0	88.8	90.8	91.6	91.2	90.8	87.0	84.0	82.6
1.25K	81.0	82.6	85.8	89.2	90.2	91.4	87.2	88.4	88.2	91.6	94.0	94.8	94.2	93.2	90.0	85.4	84.6
1.60K	80.0	81.0	81.6	83.2	83.4	84.6	83.4	86.8	88.2	91.4	93.6	94.2	93.6	92.8	89.6	84.4	84.6
2.00K	79.8	78.8	80.4	84.2	83.0	86.0	84.2	85.8	88.2	91.4	93.2	93.4	93.4	92.4	88.0	84.2	84.2
2.50K	81.2	80.0	81.8	85.0	85.0	86.0	86.4	88.2	89.6	91.4	91.6	91.4	90.2	90.2	85.4	83.4	84.2
3.15K	85.8	85.2	86.8	89.0	88.6	89.6	91.4	93.2	94.0	97.2	97.6	99.4	97.0	102.0	95.0	92.0	89.6
4.00K	95.8	94.6	95.2	100.4	96.4	97.4	96.6	101.2	101.4	101.0	104.6	106.0	105.8	114.2	109.4	105.4	101.4
5.00K	89.0	89.4	86.6	95.6	91.8	90.4	89.4	90.0	88.8	90.8	92.6	92.6	93.0	95.8	92.4	87.8	84.2
6.30K	83.6	84.6	87.4	88.2	86.4	87.0	86.4	89.2	90.0	93.4	93.6	96.2	95.0	96.0	90.8	86.8	84.0
8.00K	89.8	91.8	99.6	97.8	96.0	98.2	99.4	98.2	94.8	95.2	96.8	100.2	101.2	104.0	100.6	95.0	90.2
10.0K	87.4	86.2	89.0	93.0	89.6	91.4	93.8	93.6	93.6	94.6	95.2	96.8	96.0	97.0	92.0	88.2	85.8
OASPL	105.4	104.1	104.8	106.6	105.4	105.6	105.2	107.2	106.7	106.5	108.2	109.4	109.2	115.3	111.3	108.0	106.2
	Fan rpm, 99 percent of maximum																
50	78.8	78.6	78.0	79.0	77.4	79.0	79.4	79.6	81.0	81.2	83.2	84.0	84.8	86.8	88.2	90.4	91.2
63	81.4	81.0	80.6	80.6	80.6	81.0	80.8	82.4	83.4	83.6	84.2	85.0	85.8	88.8	88.8	90.8	91.8
80	82.0	81.4	81.0	81.8	80.8	82.6	82.6	85.0	85.4	85.2	86.0	87.0	87.4	90.4	90.6	92.4	92.8
100	82.6	82.4	82.0	82.6	82.8	84.2	84.8	86.0	86.6	86.6	88.2	88.8	89.4	92.4	92.4	94.2	93.6
125	84.8	84.2	83.6	83.2	83.8	85.0	85.8	86.6	87.8	87.8	89.0	89.8	90.6	93.4	94.0	96.0	94.6
160	85.6	84.8	84.8	85.0	84.6	85.4	86.2	87.4	88.6	88.2	90.0	91.0	91.6	93.2	94.0	96.0	94.2
200	86.6	86.0	86.4	87.2	87.2	88.4	88.6	89.4	89.6	88.2	89.4	90.4	91.2	93.0	93.6	95.0	93.4
250	90.0	89.2	88.0	89.4	89.8	90.0	88.6	90.0	91.0	87.6	88.6	89.0	90.2	92.0	92.8	91.4	92.6
315	100.8	100.4	98.6	100.2	100.6	99.4	99.8	101.8	100.4	95.6	92.2	94.0	95.2	100.0	103.6	101.4	102.8
400	89.4	89.4	89.6	91.0	91.4	91.8	91.2	92.0	91.8	86.8	85.4	86.2	86.2	87.6	89.0	86.8	88.4
500	88.8	88.2	88.8	90.4	89.8	90.8	90.2	91.2	90.2	83.6	83.4	83.8	82.8	84.6	82.0	82.6	82.6
630	88.0	87.0	88.4	90.8	91.0	91.4	90.6	91.6	89.8	85.2	84.2	85.6	86.2	87.8	83.6	83.4	82.2
800	85.4	85.2	87.6	90.0	91.4	91.8	91.8	91.4	88.0	86.2	87.8	88.0	89.0	88.6	85.0	84.8	83.2
1.00K	84.4	85.2	87.8	91.8	91.4	92.8	91.2	92.6	88.8	90.6	92.2	92.6	92.8	91.2	88.0	85.6	84.6
1.25K	83.6	85.2	90.2	92.8	92.0	91.6	89.0	91.8	91.2	94.8	96.8	97.0	97.2	96.0	91.8	87.2	87.4
1.60K	81.2	83.8	84.6	86.2	87.0	87.6	86.4	89.4	90.8	94.4	96.2	96.8	96.4	94.4	91.6	87.4	87.0
2.00K	81.0	82.4	83.4	86.4	85.6	87.2	86.0	89.2	91.2	94.4	96.0	96.4	95.8	94.0	89.6	86.8	86.6
2.50K	82.4	83.8	86.2	89.0	88.6	89.6	88.6	91.0	91.8	93.6	94.0	94.2	94.2	93.4	88.2	86.6	86.8
3.15K	86.2	86.6	89.2	91.2	92.0	94.0	95.2	97.0	99.0	100.0	100.2	100.8	98.8	100.0	94.0	91.8	90.8
4.00K	96.8	97.2	101.2	101.2	102.6	103.0	103.6	109.4	105.6	107.6	108.8	110.2	112.6	117.8	114.0	109.2	107.6
5.00K	89.8	89.8	95.4	92.2	94.4	94.6	96.2	97.4	96.4	98.0	98.8	100.4	105.0	112.8	106.2	101.2	98.4
6.30K	88.4	87.2	87.6	88.6	88.4	88.8	91.0	91.6	93.2	95.4	96.2	97.4	96.2	98.0	91.8	88.0	86.2
8.00K	89.8	88.8	97.6	96.4	94.8	95.8	95.8	96.0	97.2	98.4	100.4	103.4	104.0	109.6	101.8	95.6	93.6
10.0K	86.6	88.6	95.8	93.2	93.4	97.2	96.0	95.0	95.4	95.4	96.4	97.6	97.8	103.0	96.8	92.2	88.4
OASPL	104.2	104.1	106.3	106.6	107.2	107.6	107.8	111.4	109.3	10.4	111.4	112.8	114.6	119.8	115.6	111.5	110.3

