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ACOUSTIC TESTING OF A 1.5 PRESSURE RATIO LOW TIP SPEED FAN WITH A SERRATED ROTOR (QEP FAN B SCALE MODEL)

by

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16. Abstract

A scale model of the bypass flow region of a 1.5 pressure ratio, single stage, low tip speed fan was tested with a serrated rotor leading edge to determine its effects on noise generation. The serrated rotor was produced by cutting teeth into the leading edge of the nominal rotor blades. The effects of speed and exhaust nozzle area on the scale models noise characteristics were investigated with both the nominal rotor and serated rotor.

Acoustic results indicate the serrations reduced front quadrant PNL's at takeoff power. In particular, the 200 foot (61.0 m) sideline noise was reduced from 3 to 4 PNdB at 40° for nominal and large nozzle operation. However, the rear quadrant maximum sideline PNL's were increased 1.5 to 3 PNdB at approach thust and up to 2 PNdB at takeoff thust with these serrated rotor blades.

The configuration with the serrated rotor produced the lowest maximum 200 foot (61.0 m) sideline PNL for any given thust when the large nozzle (116% of design area) was employed.

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I. SUMMARY

A scale model fan, designated "Fan B," was utilized to determine the acoustic characteristics of a single stage fan designed for a corrected tip speed of 1160 ft/sec (353.6 m/sec) at a bypass pressure ratio of 1.5. The fan had 26 rotor blades and 60 vanes with 2 rotor aerodynamic chord spacing between the rotor and the OGV's. The scale model fan which represented a .484 linear scale model version of the NASA/GE Quiet Engine Program full scale Fan B simulated the bypass flow region through the fan.

The scale model was tested with both a nominal and a serrated rotor to determine the effect of serrations on noise generation. The acoustically treated fan frame configuration was used for the comparison tests in which the fan's nominal rotor blades were replaced by an equal number of serrated blades. The serrated blades were produced by cutting teeth .32 inch (.81 cm) deep into the leading edge of nominal rotor blades, the tip cords of which were 5.5 inches (13.9 cm). Spacing of .1 inch (.25 cm) was left between adjacent teeth including appropriate rounds and filets. The acoustic frame treatment used during the comparison tests consisted of ½ inch (1.25 cm) thick Scottfelt covered with a 22½% porosity plate.

The scale model with the nominal rotor was tested to determine the effects of speed and exhaust nozzle area on the fan's noise characteristics and thus establish a baseline. Acoustic data was recorded at ten speed points covering a range from 30% to 100% sea level thrust. The fan was tested with three different nozzles - nominal, 16% oversize and 6% undersize - for this sequence of speed points in order to identify operating points which would produce lower noise at a given thrust level. Each set of tests was then run with the serrated rotor to determine the effectiveness of the cut-in serrations.

The data obtained at each of these points was scaled up to full scale to evaluate the projected effectiveness of the design in reducing the noise of the fan system. The following table summarizes the 200 foot (61.0 m) sideline, maximum PNL's for all three fan exhaust nozzles, for both the clean and serrated rotor at approach and takeoff thrust:

FULL SCALE FAN B
200 FOOT (61.0 m) SIDELINE, MAXIMUM PNL

	Front Quadrant		Rear Quadrant	
	Approach*	Takeoff**	Approach*	Takeoff**
Nominal Nozzle				
Baseline	98.4 PNdB	110.3 PNdB	100.9 PNdB	112.4 PNdB
Serrated Rotor	99.9 PNdB	109.2 PNdB	103.7 PNdB	113.4 PNdB
Large Nozzle				
Baseline	99.3 PNdB	110.4 PNdB	101.1 PNdB	113.6 PNdB
Serrated Rotor	97.8 PNdB	108.5 PNdB	102.7 PNdB	113.5 PNdB
Small Nozzle				
Baseline	101.0 PNdB	111.0 PNdB	102.1 PNdB	113.6 PNdB
Serrated Rotor	100.1 PNdB	110.7 PNdB	103.8 PNdB	115.6 PNdB

* 6,684 pounds (29,744 newtons) static fan thrust - 60% N_{f_c}
**17,140 pounds (76,277 newtons) static fan thrust - 91% N_{f_c}

From this table, it can be seen that the lowest front quadrant, maximum 200 foot (61.0 m) sideline PNL's were produced with the serrated rotor while employing the large fan nozzle. The lowest rear quadrant maximum sideline PNL's for the serrated configuration were also produced with the large nozzle. However, the use of serrations increased the rear quadrant maximum PNL's by 1.6 to 2.8 PNdB at approach thrust with the three nozzles and by 1.0 and 2.0 PNdB at takeoff thrust for the nominal and small nozzle, respectfully.

Acoustic data also indicates that at takeoff thrust, the blade passing frequency SPL values were significantly reduced in the front quadrant by the serrations; with the nominal nozzle, the fundamental PWL was reduced 4.2 dB. Further, at takeoff power, the serrations reduced the front quadrant baseline PNL's. In particular, the 200 foot (61.0 m) sideline noise was reduced from 3 to 4 PNdB at 40° for nominal and large nozzle operation.

II. INTRODUCTION

This report describes work performed by the General Electric Company for the NASA-Lewis Research Center on the Experimental Quiet Engine Program. The major objectives of this program were:

(1) To determine the noise levels produced by turbofan bypass engines designed for low noise output and to confirm that predicted noise reductions can be achieved;

(2) To demonstrate the technology and innovations which will reduce the production and radiation of noise in turbofan engines;

(3) To acquire experimental acoustic and aerodynamic data for high bypass turbofan engines from which acoustic theory and experience can be correlated to provide a better understanding of the noise production mechanisms.

A scale model fan program was utilized to provide information pertinent to achieving these objectives. The results of the scale model testing provided directly applicable experimental data on noise reduction features that might be applied to full size fan systems. Experience indicates that such scale model acoustic tests provide accurate and effective means to readily evaluate such low noise design configurations.

Among the principle mechanisms of fan noise generation are the wakes shed from the rotor blades. The blade passing frequency and associated harmonic noise are governed by the wake width and wake velocity decrement; while the generation of broadband noise is primarily associated with the intensity of rotor wake turbulence, the width of the wake and the susceptibility of the rotor to lift fluctuations due to the impingement of random inlet turbulence on the rotor's leading edge. Therefore, means are sought to reduce the influence of this wake and inlet turbulence without impeding the aerodynamic performance of the rotor.

The source of the wake is the boundary layer along the rotor blade, thus, in order to reduce its effects, the thickness of the boundary layer must be reduced at the trailing edge of the blade. One method to accomplish this is to induce turbulent flow in the boundary layer which slows the build up of the boundary layer. Another method is to smooth adverse pressure gradients encountered by the flow along the blade and in so doing, forestall the separation of the boundary layer from the blade surface. (These adverse pressure gradients occur in regions of rapid acceleration along the blade surface, generally on the suction surface in the vicinity of the leading edge). An approach that both induces turbulent flow in the boundary layer and relieves the high acceleration region on the suction side of the blade is to cut serrations into the leading edge of the rotor blade. Although serrating the leading edge of the blades will not reduce the inlet turbulence generated in the inlet flow and in the casing boundary layers upstream of the fan, it may be hypothesized that the serrations will reduce the reaction of the airfoil to the turbulence by "breaking up" the eddies before they reach the main portion of the airfoil.

Prior to a QEP fan investigation cascade tests were run to select a serrated configuration that promised to reduce rotor generated noise. The resulting serrated blade was installed and tested in scale model Fan B with the acoustically treated fan frame. The particular serrations cut into the scale model rotor blades were determined, during cascade testing to decrease the rotor wake width while producing nearly the same turbulence intensity and wake velocity decrement as the non-serrated or clean rotor. A description of these serrations appears in the following section.

The effects, on the scale model's noise characteristics, of speed and exhaust nozzle area for the clean rotor were examined during acoustic testing to establish a baseline. Acoustic data were recorded at speed points corresponding to a range from 30% to 100% sea level static thrust. The fan was tested with three different nozzles for this sequence of speed points in order to identify operating points which would produce lower noise at a given thrust level. The same set of tests was also run for the serrated rotor configurations to determine the effectiveness of the cut-in serrations. Furthermore, the data obtained at each test point from both configurations were scaled up to full scale to evaluate the projected effectiveness of each design in reducing the noise of the fan system.

Further details on the acoustically treated baseline configuration are contained in the scale model NASA/GE Fan B report[1] which compares configurations with and without acousitc frame treatment.

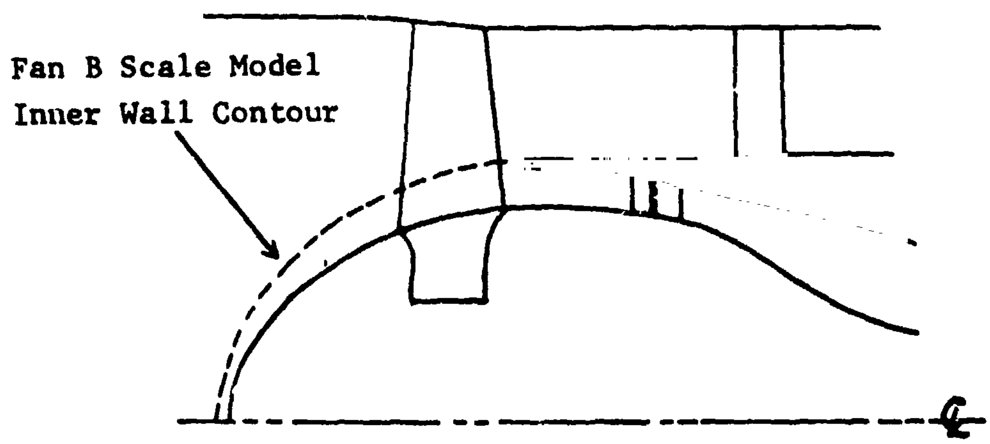
[1]Kazin, S.B., Minzner, W.R., and Paas, J.E., "Acoustic Testing of a 1.5 Pressure Ratio Low Tip Speed Fan (QEP Fan B Scale Model)," NASA CR-120789.

III. Test Vehicle Description

Full scale Fan B is a low speed, moderately loaded, single stage fan. It has been designed at the altitude cruise condition for a corrected tip speed of 1160 ft/sec (353.6 m/sec), at a bypass pressure ratio of 1.5 and with a corrected fan flow of 950 lb/sec (430.9 kg/sec). This fan incorporates 26 shroudless rotor blades and 60 outlet guide vane (OGV's) with a rotor-OGV spacing of two aerodynamic rotor chords to minimize noise generation.

The scale model used to determine the acoustic characteristics of different low noise designs was approximately a half scale version (48.4%) of Fan B which essentially simulated the bypass flow region (outer 84.5% of flow) of the full size fan as shown schematically in Figure 1. The design basis was to provide the same corrected tip speed, pressure ratio and weight flow per unit area as the bypass portion of the full scale Fan B. To maintain the bypass pressure ratio on the scale model, it was necessary to increase the loading at the hub to account for the end-wall blade boundary layer interaction. Some pertinent scale model and full scale characteristics are shown in Table I.

The acousitc treatment of the fan frame was scaled from the full scale fan and incorporated in the scale model. Figure 2 shows a cross section of the fan indicating the location of the acoustic treatment. The amount of acoustic treatment at each location is listed in Table II. The areas shown are effective areas, allowing for fasteners, assembly methods, rake pads, support ribs, etc. The treatment material used on the scaled fan was Scottfelt 3-900, ½" (1.3 cm), an open-celled polyurethane foam material having wide suppression bandwidth characteristics similar to the Multiple-Degree-of-Freedom resonator



SCHEMATIC OF FAN B

Figure 1

TABLE I

QEP FAN B

FULL SCALE AND SCALE MODEL CHARACTERISTICS

SEA LEVEL STATIC, STANDARD DAY

TAKEOFF POWER - 91% FAN SPEED

	Full Scale	Scale Model
Fan Speed, RPM	3299	6814
Tip Speed, Ft/Sec (M/Sec)	1055 (322)	1055 (322)
Bypass Total Pressure Ratio	1.415	1.415
Bypass Flow, Lb/Sec (Kg/Sec)	692 (313.9)	162 (73.5)
Fan Duct Thrust, Lb (Newtons)	17,140 (76,277)	4,010 (17,844)
Rotor Inlet Tip Diameter, In. (M)	73.35 (1.9)	35.5 (0.9)
Inlet Hub/Tip Ratio	0.465	0.579
Number of Rotor Blades	26	26
Number of OGV's	60	60

FAN B SCALE MODEL
CROSS SECTION INDICATING LOCATION OF ACOUSTIC TREATMENT
SERRATED ROTOR

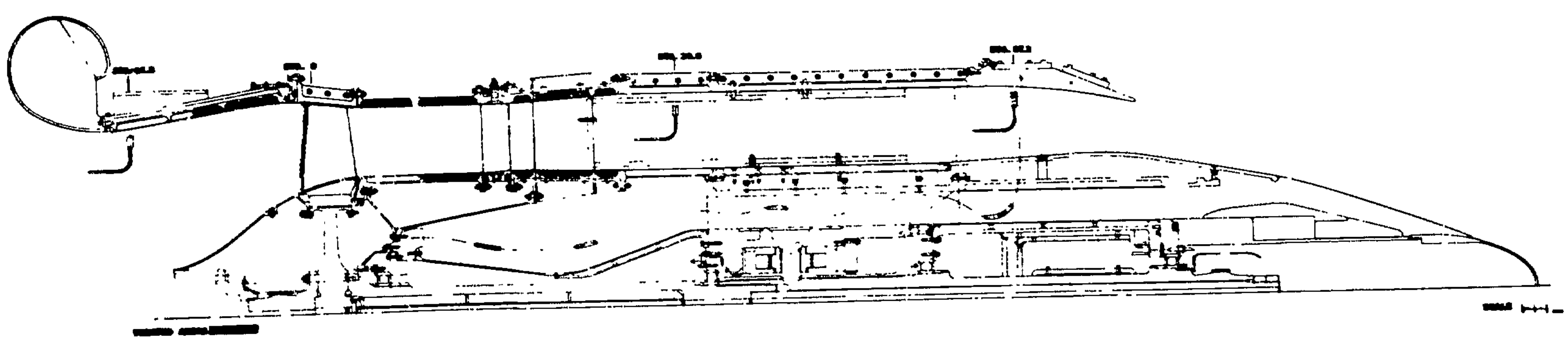


Figure 2

TABLE II

QEP SCALE MODEL FAN B
ACOUSTIC TREATMENT AREAS

Location	Area $In.^2$	Area Cm^2
Inlet	812	5,240
Rotor - OGV's		
Inner Wall	315	2,030
Outer Wall	1007	6,500
Aft of OGV/s		
Inner Wall	417	2,690
Outer Wall	668	4,310
Total	3219	20,770

suppression material used on the full scale vehicle. The scale model treatment was held in position by means of a perforated face plate with 1/16 inch diameter holes and a porosity of 22½%.

Both the clean rotor baseline and the serrated rotor configurations had the same fan frame acoustic treatment. The only difference between the two configurations was the rotor blades. The serrated blades were produced by cutting fifteen teeth into the leading edge of clean rotor blades. The teeth were cut .32 inches (.81 cm) deep with appropriate rounds and filets, leaving spacing between adjacent teeth as indicated in the rework drawing of the fan blade, Figure 3. The tip cord of the nominal rotor blade was 5.5 inches (13.9 cm). A single blade and the assembled rotor are shown in Figures 4 and 5 respectively.

The effects of varying the fan operating line were also investigated with the scale model by running three nozzle sizes on both configurations. The nozzle areas run were 372 square inches (.24 m^2), 396 sq. inches (.26 m^2) and 460 sq. inches (.30 m^2) or about 6% less than nominal, nominal and 16% greater than nominal, where the nominal nozzle was equivalent to a 1700 sq. inch (1.10 m^2) nozzle on the full scale fan. Figure 6 shows the scale model Fan B operating lines for these three nozzle areas. Note that the serrated rotor has not changed the operating lines.

FAN B SCALE MODEL

REWORK DRAWING FOR SERRATED ROTOR BLADE

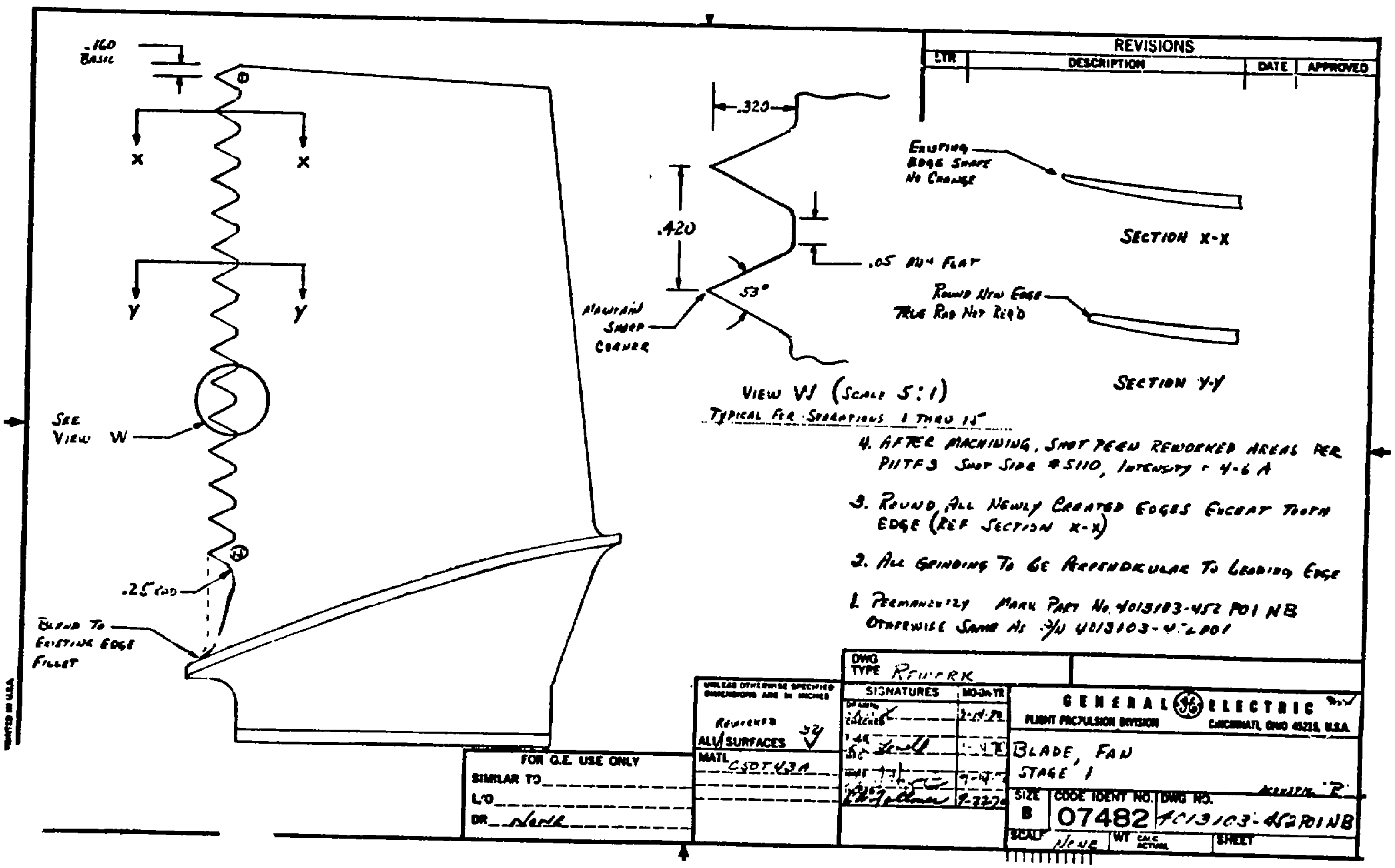


Figure 3

FAN B SCALE MODEL
SERRATED ROTOR ASSEMBLY

Figure 4

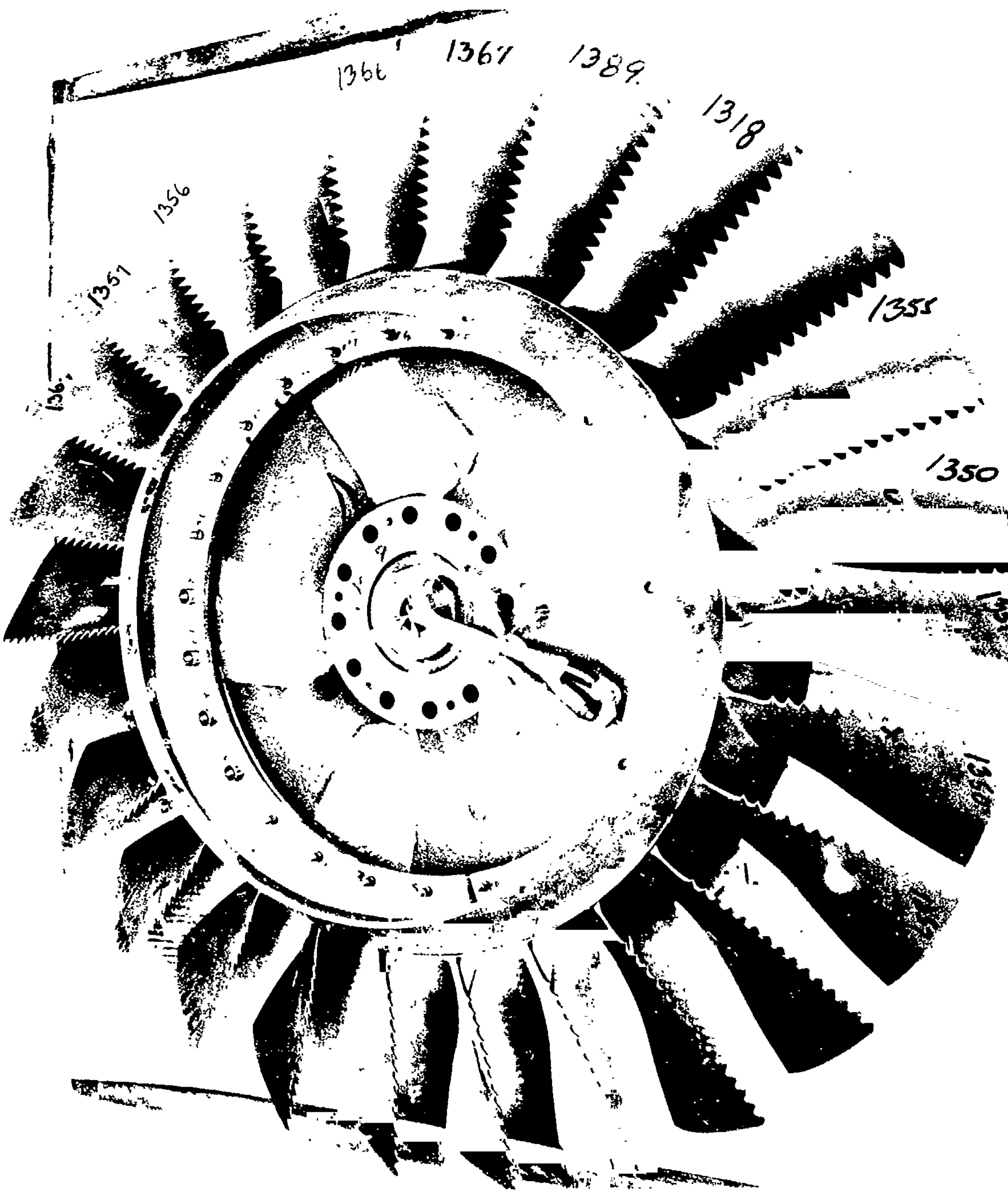
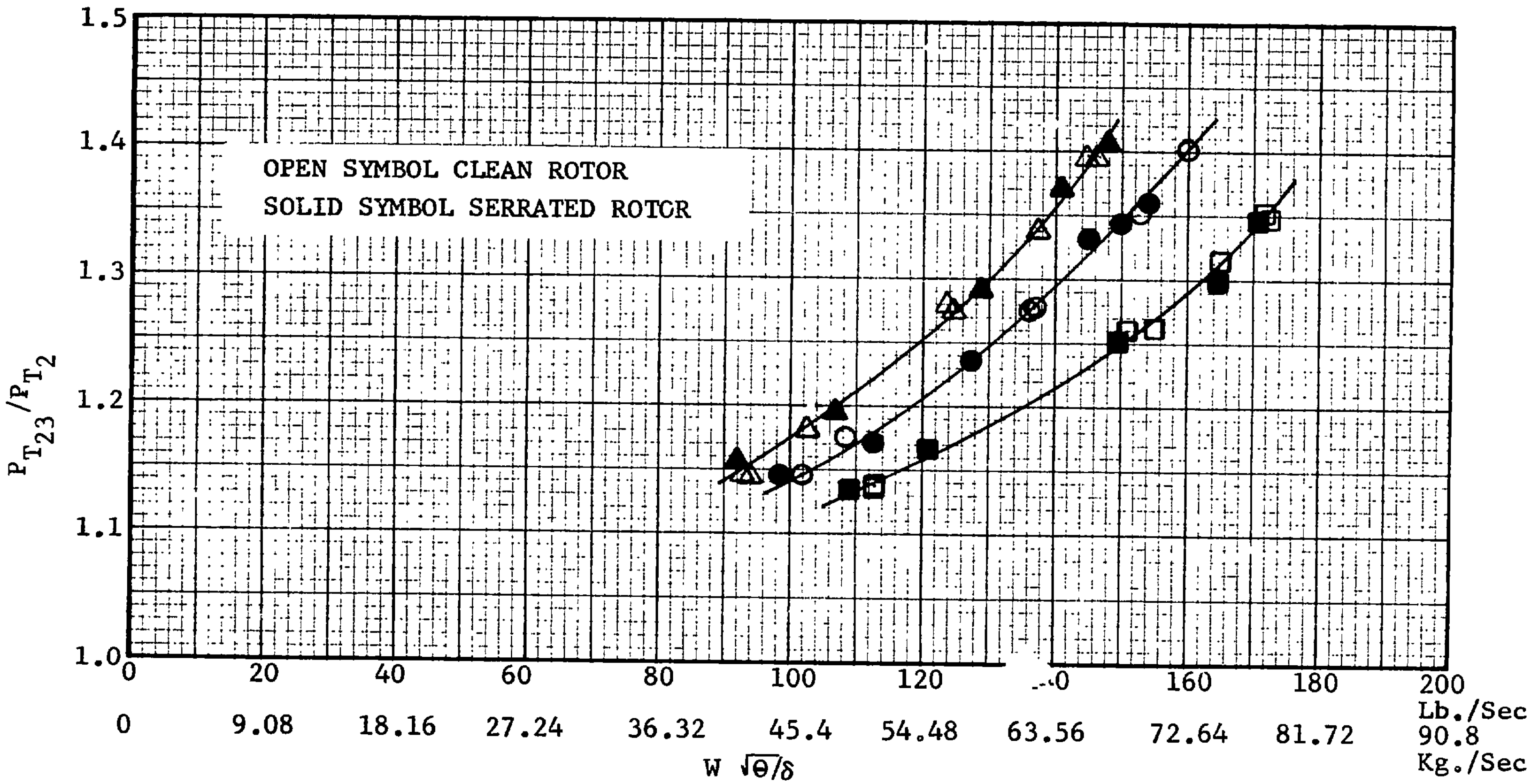


Figure 5

FAN B SCALE MODEL
SERRATED ROTOR BLADE

QUIET ENGINE PERFORMANCE
SCALE MODEL FAN B
CLEAN ROTOR AND SERRATED ROTOR



○● Nominal Nozzle Operating Line — A = 396 in^2 = .26 m^2

□■ Large Nozzle Operating Line — A = 460 in^2 = .30 m^2

△▲ Small Nozzle Operating line — A = 372 in^2 = .24 m^2

Figure 6

IV. Test Program

Testing of the scale model vehicle was performed at the Peebles Test Operation, General Electric's out-door test facility shown in Figures 7 and 8. Testing was performed at the Scale Model Fan Test Stand, using a G.E. LM1500 stationary gas turbine as the drive system. Figure 9 shows a typical scale model vehicle installation. As can be seen, the scale model fans were driven from the front to eliminate noise generation by discharge flow over the drive structures.