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(e) Series E; core engine nozzle area, 384 square inches; fan nozzle area, 659 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 60 percent of maximum																
50	77.0	74.4	75.4	75.8	76.2	78.0	80.0	81.0	83.0	85.0	85.0	85.0	86.2	85.6	86.2	87.4	84.0
63	76.8	77.2	77.4	76.4	77.0	78.4	80.8	82.4	83.4	85.6	87.0	88.2	87.0	85.8	84.8	86.4	86.0
80	79.6	79.0	79.6	79.0	80.2	82.4	81.6	82.4	83.6	85.2	86.4	87.8	87.2	86.0	86.0	87.0	85.0
100	81.8	82.0	82.2	80.4	81.4	82.6	82.4	83.4	82.6	85.0	88.4	87.8	87.4	87.2	87.0	87.8	87.0
125	81.6	80.4	80.2	79.2	79.4	80.0	81.0	81.6	81.0	84.0	87.2	85.6	86.4	85.0	85.8	86.8	86.2
160	80.0	79.4	79.2	78.0	78.0	79.8	79.8	83.8	80.8	81.8	86.0	84.6	83.4	82.2	83.0	84.0	83.6
200	77.4	76.0	75.6	78.2	76.8	79.2	78.8	84.4	79.2	80.6	80.6	81.6	81.8	82.2	82.2	82.6	82.0
250	77.4	76.0	76.0	79.4	80.6	80.2	79.0	80.2	79.6	79.6	82.0	81.8	82.2	83.4	84.2	80.6	81.4
315	78.4	76.8	76.6	80.0	79.4	78.6	79.0	79.6	79.6	79.6	80.2	80.8	81.2	81.6	83.2	79.2	78.8
400	78.2	75.8	77.0	78.4	78.2	79.2	78.8	79.2	79.2	75.8	76.4	78.2	78.2	78.2	79.0	77.0	72.4
500	77.8	76.0	76.0	77.2	77.4	77.8	76.8	77.4	75.0	72.2	72.6	74.0	74.8	73.4	73.0	70.6	71.2
630	77.4	76.8	78.4	78.8	78.2	77.2	78.2	77.8	75.0	72.4	71.0	71.4	73.8	73.6	71.6	70.2	70.2
800	75.4	77.6	77.2	77.4	77.4	78.2	77.0	76.8	75.0	72.4	73.0	75.8	77.8	80.0	76.8	71.8	69.4
1.00K	75.0	75.2	77.2	76.6	76.4	77.4	76.0	76.4	72.0	72.8	76.0	79.2	82.4	83.8	79.4	73.2	71.8
1.25K	73.6	73.8	75.2	75.0	76.2	76.0	75.8	74.2	71.2	74.6	78.4	82.6	85.2	86.4	82.2	75.4	73.4
1.60K	73.4	75.0	74.8	74.6	75.8	75.6	74.6	73.6	72.6	75.4	80.4	83.4	86.4	87.6	83.0	76.0	73.6
2.00K	76.6	77.2	77.4	76.8	77.2	76.8	76.2	75.8	75.8	80.0	83.6	87.0	87.4	90.4	85.0	77.2	74.4
2.50K	84.2	86.6	89.2	88.8	90.2	91.0	91.2	88.0	91.4	95.4	100.0	104.0	100.2	105.2	99.4	87.0	87.8
3.15K	90.4	92.2	98.6	96.0	94.8	98.8	87.4	87.6	87.4	83.6	86.2	90.0	87.0	90.4	88.6	85.4	81.4
4.00K	87.8	84.6	85.4	84.2	84.4	84.8	82.0	79.6	78.2	79.8	82.0	85.0	85.8	88.0	87.0	79.6	75.6
5.00K	85.8	84.6	86.4	88.0	88.6	92.8	93.2	89.4	92.4	89.6	93.6	98.8	99.0	101.2	99.6	91.8	86.2
6.30K	85.6	91.6	89.8	89.0	85.2	86.0	85.8	81.6	80.0	80.4	83.2	86.6	88.4	89.6	88.8	80.0	76.6
8.00K	85.8	87.0	89.6	87.0	86.8	87.8	91.0	85.6	84.6	83.8	86.6	91.8	93.2	96.0	95.0	85.0	80.8
10.0K	82.4	81.8	84.0	82.6	86.0	84.8	84.2	80.4	79.6	82.4	84.0	88.4	91.8	92.6	91.0	83.4	78.6
OASPL	96.4	97.6	100.8	99.1	98.7	101.4	98.7	96.7	97.6	98.8	102.4	106.1	104.5	107.8	104.5	98.1	96.1
	Fan rpm, 80 percent of maximum																
50	76.2	74.2	75.0	74.8	75.2	75.2	77.0	80.4	82.4	87.6	87.6	88.2	89.0	89.2	88.4	88.4	87.6
63	78.6	76.2	78.2	77.8	77.8	79.6	79.8	81.8	81.8	85.8	87.2	87.4	88.4	90.0	88.2	88.0	88.4
80	80.8	80.4	81.6	80.6	81.2	82.8	82.2	83.0	83.8	84.4	86.0	87.4	88.0	90.6	89.6	89.4	88.6
100	84.2	85.0	84.4	83.4	83.6	84.8	84.6	85.2	85.2	85.0	87.0	88.0	89.0	90.6	90.2	90.6	89.2
125	84.6	84.2	83.4	83.2	83.0	84.0	83.4	84.2	84.2	85.2	85.8	86.6	87.2	89.0	89.0	90.0	88.8
160	83.2	82.0	81.2	79.8	81.0	83.4	82.4	83.2	84.2	83.8	84.6	85.0	86.2	86.8	86.4	87.6	87.2
200	82.4	81.8	81.4	81.6	81.8	83.8	83.8	83.8	84.0	83.4	83.4	84.2	84.6	85.8	85.4	85.6	86.2
250	82.0	81.0	80.0	81.4	83.0	83.8	83.0	83.4	83.4	82.0	82.8	84.6	84.8	86.4	85.8	81.8	84.0
315	83.6	82.4	80.2	82.6	83.0	82.6	82.8	83.2	83.6	82.0	83.2	84.2	83.6	85.0	85.6	80.0	82.2
400	83.4	80.8	82.0	83.4	83.0	83.4	82.4	82.4	83.4	79.4	81.0	81.8	80.8	81.2	82.6	78.2	79.0
500	84.4	82.4	82.6	82.0	82.6	82.2	81.0	81.2	81.4	77.0	77.8	78.4	77.8	78.8	76.8	74.4	73.6
630	80.8	80.2	81.4	81.6	81.2	81.6	81.8	82.0	80.6	77.4	77.4	77.4	78.0	77.8	74.6	74.0	73.4
800	79.0	79.4	80.6	80.8	81.6	83.0	82.0	81.0	79.0	77.2	78.6	80.6	82.8	84.4	78.6	76.6	73.6
1.00K	78.0	78.0	79.0	79.8	80.4	82.8	82.8	82.4	78.4	79.4	83.4	85.6	86.8	88.0	82.8	78.6	78.6
1.25K	77.6	77.2	79.0	78.6	80.0	82.6	83.0	81.4	78.4	81.0	84.2	87.6	89.4	90.6	84.4	80.8	78.8
1.60K	77.0	76.4	77.6	78.0	79.0	81.4	80.4	79.8	79.0	82.2	85.4	88.4	90.8	91.0	85.4	81.0	79.4
2.00K	76.6	76.6	78.2	78.6	79.4	80.6	79.4	78.8	80.2	83.0	86.4	88.8	90.4	90.8	84.6	80.4	78.2
2.50K	79.4	78.8	79.0	80.4	81.8	83.2	82.8	82.6	84.4	86.4	88.8	89.2	89.0	90.6	84.8	81.2	79.4
3.15K	93.0	91.8	92.8	93.6	95.8	97.2	96.2	99.4	95.8	99.2	103.2	102.6	103.6	114.8	107.0	104.4	98.4
4.00K	94.4	92.4	92.0	96.8	91.6	91.8	92.0	91.4	88.6	92.0	94.8	94.2	94.8	103.6	100.0	97.0	91.0
5.00K	98.2	90.8	89.2	86.2	86.4	86.2	84.2	83.6	85.0	86.8	87.4	89.2	90.8	90.8	87.4	82.0	79.6
6.30K	86.6	87.0	92.0	91.8	91.6	92.4	93.2	93.8	91.0	92.8	94.4	97.4	103.6	108.2	96.6	90.8	86.4
8.00K	91.0	90.2	94.8	98.0	95.8	97.8	98.8	99.6	93.8	92.6	90.8	92.4	96.0	97.0	93.2	87.2	85.4
10.0K	88.4	87.0	88.8	88.0	86.8	87.6	88.8	87.8	89.6	90.8	92.4	94.0	97.8	99.4	95.8	88.0	84.8
OASPL	102.1	99.4	100.7	102.6	101.4	102.7	102.9	104.1	101.0	102.8	105.5	105.9	108.4	116.2	108.9	106.2	101.7

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(e) Concluded. Series E; core engine nozzle area, 384 square inches; fan nozzle area, 659 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 90 percent of maximum																
50	80.0	77.8	78.4	78.6	77.8	79.0	80.4	82.8	84.0	84.4	85.8	86.0	85.6	85.8	86.4	86.6	86.4
63	81.2	80.0	80.2	79.4	79.2	81.8	81.2	83.6	84.2	84.8	87.0	87.0	85.8	86.6	87.4	88.0	87.6
80	81.8	81.4	81.8	82.4	81.6	82.6	83.2	84.4	85.4	88.8	89.0	88.8	88.2	87.8	90.8	89.8	89.8
100	85.6	85.6	85.8	84.6	85.2	86.2	86.4	86.6	86.8	88.0	89.0	90.8	90.6	91.4	92.6	92.8	91.6
125	86.0	85.4	84.2	84.6	84.6	85.4	85.4	86.0	86.0	87.4	89.0	89.0	89.8	90.0	90.8	91.2	91.0
160	83.8	82.6	82.8	81.8	82.0	84.2	83.2	85.6	85.6	85.4	86.8	87.0	88.2	88.6	88.4	88.8	88.8
200	84.2	83.2	83.2	83.2	83.6	86.0	85.6	85.6	85.6	84.4	85.6	86.2	86.6	87.6	87.2	86.0	86.8
250	83.2	82.8	81.2	83.2	84.4	85.8	84.6	85.0	85.4	84.0	85.4	86.2	86.4	88.4	87.6	83.2	86.0
315	84.6	83.2	81.6	84.2	84.0	83.4	83.8	85.2	85.2	83.8	83.8	86.2	85.0	86.6	86.8	80.8	84.2
400	83.4	80.6	82.2	83.6	83.6	84.6	83.6	84.2	84.4	82.0	82.4	84.0	83.0	83.4	83.2	80.2	79.8
500	83.2	81.4	83.6	83.6	83.0	84.0	83.2	83.4	83.2	80.2	80.2	80.2	80.0	80.6	79.2	78.6	75.8
630	82.2	81.4	82.8	82.4	83.0	84.0	84.2	84.0	84.2	80.0	79.4	79.8	80.6	81.4	77.8	76.6	75.8
800	79.0	78.8	81.2	82.4	83.0	85.2	83.8	83.0	81.6	79.8	80.2	82.4	84.6	86.4	80.8	76.8	76.2
1.00K	78.6	77.4	79.8	81.4	81.6	84.0	83.8	83.6	80.8	80.4	83.4	86.6	88.2	89.6	83.4	78.8	78.6
1.25K	77.8	77.8	80.2	80.4	81.6	84.2	84.0	84.0	81.2	84.6	86.4	90.4	91.6	92.2	85.6	82.4	80.8
1.60K	78.6	77.8	79.6	79.8	81.0	84.0	83.6	83.8	82.0	85.2	88.4	91.4	92.8	92.8	86.8	82.8	81.4
2.00K	78.0	78.2	79.2	80.4	81.0	83.4	82.4	82.0	83.4	86.4	89.0	91.6	92.2	92.4	85.8	82.2	80.6
2.50K	79.6	78.6	81.2	82.4	82.4	84.2	85.2	84.8	86.4	88.6	89.6	91.2	91.2	90.6	84.8	82.6	81.4
3.15K	85.2	85.8	86.8	87.6	88.8	89.2	90.8	90.4	93.0	96.8	99.2	102.0	100.0	100.8	96.2	91.8	89.0
4.00K	94.6	94.6	96.6	96.8	98.8	97.6	100.0	99.0	99.8	99.2	102.2	106.6	104.0	113.0	109.6	105.0	100.0
5.00K	88.2	85.8	85.6	88.6	88.0	86.6	89.4	87.2	87.8	89.6	90.8	92.6	92.8	95.2	91.6	86.8	83.4
6.30K	82.8	83.6	86.2	85.6	85.4	85.4	86.0	86.8	89.0	91.6	93.4	95.6	96.0	95.8	90.4	85.0	82.8
8.00K	89.8	88.4	96.2	94.6	92.8	96.0	99.2	95.0	93.0	93.0	95.4	100.4	101.8	105.6	98.8	92.8	88.6
10.0K	83.4	83.4	86.8	85.6	84.8	86.4	89.6	87.6	89.4	91.4	93.8	95.2	95.4	94.8	91.6	85.2	83.4
OASPL	99.3	98.7	101.3	101.1	101.7	102.2	104.2	102.7	103.2	103.9	106.3	109.7	108.6	114.4	110.7	106.4	102.9
	Fan rpm, 99 percent of maximum																
50	79.6	78.0	78.6	78.0	78.0	79.2	79.8	80.0	80.2	82.8	83.8	85.0	86.0	87.0	88.2	87.6	87.2
63	82.6	81.6	81.2	81.0	79.8	81.2	81.2	82.2	82.8	84.0	84.2	87.0	88.2	88.2	89.4	89.0	88.8
80	85.2	84.2	83.6	85.2	84.4	84.2	85.2	86.2	87.0	84.8	85.4	87.8	88.6	90.8	91.2	91.4	90.6
100	86.6	86.6	86.8	86.2	86.6	87.8	87.4	88.2	88.4	88.2	89.8	90.8	92.8	93.0	93.8	94.0	92.2
125	87.8	86.2	85.6	86.2	85.6	87.2	86.4	88.4	87.6	87.8	89.4	90.2	90.6	92.2	93.2	93.8	92.2
160	86.0	85.0	84.8	84.2	84.0	86.0	85.4	86.2	87.2	86.8	87.8	88.6	88.8	89.6	90.2	91.0	90.0
200	86.0	85.0	84.6	84.8	85.2	87.0	87.2	86.8	87.2	86.0	87.8	88.2	88.6	89.0	88.6	88.0	88.0
250	85.6	84.0	83.8	85.6	86.8	86.6	86.0	87.2	86.8	85.4	86.8	88.2	89.0	90.2	89.0	84.8	86.8
315	86.0	84.4	83.4	85.6	85.0	85.0	85.4	86.8	86.4	84.8	84.8	87.0	87.6	88.6	88.4	81.8	85.0
400	85.0	82.6	83.6	85.0	84.6	85.6	85.2	86.8	85.6	83.0	83.6	85.2	85.0	84.8	85.2	80.4	82.0
500	84.6	82.0	84.0	84.6	84.6	85.2	84.8	85.8	85.0	80.6	81.2	83.6	82.2	83.2	78.6	77.6	79.8
630	83.6	81.8	83.0	84.0	83.4	85.2	85.2	86.2	84.4	80.8	79.8	79.0	82.6	82.6	78.0	77.4	76.8
800	81.4	80.2	82.4	83.0	84.4	86.6	85.4	86.2	84.6	81.6	82.4	85.0	86.8	88.0	82.6	78.2	77.8
1.00K	79.0	77.6	81.2	83.0	83.0	84.8	84.8	85.6	82.4	81.6	85.2	88.8	90.6	91.0	84.4	81.8	80.4
1.25K	79.4	79.4	82.2	82.8	83.6	85.8	85.2	86.6	82.6	86.0	89.0	92.2	94.2	93.6	87.6	84.0	81.8
1.60K	79.4	78.6	81.2	81.6	83.6	87.0	86.4	86.6	84.8	87.6	90.2	93.8	94.8	94.0	88.6	84.8	83.4
2.00K	79.6	79.4	81.0	82.2	83.8	86.2	85.6	85.8	86.4	89.0	91.2	94.0	95.2	93.6	87.8	84.8	83.4
2.50K	82.2	80.4	82.0	83.8	84.4	86.8	87.2	87.4	88.0	89.8	91.2	93.0	94.2	91.8	86.6	84.2	83.8
3.15K	86.4	85.4	87.2	88.4	88.8	92.0	93.8	94.8	96.4	98.0	98.8	99.2	98.0	97.8	94.0	90.8	89.4
4.00K	97.4	96.4	102.6	103.2	101.2	104.0	108.0	107.0	106.4	106.0	107.6	108.8	111.8	116.6	114.0	109.6	107.6
5.00K	90.8	93.2	95.0	92.8	93.8	94.4	96.0	97.0	97.6	98.0	98.2	100.6	103.2	108.0	106.0	101.8	98.0
6.30K	85.8	84.6	87.0	87.0	86.2	86.4	89.8	90.6	91.8	93.0	94.8	96.6	96.2	96.0	91.8	86.8	85.4
8.00K	88.0	87.4	94.2	93.8	93.8	92.8	95.4	94.2	96.0	97.6	98.8	101.0	104.6	106.0	103.0	94.8	92.4
10.0K	85.8	88.2	90.8	93.6	93.2	93.0	92.8	92.2	92.8	92.6	94.2	95.6	97.4	98.4	96.4	90.2	86.8
OASPL	101.2	100.7	104.8	105.2	104.2	106.1	109.2	108.5	108.3	108.4	109.8	111.2	113.8	117.8	115.2	110.9	108.9