Table III summarizes the acoustic tests conducted for the baseline and the serrated rotor configruations, each with three nozzle sizes. The speeds selected correspond to the net engine thrusts shown below:

RPM	% SPEED	% F_n SLS	** % F_n alt=0 M = .25
4040	54.0	29.5	22.3
4474	59.8	36.8	30.6
4700	62.8	40.9	35
4907	65.5	45.2	40
5505	73.5	58.6	55
5990	80	71.1	70
6354	84.9	81.9	82.5
6526	87.1	88.4	90
6649	88.8	92.9	95
6845	91.4	100	102.5

* 100% = 22,000 lbs (97,900 newtons) full scale
** 100% = 16,000 lbs (71,200 newtons) full scale

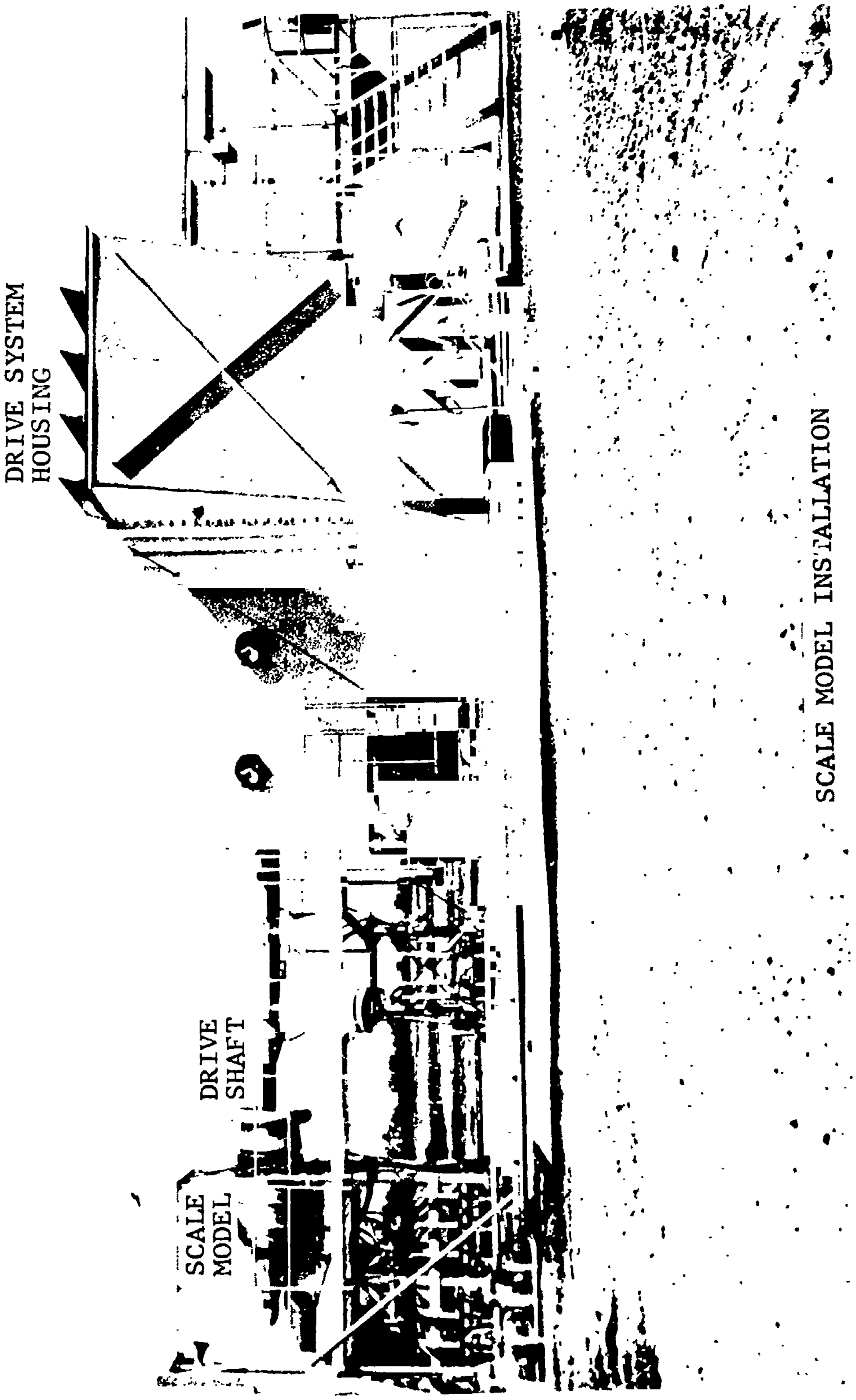
These physical speeds were set in order to avoid shifting the frequency of the tones between 1/3 octave bands due to day to day ambient temperature variations.

AERIAL VIEW OF PEEBLES
TEST FACILITY SITE 4

Figure 7


CROSSWIND FACILITY
CONTROL
HOUSE
FULL SCALE ENGINE
TEST STAND
SCALE MODEL FAN
TEST STAND
AERIAL VIEW OF
GE PEEBLES SOUND FIELD

Figure 8



SCALE MODEL INSTALLATION

Figure 9

TABLE III

QEP FAN B SCALE MODEL TEST DATA
BASELINE AND SERRATED ROTOR WITH NOZZLE VARIATIONS

Configuration	Baseline			Serrated Rotor		
Run No.	17	14	13	31B	32	34
Test Date	10/6/70	9/19/70	9/19/70	1/23/71	1/23/71	2/6/71
Nozzle Size	Nominal	Large	Small	Nominal	Large	Small
Fan Speed	Reading Numbers			Reading Numbers		
4040 RPM	261 271	- -	218 229	489 499	509 519	537 547
4474 (Approach)	262* 272	239* 244	219* 230	490* 500	510* 520	538* 548
4700	263 273	- -	220 231	491 501	511 521	539 549
4907	264 274	240* 245	221 232	492* 502	512* 522	540* 550
5505	265* 275	- -	222* 233	493 503	513 523	541 551
5990	266* 276	241* 246	223* 234	494* 504	514* 524	542* 552
6354	267 277	- -	224 235	495 505	515 525	543 553
6526	268 278	242 247	226 236	496 506	516 526	544 554
6649	269 279	- -	227 237	497* 507	517* 527	545* 555
6845 (Takeoff)	270* 280	243* 248	228* 238	498 508	518 528	546 556

Small Nozzle = 372 in^2 (.24 m^2)
Nominal Nozzle = 396 in^2 (.26 m^2)
Large Nozzle = 460 in^2 (.30 m^2)

*100-foot, 1/3 octave data are presented in the Appendix.

Moreover, the following restrictions were imposed on acoustic testing:

1. Acoustic data were not taken with steady winds greater than 5 mph (8.05 km/sec) or gusts greater than 3 mph (4.83 km/sec);
2. Water or snow accumulation on the sound field prohibited testing;
3. Rain, snow or fog at the test site prohibited testing;
4. Testing was restricted to conditions where the relative humidity was greater than 30% and lower than 90%;
5. No absolute level acoustic data was taken while aerodynamic instrumentation was installed.

The acoustic data was taken[2] with microphones located on a 100 foot (30.5 m) arc, positioned at 10 degree increments from 20° to 160° as measured from the fan inlet centerline at the rotor leading edge. The microphones were set at the height of the fan centerline, 12 feet (3.7 m) above the sound field surface. This sound field surface consisted of a level, 250 ft. (76.3 m) arc of crushed stone. The 1/3 octave scale model data used to prepare this report are presented in the Appendix, Section VII.

In addition to providing comparative data on noise reduction features, the scale model results were used to predict the full scale fan noise levels.

[2] Kazin, S.B., Minzner, W.R., and Paas, J.E., "Acoustic Testing of a 1.5 Pressure Ratio, Low Tip Speed Fan (QEP Fan B Scale Model), NASA CR-120789, pp 13, 17 and 20-25.

V. Acoustic Data Analysis

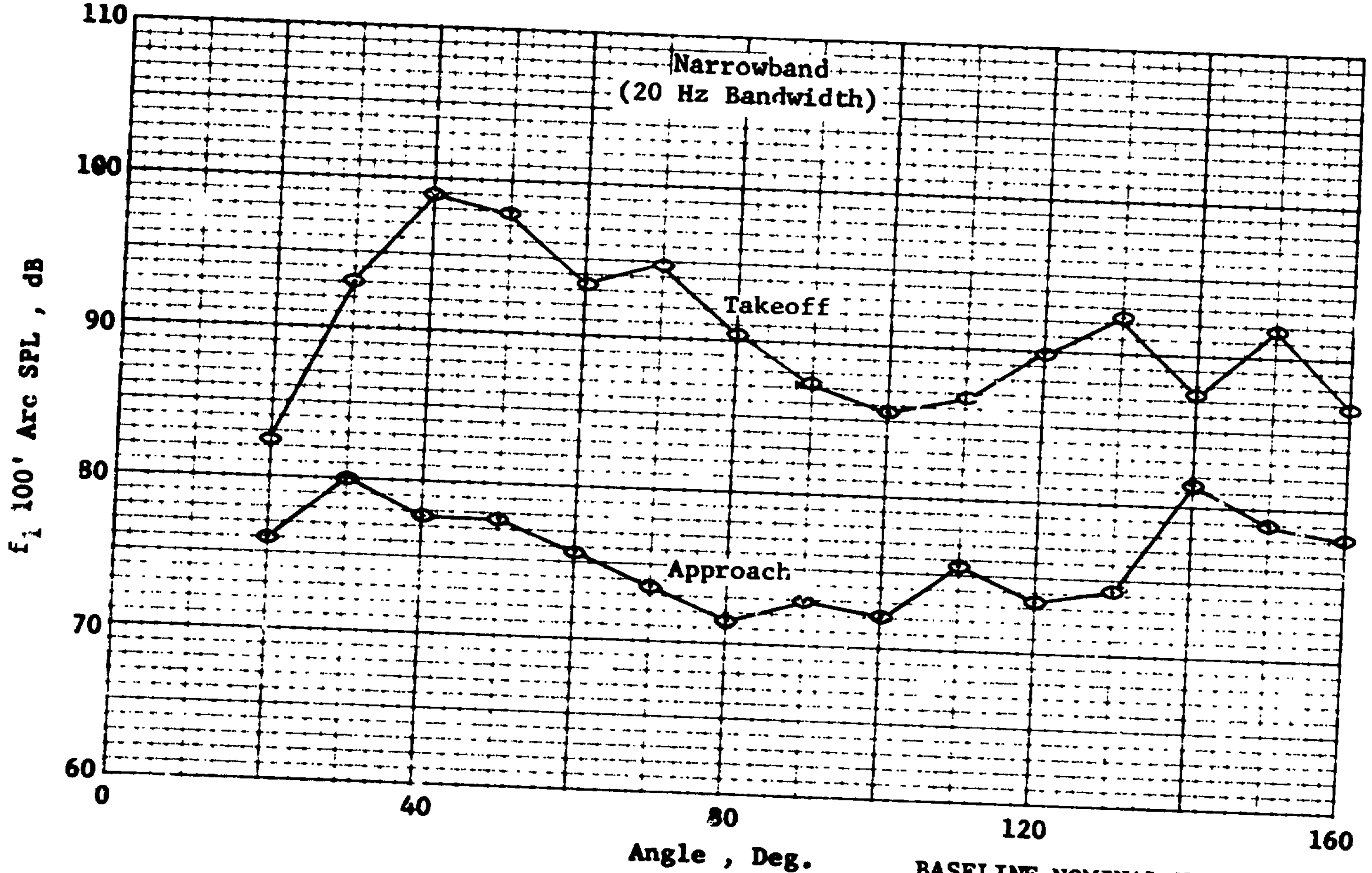
A. Noise Variations with Speed

The noise characteristics of scale model Fan B with the nominal nozzle are shown in Figures 10-14 at several speeds for the configuration with nominal rotor blades. The data presented were recorded around a 100 foot (30.5 m) arc and have been corrected to Standard Day conditions of 59°F (15°C) temperature and 70% relative humidity.

Figures 10 and 11 show the distribution of the fundamental and second harmonic respectfully around the arc at approach and takeoff thrust. The SPL's of the tones were derived from narrowband data and then corrected to Standard Day. The sound power levels were calculated from these tone SPL values. The fundamental at approach was 17.4 dB PWL lower than at takeoff thrust and the second harmonic was 10.3 dB PWL lower at approach than at takeoff. The maximum takeoff fundamental and approach second harmonic tones occurred in the front quadrant while the maximum approach fundamental and takeoff second harmonic tones occurred in the rear quadrant.

Figures 12 and 13 present the 1/3 octave spectrum at 50° and 130° respectfully, for corrected fan speeds of approximately 60%, 70%, 80% and 90%. Although the blade passing frequency occurred within different 1/3 octave bands for the different fan speeds, it can be seen that both the fundamental and second harmonic tones increased with increasing speed. Further, the broadband noise level generally increased with speed at both angles. (The 1/3 octave scale model data for all angles is presented in the Appendix).

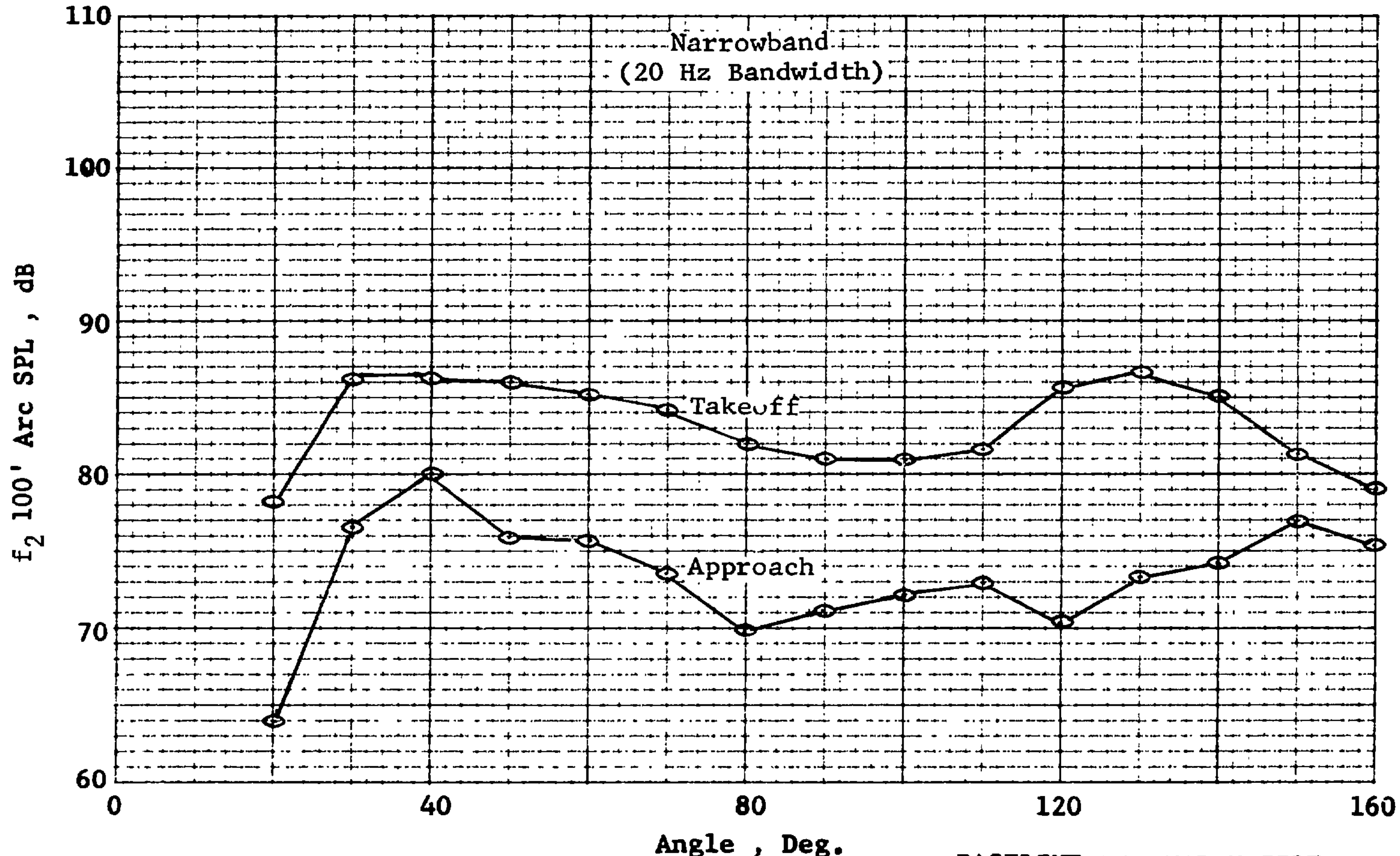
SCALE MODEL FAN B
FUNDAMENTAL - STANDARD DAY



BASELINE NOMINAL NOZZLE
Approach - PWL=126.6 dB
Takeoff - PWL=144.0 dB

Figure 10

SCALE MODEL FAN B
SECOND HARMONIC - STANDARD DAY



BASELINE NOMINAL NOZZLE
Approach - PWL=125.5 dB
Takeoff - PWL=135.8 dB

Figure 11

QEP FAN B SCALE MODEL RESULTS

50°

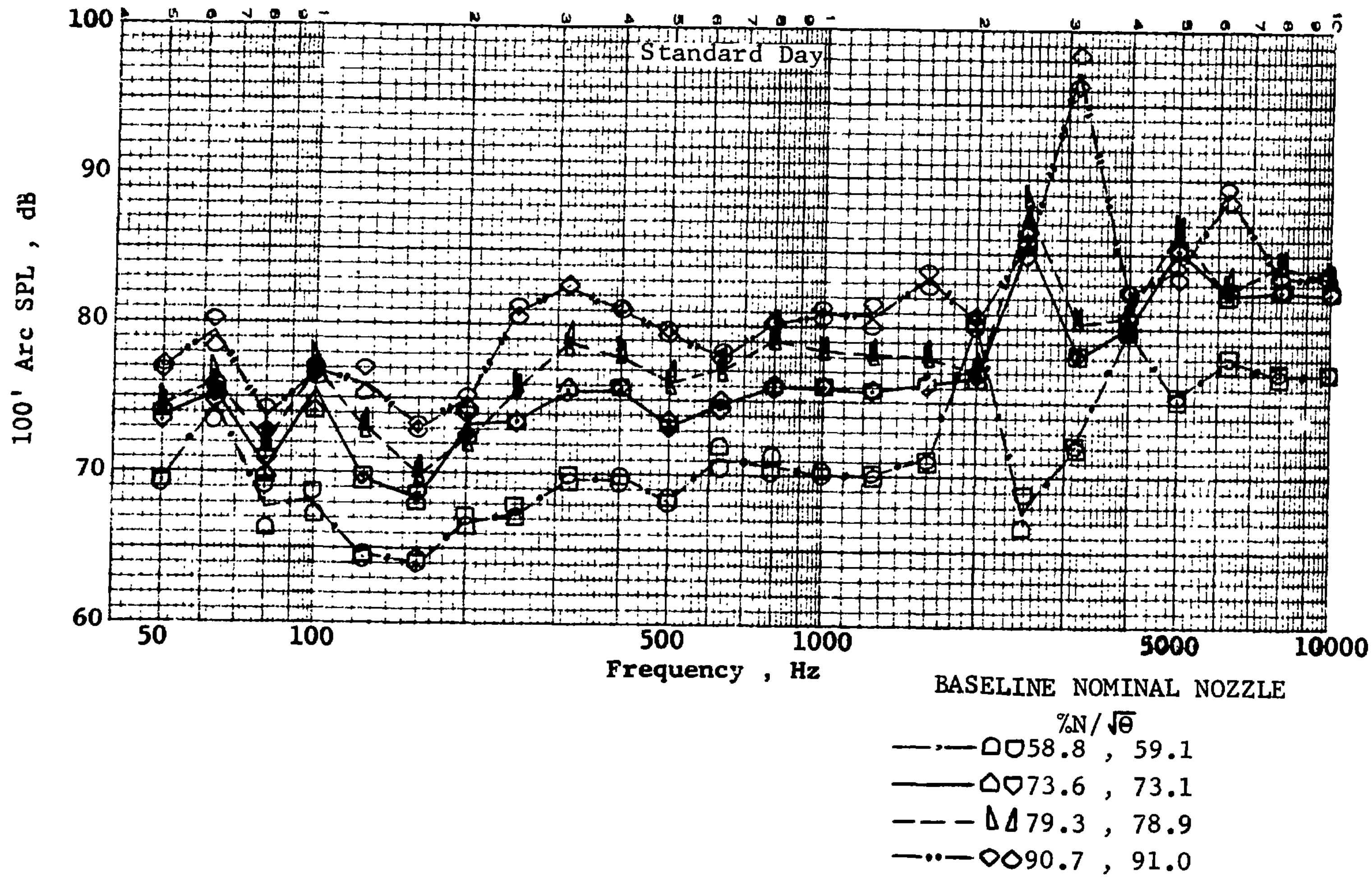


Figure 12

QEP FAN B SCALE MODEL RESULTS
130°

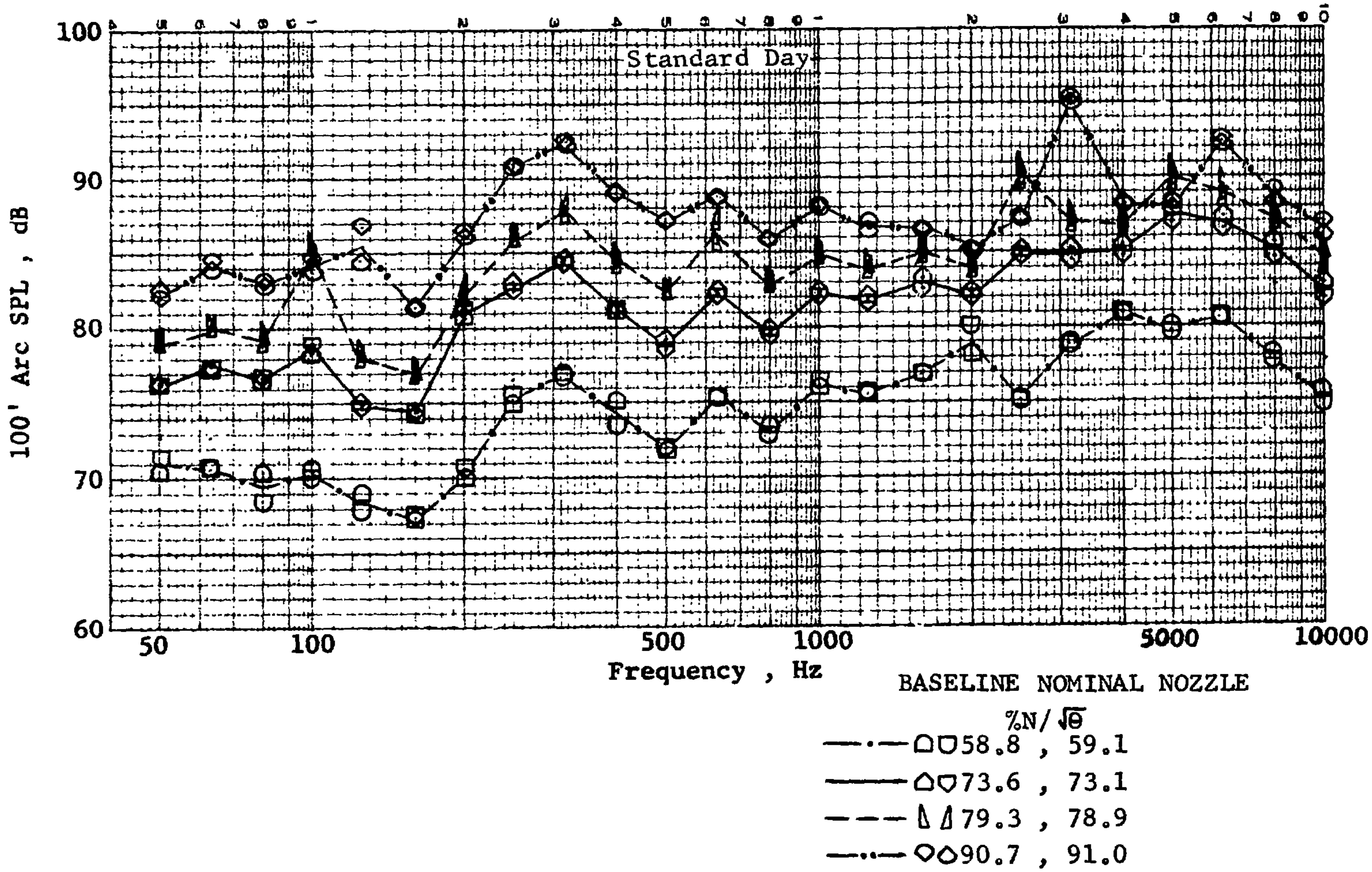


Figure 13

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS

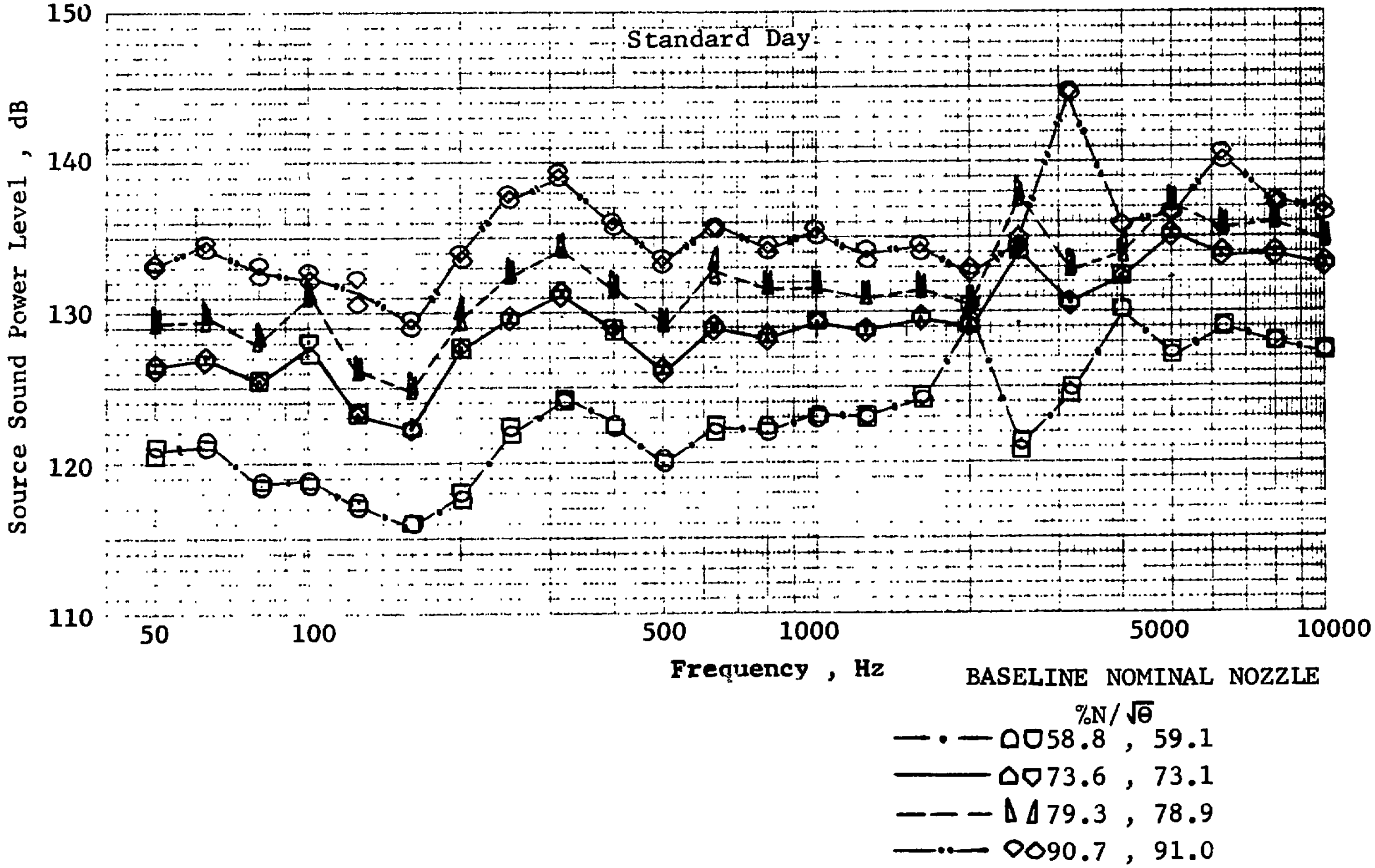


Figure 14

Figure 14 contains the sound power level spectra versus frequency for the four speeds. Again, it can be seen that the levels of the tones and the broadband noise increased with increasing speed.

B. Noise Variations with Fan Nozzle Area

Figures 15-24 present the noise characteristics of the scale model with nominal rotor blades at approach and takeoff thrusts with three different fan nozzles. These nozzles were designated small, 372 square inches (.24 m^2); nominal, 396 sq. inches (.26 m^2); and large, 460 sq. inches (.30 m^2). The data presented in these figures are for a 100 foot (30.5 m) arc.

The distribution of the fundamental and the second harmonic around the arc for the fan with each of the three nozzles is shown in Figures 15 and 16 for approach thrust and in Figures 17 and 18 for takeoff thrust. The sound pressure levels of the tones were derived from narrowband data and these levels have been corrected to Standard Day conditions. At approach, the fan tone levels were approximately the same with both the nominal and small nozzles. However, the fundamental was generally higher around the arc with the large nozzle than with the other nozzles, resulting in a 1.8 dB higher power level than produced with the nominal nozzle. The sound power level of the second harmonic was also greater with the large nozzle, although the difference in SPL occurred only at 120° and 130°. In comparison, at takeoff thrust, the fan with the nominal nozzle produced notably higher fundamental tones - 5.2 dB PWL higher than with the large nozzle and 3.5 dB PWL higher than with the small nozzle. These fundamental tones were particularly higher in the front quadrant. Similarly, the second harmonic produced by the fan with the nominal nozzle was 3.2 dB PWL higher than with the large nozzle, again the difference occurred primarily in the front quadrant. In contrast, however, the second harmonic resulting with the small nozzle was generally the same tone level as with the nominal nozzle.

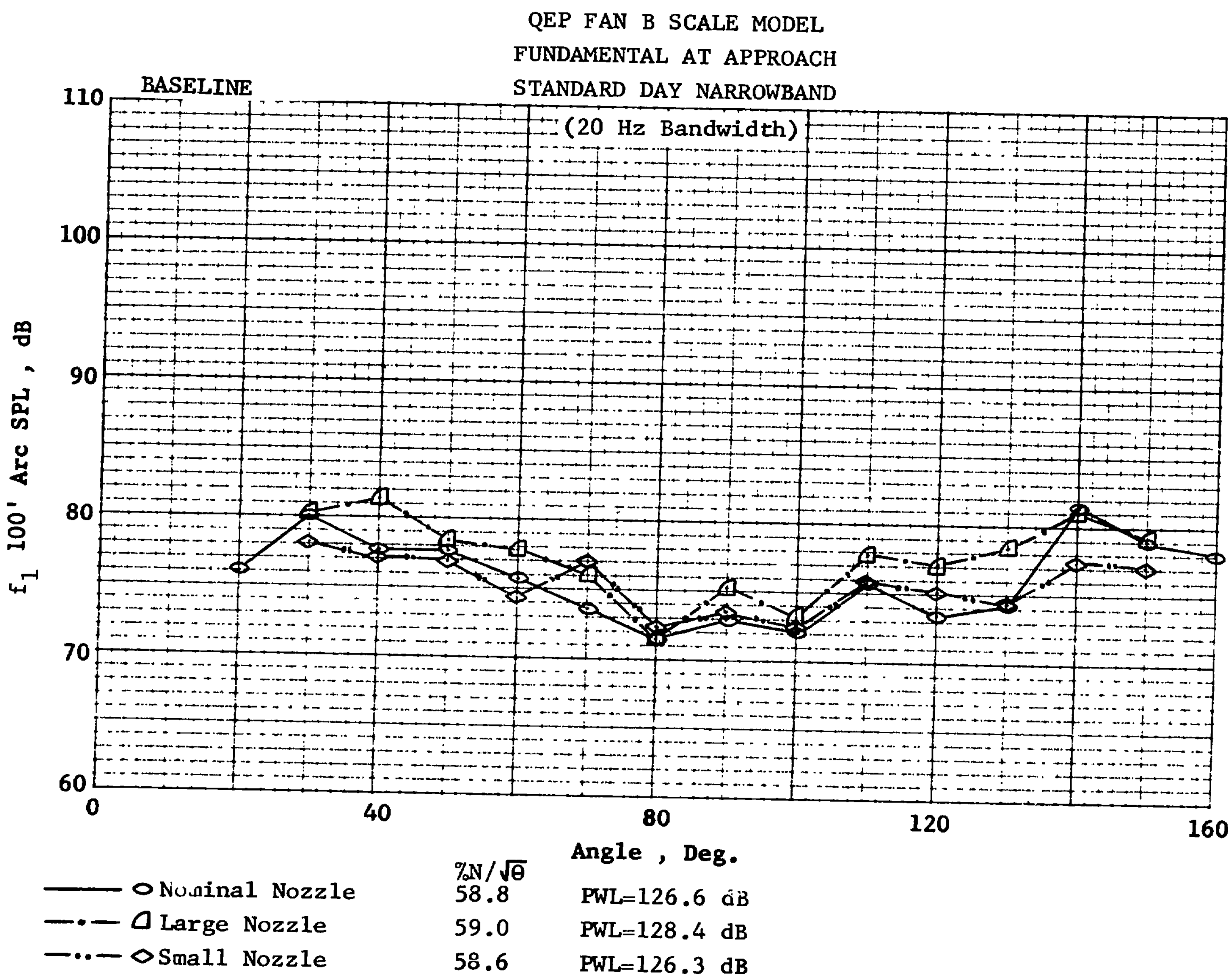

QEP FAN B SCALE MODEL
FUNDAMENTAL AT APPROACH
STANDARD DAY NARROWBAND
(20 Hz Bandwidth)
BASELINE
110
100
90
80
70
60
0
40
80
120
160
f_1 100' Arc SPL , dB
Angle , Deg.
%N/√θ
Nominal Nozzle 58.8 PWL=126.6 dB
Large Nozzle 59.0 PWL=128.4 dB
Small Nozzle 58.6 PWL=126.3 dB

Figure 15

QEP FAN B SCALE MODEL
SECOND HARMONIC AT APPROACH
STANDARD DAY NARROWBAND

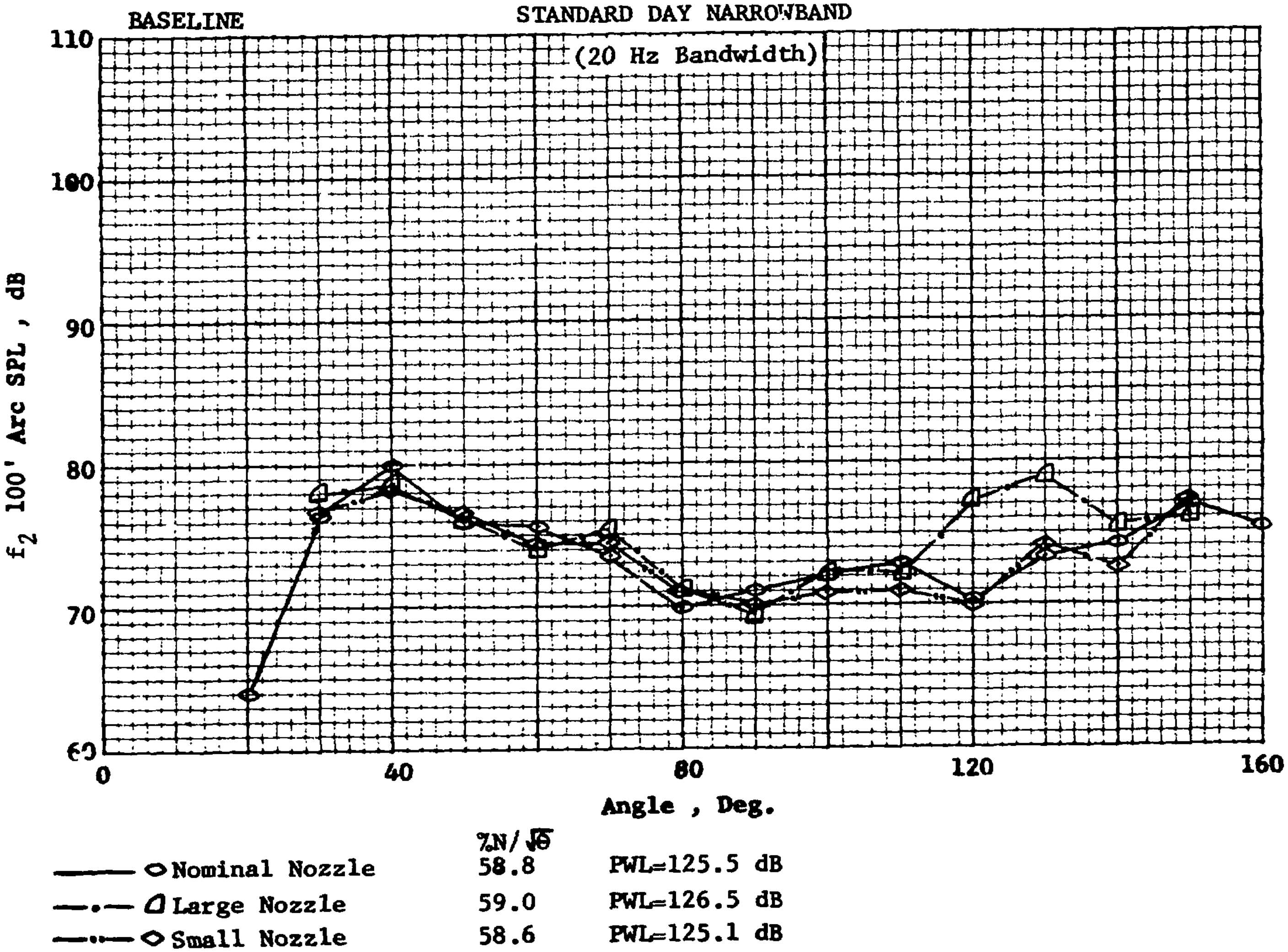


Figure 16

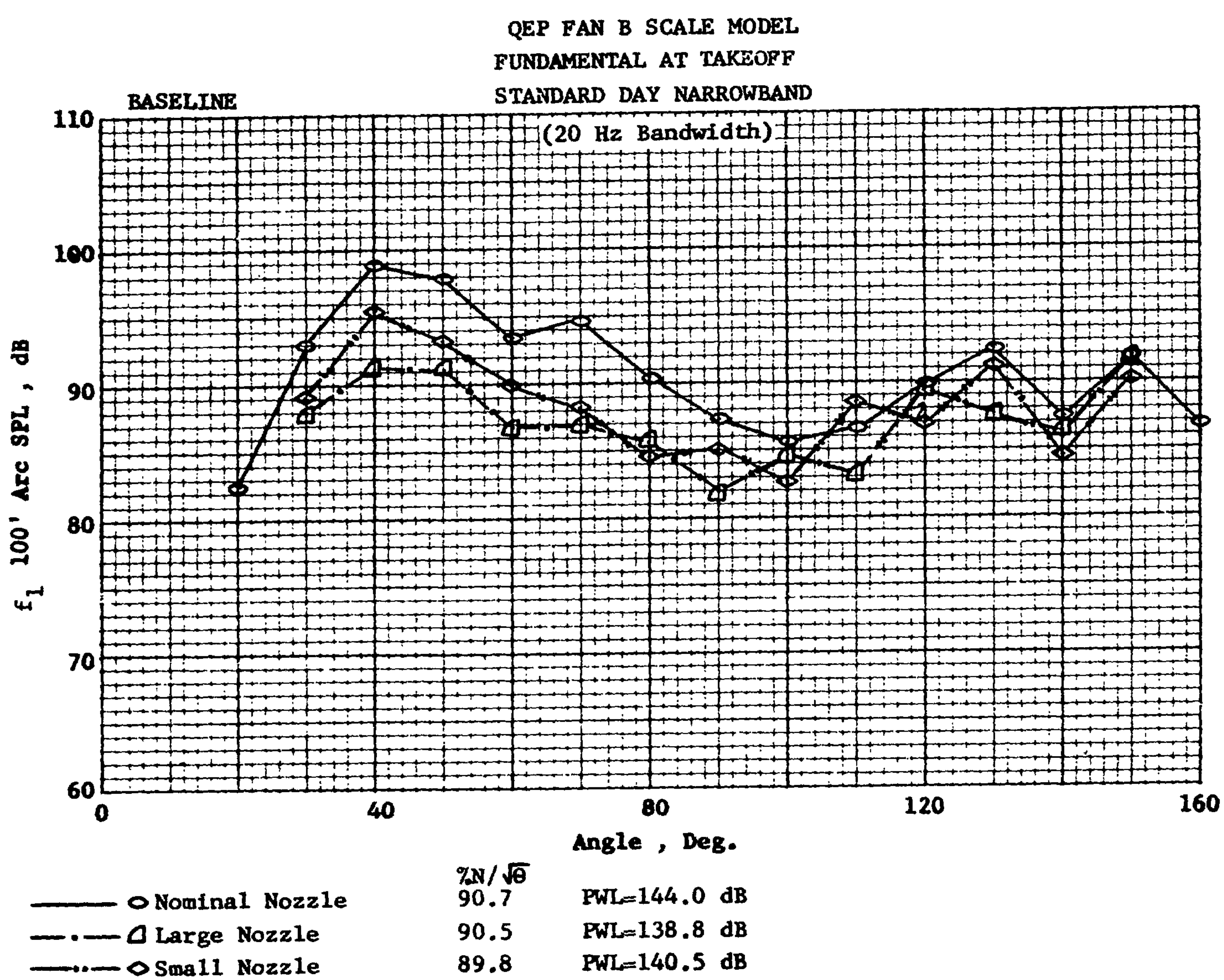

QEP FAN B SCALE MODEL
FUNDAMENTAL AT TAKEOFF
STANDARD DAY NARROWBAND
(20 Hz Bandwidth)
BASELINE
f_1 100' Arc SPL , dB
110
100
90
80
70
60
0
40
80
120
160
Angle , Deg.
%N/√θ
Nominal Nozzle 90.7 PWL=144.0 dB
Large Nozzle 90.5 PWL=138.8 dB
Small Nozzle 89.8 PWL=140.5 dB

Figure 17

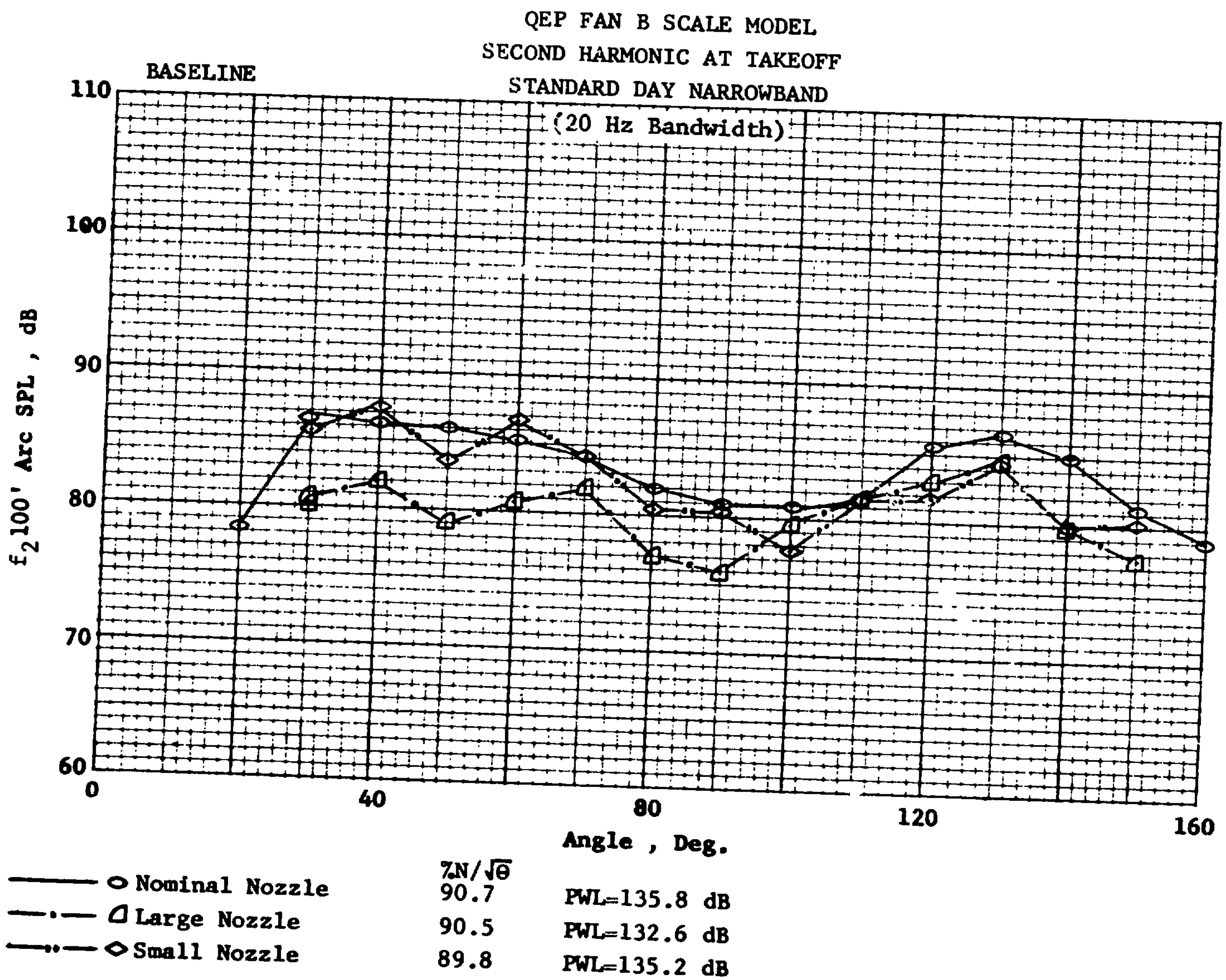

QEP FAN B SCALE MODEL
SECOND HARMONIC AT TAKEOFF
STANDARD DAY NARROWBAND
(20 Hz Bandwidth)
BASELINE
110
100
90
80
70
60
f_2 100' Arc SPL , dB
0
40
80
120
160
Angle , Deg.
%N/√θ
Nominal Nozzle 90.7 PWL=135.8 dB
Large Nozzle 90.5 PWL=132.6 dB
Small Nozzle 89.8 PWL=135.2 dB

Figure 18

The 1/3 octave spectra are presented at 50° and 130° for approach thrust, Figures 19 and 20, and for takeoff thrust, Figures 21 and 22. The spectra show that the fundamental was much more prominent at 50° than at 130°, especially for takeoff thrust. Of the three nozzles, the spectra indicate that the fan with the small nozzle generated the most broadband noise from 500 to 1600 Hz, while the least amount was produced with the large nozzle.

Figure 23 contains sound power levels versus frequency for the three nozzles at approach thrust. The spectra shows the same relative broadband noise levels among the three nozzles as does the 1/3 octave data. From 200 to 1600 Hz, the fan with the small nozzle was 3 dB to 4½ dB PWL higher than with the nominal nozzle which was, in turn, higher than the large nozzle throughout this frequency range. Figure 24 contains the PWL spectra at takeoff thrust for the three nozzles. At this thrust level, the broadband noise was again higher with the small nozzle than with the other nozzles, although the difference was not as great as that at approach thrust.

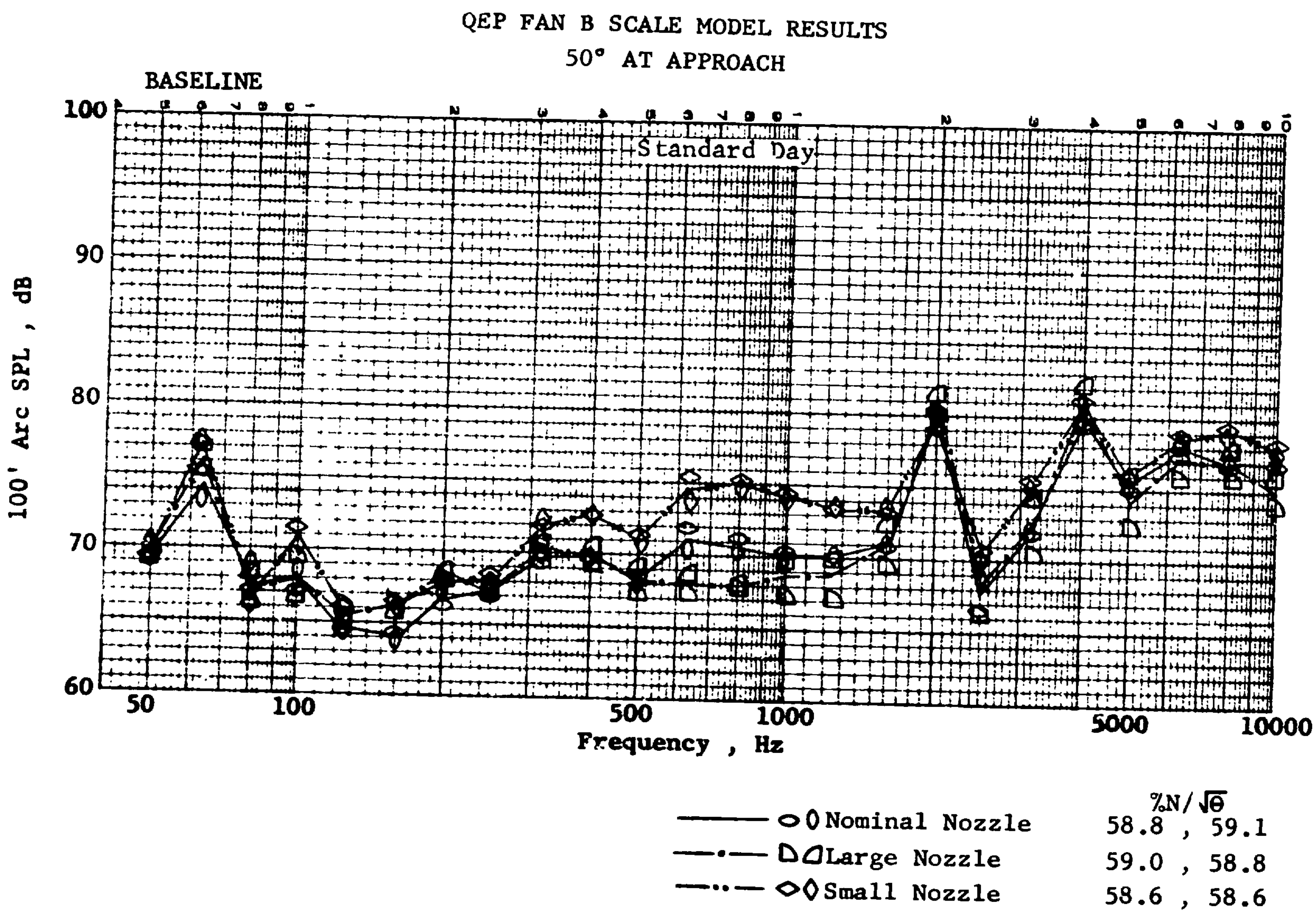
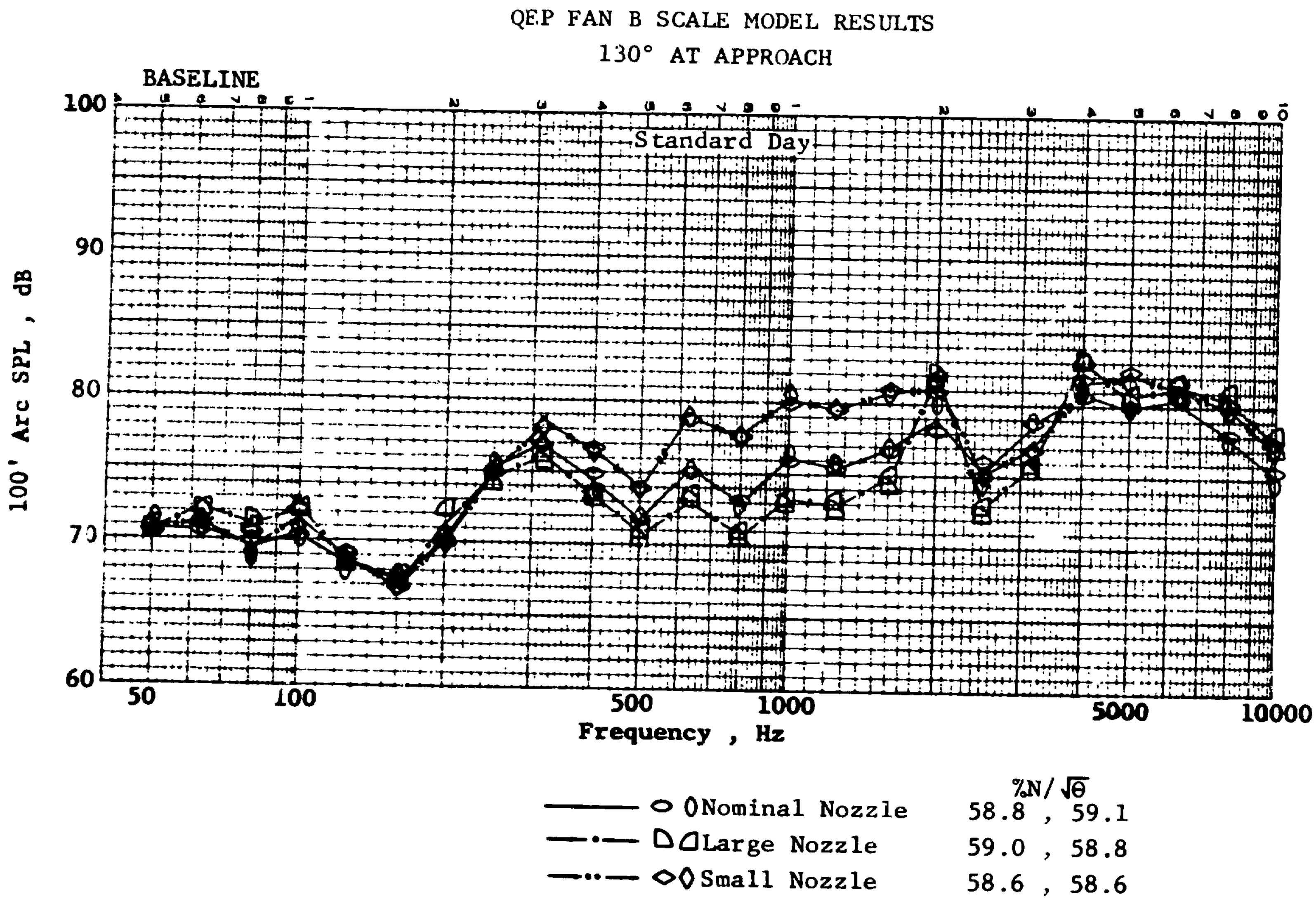

QEP FAN B SCALE MODEL RESULTS
50° AT APPROACH
BASELINE
Standard Day
100' Arc SPL , dB
100
90
80
70
60
50
100
500
1000
5000
10000
Frequency , Hz
%N/√θ
Nominal Nozzle 58.8 , 59.1
Large Nozzle 59.0 , 58.8
Small Nozzle 58.6 , 58.6

Figure 19



QEP FAN B SCALE MODEL RESULTS
130° AT APPROACH
BASELINE
Standard Day
100
90
80
70
60
100' Arc SPL , dB
50
100
500
1000
5000
10000
Frequency , Hz
%N/ √θ
Nominal Nozzle 58.8 , 59.1
Large Nozzle 59.0 , 58.8
Small Nozzle 58.6 , 58.6

Figure 20

QEP FAN B SCALE MODEL RESULTS
50° AT TAKEOFF

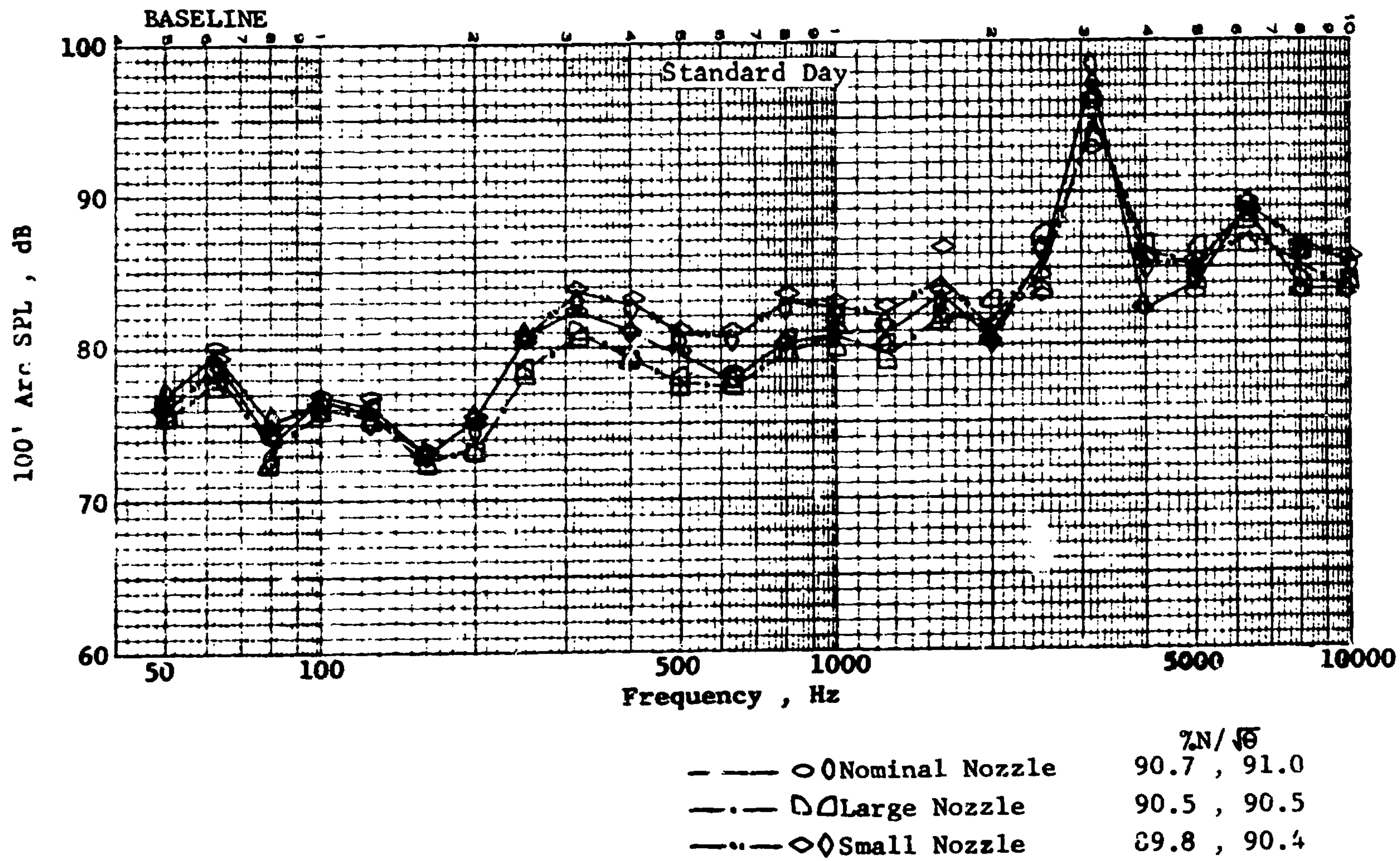
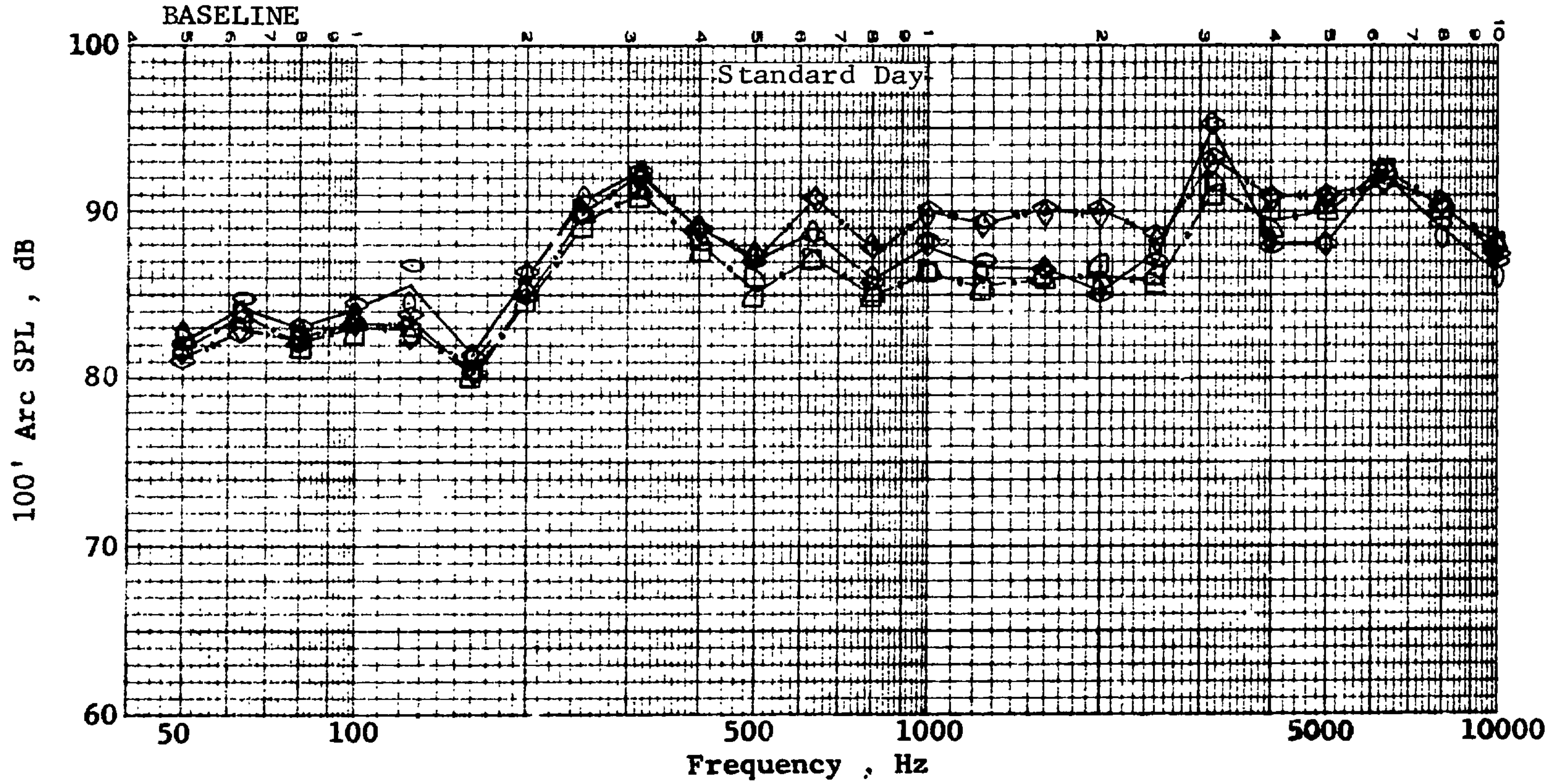