TABLE III. - Continued. AVERAGE SOUND PRESSURE LEVEL DATA

(f) Series F; core engine nozzle area, 384 square inches; fan nozzle area, 429 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 60 percent of maximum																
50	72.2	72.6	72.4	72.0	71.8	72.6	72.8	72.8	73.8	74.0	74.2	75.0	74.6	76.2	75.0	77.0	76.8
63	74.4	74.8	75.0	74.6	74.4	75.4	75.4	75.8	76.8	77.2	77.8	78.2	77.4	79.0	79.2	79.2	81.2
80	77.2	77.0	77.4	78.8	77.6	78.0	79.6	79.4	80.2	79.8	80.2	80.8	81.8	82.8	83.0	83.0	82.8
100	80.6	81.4	80.8	80.0	80.2	81.2	81.4	81.0	81.4	81.2	83.4	84.6	86.0	86.8	86.4	86.6	86.0
125	80.6	80.4	79.0	78.6	78.0	79.4	79.4	78.8	80.2	81.6	83.2	83.6	84.0	84.8	84.2	84.8	84.6
160	77.6	77.4	77.2	75.4	76.2	76.8	77.4	78.0	79.4	79.6	80.6	81.2	81.0	81.2	80.8	80.2	81.2
200	77.8	76.2	75.8	76.0	76.6	78.8	79.2	78.6	78.8	78.0	79.0	79.8	79.4	80.0	81.2	78.8	79.6
250	78.2	77.0	77.4	78.6	80.6	80.0	79.0	79.6	79.8	78.8	80.2	80.4	81.2	83.0	83.2	78.8	80.4
315	79.4	77.4	78.0	79.6	78.6	78.0	79.0	79.0	79.8	79.0	79.4	80.8	80.6	81.4	82.8	76.6	78.6
400	76.8	73.8	76.0	78.0	77.0	78.2	78.4	77.8	79.0	76.8	77.6	79.0	79.0	78.6	79.6	76.8	74.4
500	76.0	74.4	77.8	77.4	77.8	78.0	77.0	76.2	76.0	72.2	73.0	72.8	73.0	73.4	71.4	70.6	70.4
630	77.8	78.0	78.0	79.2	79.2	77.6	76.6	76.2	76.2	71.0	70.8	72.0	74.4	75.0	70.8	70.4	69.6
800	77.2	77.0	77.2	78.2	77.2	76.6	76.2	75.8	75.6	73.2	75.2	76.6	78.6	80.8	75.2	71.2	69.4
1.00K	75.0	75.4	75.4	75.4	75.2	76.6	76.4	74.8	74.2	73.0	76.8	79.6	81.8	83.6	77.0	72.8	71.2
1.25K	74.4	73.6	73.6	74.2	75.2	76.2	75.6	75.4	75.4	76.6	79.6	82.6	85.2	86.2	79.6	75.0	73.4
1.60K	73.8	73.8	74.2	75.2	75.0	76.2	75.4	75.8	76.2	77.8	81.0	84.4	86.8	87.8	81.4	76.2	74.4
2.00K	77.0	77.2	77.2	79.8	78.2	79.4	78.2	75.8	81.8	85.6	85.8	87.0	89.4	91.8	87.8	80.6	77.6
2.50K	87.4	89.8	95.4	98.6	94.0	96.8	96.8	96.2	99.2	102.6	100.4	98.2	99.8	104.6	102.2	95.8	91.8
3.15K	94.0	93.0	92.0	91.8	93.2	97.0	87.4	87.6	87.2	87.6	86.8	86.4	88.4	91.0	87.6	84.8	82.2
4.00K	83.4	84.0	83.8	84.2	85.2	86.4	81.8	79.6	81.0	82.2	83.0	83.0	83.2	89.2	83.4	79.8	76.6
5.00K	93.2	88.0	93.0	95.2	100.6	104.4	96.8	92.6	92.2	91.0	93.4	94.2	94.6	98.0	92.2	89.6	85.6
6.30K	86.0	90.8	91.6	90.0	88.4	90.0	86.0	83.2	82.2	82.0	83.8	84.2	84.4	88.4	84.4	79.6	76.8
8.00K	86.8	83.8	92.2	88.0	88.8	90.0	90.4	92.0	89.4	86.0	89.4	92.4	95.4	98.6	91.8	86.2	80.6
10.0K	84.4	84.6	84.6	86.8	87.6	88.6	85.4	85.6	83.4	83.2	83.0	91.2	93.2	96.4	90.0	84.2	79.8
OASPL	98.7	98.1	100.6	101.9	102.9	106.2	101.2	99.9	101.2	103.5	102.3	101.9	103.5	107.3	103.9	98.8	96.0
	Fan rpm, 80 percent of maximum																
50	74.8	74.2	76.0	75.0	74.8	75.8	76.0	76.4	77.4	78.4	81.6	81.4	81.8	83.6	84.0	85.0	86.4
63	78.2	77.2	79.2	76.8	77.2	78.2	78.2	78.4	80.8	82.2	83.0	83.0	83.4	85.4	86.2	87.6	87.0
80	80.4	79.6	82.6	80.2	80.2	80.8	81.4	81.2	83.2	83.8	84.0	86.0	86.8	88.6	88.2	89.2	89.6
100	83.8	85.0	85.4	82.6	82.6	84.2	84.2	84.2	85.0	87.0	88.4	89.0	90.0	90.4	92.4	92.0	90.6
125	84.0	83.8	83.6	82.2	82.4	84.0	84.2	84.0	85.0	85.8	87.6	88.4	88.0	89.0	89.2	90.4	89.8
160	82.6	82.6	82.2	81.2	80.8	82.6	83.4	83.6	85.6	84.8	86.2	86.4	86.6	87.2	87.6	88.4	88.2
200	81.4	81.4	81.8	81.2	82.2	83.4	84.4	84.4	84.8	84.0	85.2	85.8	86.2	86.0	86.6	86.2	87.0
250	81.8	80.6	81.6	83.6	84.8	84.8	83.4	83.8	84.6	83.4	84.8	85.0	86.2	87.2	87.2	83.4	85.8
315	82.0	80.8	82.0	84.2	82.6	82.8	82.8	83.4	84.4	82.8	83.6	85.0	84.4	85.8	86.6	80.4	84.0
400	82.6	80.4	82.2	82.8	82.4	83.8	83.2	82.6	83.4	80.4	82.2	82.8	81.8	81.8	83.6	79.0	79.2
500	83.8	81.6	82.4	82.4	83.0	82.8	81.8	80.6	81.0	77.8	78.6	79.4	79.8	80.6	77.4	75.6	73.4
630	81.6	82.0	82.4	83.8	83.0	81.8	82.2	81.4	82.0	78.0	77.0	77.8	79.2	80.2	76.0	75.6	73.2
800	79.8	81.0	80.4	81.8	81.6	82.8	82.4	81.4	81.4	78.8	78.8	81.4	83.2	84.8	78.6	77.0	74.8
1.00K	79.8	79.6	79.0	80.6	80.8	83.0	83.0	81.4	81.0	79.8	82.6	85.6	87.6	88.0	82.2	78.6	77.0
1.25K	77.4	77.2	78.4	79.4	80.0	82.2	82.0	81.0	80.6	82.4	85.8	88.6	90.4	90.4	84.2	81.4	79.0
1.60K	77.0	76.8	78.6	79.6	79.2	81.0	81.4	80.8	81.2	83.4	86.0	90.0	91.6	92.2	85.4	82.0	80.4
2.00K	77.2	78.0	80.6	80.4	80.8	80.8	82.0	81.6	82.6	86.6	88.6	90.8	91.6	92.4	85.8	82.4	81.0
2.50K	81.4	81.6	82.6	83.2	84.0	84.8	84.4	83.4	85.2	89.0	90.2	90.2	92.2	92.6	85.4	83.0	81.4
3.15K	90.8	88.2	95.0	96.6	97.8	100.6	102.6	100.4	104.6	108.8	107.0	103.2	103.4	111.8	101.8	96.0	94.0
4.00K	96.0	93.0	96.6	94.0	92.0	92.4	93.0	91.8	93.4	99.2	96.6	95.2	95.0	101.8	96.0	91.0	87.8
5.00K	101.2	93.4	88.8	88.2	85.6	87.2	86.2	84.8	85.0	88.2	88.6	90.0	89.4	90.8	85.4	82.8	81.0
6.30K	89.4	87.6	93.6	97.0	96.0	95.4	96.2	95.0	95.2	96.2	100.8	99.4	99.0	99.0	93.0	91.8	91.4
8.00K	92.4	92.0	95.0	95.6	94.6	94.0	99.0	96.8	92.2	92.0	93.0	94.4	93.2	93.2	89.6	86.8	86.0
10.0K	89.6	88.4	88.4	87.6	88.4	92.4	91.2	90.0	91.2	95.8	98.0	99.6	99.2	100.0	94.8	90.6	86.2
OASPL	103.9	100.0	102.4	102.9	102.6	103.9	105.7	103.9	106.2	109.9	109.1	107.3	107.4	113.0	105.2	101.9	100.7

TABLE III. - Concluded. AVERAGE SOUND PRESSURE LEVEL DATA

(f) Concluded. Series F; core engine nozzle area, 384 square inches; fan nozzle area, 429 square inches

Frequency, Hz	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	Sound pressure levels, SPL, dB (referenced to 0.0002 μbar)																
	Fan rpm, 90 percent of maximum																
50	77.0	77.0	76.2	76.6	77.0	78.0	78.6	78.6	80.0	81.4	81.6	83.0	84.4	86.2	87.0	88.4	90.0
63	78.6	78.6	78.8	79.2	78.8	80.0	81.4	81.4	82.0	83.6	83.8	85.0	86.0	88.0	90.0	90.6	91.6
80	83.0	81.6	82.0	83.4	81.6	83.0	84.0	84.4	85.6	87.0	87.6	88.8	89.2	90.4	92.0	93.0	92.4
100	85.8	86.0	86.0	84.6	85.2	86.4	87.0	87.0	87.8	88.8	90.6	91.6	92.2	93.2	94.4	95.2	93.8
125	86.6	86.0	84.8	85.0	85.0	85.8	86.2	86.2	87.0	88.6	90.2	90.8	91.4	92.8	93.4	94.0	93.0
160	84.8	84.6	84.0	83.6	83.6	85.2	85.4	85.8	87.6	87.6	89.4	89.2	89.8	91.4	91.2	92.0	91.4
200	84.4	84.0	83.2	83.8	84.8	87.0	87.0	87.2	87.8	86.6	88.4	88.6	89.0	89.8	90.8	90.8	90.8
250	84.0	83.4	83.4	86.2	87.0	87.2	86.4	89.4	87.4	86.4	87.2	87.8	88.4	89.4	89.4	87.4	89.0
315	85.4	84.2	83.6	86.2	85.8	85.8	86.4	86.6	87.0	85.8	86.0	87.6	87.2	88.4	89.4	84.8	87.4
400	85.6	84.0	83.4	85.2	85.2	85.8	85.6	85.4	86.4	83.8	85.2	86.0	85.2	84.8	85.8	82.8	82.4
500	85.4	82.8	84.0	85.0	85.0	85.6	84.4	86.0	84.0	81.0	82.4	82.6	82.2	84.0	81.0	79.6	78.6
630	83.0	83.4	84.8	85.4	85.2	85.2	84.8	84.6	83.8	79.2	80.2	80.6	81.8	82.6	79.8	79.0	77.2
800	82.4	81.8	82.6	83.6	84.4	85.6	84.8	84.4	81.6	81.2	82.0	84.6	86.0	86.8	81.6	79.8	79.0
1.00K	80.2	80.4	81.0	83.0	83.8	85.2	84.6	84.0	83.2	82.6	86.0	88.6	90.4	90.0	84.6	82.2	80.4
1.25K	79.6	80.0	81.4	83.2	83.0	84.6	83.6	83.4	84.6	85.6	88.6	91.4	93.0	92.6	87.4	84.4	83.0
1.60K	79.0	79.8	80.4	82.0	81.8	83.6	83.6	83.4	83.6	88.0	91.4	93.8	94.8	94.0	88.4	85.4	84.2
2.00K	80.0	79.8	81.2	83.0	83.6	85.4	86.0	86.2	87.0	90.2	92.6	94.8	95.4	94.6	89.0	86.0	84.8
2.50K	82.0	81.6	83.2	84.2	85.2	87.0	87.6	86.8	88.0	91.0	92.2	93.8	94.8	92.8	87.2	85.4	84.8
3.15K	85.6	86.0	86.4	89.2	90.0	90.2	91.4	91.8	93.8	97.2	97.0	100.2	100.2	101.2	94.0	91.2	89.0
4.00K	93.0	90.6	93.6	96.4	96.8	99.2	101.8	99.8	103.0	104.0	105.6	107.0	106.8	113.4	106.4	101.8	101.4
5.00K	92.0	88.4	90.8	91.4	87.4	89.4	88.4	88.4	89.0	91.6	92.0	93.0	93.2	94.8	91.8	89.2	86.0
6.30K	84.8	85.8	87.6	89.2	88.6	89.2	90.0	89.6	89.6	93.6	94.0	96.2	95.0	94.2	89.0	86.8	85.2
8.00K	91.6	90.0	97.2	94.6	94.8	94.8	97.2	95.4	93.4	99.8	101.2	102.2	103.2	101.6	96.0	93.8	91.8
10.0K	83.8	83.4	86.0	87.0	91.0	89.4	89.6	89.0	89.6	93.8	94.6	97.0	97.8	97.6	89.8	84.4	83.8
OASPL	99.9	98.6	101.4	101.8	102.1	103.2	104.8	103.7	105.3	107.3	108.7	110.2	110.5	114.5	108.4	105.5	104.9
	Fan rpm, 99 percent of maximum																
50	79.8	79.6	79.6	80.0	79.4	80.4	82.4	81.6	83.6	83.4	85.8	85.4	87.2	88.4	91.2	92.6	93.4
63	81.0	81.2	80.6	81.8	82.2	83.0	83.4	83.4	85.2	86.8	88.6	89.2	90.0	91.8	92.8	93.4	94.6
80	84.8	85.2	84.6	85.6	85.4	86.0	86.4	87.6	87.6	88.8	89.4	91.4	92.2	94.0	95.8	96.8	96.4
100	87.4	88.2	87.0	87.0	87.4	88.8	88.4	89.0	90.6	91.6	93.0	94.2	95.6	96.4	97.6	98.2	96.6
125	88.4	87.8	87.2	87.2	87.2	88.2	88.2	88.4	89.8	91.0	93.0	93.6	94.2	95.8	97.8	97.4	95.8
160	87.4	87.0	86.8	86.4	86.2	87.8	87.8	88.6	90.2	90.2	91.8	92.4	93.0	94.2	95.4	95.8	94.4
200	87.0	86.6	86.0	86.6	87.0	89.2	89.6	89.6	90.4	89.2	90.8	91.8	92.2	93.6	94.2	94.2	93.2
250	86.8	86.6	85.8	88.2	89.4	89.8	88.4	89.2	89.6	88.2	89.8	90.8	91.6	93.2	92.8	91.0	91.6
315	88.4	87.6	86.4	88.8	88.8	89.0	88.6	88.6	89.4	88.0	88.2	90.2	90.2	92.0	92.0	87.8	90.2
400	88.2	86.2	85.8	88.0	87.6	88.8	88.4	88.2	88.6	86.2	87.0	88.2	88.0	88.2	89.2	85.2	85.0
500	86.4	84.4	86.8	88.2	88.2	88.2	86.8	86.4	86.4	83.2	84.0	84.6	85.2	86.0	82.8	81.4	79.4
630	86.0	85.0	86.4	88.0	87.8	88.0	87.2	87.2	85.4	81.8	82.0	82.8	85.6	85.8	82.0	81.6	79.8
800	84.4	83.6	85.0	86.6	88.0	89.8	88.4	87.6	85.8	85.0	88.0	90.4	90.6	90.0	85.6	84.2	83.4
1.00K	82.2	82.6	86.6	89.6	91.0	92.0	88.8	87.8	86.6	89.6	93.4	95.6	96.8	94.6	89.6	86.4	85.8
1.25K	81.6	83.2	86.0	87.8	87.4	87.2	87.0	87.0	86.4	91.0	94.6	97.6	99.0	95.6	91.2	88.2	86.4
1.60K	80.6	81.2	82.8	84.4	85.4	86.2	86.6	86.8	87.8	91.4	95.2	98.4	99.4	95.6	92.0	88.8	86.6
2.00K	81.4	81.8	83.6	86.0	87.0	89.0	88.6	89.0	90.4	94.0	97.4	100.4	101.4	96.6	92.4	89.0	86.8
2.50K	84.4	83.4	85.4	87.0	88.8	92.8	92.6	91.0	92.2	93.8	96.0	98.8	99.4	95.8	90.8	88.2	87.2
3.15K	86.6	86.6	87.4	89.6	90.8	94.0	96.4	95.8	95.6	98.6	98.2	99.0	97.0	96.6	91.8	89.8	88.0
4.00K	95.2	97.6	97.0	97.2	98.6	100.4	101.4	102.6	102.2	105.6	107.2	108.4	109.8	116.6	109.4	104.0	103.2
5.00K	92.0	93.0	96.8	94.6	92.2	94.2	95.2	95.0	95.0	96.0	99.4	101.0	103.2	107.8	102.6	97.4	94.6
6.30K	95.8	91.8	90.0	90.4	89.8	90.6	92.0	92.2	92.2	93.6	94.0	97.6	98.2	94.2	91.8	88.8	86.8
8.00K	89.8	88.4	91.8	94.6	95.8	94.2	96.8	96.4	97.6	100.2	100.2	102.8	102.6	103.6	97.8	93.4	91.8
10.0K	84.2	85.6	90.0	91.6	91.2	92.4	94.8	92.0	93.2	94.0	93.8	98.6	99.6	100.0	94.2	88.2	86.4
OASPL	102.3	102.2	103.1	103.7	104.2	105.5	106.3	106.5	106.6	109.0	110.5	112.4	113.4	117.8	111.9	108.4	107.4