Figure 21

QEP FAN B SCALE MODEL RESULTS
130° AT TAKEOFF



		$\%N/\sqrt{\theta}$
——— ○ ()	Nominal Nozzle	90.7 , 91.0
—·— □ ◿	Large Nozzle	90.5 , 90.5
—··— ◇ ◊	Small Nozzle	89.8 , 90.4

Figure 22

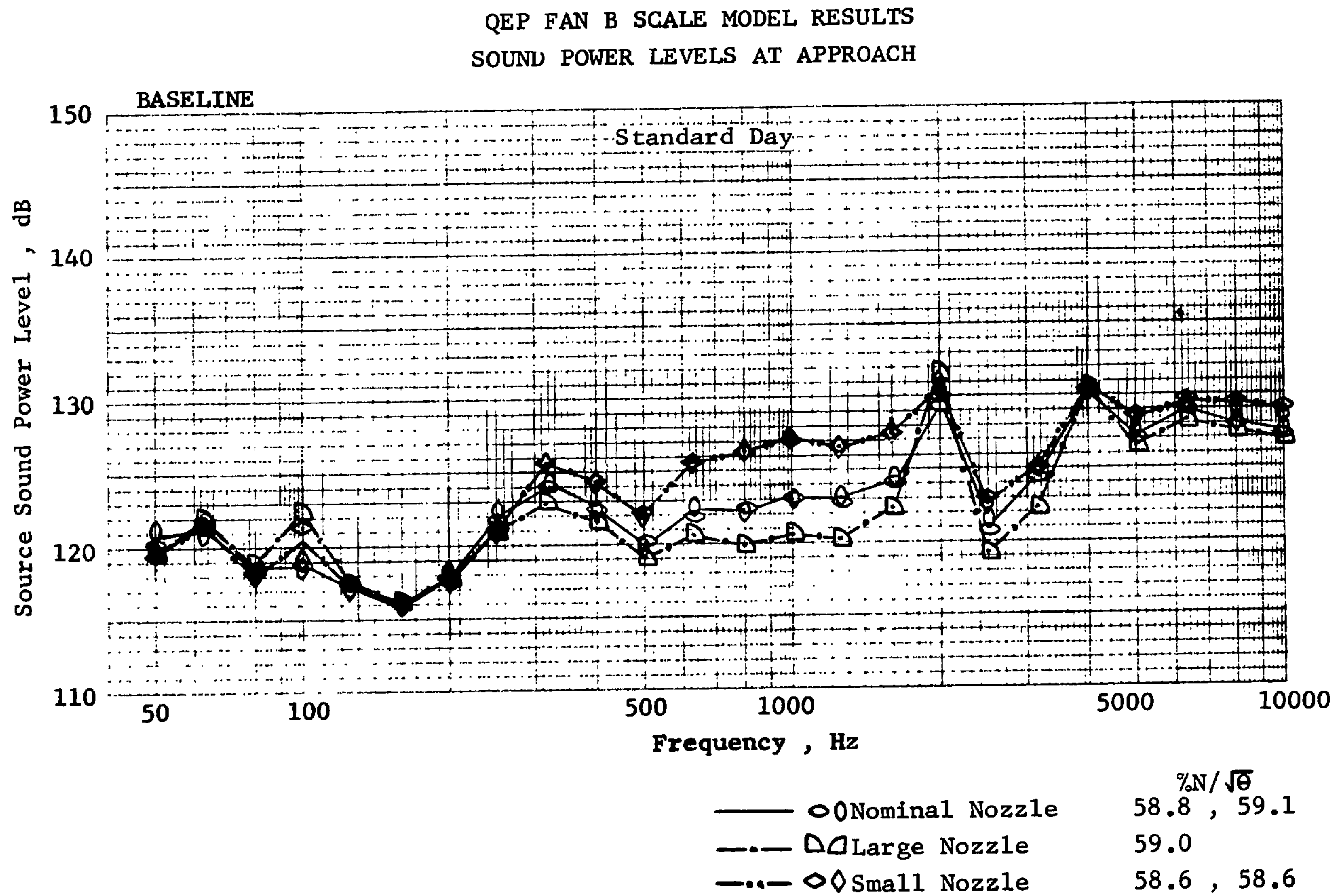

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS AT APPROACH
BASELINE
Standard Day
Source Sound Power Level , dB
150
140
130
120
110
50
100
500
1000
5000
10000
Frequency , Hz
%N/√θ
Nominal Nozzle 58.8 , 59.1
Large Nozzle 59.0
Small Nozzle 58.6 , 58.6

Figure 23

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS AT TAKEOFF

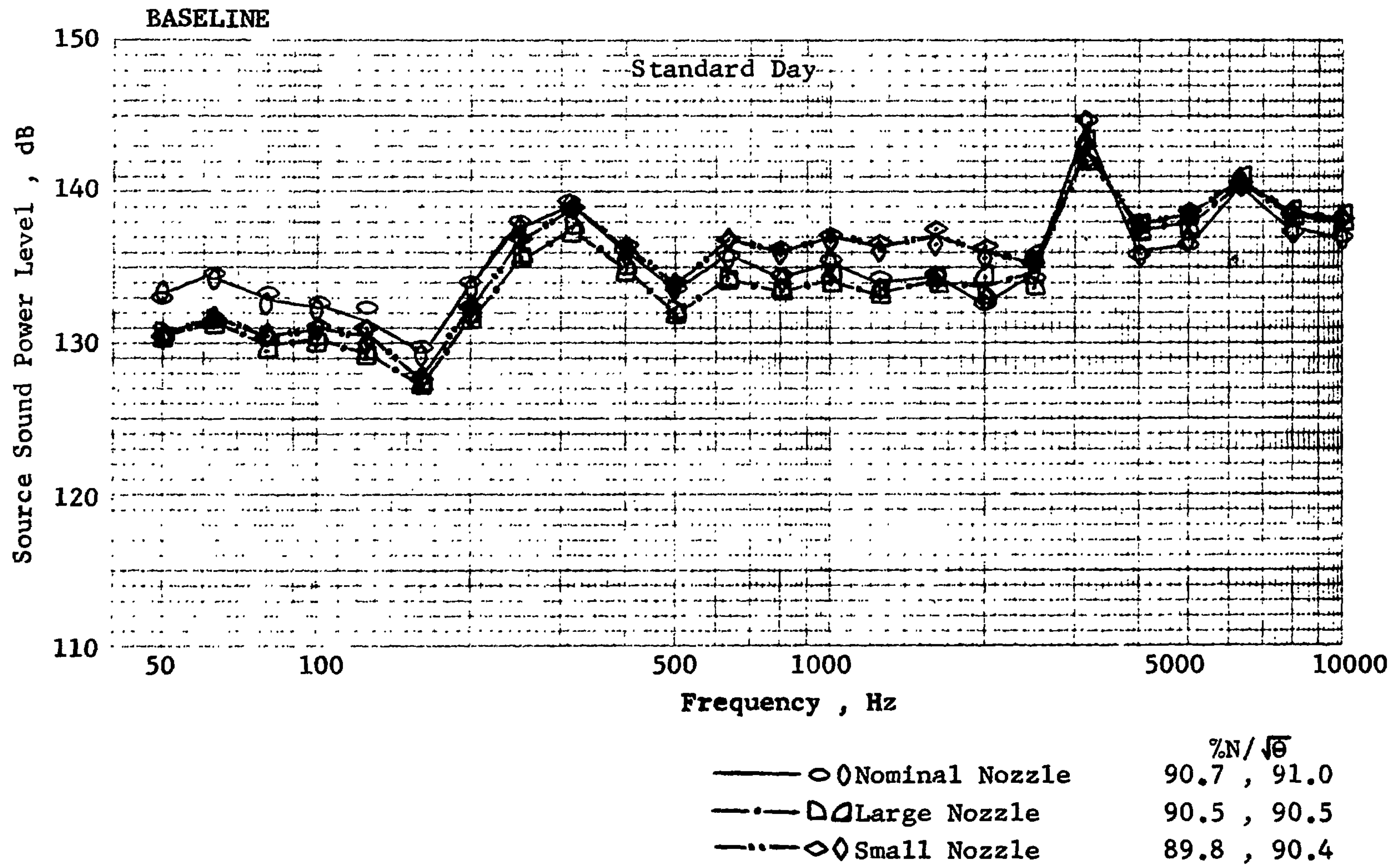


Figure 24

C. SERRATED ROTOR EFFECTS

Comparisons of the treated baseline and the serrated rotor configurations of the scale model fan with the nominal nozzle are presented in Figures 25-34. Both of these configurations contained acoustic treatment in the fan frame. In fact, these two configurations differ only by the rotor blading. The details of the rotor serrations are presented in Section III, Test Vehicle Description.

Figures 25-28 show the distribution of the fundamental and second harmonic around the 100 foot (30.5 m) arc as derived from narrowband data which have been corrected to Standard Day conditions. At approach thrust, (Figures 25 and 26), no significant tone power level differences are indicated by the data for either the fundamental or second harmonic tones. Figures 27 and 28 present the tones at takeoff thrust and include a split PWL computed by segmenting the arc into a front quadrant with angles less 85 degrees and an aft quadrant with angles greater than 85 degrees. The data shows that the fundamental tone power levels were significantly reduced by the serrated rotor in both the front and aft quadrants. The reductions were 4.2 dB PWL and 2.1 dB PWL for the front and aft quadrants respectively, resulting in a 3.6 dB PWL reduction around the arc. In addition, the second harmonic tone power level was reduced 1.6 dB in the front quadrant by the serrated rotor. However, a noise increase of 2.1 dB PWL in the aft is indicated (controlled by the point at 130^{o}) resulting in a total PWL increase of .6 dB.

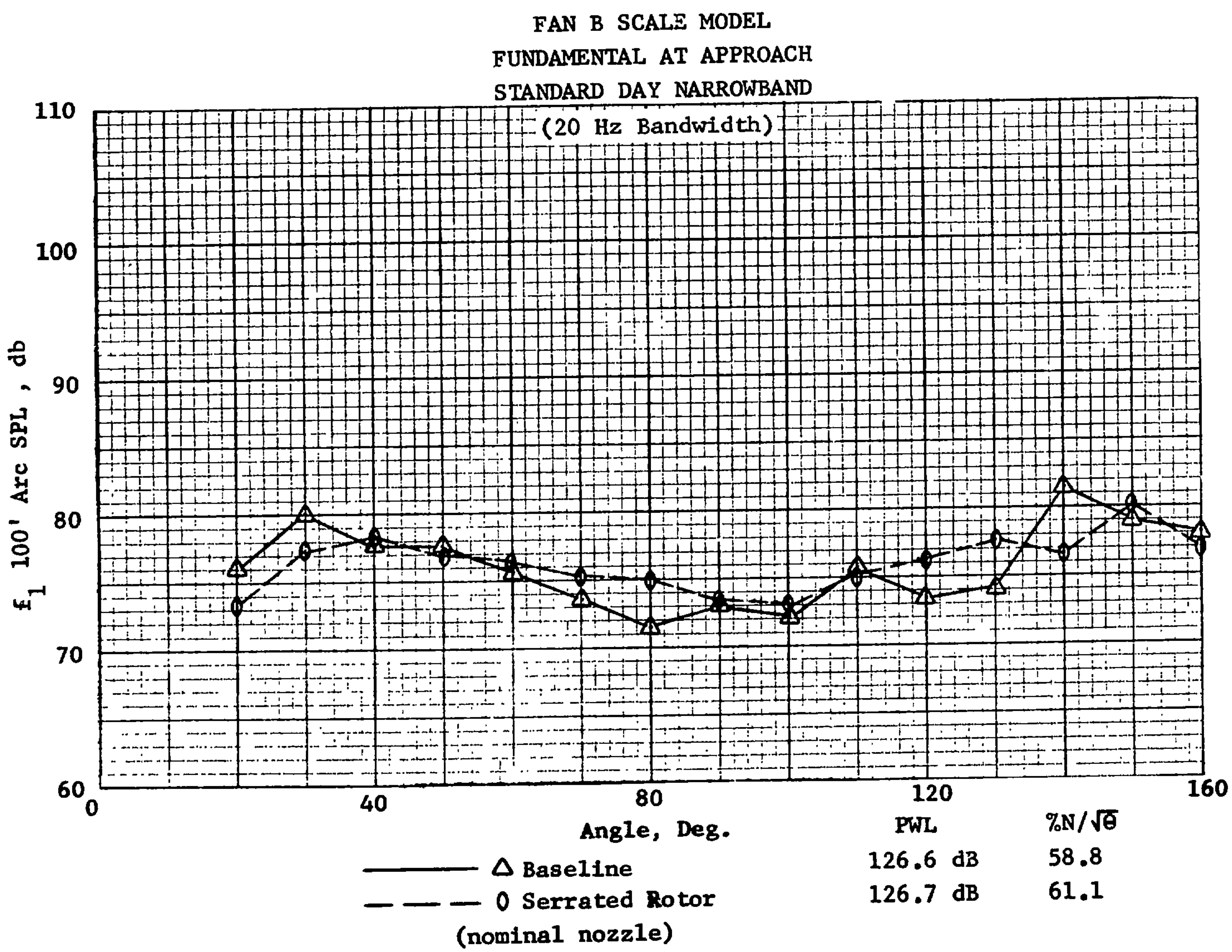

FAN B SCALE MODEL
FUNDAMENTAL AT APPROACH
STANDARD DAY NARROWBAND
(20 Hz Bandwidth)
110
100
90
80
70
60
0
40
80
120
160
f_1 100' Arc SPL , db
Angle, Deg.
Δ Baseline
0 Serrated Rotor
(nominal nozzle)
PWL
126.6 dB
126.7 dB
%N/√θ
58.8
61.1

Figure 25

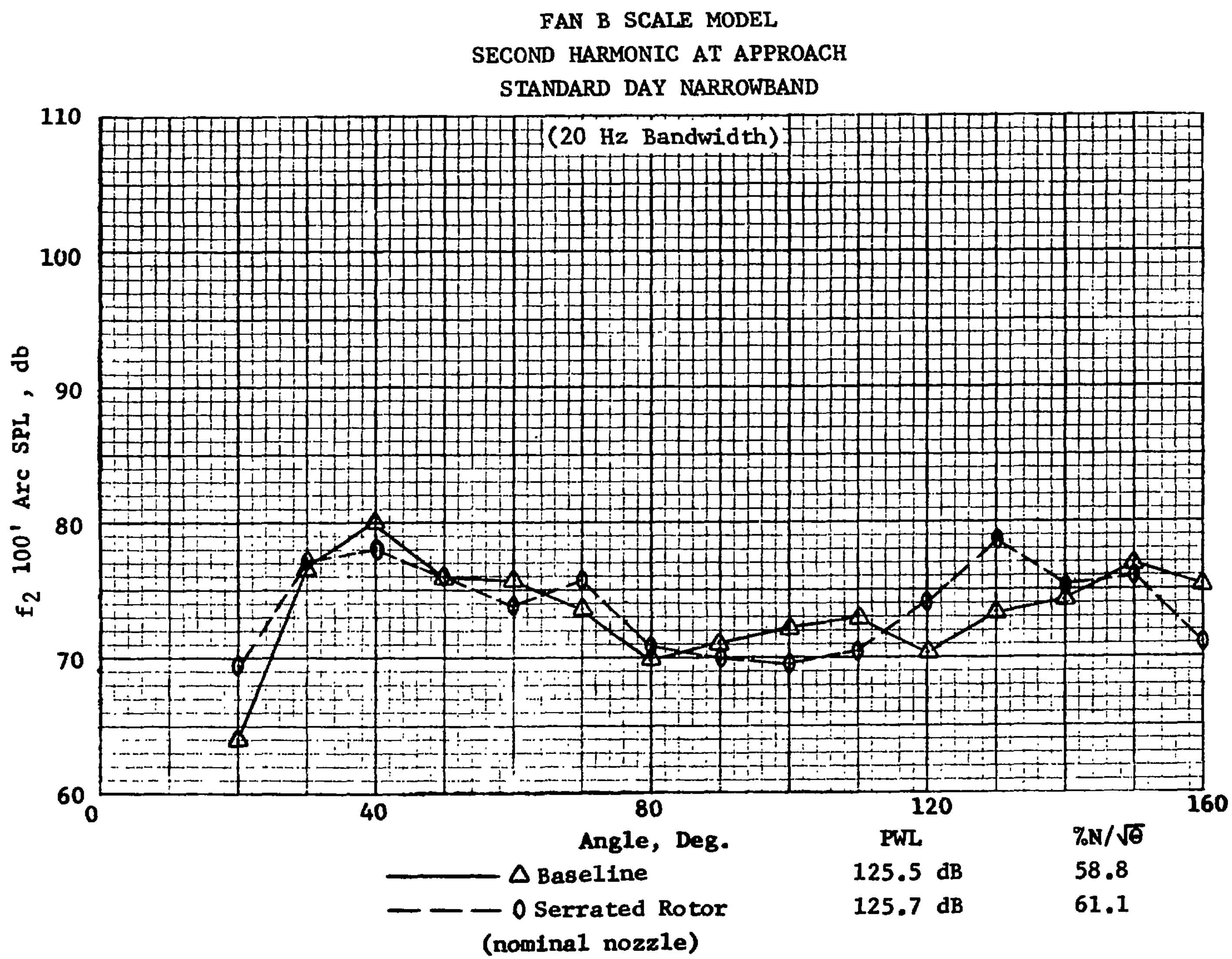

FAN B SCALE MODEL
SECOND HARMONIC AT APPROACH
STANDARD DAY NARROWBAND
(20 Hz Bandwidth)
110
100
90
80
70
60
0
40
80
120
160
f_2 100' Arc SPL , db
Angle, Deg.
PWL
%N/√θ
△ Baseline
125.5 dB
58.8
0 Serrated Rotor
(nominal nozzle)
125.7 dB
61.1

Figure 26

FAN B SCALE MODEL
FUNDAMENTAL AT TAKEOFF
BASELINE VS SERRATED ROTOR
STANDARD DAY NARROWBAND

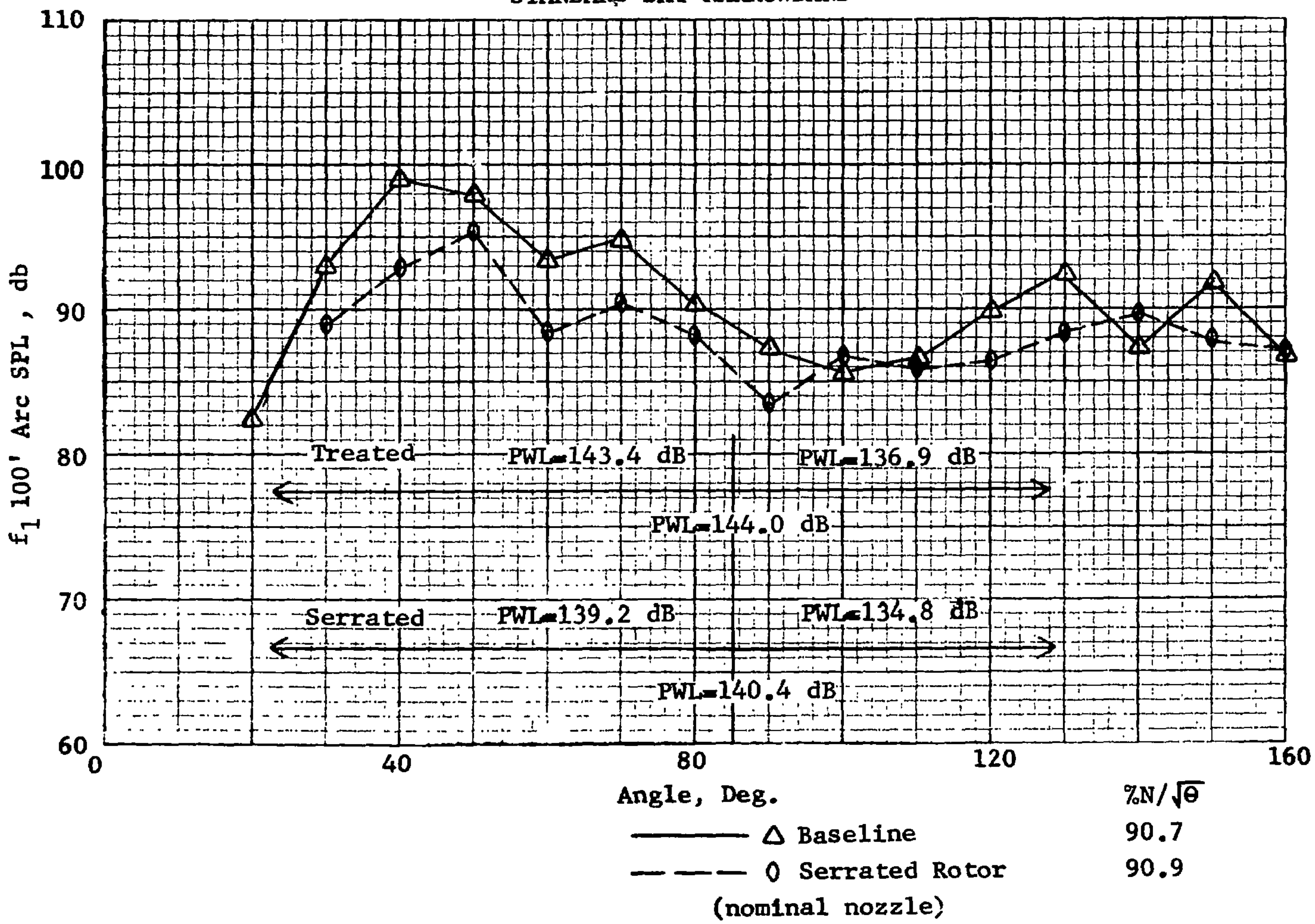


Figure 27

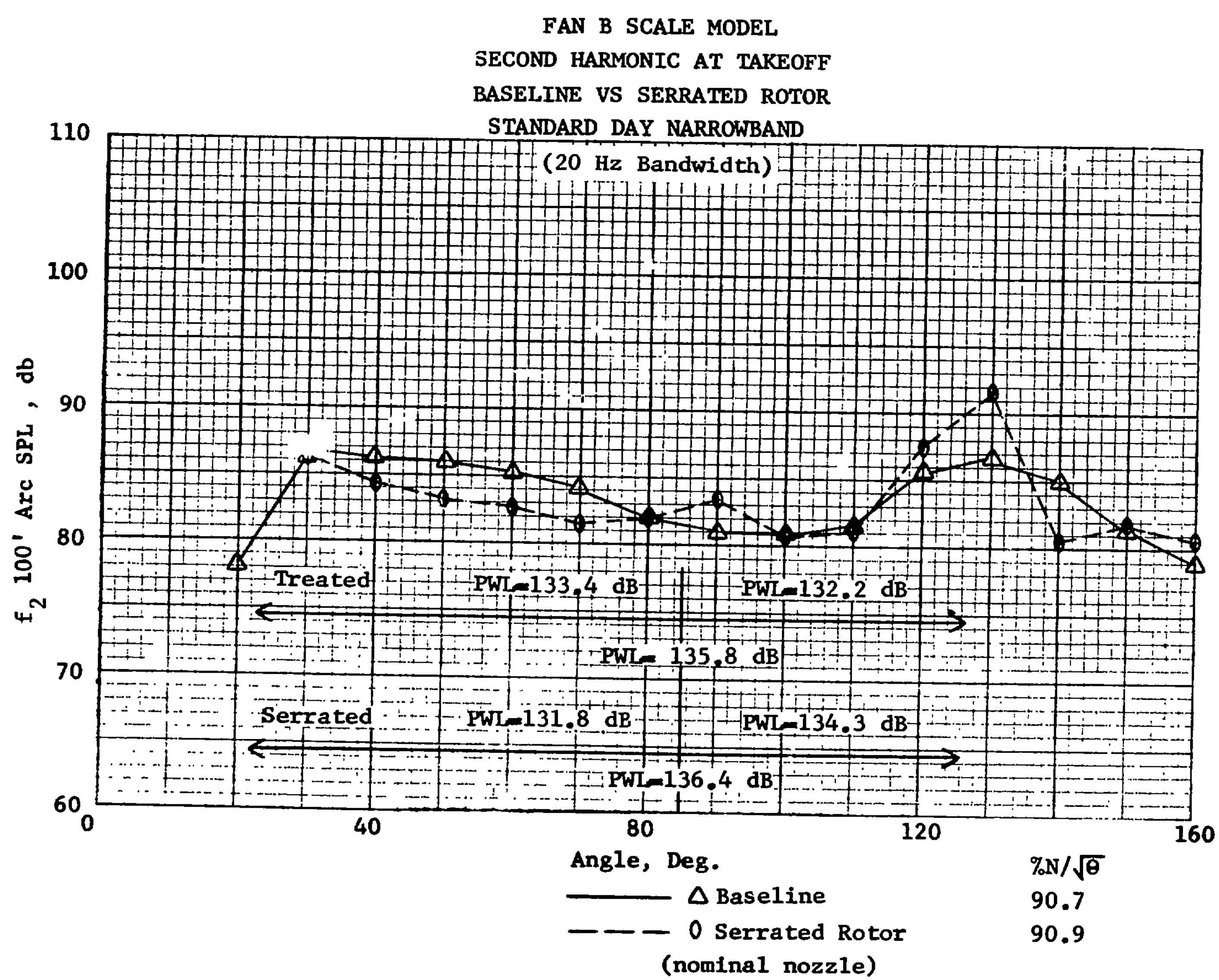

FAN B SCALE MODEL
SECOND HARMONIC AT TAKEOFF
BASELINE VS SERRATED ROTOR
STANDARD DAY NARROWBAND
(20 Hz Bandwidth)
110
100
90
80
70
60
f_2 100' Arc SPL , db
0
40
80
120
160
Treated
PWL=133.4 dB
PWL=132.2 dB
PWL= 135.8 dB
Serrated
PWL=131.8 dB
PWL=134.3 dB
PWL=136.4 dB
Angle, Deg.
%N/√θ
Δ Baseline
90.7
0 Serrated Rotor
90.9
(nominal nozzle)

Figure 28

Corresponding to the narrowband data, the 1/3 octave data show no tone reduction at approach thrust for 50° (Figure 29). The spectra show, however, that the broadband noise did increase at 2500 Hz and at frequencies above 6300 Hz with the serrated rotor. The figure also indicates that the baseline spectrum was higher at 630 Hz and 800 Hz resulting from pure tones occurring within these octave bands. At 130° (Figure 30), the serrated rotor data indicates a general noise increase above the treated baseline levels. Both tones have increased 4 dB with the serrated rotor and the broadband noise has increased as much as 6½ dB above the baseline - this maximum occurring at 10 KHz.

At takeoff thrust, on the other hand, the spectra show tone reductions of approximately 2 dB at 50° (Figure 31) due to the serrations. This figure also indicates broadband noise reductions with the serrated rotor from 1250 - 2000 Hz and between the fundamental and second harmonic tones. The magnitude of the difference occurring at 1600 Hz was due to multiple pure tones generated with the baseline configuration which did not occur with serrations. At 130° (Figure 32), the fundamental decreased with the serrated rotor while the second harmonic increased. The baseline broadband noise was lower at this angle from 8-10 KHz, with the maximum difference of 3½ dB occurring at 10 KHz. Note that the serrated rotor generates higher SPL values than the clean rotor at the high frequencies for the spectra examined.

Figure 33 contains the sound power level spectra for the two configurations at approach thrust, showing a 1 dB PWL increase at both tones as well as 2 dB or more PWL broadband noise increase at 2500 Hz and from 6300 to 10 KHz.

QEP FAN B

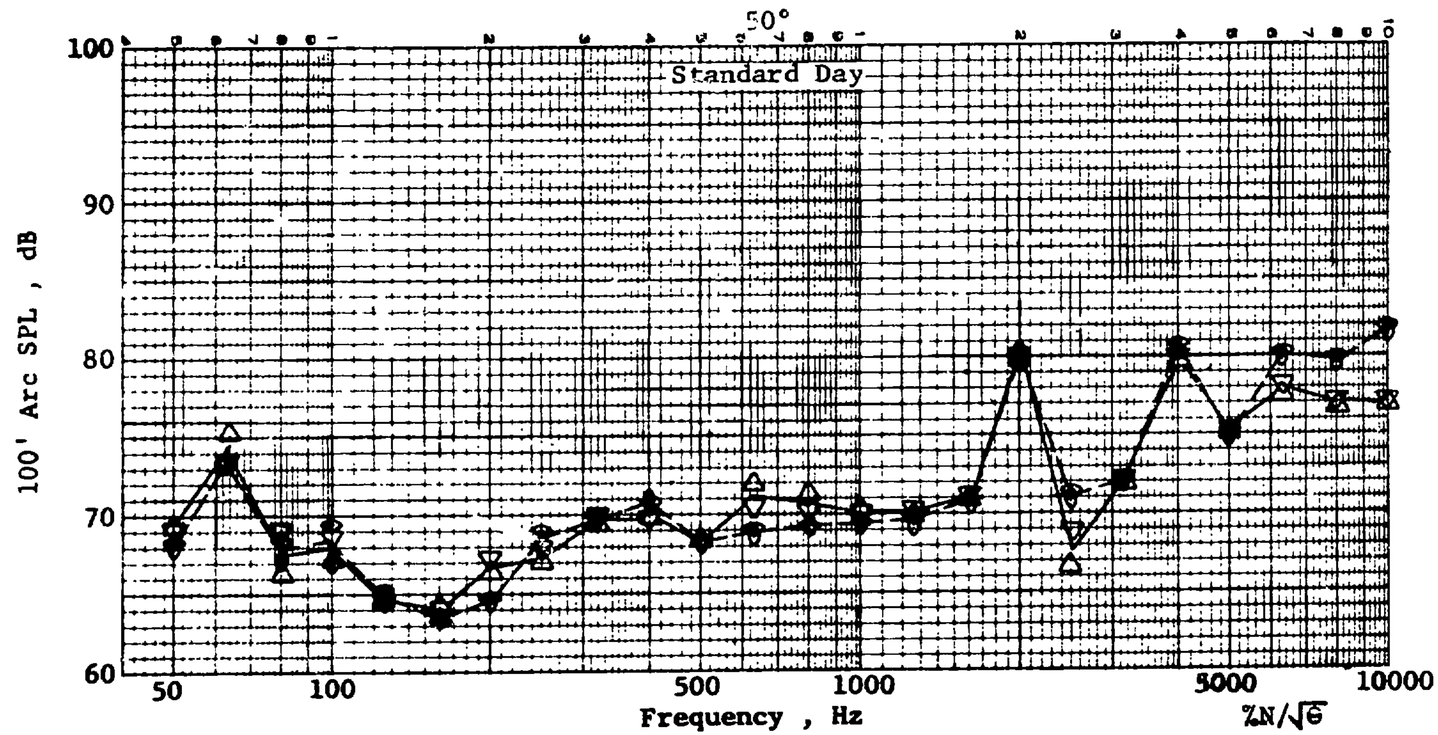
SCALE MODEL RESULTS

100' ARC SPL

BASELINE VS SERRATED ROTOR

APPROACH - SINGLE FAN

50°



———	△▽ Baseline	58.8 , 59.1
— — —	○0 Serrated Rotor	61.4 , 61.1

%N/√θ

△ 0 Correspond to Narrowband Data (nominal nozzle)

Figure 29

QEP FAN B

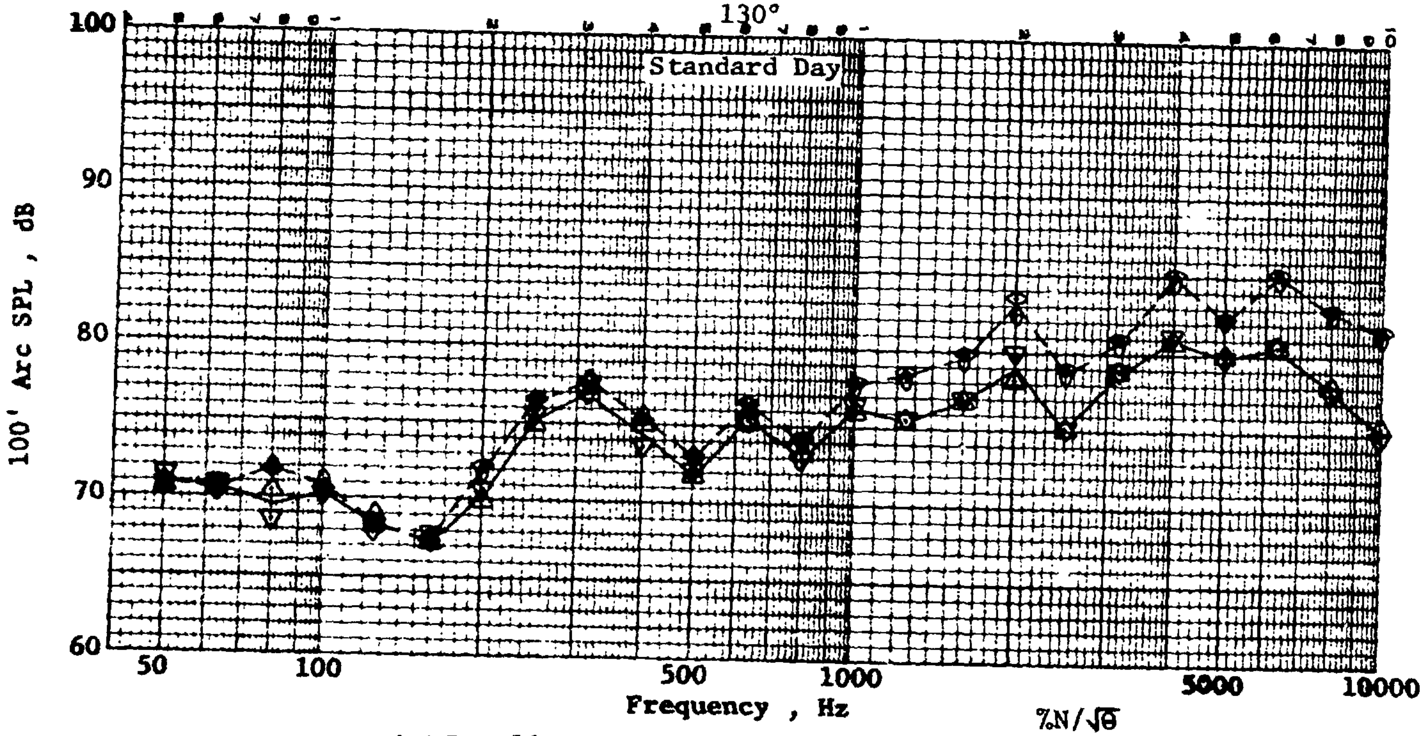
SCALE MODEL RESULTS

100' ARC SPL

BASELINE VS SERRATED ROTOR

APPROACH - SINGLE FAN

130°



——— △▽ Baseline
– – – ○ ◊ Serrated Rotor
△ ◊ Correspond to Narrowband Data (nominal nozzle)

%N/√θ
58.8 , 59.1
61.4 , 61.1

Figure 30

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

BASELINE VS SERRATED ROTOR

TAKEOFF - SINGLE FAN

50°

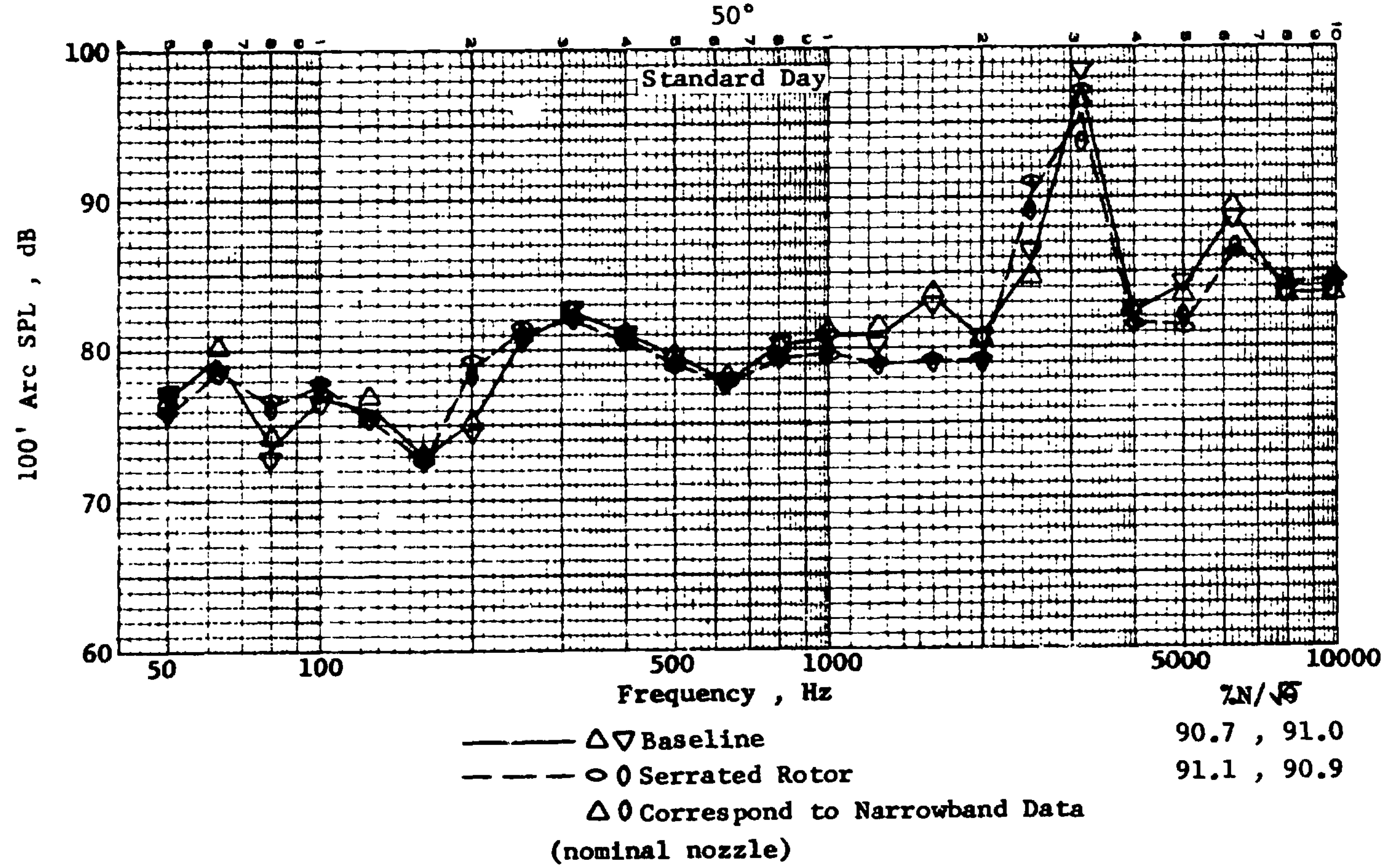


Figure 31

QEP FAN B

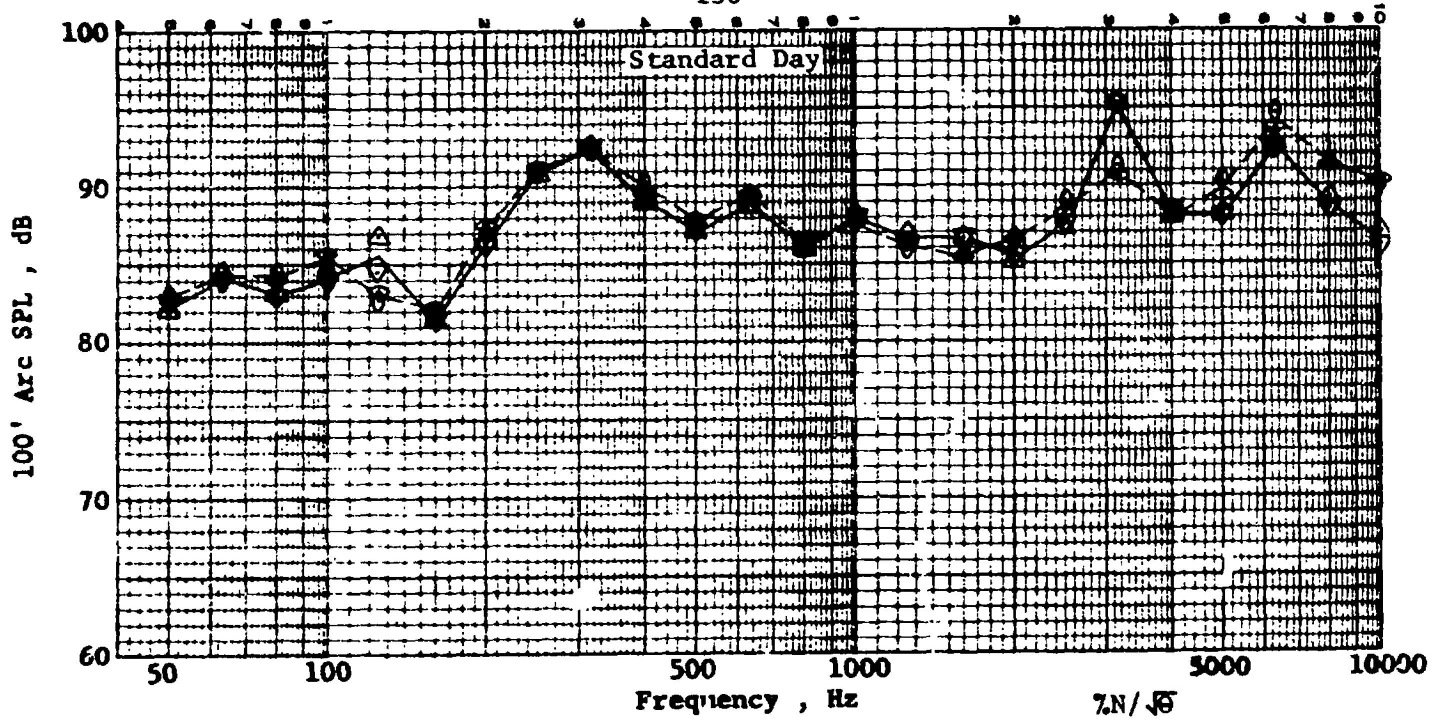
SCALE MODEL RESULTS

100' ARC SPL

BASELINE VS SERRATED ROTOR

TAKEOFF - SINGLE FAN

130°



		%N/√θ
———	△▽ Baseline	90.7 , 91.0
— — —	○◊ Serrated Rotor	91.1 , 90.9
	△◊ Correspond to Narrowband Data (nominal nozzle)	

Figure 32

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS AT APPROACH
BASELINE VS SERRATED ROTOR

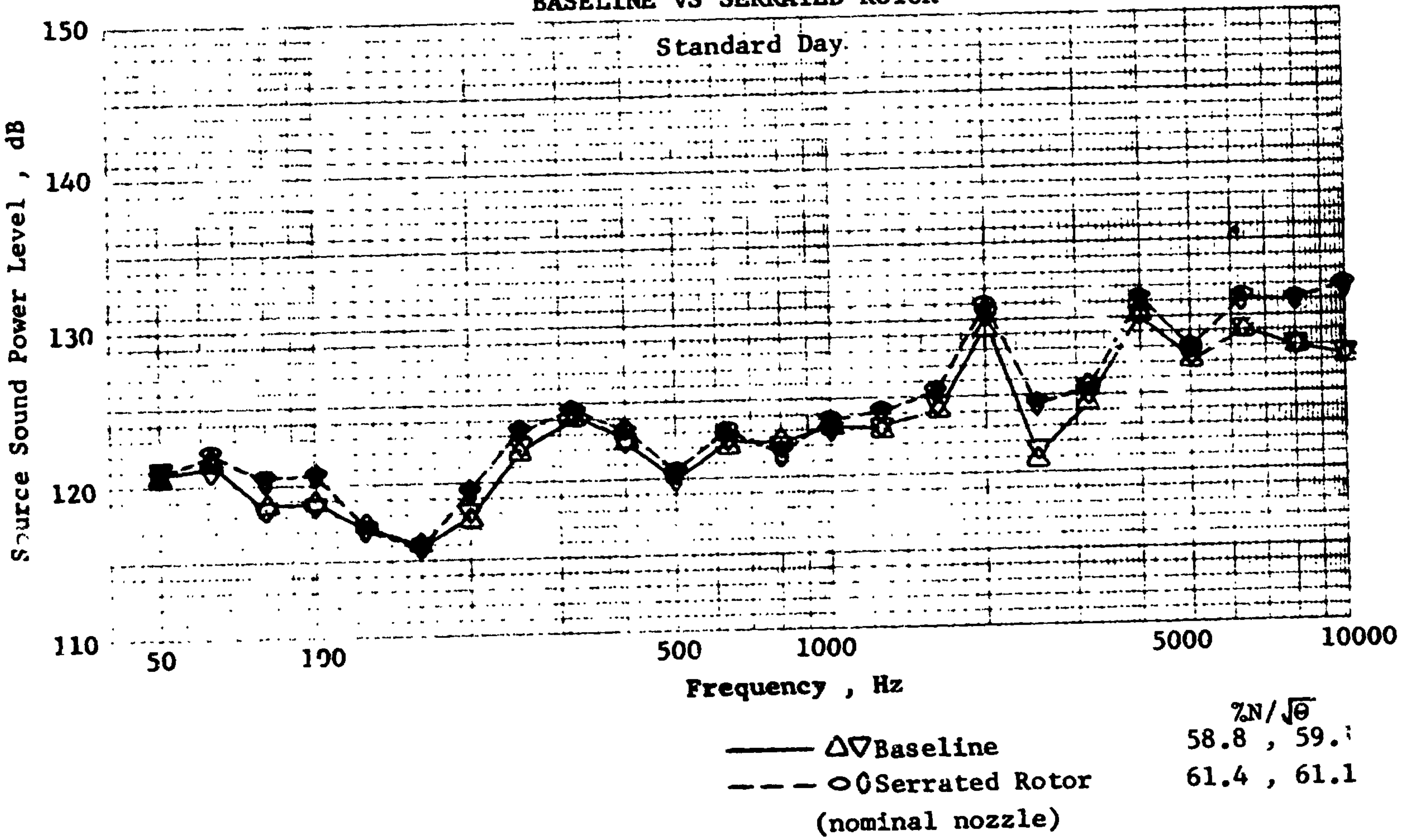


Figure 33

due to the serrations. However, at takeoff thrust (Figure 34), the serrated rotor PWL spectrum shows a 4 dB decrease at the fundamental and a 1½ to 2 dB decrease from 1000 to 1600 Hz while the high frequency power levels have increased 1½ dB at 8 and 10 KHz.

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS AT TAKEOFF
BASELINE VS SERRATED ROTOR

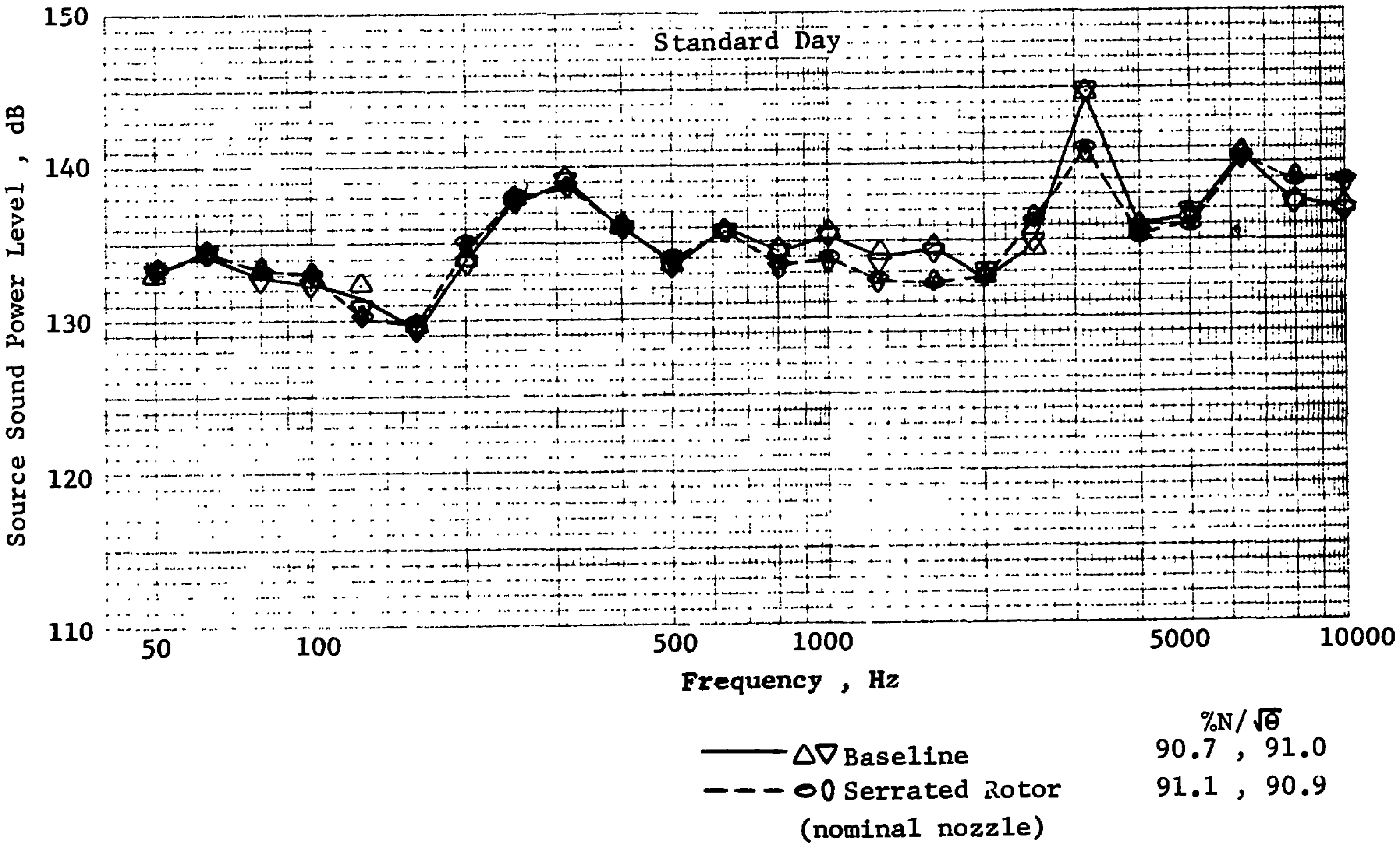


Figure 34

D. SCALED-UP TO FULL SCALE RESULTS

In order to obtain a picture of the full scale results, the scale model data was scaled up to full scale.[3] Figures 35-40 present the 200 foot (61.0 m) sideline perceived noise levels for both the baseline and serrated rotor configurations with each of the three nozzles tested. The rotor serrations reduced the front end noise of the fan with both the large and nominal nozzles at takeoff thrust. The maximum reduction occurred at 40° and was from 3 to 4 PNdB. In the rear quadrant, the noise levels remained unchanged with the large nozzle although they increased with the nominal nozzle. However, with the small nozzle, the perceived noise increased from 1 to 3 PNdB at angles of 30°, 40° and 50° in the front quadrant and throughout the rear quadrant. Further, at approach thrust, the serrations did not reduce noise levels. The major PNL difference between the clean and serrated rotor at this thrust occurred at 130° where the serrated rotor was approximately 1½ PNdB higher with the large and small nozzles and 3 PNdB higher with the nominal nozzle. Through the remaining angles, the PNL's were approximately the same with the large and small nozzles while the serrated rotor generally generated 1½ to 2 PNdB higher levels with the nominal nozzle.

Note that the fan noise was aft dominant for both configurations at both thrust levels. Further, no dip in perceived noise was indicated with the serrated rotor from 80° to 100° as was with the clean rotor. Most likely, aft quadrant noise was radiated into the front quadrant, thus possibly masking some of the front end noise reductions with the serrated configuration.

[3]Kazin, S.B., Minzner, W.R., and Paas, J.E., "Acoustic Testing of a 1.5 Pressure Ratio, Low Tip Speed Fan (QEP Fan B Scale Model), NASA CR-120789, pp. 22 - 24.

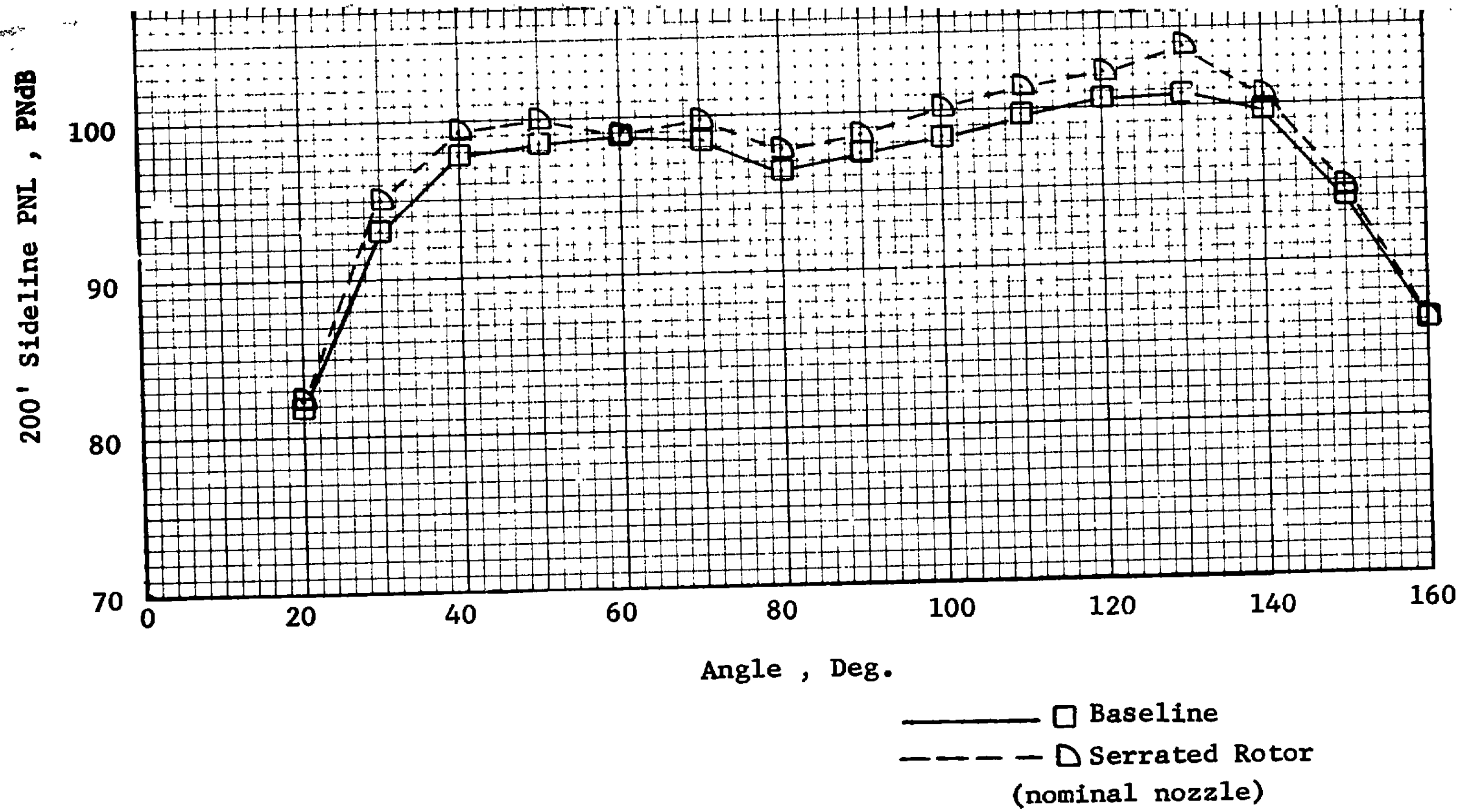

200' Sideline PNL , PNdB
100
90
80
70
0
20
40
60
80
100
120
140
160
Angle , Deg.
Baseline
Serrated Rotor
(nominal nozzle)

Figure 35

QEP FAN B
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL
BASELINE VS SERRATED ROTOR
TAKEOFF - SINGLE FAN
STANDARD DAY

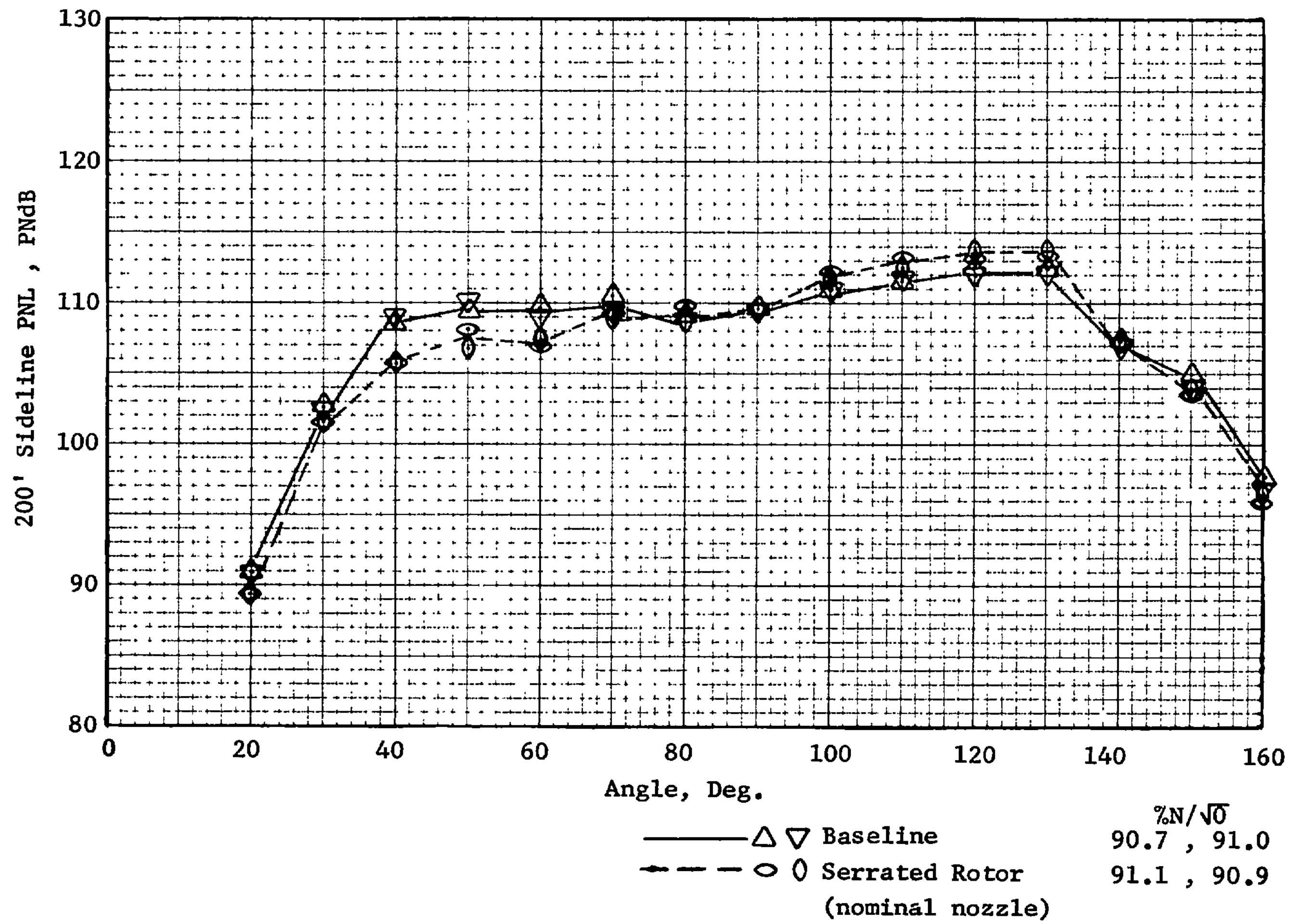


Figure 36

QEP FAN B FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL AT APPROACH WITH SINGLE FAN
BASELINE VS SERRATED ROTOR FOR $60\%N/\sqrt{\theta}$
STANDARD DAY