TABLE IV. - SOUND POWER LEVEL DATA

(a) Series A

Frequency, Hz	Fan speed, percent of maximum							
	30	35	60	80	85	90	95	99
	Sound power levels, PWL, dB (referenced 10^{-13} W)							
50	118.3	116.9	122.6	128.0	129.7	131.5	133.2	135.3
63	119.4	119.1	124.9	129.7	131.2	132.6	134.8	136.3
80	120.2	119.7	126.3	131.7	132.9	134.5	136.0	137.6
100	127.9	121.9	128.4	133.6	135.0	135.6	138.0	139.4
125	128.0	134.7	130.2	135.3	136.8	138.3	139.6	140.8
160	124.0	125.7	130.8	136.2	137.5	138.8	140.3	141.3
200	123.7	124.6	146.2	135.6	137.4	139.3	140.7	141.8
250	123.9	121.5	139.7	141.1	138.7	138.7	140.0	141.4
315	118.1	118.8	128.1	146.1	148.3	150.1	148.7	146.1
400	115.3	116.9	128.5	133.7	136.6	140.9	148.0	151.3
500	114.4	115.3	126.7	133.0	134.7	136.4	138.5	140.4
630	115.1	116.0	126.3	134.2	136.3	138.0	139.3	140.5
800	115.3	116.7	126.4	133.9	135.6	137.4	140.0	142.2
1.00K	116.8	117.4	126.8	134.8	136.5	138.7	141.0	142.5
1.25K	121.8	125.3	127.8	135.5	137.3	139.7	141.6	143.3
1.60K	125.6	136.2	128.2	136.0	137.6	140.1	142.1	143.9
2.00K	124.4	127.4	130.6	136.0	137.9	140.2	142.5	144.3
2.50K	124.2	124.3	145.8	136.0	137.9	139.5	142.0	143.5
3.15K	125.0	131.6	139.9	152.6	149.8	145.4	145.7	145.7
4.00K	135.9	128.6	129.5	143.4	152.4	152.9	153.4	152.7
5.00K	135.1	135.2	140.1	134.5	136.0	138.3	142.1	145.5
6.30K	132.4	137.2	133.8	144.1	141.0	139.1	139.4	141.0
8.00K	126.4	127.7	139.9	143.8	144.7	147.0	148.0	147.4
10.0K	123.8	125.8	139.3	144.4	144.3	142.1	142.7	143.7
OAPWL	141.3	143.3	151.5	155.8	156.8	157.3	158.2	158.8

TABLE IV. - Continued. SOUND POWER LEVEL DATA

(b) Series B

Frequency, Hz	Fan speed, percent of maximum			
	60	80	90	99
	Sound power levels, PWL dB (referenced 10^{-13} W)			
50	122.0	128.4	132.5	135.9
63	124.1	130.3	133.9	137.4
80	126.5	132.2	135.5	138.4
100	128.3	134.2	137.4	140.0
125	129.9	136.0	138.9	141.4
160	129.9	136.9	139.7	142.1
200	141.8	136.3	140.0	142.9
250	138.7	139.5	139.0	142.3
315	127.7	146.5	149.0	143.8
400	127.0	134.3	143.3	150.9
500	126.5	133.3	136.6	141.3
630	125.6	134.4	137.8	140.8
800	125.6	133.9	137.7	142.5
1.00K	126.0	134.7	138.6	143.0
1.25K	127.5	135.4	139.5	143.7
1.60K	128.7	135.9	140.0	144.5
2.00K	131.1	136.1	140.4	144.7
2.50K	146.4	136.5	140.0	144.1
3.15K	139.0	152.8	145.6	147.0
4.00K	130.3	145.2	153.0	154.4
5.00K	141.5	134.4	139.2	146.4
6.30K	133.9	144.1	139.3	141.7
8.00K	140.5	145.1	147.5	148.2
10.0K	139.0	144.8	142.0	144.1
OAPWL	150.8	156.2	157.3	159.5

(c) Series C

Frequency, Hz	Fan speed, percent of maximum			
	60	80	90	99
	Sound power levels, PWL dB (referenced 10^{-13} W)			
50	124.8	130.8	134.0	137.4
63	126.4	132.3	135.6	139.2
80	128.0	133.9	137.0	140.3
100	129.4	135.8	138.8	141.8
125	131.1	137.4	140.4	142.9
160	130.5	138.5	141.0	144.2
200	136.6	137.8	141.5	144.5
250	141.0	137.9	140.2	143.8
315	128.4	147.0	145.4	143.6
400	126.7	136.0	148.4	151.2
500	127.1	134.0	137.9	143.5
630	126.2	135.2	138.4	143.1
800	126.7	135.1	139.3	144.5
1.00K	127.3	135.6	139.8	145.0
1.25K	128.6	136.3	140.5	145.4
1.60K	129.5	136.8	141.0	145.8
2.00K	132.5	137.2	141.4	146.2
2.50K	149.2	138.4	141.7	146.2
3.15K	139.3	154.7	148.8	149.7
4.00K	132.0	148.3	156.7	156.7
5.00K	144.4	137.8	141.7	149.7
6.30K	135.5	146.8	141.4	144.2
8.00K	141.2	147.3	149.3	149.0
10.0K	139.1	145.7	143.0	145.0
OAPWL	152.4	158.0	159.7	161.3