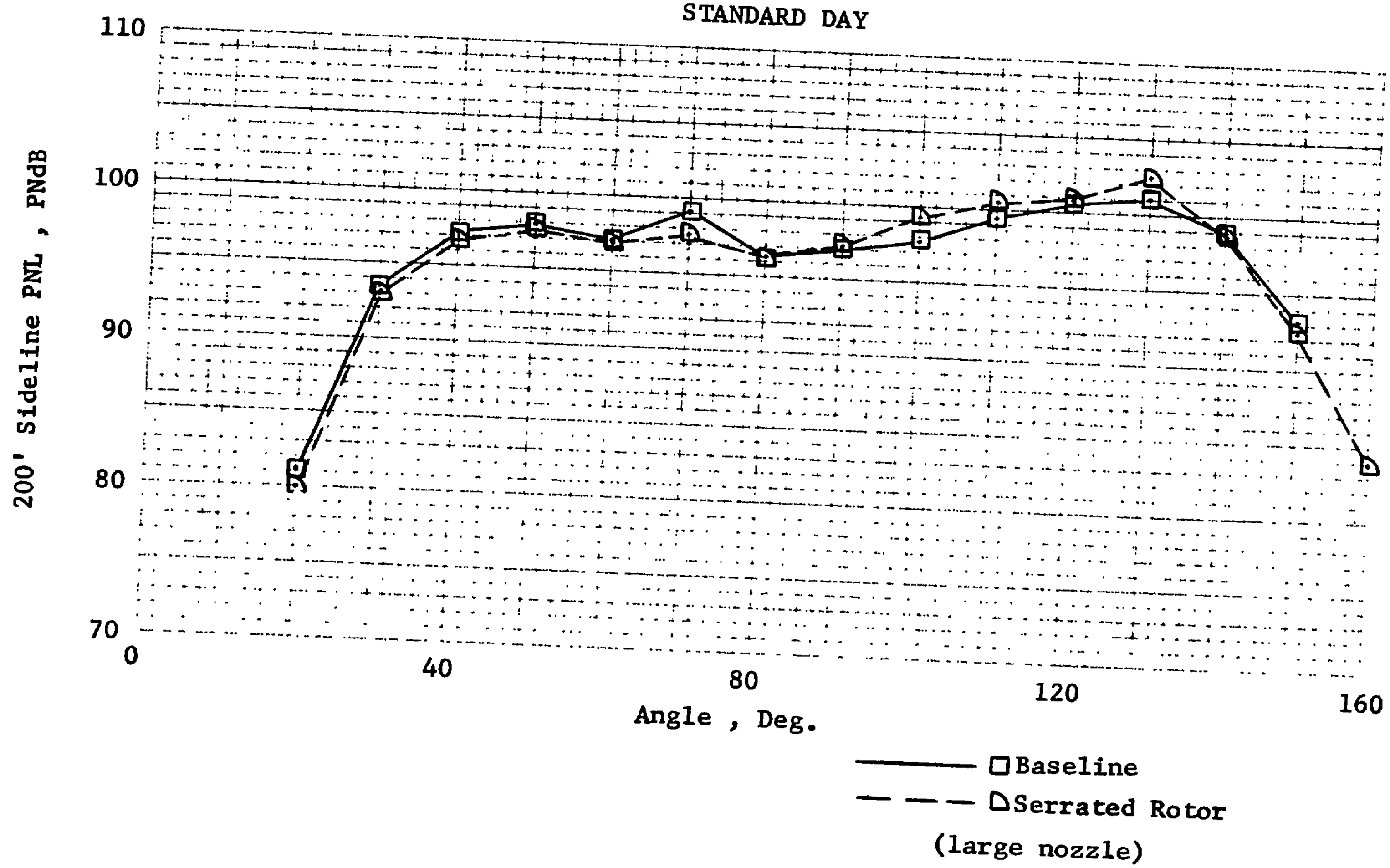


Figure 37

QEP FAN B
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL
BASELINE VS SERRATED ROTOR
TAKEOFF - SINGLE FAN
STANDARD DAY

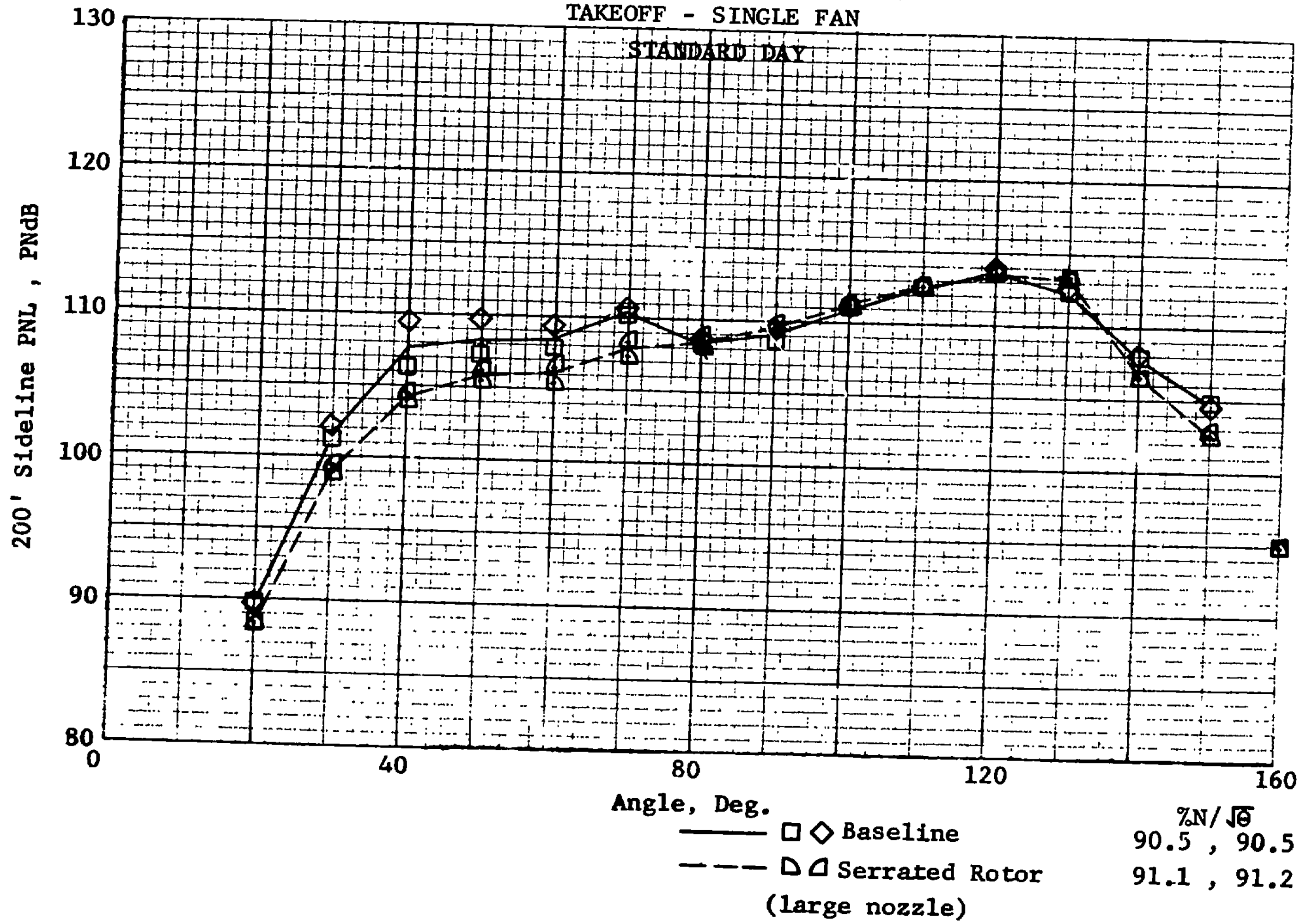


Figure 38

QEP FAN B FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL AT APPROACH WITH SINGLE FAN
BASELINE VS SERRATED ROTOR FOR $60\%N/\sqrt{\theta}$
STANDARD DAY

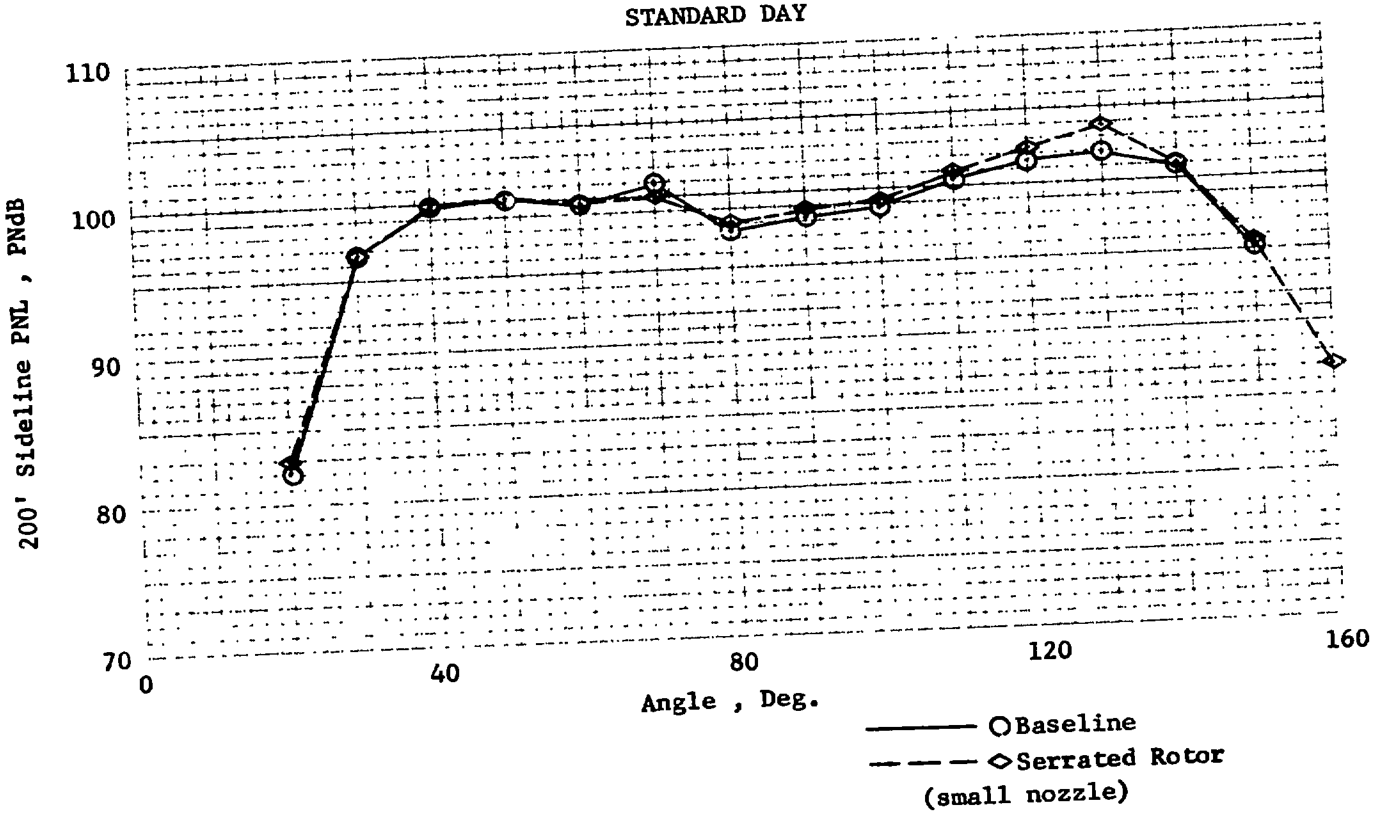


Figure 39

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

BASELINE VS SERRATED ROTOR

TAKEOFF - SINGLE FAN

STANDARD DAY

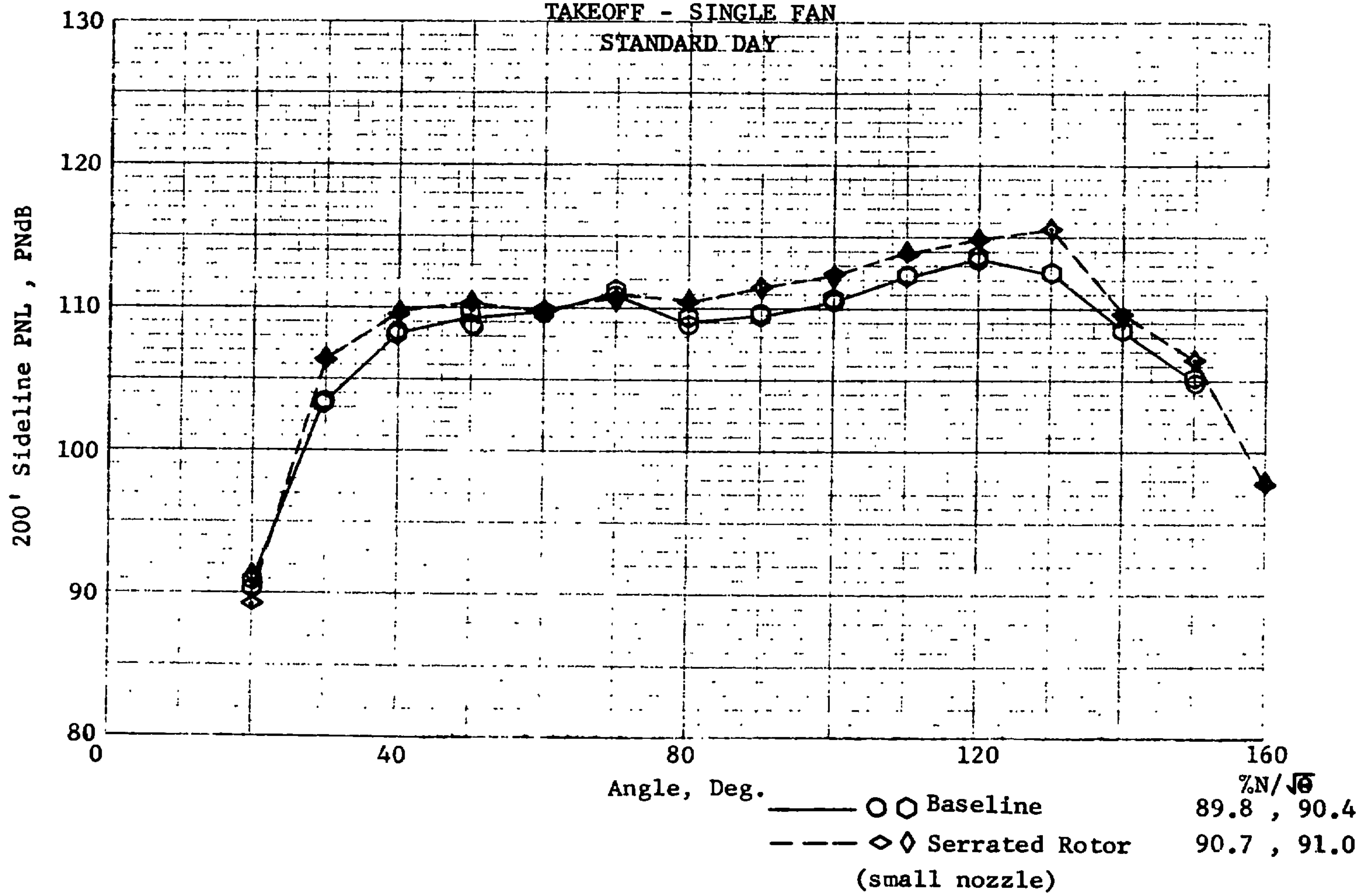


Figure 40

Figures 41-43 present the variation of maximum 200 foot (61.0 m) sideline PNL with corrected speed. The approach and takeoff points which have been examined in detail are shown. The data generally indicates that the maximum perceived noise for the serrations was higher than for the baseline. These results correspond to the data presented in Figures 35-40 which showed the noise to be aft dominant and indicated no rear quadrant noise reductions with the serrations. Recall that the major difference in PNL at approach thrust occurred at 130°, the angle of maximum perceived noise. The maximum PNL data indicates that the same magnitude of difference extends to 80% corrected fan speed with the nominal and small nozzle and to 70% corrected speed with the large nozzle. Note that at takeoff thrust perceived noise no longer peaked at 130° but rather flattened out between 120° and 130°.

To show the effects of the serrations more clearly, Figures 44-46 present the front quadrant, maximum 200 foot (61.0 m) sideline PNL's as they varied with corrected fan speed. Operating with the nominal nozzle, the fan did radiate higher noise levels at speeds below 88% N_{f_c}. However, at higher speeds (including the important takeoff speed), the serrated rotor blades reduced maximum perceived front end noise. Moreover, with the large nozzle, the maximum front quadrant PNL's were reduced 1½ to 2 PNdB by the serrations at every fan speed examined. The serrations also reduced maximum perceived noise in the front quadrant with the small nozzle at speeds below takeoff although not to the extent as with the large nozzle; at takeoff power, the PNL values were approximately equal with both configurations.

Another data presentation which provides more insight into the thrust-maximum PNL situation is an iso-noise map. Figure 47 presents this information for the baseline configuration. Lines of constant maximum PNL, fan speed and

QEP FAN B
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200 FT. SIDELINE MAX PNL
BASELINE VS SERRATED ROTOR
STANDARD DAY
SINGLE FAN
(NOMINAL NOZZLE)

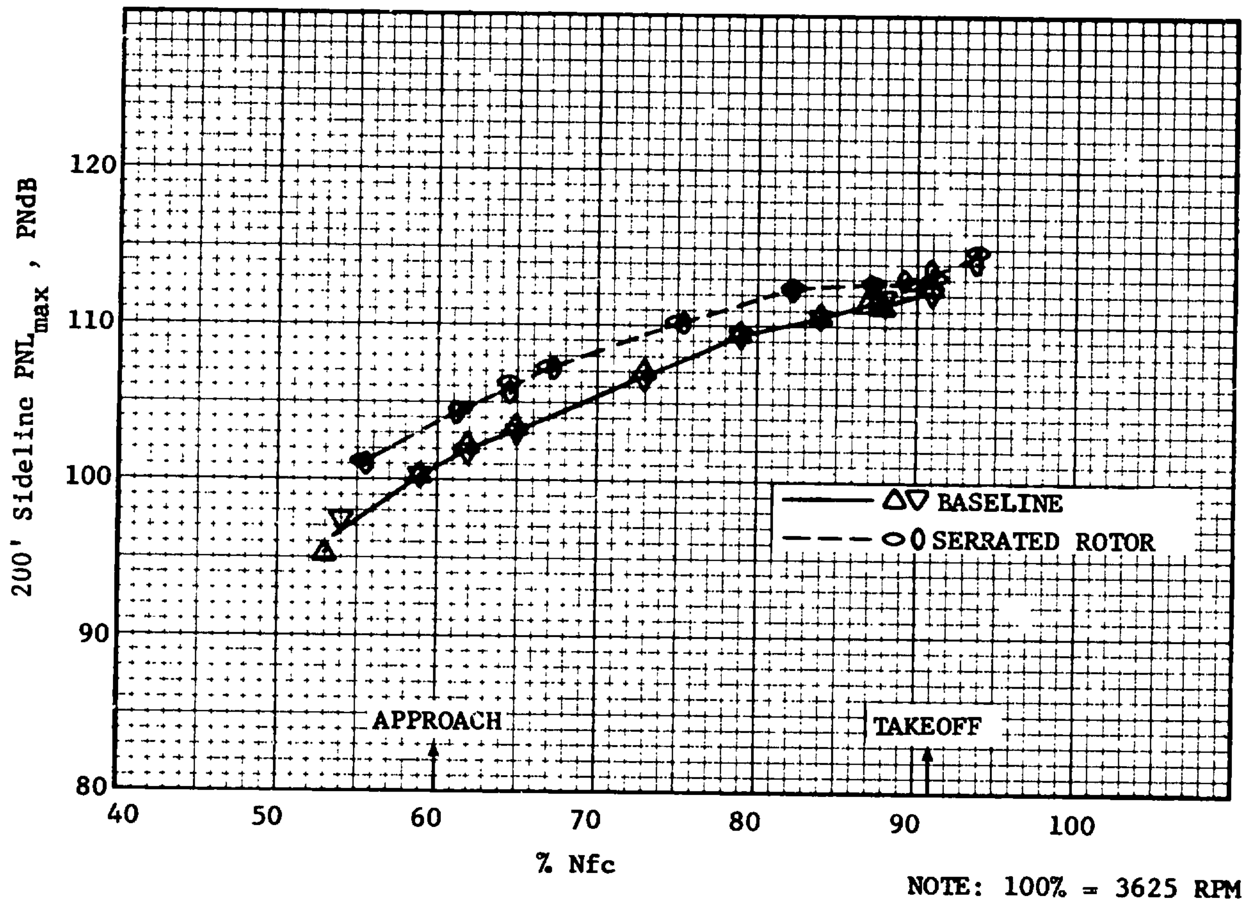


Figure 41

QEP FAN B
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200 FT. SIDELINE MAX PNL
BASELINE VS SERRATED ROTOR
STANDARD DAY
SINGLE FAN
(LARGE NOZZLE)

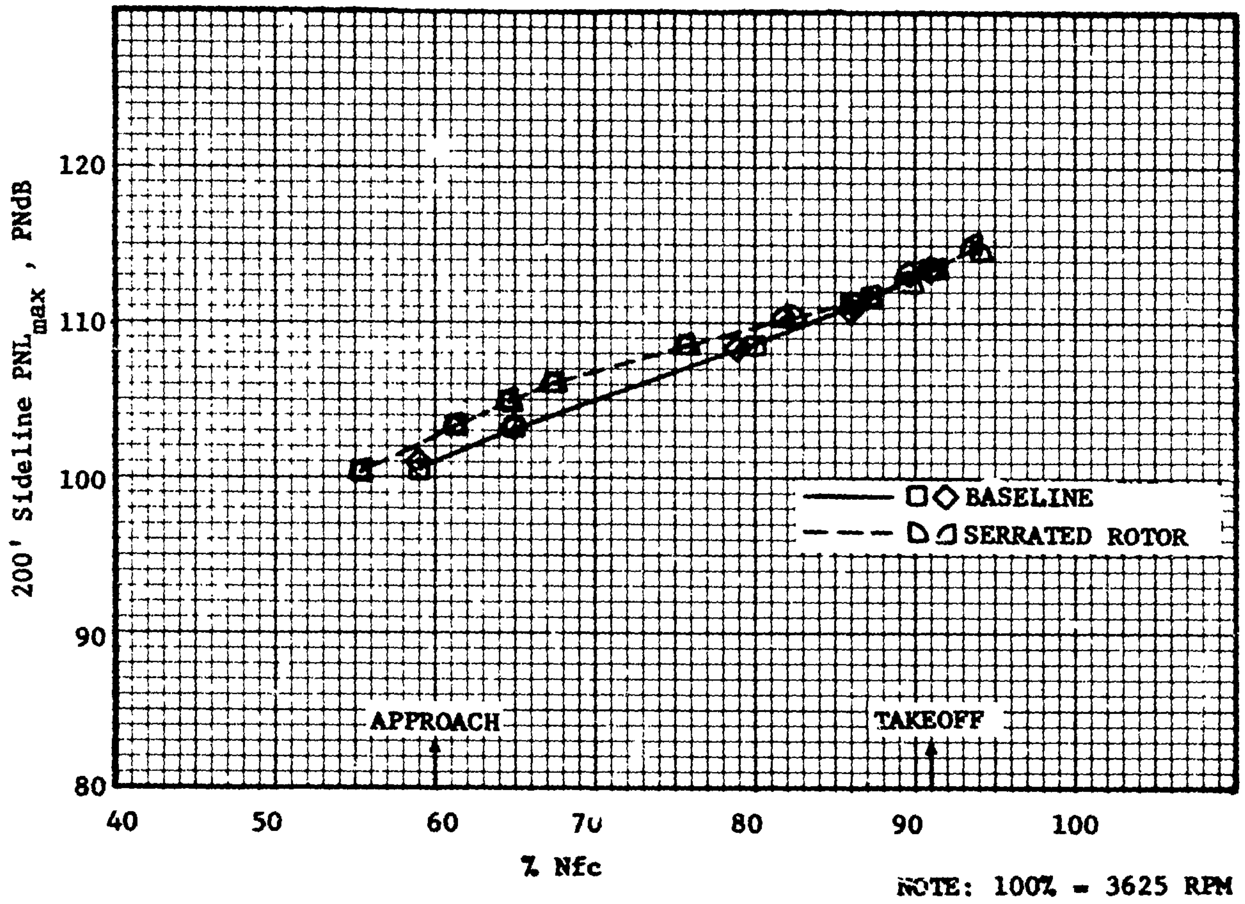
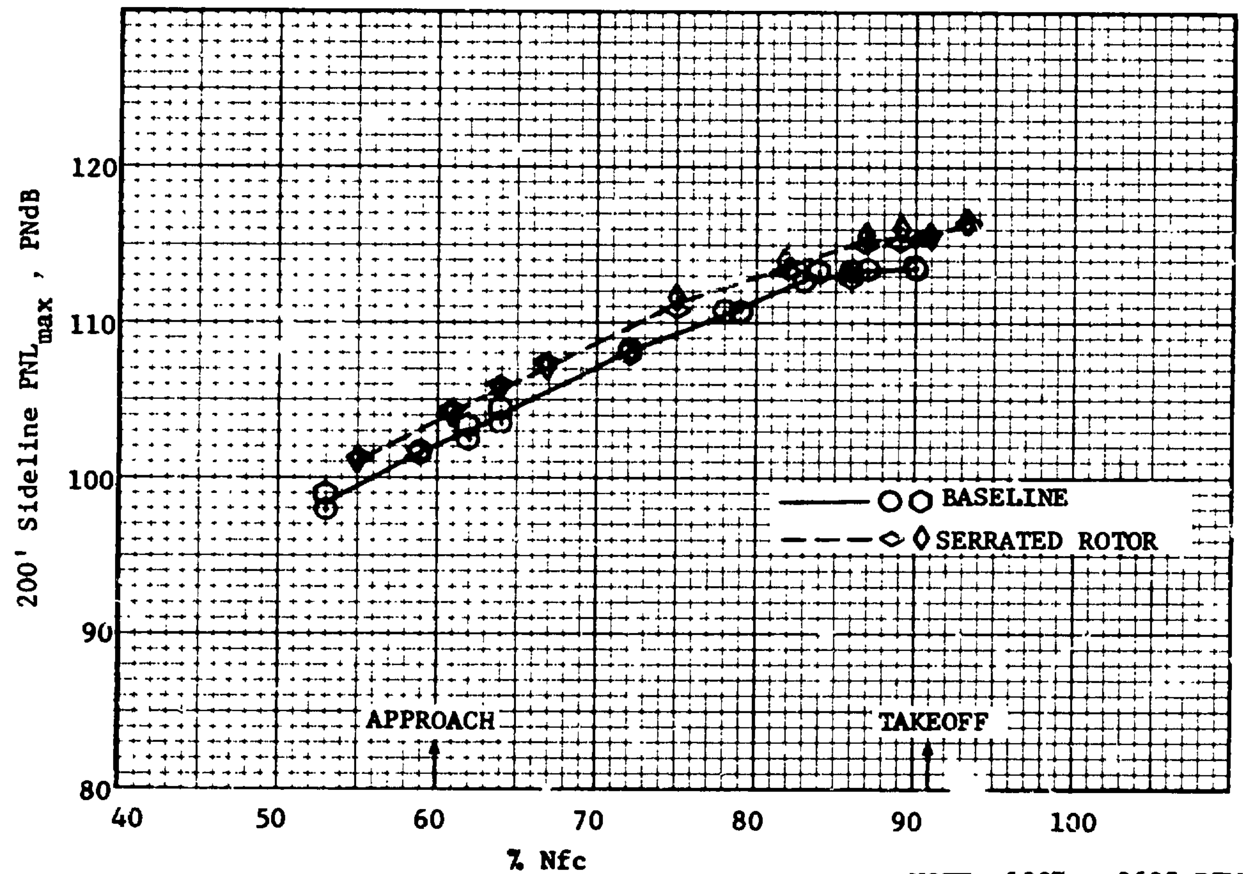


Figure 42

QEP FAN B
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200 FT. SIDELINE MAX PNL
BASELINE VS SERRATED ROTOR
STANDARD DAY
SINGLE FAN
(SMALL NOZZLE)



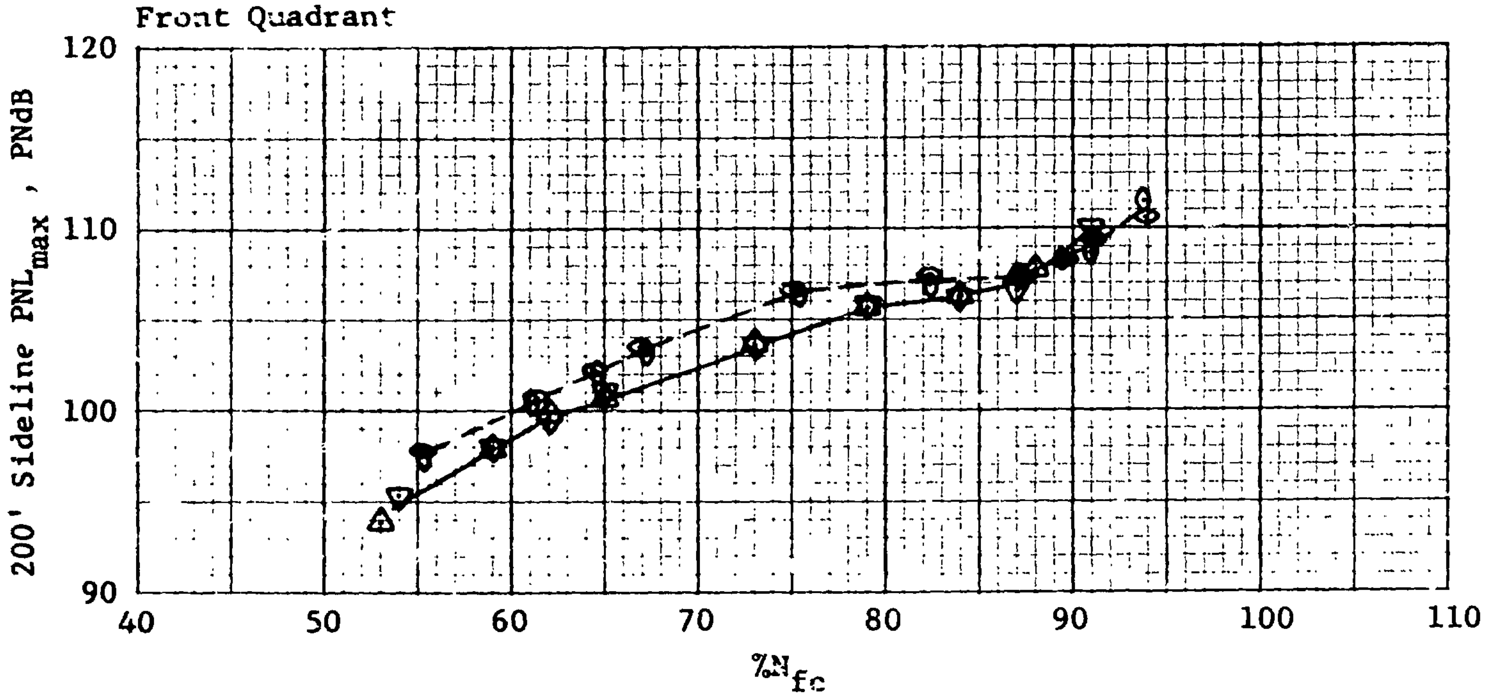
NOTE: 100% = 3625 RPM

Figure 43

QEP FAN B FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL_{max}

BASELINE VS SERRATED ROTOR

STANDARD DAY ; SINGLE ENGINE



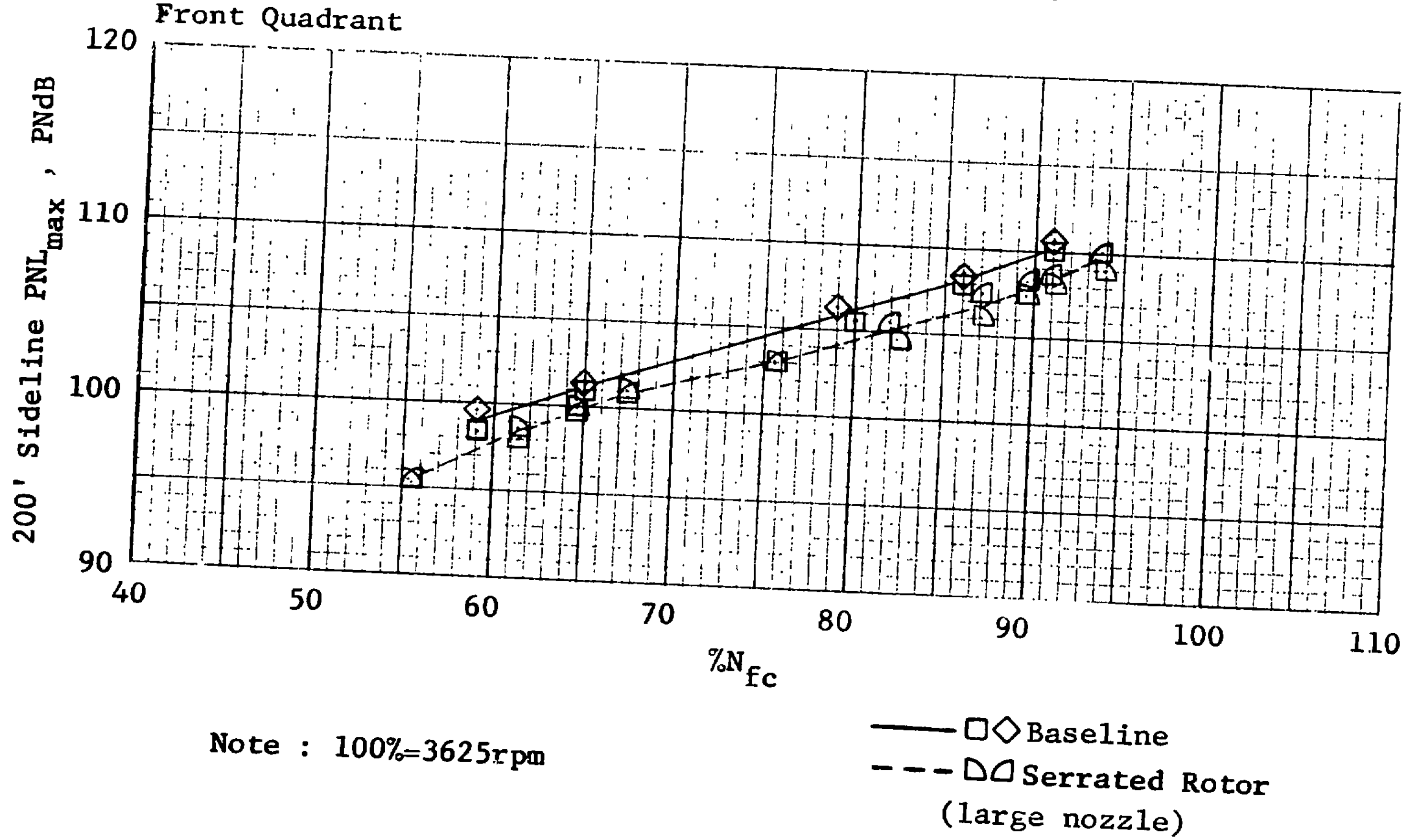
Note : 100%=3625rpm

——— △▽ Baseline
– – – ○O Serrated Rotor
(nominal nozzle)

Figure 44

QEP FAN B FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL_{max}

BASELINE VS SERRATED ROTOR
STANDARD DAY ; SINGLE ENGINE

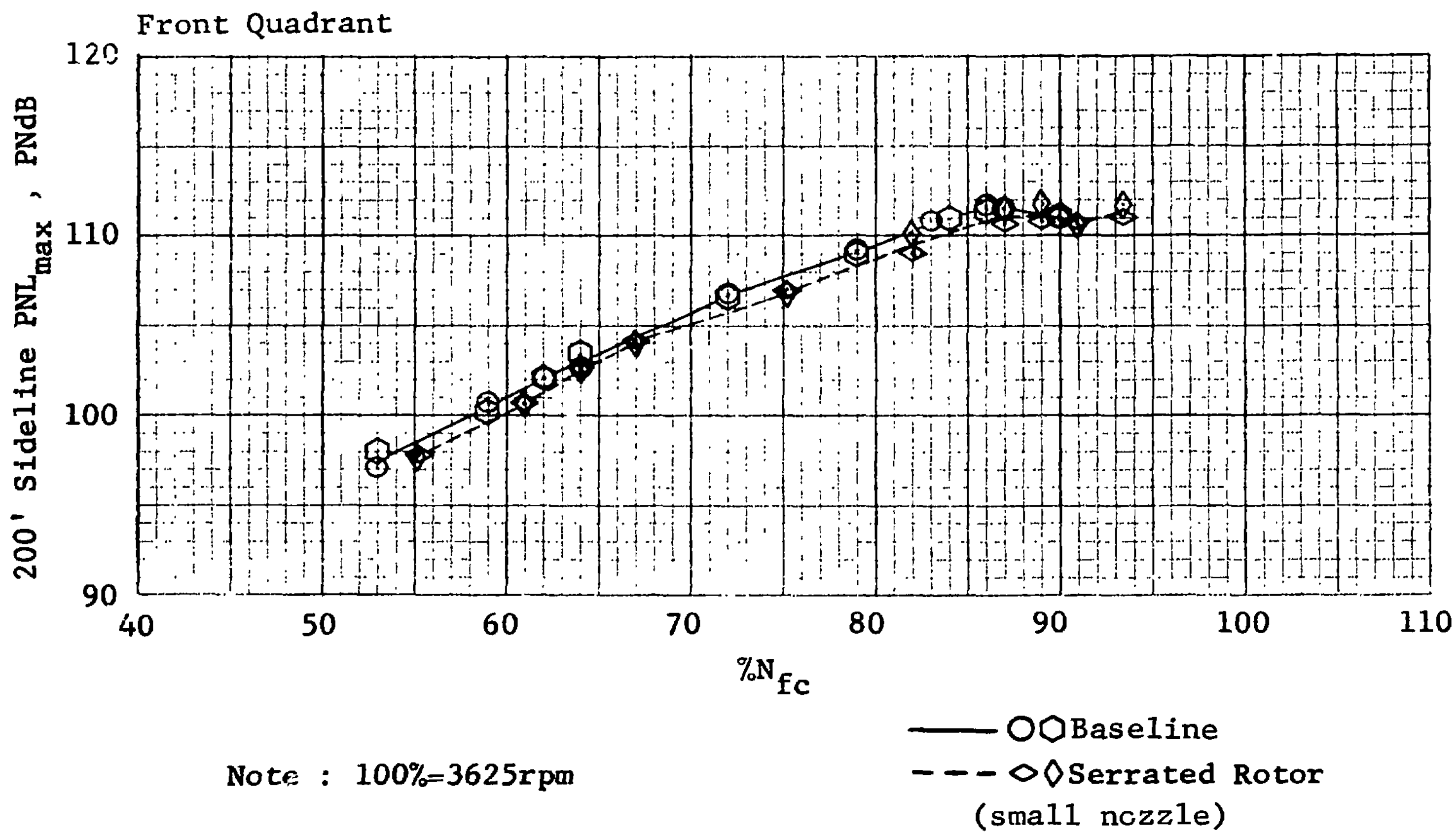


Note : 100%=3625rpm

Figure 45

QEP FAN B FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
200' SIDELINE PNL_{max}

BASELINE VS SERRATED ROTOR
STANDARD DAY ; SINGLE ENGINE



Note : 100%=3625rpm

Figure 46

QEP FAN B FULL SCALE ISO-NOISE MAP
BASELINE
200 FT. SIDELINE PNL
SINGLE FAN

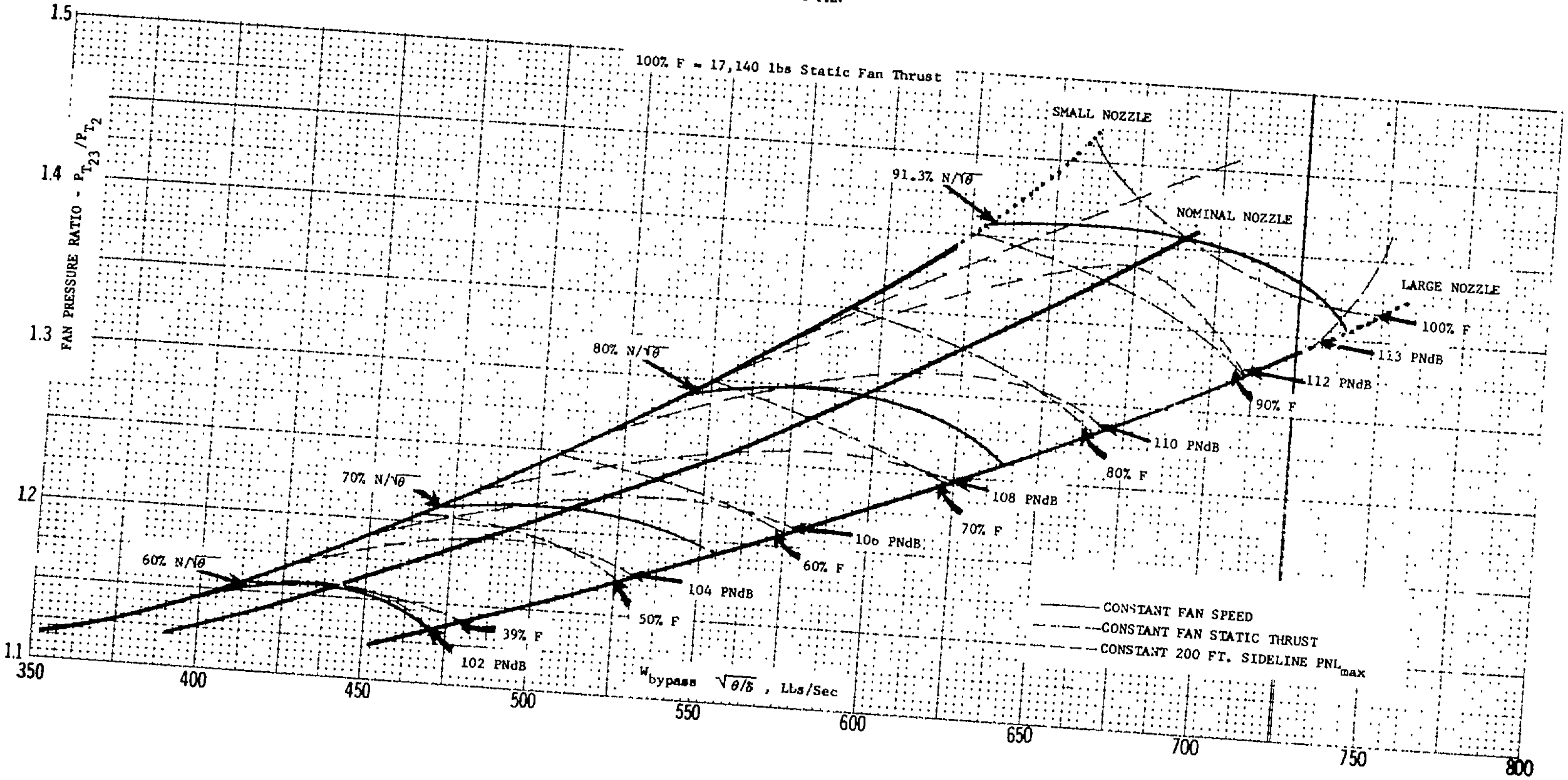


Figure 47

fan thrust appear along with the three operating lines. The identification of a point along a constant thrust line which produces the least noise represents an improvement from an acoustics viewpoint.

At both takeoff (100% thrust) and approach (39% thrust) points, the constant PNL lines are such that at operating points other than on the nominal operating line, noise increases. In fact, at approach static thrust, the constant thrust, speed and PNL lines are for all practical purposes parallel. However, from 50% to 80% static thrust, the large nozzle produced the lowest noise. Nevertheless, these static thrust levels do not have the importance of the approach and takeoff thrust levels for which airport noise regulations are formulated.

The iso-noise map for the serrated configuration, Figure 48, shows that the large nozzle produces the lowest maximum perceived noise from the approach thrust level to the takeoff thrust level. Thus, at any static thrust level, a decrease in fan nozzle area from the large nozzle size increases the noise level.

Figure 49 shows the PNL for a level flyover at approach power setting of a single uninstalled fan at 370 feet (112.8 m) wi[illegible] flight speed of 279 feet per second (85.0 m/sec), flight Mach number 0.25. The PNL directivity shows a maximum angle (130°) increase of 4½ PNdB with the serrated rotor.

Figure 50 presents the PNL for a 1000 foot (304.8 m) level flyover of a single uninstalled fan at takeoff power for Mach number 0.25. At this condition, the front end noise was reduced significantly, 4 PNdB at 40°, with the serrations while the aft quadrant noise only increased 1 PNdB from 100° to 130°. Again, it should be noted that the serrated data shows a nearly monotonic

QEP FAN B FULL SCALE ISO-NOISE MAP
SERRATED ROTOR
200 FT. SIDELINE PNL
SINGLE FAN

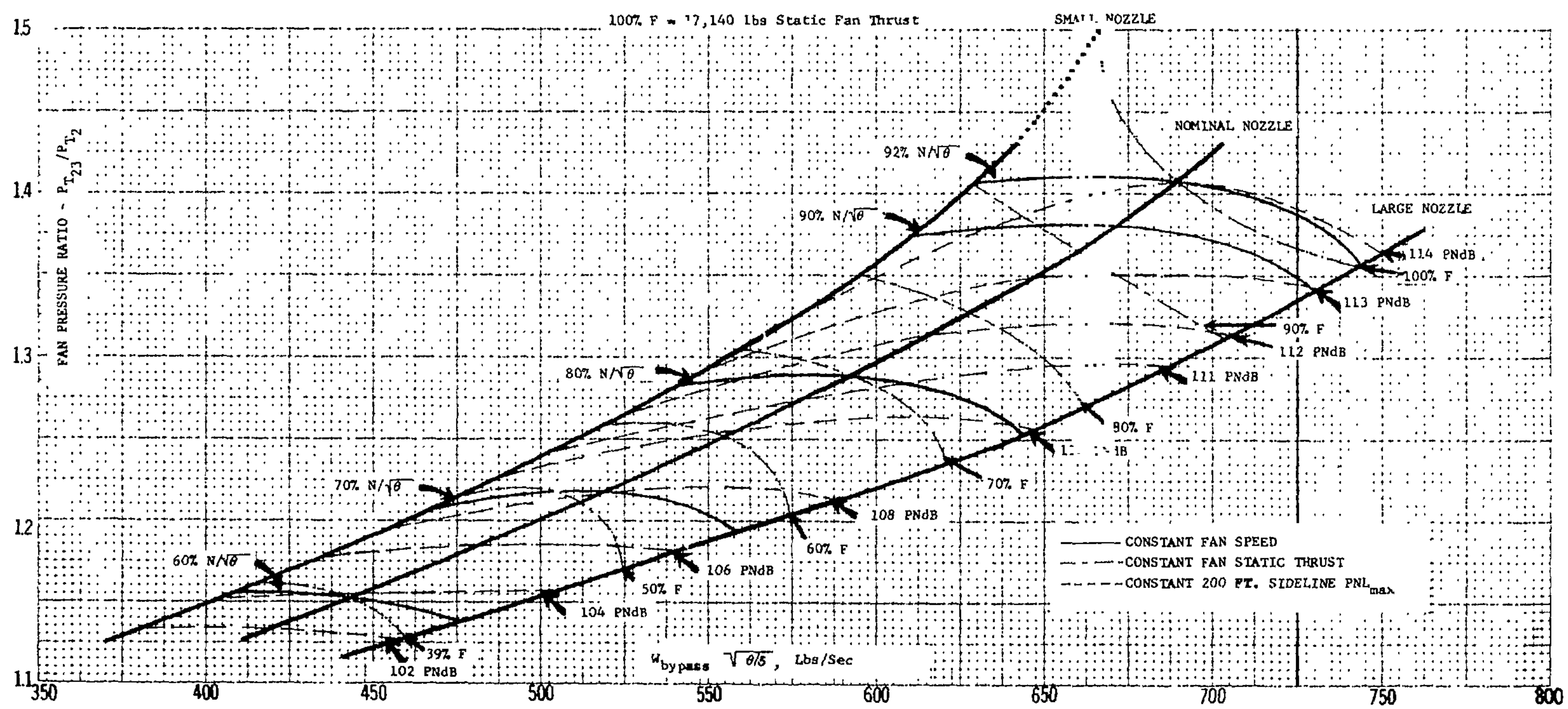


Figure 48

QEP FAN B -- FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
LEVEL FLYOVER AT APPROACH FOR STANDARD ACOUSTIC CONDITIONS
SINGLE FAN

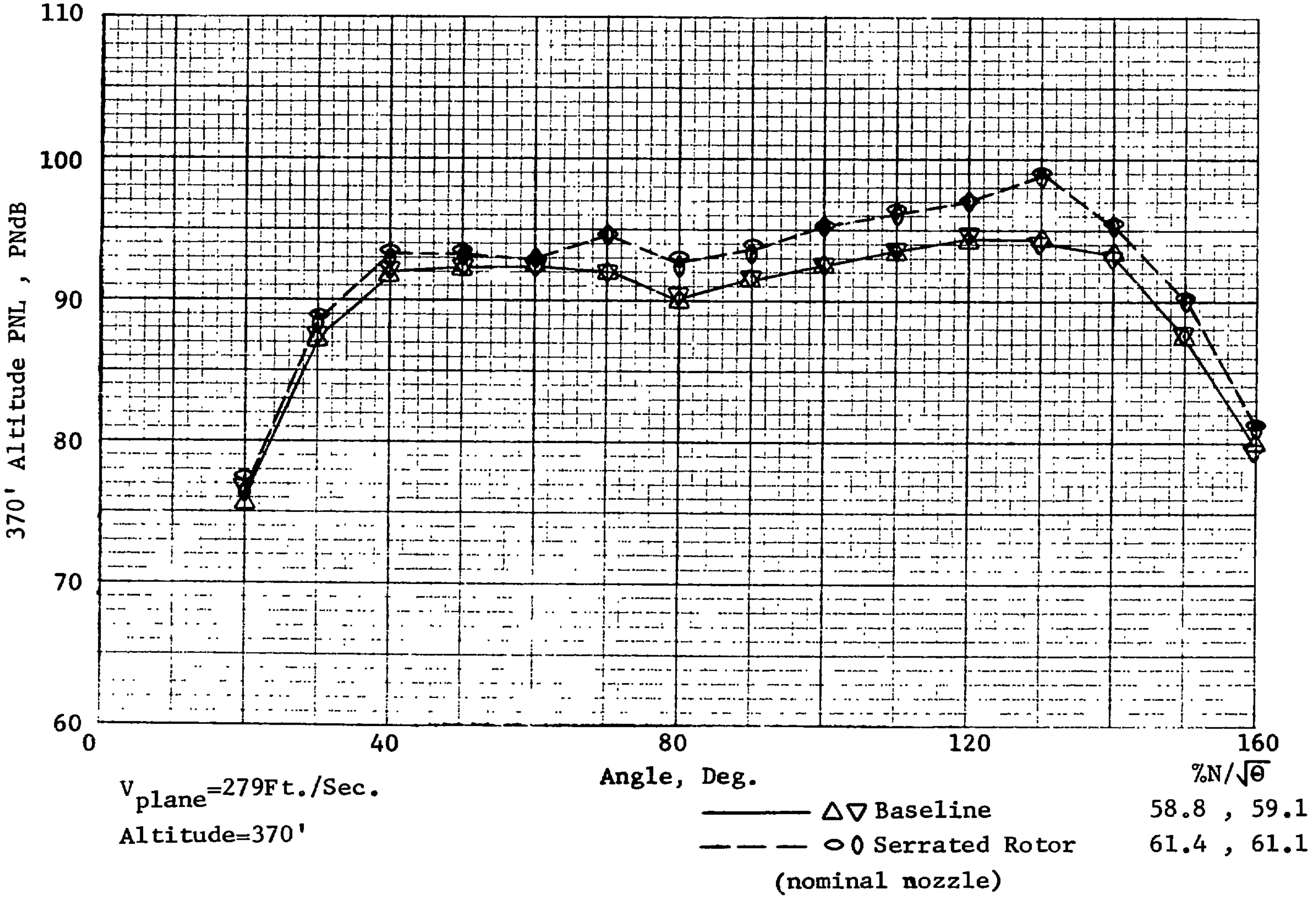
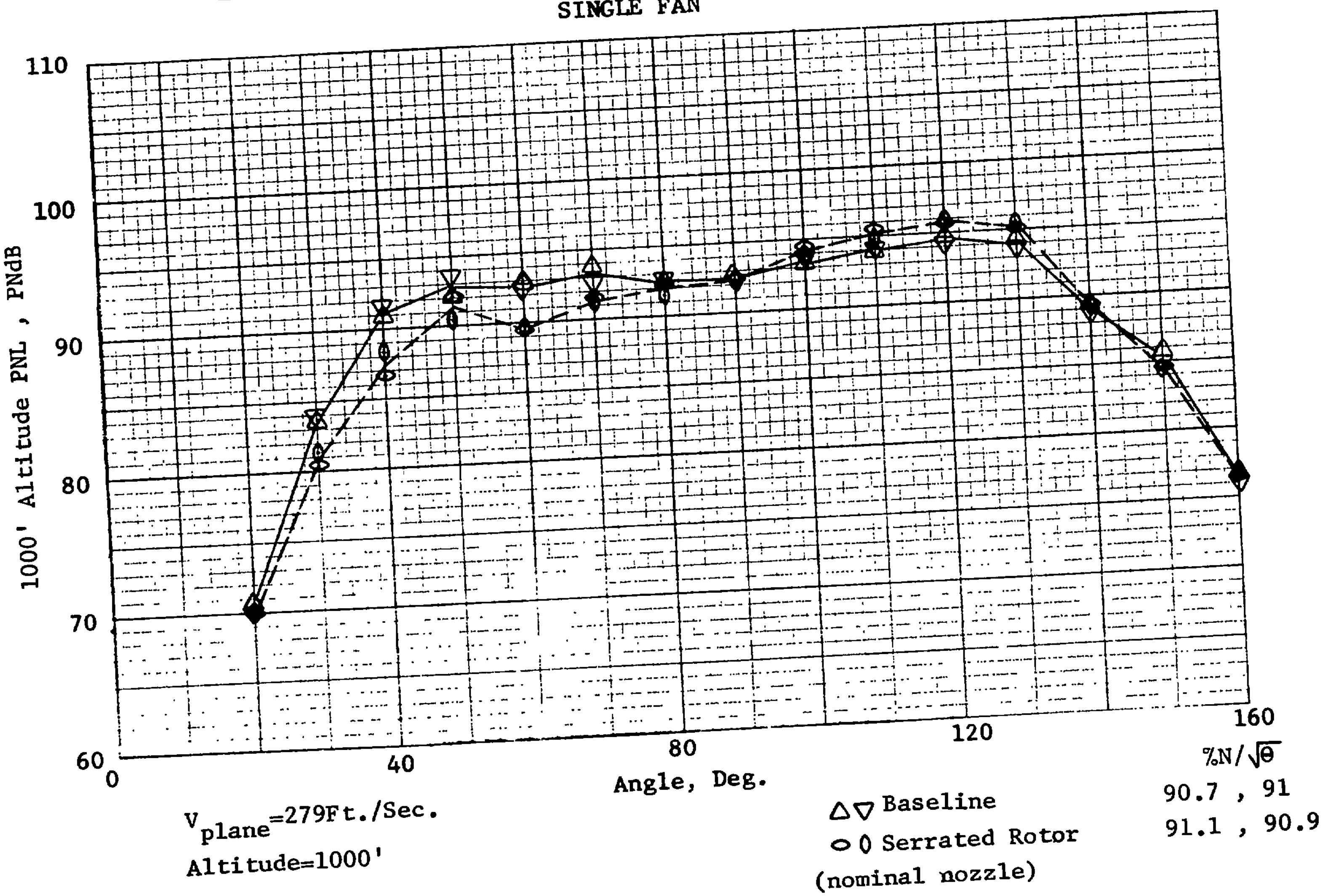


Figure 49

QEP FAN B -- FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS
LEVEL FLYOVER AT TAKEOFF FOR STANDARD ACOUSTIC CONDITIONS
SINGLE FAN



V_{plane}=279Ft./Sec.
Altitude=1000'

Figure 50

increase from front to rear indicating the possibility of rear radiated noise playing a significant role in the front maximum and thus obscuring some of the front end noise decrease due to serrations.

VI. CONCLUSIONS

From this data, it can be concluded:

1. The serrated rotor produced the lowest maximum 200 foot (61.0 m) sideline PNL for any given thrust when the large nozzle (116% of design area) was employed.

2. The serrations reduced front quadrant PNL's at takeoff power. In particular, the 200 foot (61.0 m) sideline noise was reduced from 3 to 4 PNdB at 40° for nominal and large nozzle operation.

3. The use of serrations increased rear quadrant maximum PNL's at approach thrust by 1½ to 3 PNdB.

4. The serrations reduced blade passing frequency SPL values significantly in the front quadrant at takeoff thrust; with the nominal nozzle, the fundamental PWL was reduced 4.2 dB.

Summarizing the results, projections of full scale Fan B indicate the following 200 foot (61.0 m) sideline maximum perceived noise levels:

FULL SCALE FAN B
200 FOOT (61.0 m) SIDELINE, MAXIMUM PNL

	Front Quadrant		Rear Quadrant	
	Approach*	Takeoff**	Approach*	Takeoff**
Nominal Nozzle				
Baseline	98.4 PNdB	110.3 PNdB	100.9 PNdB	112.4 PNdB
Serrated Rotor	99.9 PNdB	109.2 PNdB	103.7 PNdB	113.4 PNdB
Large Nozzle				
Baseline	99.3 PNdB	110.4 PNdB	101.1 PNdB	113.6 PNdB
Serrated Rotor	97.8 PNdB	108.5 PNdB	102.7 PNdB	113.5 PNdB
Small Nozzle				
Baseline	101.0 PNdB	111.0 PNdB	102.1 PNdB	113.6 PNdB
Serrated Rotor	100.1 PNdB	110.7 PNdB	103.8 PNdB	115.6 PNdB

* 6,684 pounds (29,744 newtons) static fan thrust - 60% N_{f_c}

** 17,140 pounds (76,277 newtons) static fan thrust - 91% N_{f_c}

VII. APPENDIX

Tables A1 - A24 contain the 1/3 octave scale model data used to prepare this report. The data presented is for the 100 foot (30.5 m) arc and has been corrected to Standard Day conditions. Tables A1 - A4 contain the data for the treated fan frame configuration with nominal nozzle at speeds as close as possible to 60, 70, 80 and 90% corrected fan speed. Tables A5 - A8 present the data for the serrated rotor configuration with nominal nozzle at these speeds. Tables A9 - A16 contain the same set of information for the fan with large nozzle and Tables A17 - A24 present the data for the small nozzle.