TABLE IV. - Continued. SOUND POWER LEVEL DATA

(d) Series D

Frequency, Hz	Fan speed, percent of maximum			
	60	80	90	99
	Sound power levels, PWL dB (referenced 10^{-13} W)			
50	121.5	125.8	129.0	131.8
63	123.5	127.8	130.7	133.0
80	125.2	130.1	132.3	134.6
100	126.8	131.9	134.7	136.3
125	128.5	133.2	135.7	137.5
160	136.9	133.8	136.1	137.9
200	143.5	136.0	136.1	137.9
250	128.1	147.2	143.4	137.6
315	126.2	133.8	145.4	147.0
400	126.0	131.0	133.7	137.0
500	124.7	131.3	133.4	135.3
630	125.6	131.2	134.2	136.0
800	126.2	132.4	134.7	136.6
1.00K	126.5	135.2	137.1	138.6
1.25K	127.7	135.0	138.8	141.4
1.60K	128.1	134.6	137.7	140.3
2.00K	130.1	134.1	137.4	140.0
2.50K	144.0	133.7	136.4	139.2
3.15K	141.8	152.2	143.6	145.2
4.00K	130.6	143.9	153.3	157.9
5.00K	143.7	135.2	139.3	150.9
6.30K	134.0	146.9	139.6	141.5
8.00K	139.0	144.5	146.4	149.0
10.0K	136.8	142.1	141.5	144.3
OAPWL	150.6	155.7	156.3	160.2

(e) Series E

Frequency, Hz	Fan speed, percent of maximum			
	60	80	90	99
	Sound power levels, PWL dB (referenced 10^{-13} W			
50	131.2	133.4	131.6	131.4
63	132.2	133.2	132.5	132.9
80	132.3	133.7	134.7	135.0
100	133.1	134.7	136.6	137.8
125	131.6	133.6	135.6	137.1
160	130.1	132.0	133.8	135.2
200	128.4	131.5	133.2	134.8
250	128.5	131.1	133.0	134.7
315	127.5	130.7	132.1	133.6
400	125.5	129.3	130.7	132.2
500	122.7	127.4	129.2	130.9
630	122.9	127.0	129.4	130.4
800	123.9	128.3	130.2	132.2
1.00K	125.6	130.7	131.9	133.6
1.25K	127.6	132.3	134.4	136.3
1.60K	128.6	132.9	135.2	137.2
2.00K	131.0	132.8	135.1	137.5
2.50K	146.1	133.7	135.1	137.1
3.15K	139.3	152.6	144.3	143.5
4.00K	131.3	143.4	152.4	157.2
5.00K	143.0	135.0	137.8	148.5
6.30K	133.6	146.6	139.1	140.3
8.00K	137.8	143.2	146.0	147.3
10.0K	134.5	140.6	139.0	141.8
OAPWL	149.8	154.9	154.8	158.8

TABLE IV. - Concluded. SOUND POWER LEVEL DATA

(f) Series F

Frequency, Hz	Fan speed, percent of maximum			
	60	80	90	99
	Sound power levels, PWL, dB (referenced 10^{-13} W)			
50	121.6	128.1	130.7	134.0
63	124.7	130.1	132.8	136.1
80	128.0	132.6	135.5	138.6
100	131.1	135.5	138.0	140.8
125	129.6	134.2	137.3	140.3
160	126.9	132.9	136.0	139.0
200	126.3	132.3	135.6	138.5
250	127.8	132.3	135.1	137.7
315	127.2	131.3	134.2	136.9
400	125.5	129.8	132.6	135.2
500	122.6	127.9	131.0	133.2
630	122.9	127.9	130.4	132.9
800	124.0	128.8	131.3	135.5
1.00K	125.3	130.9	133.5	139.5
1.25K	127.6	132.8	135.5	140.5
1.60K	129.0	133.9	137.1	140.9
2.00K	132.9	134.7	138.2	142.8
2.50K	147.1	135.6	137.8	141.9
3.15K	137.7	152.5	143.8	143.4
4.00K	131.2	143.4	153.0	155.5
5.00K	144.2	135.5	138.6	147.7
6.30K	133.7	144.5	139.6	141.2
8.00K	139.5	141.7	146.4	146.8
10.0K	136.8	143.1	140.8	142.8
OAPWL	150.4	154.7	155.5	158.2

TABLE V. - PERCEIVED NOISE LEVELS (PNDB) AT MEASURED POINTS 100 FEET FROM ENGINE

(a) Series A

Fan speed, percent of maximum	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	PNDB sideline values																
30	112.6	115.7	112.2	113.0	110.8	108.1	106.0	101.6	100.4	100.9	102.8	105.6	106.0	107.8	106.9	103.2	99.2
35	109.8	113.9	109.5	111.3	108.2	108.7	107.7	104.4	103.9	106.6	108.5	109.4	108.1	108.4	107.9	104.5	101.7
60	110.8	114.2	115.4	115.7	116.9	116.7	112.2	111.0	110.7	112.7	116.3	116.6	116.9	119.5	114.9	110.0	109.3
80	118.1	115.2	115.4	116.8	117.2	118.1	117.6	118.1	116.8	121.3	119.3	121.9	121.9	128.4	123.3	118.5	116.3
85	113.9	114.1	117.2	117.9	118.2	118.3	118.3	118.3	118.4	118.5	121.9	124.3	125.1	130.5	121.8	116.8	115.3
90	115.1	115.0	117.5	119.5	118.8	119.2	120.0	120.4	119.2	122.0	123.0	123.2	124.1	129.5	122.6	118.3	118.3
95	115.1	115.5	118.5	121.1	119.3	120.7	121.2	121.5	123.8	123.3	125.0	124.5	125.5	129.5	125.5	120.4	119.6
99	115.6	116.7	119.0	120.7	120.4	120.7	122.6	123.2	123.7	123.4	123.5	125.0	126.2	129.7	125.4	121.6	119.9

Fan speed, percent of maximum	Axial distance in front of engine, ft															
	566	275	173	119	84	58	36	18	0	-18	-36	-58	-84	-119	-173	-275
	PNDB sideline values															
30	99.9	103.3	106.9	106.9	106.2	104.3	100.8	100.4	100.9	102.7	104.8	104.7	105.9	102.8	97.7	89.9
35	99.2	100.8	105.8	104.2	106.8	106.8	104.1	103.8	106.6	108.5	108.7	107.3	106.4	103.8	98.7	92.6
60	99.6	106.3	109.5	112.9	114.6	111.1	110.8	110.6	112.7	116.3	115.9	115.1	117.5	111.2	104.0	100.3
80	100.5	105.9	110.7	113.0	116.1	116.4	118.0	116.6	121.3	119.3	121.7	120.8	126.4	119.3	112.7	106.7
85	99.7	108.2	111.8	114.0	115.4	117.3	118.0	118.3	118.5	121.9	123.3	123.3	127.4	118.0	110.7	106.3
90	100.3	108.6	113.3	114.8	117.2	118.9	119.8	119.1	122.0	123.0	123.2	123.1	127.4	119.5	112.1	109.2
95	100.8	109.3	115.2	115.5	118.6	119.7	120.5	123.0	123.3	125.0	124.4	124.3	127.5	121.5	114.4	110.5
99	102.0	109.9	114.7	116.7	118.8	121.5	122.2	123.6	123.4	123.5	124.1	125.1	127.7	121.5	115.7	110.3

(b) Series B

Fan speed, percent of maximum	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	PNDB sideline values																
60	111.5	114.0	113.7	116.8	116.7	116.1	112.9	111.2	110.9	114.0	116.0	116.3	117.1	119.6	116.9	110.4	109.5
80	117.4	113.9	114.3	117.8	116.5	116.9	119.7	118.4	119.4	119.7	122.5	123.2	122.0	128.6	121.3	117.5	116.2
90	114.9	114.5	115.5	120.1	118.5	118.8	120.1	119.8	120.5	122.4	123.1	124.1	124.2	129.7	123.0	119.7	119.9
99	117.8	116.7	120.7	119.8	120.2	120.9	124.7	123.3	122.7	125.6	125.8	126.6	126.2	131.2	126.4	121.0	120.0

Fan speed, percent of maximum	Axial distance in front of engine, ft															
	566	275	173	119	84	58	36	18	0	-18	-36	-58	-84	-119	-173	-275
	PNDB sideline values															
60	99.3	104.7	110.6	112.8	113.3	111.8	110.7	110.9	114.0	116.0	115.3	115.9	117.5	112.9	104.5	100.3
80	99.1	105.2	111.6	112.4	114.7	118.0	117.5	118.8	119.7	122.4	123.0	120.7	126.5	117.5	111.4	107.4
90	99.3	106.4	114.2	114.3	116.6	119.0	119.6	119.8	122.4	123.1	123.2	123.1	127.4	119.8	113.6	110.6
99	102.0	111.6	113.7	116.3	119.0	123.5	123.1	122.7	125.6	125.1	126.4	125.2	129.1	122.3	115.0	110.5

(c) Series C

Fan speed, percent of maximum	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	PNDB sideline values																
60	112.6	113.4	115.4	115.9	117.4	119.0	114.4	110.6	114.0	117.2	118.3	119.3	119.9	119.2	117.9	114.0	110.2
80	117.1	113.1	116.8	120.5	118.7	120.6	123.6	118.0	119.8	121.2	124.4	123.7	124.4	130.2	125.9	120.0	116.8
90	115.1	114.6	118.4	119.9	120.7	120.1	123.6	124.7	124.6	124.2	125.1	127.7	129.0	131.3	126.5	125.3	121.8
99	118.5	117.8	120.5	121.2	123.0	122.2	125.2	124.4	124.3	127.0	130.0	128.8	130.4	132.4	126.9	125.6	123.3

Fan speed, percent of maximum	Axial distance in front of engine, ft															
	566	275	173	119	84	58	36	18	0	-18	-36	-58	-84	-119	-173	-275
	Axial distance in front of engine, ft															
60	106.6	109.8	113.8	116.9	112.7	109.9	114.0	117.2	118.2	118.9	118.2	117.2	113.8	108.2	101.1	112.2
80	107.8	114.5	114.7	118.4	122.6	117.7	119.2	121.2	124.2	122.9	123.2	128.1	121.9	114.0	107.4	117.3
90	108.8	113.8	117.0	118.1	121.8	124.3	124.6	124.2	125.0	127.0	127.8	129.0	122.4	119.2	112.9	119.7
99	111.5	115.4	119.7	119.6	123.4	124.1	124.2	127.0	129.2	128.6	129.4	129.6	123.4	119.6	114.3	121.4

TABLE V. - Concluded. PERCEIVED NOISE LEVELS (PNDB) AT MEASURED POINTS 100 FEET FROM ENGINE

(d) Series D

Fan speed, percent of maximum	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	PNDB sideline values																
60	111.4	114.6	117.5	115.3	117.4	117.2	112.5	111.8	111.0	110.7	113.1	115.0	118.5	119.8	117.4	112.3	109.3
80	117.6	115.1	116.0	118.8	117.5	118.9	118.2	119.6	116.7	118.0	118.9	119.2	121.1	128.8	123.6	119.7	114.0
90	114.7	114.6	115.5	118.8	116.9	117.2	116.9	119.7	119.5	119.5	121.8	123.3	122.9	128.7	124.8	120.9	118.3
99	115.6	116.2	119.2	119.6	120.3	121.2	120.9	125.0	122.8	124.2	125.3	126.9	128.4	133.5	128.8	124.6	123.8

Fan speed, percent of maximum	Axial distance in front of engine, ft															
	566	275	173	119	84	58	36	18	0	-18	-36	-58	-84	-119	-173	-275
	PNDB sideline values															
60	99.9	107.6	109.1	113.7	115.1	111.4	111.5	110.9	110.7	113.1	114.9	117.1	118.0	114.0	106.9	99.6
80	100.3	107.1	112.7	114.0	116.2	116.4	118.8	116.7	118.0	118.9	119.0	120.0	126.0	119.5	113.9	105.0
90	105.7	112.9	112.8	114.9	115.9	119.1	119.4	119.5	121.8	122.6	121.7	126.7	120.6	115.2	108.8	116.0
99	110.1	113.8	116.5	118.4	119.9	124.8	122.8	124.2	125.3	126.1	127.2	130.6	125.0	118.4	114.0	119.9

(e) Series E

Fan speed, percent of maximum	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	PNDB sideline values																
60	110.1	110.7	115.1	112.8	112.8	115.3	111.9	109.5	110.7	110.5	114.7	118.4	117.2	119.7	117.6	110.1	106.9
80	115.8	112.9	113.4	115.1	114.4	115.5	115.0	116.9	113.8	116.5	118.9	119.5	121.0	129.5	122.2	119.7	115.2
90	112.3	112.0	114.4	114.4	115.7	115.6	117.1	116.3	116.8	117.6	120.1	123.8	121.8	127.8	124.0	120.0	116.1
99	114.9	114.5	118.6	118.9	118.1	119.9	123.0	122.3	122.2	122.3	123.6	125.0	127.3	131.3	128.2	124.3	122.6

Fan speed, percent of maximum	Axial distance in front of engine, ft															
	566	275	173	119	84	58	36	18	0	-18	-36	-58	-84	-119	-173	-275
	PNDB sideline values															
60	95.9	105.3	107.0	108.8	112.9	110.7	109.5	110.7	110.5	114.6	117.6	116.2	117.8	113.7	104.1	97.8
80	98.0	104.6	109.1	110.3	113.3	113.7	116.2	113.8	116.5	118.9	118.6	119.9	126.5	118.9	113.9	105.4
90	97.4	105.6	108.4	111.6	113.4	116.2	116.1	116.7	117.6	120.0	122.8	120.7	125.9	120.6	114.2	107.0
99	99.7	109.4	113.0	114.4	117.7	121.8	122.1	122.2	122.3	123.6	124.7	126.4	128.3	124.3	118.2	112.7

(f) Series F

Fan speed, percent of maximum	Angle from upstream engine axis, deg																
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
	PNDB sideline values																
60	112.4	111.4	113.1	114.8	116.8	119.9	114.3	111.8	113.5	115.3	114.4	114.0	115.6	119.0	116.2	110.5	108.1
80	117.3	113.2	115.8	115.3	115.9	117.4	119.0	117.3	119.3	123.6	122.7	120.8	120.8	126.7	118.4	114.6	113.0
90	112.9	111.5	113.4	115.5	115.6	117.2	118.5	117.3	119.2	121.2	122.3	123.6	123.8	127.9	121.8	118.5	117.8
99	115.3	116.3	117.0	117.1	117.9	119.3	120.0	120.6	120.1	122.5	124.6	126.3	127.0	131.6	125.7	120.8	119.8

Fan speed, percent of maximum	Axial distance in front of engine, ft															
	566	275	173	119	84	58	36	18	0	-18	-36	-58	-84	-119	-173	-275
	PNDB sideline values															
60	96.7	104.1	108.8	112.9	117.1	113.2	111.5	113.4	115.3	114.4	113.6	114.4	116.9	112.1	104.6	98.5
80	98.4	106.7	109.3	111.9	115.5	117.4	116.5	119.3	123.6	122.5	119.9	119.1	124.0	115.5	108.6	103.3
90	96.8	104.4	109.4	111.6	114.5	117.5	117.1	119.1	121.2	122.3	123.4	122.7	125.8	117.9	112.6	108.5
99	100.5	107.5	110.8	114.0	116.9	119.0	119.8	120.1	122.5	124.5	125.3	126.0	128.7	121.8	115.0	110.6

NASA-Langley, 1970 —— 28 E-5330

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