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QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 58.8%N_{fc} ; NOMINAL NOZZLE ; BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC, DATE - MONTH 12 DAY 8 HR, 20.8

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	72.3	69.2	67.9	69.5	69.8	68.0	66.4	69.6	69.7	70.3	70.1	70.6	72.8	74.7	77.3			120.5
(30. M)	63	64.9	65.0	65.3	75.3	68.6	67.7	65.4	75.7	68.5	69.4	71.3	70.7	74.0	74.3	76.3			121.6
VEHICLE .5FAN	80	61.3	63.6	63.8	66.3	66.0	66.2	64.8	67.0	68.8	69.6	70.4	70.4	71.6	73.1	74.2			118.7
CONFIG FANB	100	64.5	67.1	70.8	67.3	66.9	68.9	65.6	67.7	67.7	68.7	69.8	70.5	72.0	71.9	71.9			119.0
LOC PTO	125	65.0	65.1	66.0	64.7	66.9	66.7	66.1	66.3	66.5	67.3	68.7	68.9	69.2	70.3	68.5			117.3
DATE 10/6/70	160	63.7	62.9	64.5	64.1	66.2	65.7	63.9	66.0	64.9	66.0	66.2	67.4	67.9	68.5	68.4			116.0
RUN 17. PT. 262	200	62.7	62.9	63.6	66.4	62.6	64.5	63.3	66.9	65.4	67.7	67.9	69.9	71.1	72.7	72.5			117.6
TAPE 9541.	250	65.0	65.7	65.6	67.2	66.9	67.8	68.7	70.6	71.4	72.6	73.7	75.0	75.3	76.3	75.0			121.9
BAR 29.0 HG	315	66.3	67.7	68.7	69.6	69.4	70.2	70.2	72.7	73.8	75.3	76.4	77.0	77.4	77.5	74.3			124.0
(97760. N/M2)	400	67.9	70.9	71.1	69.9	70.2	70.3	70.1	71.6	72.5	73.7	74.9	75.1	74.4	74.6	71.8			122.7
TAMB 73. DEG F	500	68.7	71.0	69.9	65.4	69.1	69.4	68.2	68.4	69.4	69.7	71.0	71.8	71.2	71.9	69.9			[illegible]
(296. DEG K)	630	67.6	68.8	69.1	71.8	68.7	69.8	68.4	70.3	71.4	72.9	73.8	75.3	74.6	72.7	71.2			122.0
TWET 60. DEG F	800	71.1	70.6	70.7	71.3	70.4	71.3	70.1	72.3	72.4	72.6	74.0	73.5	73.5	73.0	71.9			122.5
(289. DEG K)	1000	69.0	69.4	73.6	70.3	70.6	69.9	69.2	71.3	72.2	73.9	75.6	76.1	75.2	73.8	72.2			123.2
HACT 9.52 GM/M3	1250	67.5	68.7	71.1	70.1	69.8	69.2	68.5	73.0	72.2	73.3	75.7	75.7	76.1	73.0	71.5			122.9
(.00952 KG/M3)	1600	70.4	71.3	71.7	71.0	70.0	69.4	68.7	70.5	72.8	74.5	76.4	76.9	78.2	74.6	72.6			124.1
NPA 4460. RPM	2000	79.1	82.1	80.3	80.2	76.7	76.2	74.9	75.9	76.3	78.6	77.1	78.2	83.2	81.5	80.2			129.5
(467. RAD/SEC)	2500	66.7	69.6	67.1	66.7	66.5	65.2	66.0	66.0	69.0	70.2	71.6	75.1	74.4	71.2	69.3			120.8
NFK 4401. RPM	3150	64.0	74.9	73.9	72.0	71.9	71.0	70.4	70.8	71.5	73.2	75.0	78.[illegible]	75.6	75.2	72.0			124.6
(461. RAD/SEC)	4000	69.9	80.8	82.7	79.9	78.5	77.4	73.4	74.9	76.5	78.4	78.8	80.8	80.6	81.8	78.4			133.1
NPD 7488. RPM	5000	70.6	75.3	76.7	75.2	72.9	72.3	69.7	72.3	74.2	75.7	77.5	80.0	80.7	76.0	73.7			127.1
(784. RAD/SEC)	6300	71.0	78.6	79.1	77.8	76.7	74.8	72.3	72.4	73.9	75.1	78.0	80.6	82.5	76.9	74.2			128.9
NO. BLADES 26	8000	68.2	76.9	78.6	77.1	75.6	74.3	73.4	71.6	72.4	74.7	76.3	78.1	78.6	77.1	72.7			127.9
	10000	66.5	75.8	77.7	77.[illegible]	74.7	73.5	69.2	70.2	72.1	72.9	75.0	75.4	76.4	73.3	71.1			127.3
	12500	66.1	73.2	75.6	74.2	72.7	71.1	66.6	66.8	68.8	69.8	71.4	70.7	72.8	71.7	68.2			125.7
	16000	64.8	69.6	73.3	70.8	69.7	68.7	64.4	64.6	66.7	66.2	67.9	66.0	69.0	63.1	55.8			124.6
	20000	67.9	67.5	71.8	69.7	68.9	69.0	65.2	66.1	68.5	66.5	67.2	63.6	67.0	66.7	65.3			126.7
	OVERALL MEASURED	85.3	89.3	90.0	88.8	87.0	86.2	84.1	85.9	87.0	88.6	89.8	91.5	92.4	90.7	88.6			
	OVERALL CALCULATED	83.8	88.2	89.0	87.9	86.3	85.9	83.5	85.3	86.0	87.5	88.6	90.0	91.0	89.6	88.0			139.1
	PNDB	97.1	101.8	102.9	101.2	99.9	99.1	96.5	98.0	99.3	100.9	101.9	103.6	103.9	103.4	100.8			

TABLE A1

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 73.0%N_{fc} ; NOMINAL NOZZLE ; BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC, DATE - MONTH 12 DAY 8 HR, 20,9

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	74.8	72.6	71.9	74.1	73.0	71.1	71.8	73.9	74.4	75.2	75.7	76.4	79.4	82.6	85.9			126.6
(30. M)	63	68.9	69.7	73.3	75.9	72.0	71.1	71.4	77.6	75.0	75.8	76.8	77.7	80.3	82.7	85.7			127.1
VEHICLE .5FAN	80	65.9	67.5	68.6	69.8	70.0	69.8	71.4	73.5	74.1	74.6	75.5	76.7	79.3	81.5	83.8			125.4
CONFIG FANB	100	74.8	71.2	74.6	[illegible]	74.7	74.8	76.7	78.2	76.3	76.1	77.4	78.3	80.6	80.7	82.4			127.2
LOC PTO	125	68.9	68.7	69.5	69.4	70.8	70.4	70.8	71.7	72.7	73.6	74.9	75.0	76.3	77.5	76.5			123.1
DATE 10/6/70	160	67.7	69.1	70.5	68.0	69.2	68.9	69.8	69.6	70.0	72.5	72.6	74.4	75.3	77.6	77.7			122.3
RUN 17. PT. 265	200	68.2	76.5	78.6	72.6	72.4	73.4	75.2	73.5	73.3	78.0	76.9	83.7	80.9	82.9	82.0			127.5
TAPE T9889.	250	69.0	70.8	73.4	73.6	74.2	74.6	75.2	77.3	78.2	80.0	81.7	83.0	84.3	85.4	84.0			129.8
BAR 29.0 HG	315	72.6	73.7	76.2	75.8	76.2	77.0	77.1	79.6	80.4	82.3	83.7	84.6	85.2	85.3	82.7			131.3
(97760. N/M2)	400	74.0	75.3	76.6	75.8	75.4	75.6	75.8	77.6	79.4	80.3	81.5	81.3	81.0	80.2	78.7			128.8
TAMB 69. DEG F	500	73.2	75.5	75.0	73.6	73.7	73.3	72.4	74.0	75.2	76.1	78.0	79.2	79.2	79.4	76.9			126.3
(294. DEG K)	630	71.9	73.9	74.7	75.0	73.8	75.0	75.3	77.8	79.5	80.5	81.4	82.3	82.2	80.3	79.0			129.1
TWET 59. DEG F	800	74.6	76.5	76.5	76.1	76.5	76.6	76.1	77.5	78.9	79.8	80.1	79.8	79.6	78.5	78.0			128.5
(288. DEG K)	1000	73.3	75.2	76.4	75.9	75.5	75.7	75.5	77.5	79.0	80.9	82.1	82.3	80.6	79.6	79.0			129.3
HACT 9.93 GM/M3	1250	72.6	74.2	76.0	75.8	75.6	75.4	74.8	76.3	78.5	79.8	82.2	82.0	80.8	78.6	77.1			125.9
(.00993 KG/M3)	1600	74.2	75.3	76.7	76.3	75.6	75.7	74.7	76.9	79.1	81.1	82.6	83.3	81.9	79.3	77.6			129.7
NFA 5521. RPM	2000	73.7	76.7	77.1	76.4	75.7	75.3	[illegible]	76.9	78.8	80.2	81.0	82.3	81.2	78.4	76.7			129.2
(578. RAD/SEC)	2500	79.1	88.4	84.7	85.6	83.8	81.6	80.0	78.5	80.1	81.4	81.7	85.0	84.0	85.2	81.7			134.0
NPK 5469. RPM	3150	69.2	80.4	79.1	75.1	78.1	77.5	77.0	77.5	78.3	80.2	82.1	85.2	80.0	80.3	77.0			130.8
(573. RAD/SEC)	4000	71.5	80.0	81.5	79.9	79.1	78.4	76.1	78.3	80.2	82.7	83.5	85.3	82.4	81.9	78.5			132.2
NPD 7488. RPM	5000	77.4	83.7	86.3	85.2	82.5	81.9	79.1	80.9	82.7	84.5	85.7	88.3	85.0	84.2	81.3			135.3
(784. RAD/SEC)	6300	75.2	82.6	82.7	82.2	81.3	79.9	78.9	79.1	80.5	82.3	85.1	[illegible]	84.2	81.4	78.3			134.1
NO. BLADES 26	8000	73.6	82.4	83.8	82.6	81.8	80.7	77.9	78.8	79.8	82.3	83.5	83.6	81.9	82.5	78.0			134.1
	10000	71.4	80.7	82.7	82.4	80.7	79.4	76.3	77.0	79.1	80.4	81.6	82.8	79.9	79.0	76.2			133.3
	12500	70.4	77.8	80.5	79.0	78.4	76.7	73.2	73.2	75.0	76.8	77.9	77.8	76.4	76.8	72.9			131.2
	16000	66.2	73.6	77.7	75.3	74.8	73.7	69.5	68.9	71.2	72.2	73.9	72.8	72.5	72.5	69.3			129.4
	20000	66.7	69.6	74.4	72.2	71.2	71.8	66.0	66.1	69.8	68.7	69.9	67.9	68.6	68.4	66.8			126.7
	OVERALL MEASURED	89.1	94.7	94.9	94.2	93.0	92.3	91.1	92.4	93.8	95.5	96.8	98.6	97.0	96.8	95.2			
	OVERALL CALCULATED	87.4	93.3	93.6	93.8	91.9	91.1	89.8	91.2	92.4	94.1	95.3	96.9	95.6	95.6	94.7			144.8
	PNDB	100.6	107.6	107.1	108.4	105.2	104.1	102.8	104.0	105.4	107.2	108.4	113.4	108.2	108.1	105.6			

TABLE A2

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 79.37%N_{fc} ; NOMINAL NOZZLE ; BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PHOC, DATE - MONTH 12 DAY 8 HR, 20.9

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	76.2	74.5	74.1	74.8	74.4	72.6	73.8	76.1	76.8	77.8	78.1	79.0	82.5	86.2	89.5			129.5
(30. M)	63	70.5	72.2	73.2	76.7	74.3	73.1	74.0	78.9	77.5	78.7	79.1	79.9	83.1	86.1	89.3			129.8
VEHICLE .5FAN	80	67.5	69.9	70.7	73.0	72.1	70.5	72.9	75.2	76.8	77.9	78.5	79.5	82.3	84.9	87.3			128.4
CONFIG FAND	100	73.8	72.1	75.9	77.4	76.6	78.4	79.2	78.6	77.8	82.1	83.9	85.4	83.2	84.7	86.9			131.3
LOC PTO	125	71.4	71.8	73.1	72.9	73.4	73.1	73.6	74.4	75.3	76.5	77.8	78.3	79.6	81.0	80.1			126.2
DATE 10/6/78	160	70.4	69.7	70.5	69.9	71.2	70.5	71.0	71.6	72.8	74.5	75.4	77.2	78.9	81.6	81.5			125.1
RUN 17. PT. 286	200	75.7	72.8	71.5	72.0	71.0	74.0	72.8	75.2	78.0	79.3	79.8	82.0	84.0	86.4	86.0			129.5
TAPE 90889.	250	70.0	72.4	74.5	76.0	75.6	76.9	77.7	79.4	80.5	82.4	84.2	85.9	87.6	89.1	87.4			132.8
BAR 29.0 HG	315	75.1	76.3	78.6	78.5	78.9	79.3	80.0	82.0	83.3	84.9	86.6	87.6	88.5	88.7	86.4			134.2
(97760. N/M2)	400	76.5	77.7	79.1	73.4	78.0	78.1	78.6	80.1	82.1	83.3	84.6	84.8	84.4	83.3	82.2			131.8
TAMB 69. DEG F	500	76.0	77.7	76.1	76.0	76.4	76.2	75.6	76.1	77.8	78.7	80.7	82.3	82.8	82.9	79.7			129.2
(294. DEG K)	630	74.5	77.1	78.2	76.9	78.8	78.6	79.2	81.5	82.5	83.2	84.6	85.6	85.5	83.7	82.2			132.3
TWET 59. DEG F	800	75.9	78.7	79.2	79.0	80.5	80.6	79.6	80.4	82.1	83.6	83.4	83.1	82.9	81.4	80.6			131.7
(288. DEG K)	1000	75.1	77.5	78.2	78.4	77.9	78.0	77.9	79.8	81.2	83.2	84.7	84.9	83.0	81.9	81.0			131.7
HACT 9.93 GM/M3	1250	74.7	76.3	77.9	78.1	77.6	77.7	76.9	78.7	80.5	82.1	84.3	84.1	82.6	80.5	79.2			131.0
(.00993 KG/M3)	1600	75.7	76.4	78.5	78.0	77.6	78.0	76.9	78.8	80.9	82.9	84.9	85.3	83.5	[illegible]	79.1			131.7
NFA 5996. RPM	2000	74.5	76.0	77.7	77.0	76.4	76.4	76.0	78.4	80.2	81.8	83.1	84.3	82.2	79	77.6			130.6
(628. RAD/SEC)	2500	81.7	91.7	89.1	[illegible]	89.6	85.2	84.5	82.9	83.1	83.1	85.9	90.7	85.4	88.2	84.8			137.9
NFK 5939. RPM	3150	72.2	82.9	81.5	80.4	81.0	79.9	79.7	79.5	80.2	82.2	84.9	87.5	81.1	82.5	79.0			133.1
(622. RAD/SEC)	4000	[illegible]	79.9	81.6	80.1	79.6	79.8	77.6	79.9	82.5	84.8	86.7	87.1	83.1	83.1	79.7			133.8
NFD 7488. RPM	5000	79.4	85.7	87.7	86.8	84.5	84.0	81.1	82.4	84.5	86.5	88.9	90.3	85.9	85.1	83.0			137.3
(784. RAD/SEC)	6300	76.1	83.9	83.7	82.8	82.0	81.1	80.3	81.2	82.5	84.6	87.8	89.4	84.7	82.8	80.0			135.8
NO. BLADES 26	8000	75.2	83.4	86.1	84.3	83.0	82.5	80.1	81.1	81.8	84.0	86.3	87.9	83.2	84.3	80.0			136.2
	10000	72.6	81.3	83.8	83.5	82.6	81.2	78.9	79.1	81.0	82.2	84.3	85.0	81.3	80.6	77.8			135.0
	12500	71.2	78.0	81.4	79.9	79.2	77.9	75.2	75.5	76.0	79.1	80.8	80.5	77.7	77.9	74.2			132.9
	16000	66.6	73.5	78.2	75.8	75.4	74.6	71.1	70.9	73.4	74.4	76.8	75.5	73.8	73.4	70.3			130.8
	20000	66.7	69.3	74.8	72.6	71.6	72.3	67.9	67.6	70.6	70.7	[illegible]	70.7	69.6	69.3	67.5			129.8
	OVERALL MEASURED	91.0	96.7	97.0	96.2	95.9	94.6	93.8	94.7	96.1	97.9	99.9	101.3	99.3	99.6	98.3			
	OVERALL CALCULATED	89.5	95.3	95.5	94.9	94.5	93.3	92.4	93.4	94.7	96.4	98.3	99.7	97.6	98.4	98.0			147.2
	PNDB	102.7	110.0	109.3	108.8	108.9	108.8	106.0	106.1	107.6	109.4	111.3	113.0	109.8	110.7	108.4			

TABLE A3

QCSEE SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 90.7% N_{fc} ; NOMINAL NOZZLE ; BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC. DATE = MONTH 12 DAY 8 HR. 20.8

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	78.1	76.9	75.4	76.8	76.0	74.9	76.8	79.3	79.9	81.0	83.4	82.3	85.9	93.0	93.8			133.0
(30. M)	63	74.5	77.8	77.4	83.3	77.2	76.1	77.7	83.4	80.9	81.9	83.6	84.6	87.7	91.7	95.1			134.8
VEHICLE QFAN	80	71.7	73.8	72.6	74.2	75.1	75.2	77.1	79.1	80.6	81.6	81.9	83.2	86.8	90.0	92.9			133.0
CONFIG FANB	100	74.7	75.7	74.2	77.2	76.9	76.8	78.2	79.3	80.9	82.1	82.7	84.8	86.9	89.3	89.9			132.6
LOC PTO	125	79.0	77.0	76.1	76.9	79.1	77.7	79.9	78.5	80.3	83.0	82.0	85.8	86.2	87.0	85.8			132.2
DATE 10/6/78	160	73.3	73.0	73.4	73.1	74.5	73.9	74.6	75.0	76.4	78.3	80.0	81.7	83.5	86.7	87.1			129.6
RUN 17. PT. 278	200	72.4	73.6	72.8	75.2	75.8	77.1	77.0	78.6	80.0	82.1	84.0	90.6	89.2	91.9	90.7			134.0
TAPE 79889.	250	75.8	77.1	78.5	81.1	81.7	82.3	82.0	83.5	85.2	86.7	89.0	90.9	93.1	95.0	92.8			138.0
BAR 29.0 HG	315	80.4	81.1	82.3	82.7	83.3	84.0	84.4	86.2	87.4	89.3	91.2	92.8	93.9	94.7	92.1			139.2
(97794. N/M2)	400	80.6	81.5	82.6	81.3	82.1	82.1	82.9	84.2	85.8	86.8	88.5	89.1	89.6	88.9	87.8			136.1
TAMB 68. DEG F	500	79.3	80.8	80.0	79.7	79.9	80.4	79.3	80.5	81.8	83.3	85.5	87.2	87.9	88.0	84.7			133.7
(293. DEG K)	630	77.3	78.9	78.9	78.2	79.1	81.0	81.5	83.8	85.5	86.8	88.5	88.9	90.2	88.3	86.6			135.8
TWET 58. DEG F	800	77.9	79.7	81.1	80.2	81.8	82.5	82.5	83.7	84.9	85.6	86.5	86.2	86.9	88.0	84.4			134.5
(288. DEG K)	1000	78.3	80.3	81.0	81.2	81.2	81.5	82.1	83.8	85.7	87.6	88.8	88.1	87.0	86.5	84.9			135.8
HALT 9.50 GM/M3	1250	78.4	80.1	82.5	81.5	81.5	81.7	[illegible]	81.9	83.6	85.0	86.8	86.9	86.3	85.1	83.5			134.3
(.00950 KG/M3)	1600	79.8	81.1	83.2	83.8	81.5	81.3	83.7	82.4	84.6	85.4	86.2	86.6	86.5	85.2	83.4			134.6
NFA 6850. RPM	2000	78.1	79.1	80.9	80.6	79.2	79.4	78.7	[illegible]	82.7	83.6	84.1	85.3	84.8	82.9	81.3			132.9
(717. RAD/SEC)	2500	76.9	84.2	86.3	84.7	83.5	83.9	82.2	[illegible]	81.6	82.2	84.5	87.5	82.8	83.8	80.9			134.5
NFK 6791. RPM	3150	84.6	94.2	[illegible]	95.6	95.0	95.6	92.0	90.4	89.1	89.8	92.2	95.3	89.5	93.9	89.5			144.7
(711. RAD/SEC)	4000	74.3	81.2	83.7	82.5	82.9	82.7	81.3	83.3	85.0	87.1	86.2	86.1	84.5	85.2	82.6			135.9
NPD 7488. RPM	5000	77.5	82.9	85.3	83.6	82.7	82.9	81.4	83.3	85.5	87.4	89.4	88.3	85.3	84.1	82.8			136.6
(784. RAD/SEC)	6300	82.9	89.4	[illegible]	89.4	89.0	87.1	86.4	86.3	87.8	88.5	91.3	92.8	89.4	86.9	85.4			140.6
NO. BLADES 26	8000	74.7	81.7	84.8	83.7	83.5	83.1	81.8	83.6	84.6	87.3	88.6	89.3	84.1	[illegible]4.3	80.7			137.4
	10000	73.1	80.7	84.2	83.7	82.8	82.3	80.7	82.5	[illegible]	85.7	87.0	87.0	82.9	81.8	79.5			136.9
	12500	71.1	76.6	81.1	80.0	79.7	78.8	77.0	78.7	82.1	82.6	83.8	82.4	79.1	78.8	75.6			134.7
	16000	66.3	71.6	77.6	75.4	73.1	75.2	72.3	73.9	78.2	77.6	79.7	77.2	75.2	75.0	72.9			132.1
	20000	60.7	67.4	74.1	72.2	71.3	72.8	68.1	70.4	73.0	73.8	77.0	73.5	73.2	74.2	73.3			131.7
OVERALL MEASURED		93.7	99.2	101.9	101.5	99.8	99.8	98.2	98.5	99.8	101.1	102.8	104.1	103.3	104.3	102.8			
OVERALL CALCULATED		92.3	97.6	100.7	99.3	98.3	98.5	96.7	97.3	98.3	99.7	101.4	102.6	102.0	103.2	102.7			150.8
	PNDB	106.1	112.9	116.1	114.7	113.7	114.0	111.8	111.6	111.8	112.9	114.9	116.7	113.7	115.8	112.9			

TABLE A4

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 61.4% N_{fc} ; NOMINAL NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM — PROC. DATE - MONTH 2 DAY 3 HR. 12.0

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	PNL
RADIAL 100. FT.	50	72.1	71.9	67.8	68.4	66.8	68.0	68.2	71.4	69.4	70.2	70.7	71.1	73.4	74.0	78.6	121.9
(30. M)	63	69.3	80.0	67.0	73.5	66.4	67.2	67.9	74.0	69.1	69.7	70.8	70.8	73.7	75.3	77.6	122.3
VEHICL .5 FAN	80	69.1	68.4	68.4	68.5	66.8	67.9	69.2	70.0	71.6	71.9	71.8	71.8	72.2	74.0	76.2	120.6
CONFIG FAN B	100	73.4	67.6	73.0	69.4	72.2	71.4	68.1	69.3	69.4	71.6	71.2	70.6	71.5	73.1	73.4	120.8
LOC PTO	125	68.8	67.0	67.7	65.2	65.8	66.0	66.7	67.4	66.2	67.2	68.4	68.5	68.8	70.2	69.5	117.3
DATE 1/23/71	160	68.4	66.0	66.0	63.3	63.5	63.4	64.5	65.5	64.8	65.8	66.7	67.3	68.1	70.1	70.9	118.[illegible]
RUN 318. PT. 490	200	67.8	66.0	58.2	64.8	64.3	66.4	6[illegible].4	68.2	69.0	70.1	70.9	72.2	73.3	74.7	74.8	119.7
TAPE T0499.	250	68.7	67.2	69.0	69.0	68.5	69.9	71.3	72.8	73.9	74.6	75.7	76.6	76.6	77.8	76.6	123.6
BAR 28.9 HG	315	70.9	68.4	71.6	70.0	70.5	71.6	72.2	73.8	75.0	76.5	77.5	77.8	77.7	77.8	74.8	124.8
(97504. N/M2)	400	72.3	70.3	71.6	70.8	71.7	71.0	72.1	71.6	73.7	74.2	75.3	75.2	75.0	74.7	72.7	123.3
TAMB 30. DEG F	500	71.7	71.0	70.9	68.3	69.1	69.4	68.4	68.3	69.9	70.2	72.3	73.1	72.7	72.4	70.9	120.7
(272. DEG K)	630	71.7	69.8	70.7	69.1	68.8	69.0	70.5	71.3	73.8	76.0	75.8	76.9	76.1	74.1	72.6	123.2
TWET 26. DEG F	800	70.0	70.5	70.3	69.3	69.6	69.9	69.9	70.3	73.4	72.3	74.0	74.1	73.4	72.5	70.8	121.8
(270. DEG K)	1000	69.5	69.2	70.9	69.8	69.6	69.2	69.6	71.1	73.4	75.2	77.5	78.0	75.8	74.1	72.4	123.8
HACT 2.45 GM/M3	1250	68.7	69.1	70.9	69.9	70.1	69.3	69.9	70.7	73.0	74.7	78.4	78.7	77.4	74.1	72.2	124.3
(.00245 KG/M3)	1600	69.9	71.4	72.2	70.9	70.3	70.5	70.7	71.7	73.3	76.3	77.0	79.9	78.9	75.5	73.1	125.9
NFA 4480. RPM	2000	77.8	81.5	82.2	79.6	80.0	79.1	77.0	77.7	78.4	80.8	81.0	83.6	82.9	83.4	86.8	131.1
(469. RAD/SEC)	2500	87.8	72.5	73.3	71.3	70.4	69.7	69.6	70.5	73.8	73.8	74.8	79.0	79.6	74.9	71.8	124.7
NFK 4611. RPM	3150	67.3	74.3	83.9	72.4	69.8	71.4	70.9	73.1	72.5	75.8	76.4	81.0	77.9	74.0	72.4	125.7
(483. RAD/SEC)	4000	73.8	81.7	81.8	82.8	76.6	76.2	75.1	74.9	77.3	70.8	81.9	88.1	83.1	81.1	77.7	131.3
NFD 7488. RPM	5000	70.0	76.2	78.8	79.3	75.6	72.7	71.8	73.2	76.1	76.0	78.4	82.4	80.7	77.8	73.7	128.1
(784. RAD/SEC)	6300	71.7	81.3	81.8	80.2	76.4	76.7	78.9	75.5	76.4	79.3	80.9	85.2	82.8	78.6	75.5	131.3
NO. BLADES 26	8000	71.7	80.1	81.8	79.9	78.2	78.6	78.2	75.3	77.8	77.9	79.8	88.0	82.8	79.8	75.3	131.2
	10000	72.1	82.0	83.1	81.9	78.9	78.2	75.1	74.6	74.6	77.9	78.9	81.8	80.9	79.0	75.9	132.1
	12500	71.2	82.1	83.3	81.2	78.3	77.5	73.4	73.0	74.2	76.0	77.2	79.9	79.4	78.7	74.9	132.9
	16000	70.8	82.3	83.4	80.4	78.[illegible]	77.3	72.9	72.2	71.7	74.8	75.1	78.9	78.9	78.7	75.0	134.0
	20000	70.9	82.6	83.6	81.1	78.[illegible]	76.9	72.7	72.1	71.3	[illegible].6	75.5	78.3	78.5	78.2	75.5	130.7
	OVERALL MEASURED	88.7	90.8	91.6	89.4	88.0	87.8	86.6	87.8	88.9	91.2	91.8	94.3	93.1	91.7	90.0	
	OVERALL CALCULATED	88.6	91.9	92.6	90.6	88.8	88.1	86.1	86.9	88.1	89.7	91.2	93.8	92.7	91.4	89.4	143.8
	PNDB	97.9	103.1	104.2	102.2	99.9	100.3	98.2	99.1	100.8	102.4	105.9	107.2	105.8	103.9	101.2	

TABLE A5

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 66.9% N_{fc} ; NOMINAL NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 2 HR. 14.2

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	72.8	72.9	70.5	69.	68.7	69.9	70.4	72.	72.1	72.7	72.9	73.3	75.5	79.0	81.8			123.3
(30. M)	63	68.3	80.	69.8	73.6	68.2	69.2	70.4	75.1	71.5	72.0	73.2	73.6	76.2	78.5	80.6			124.0
VEHICLE .5 FAN	80	.2	70.4	73.3	75.	72.4	73.1	74.2	74.0	73.7	73.	72.9	73.4	74.9	77.6	79.1			123.9
CONFIG FAN 3	100	73.5	66.7	69.6	69.	69.9	70.0	71.6	72.8	72.1	72.4	72.9	73.7	74.4	76.4	76.5			122.2
LOC PTD	125	67.3	66.	69.5	65.	66.8	67.3	66.5	68.8	68.8	69.9	71.2	71.5	72.1	73.4	72.6			119.5
DATE 1/23/71	160	73.4	70.8	71.7	68.	68.1	67.5	70.2	73.8	68.5	71.6	70.3	71.0	71.7	75.0	74.9			121.
RUN 318. PT. 492	200	66.3	6[illegible]	67.9	67.	66.7	68.4	69.1	70.7	71.3	73.3	74.3	75.4	77.1	78.9	78.9			122.9
TAPE S 2600	250	67.9	66.3	72.1	7[illegible]	73.3	74.2	74.2	75.3	76.6	78.1	79.2	79.9	80.4	81.8	80.3			127.0
BAR 28.9 HG	315	[illegible]	7.5	74.6	72.	73.	74.2	75.8	76.7	77.7	79.5	81.1	81.0	80.8	81.3	78.6			127.9
(97564 N/M2)	400	73.1	72.4	75.8	73.	73.7	72.4	73.7	73.9	75.6	76.5	77.9	78.2	77.4	76.9	75.6			125.5
TAMB 30. DEG F	500	71.6	71.9	73.0	70.	70.9	70.7	70.2	70.3	71.7	73.3	75.2	76.0	75.9	75.9	73.5			123.1
(272. DEG K)	630	71.5	71.4	73.6	7[illegible]	71.0	71.5	73.4	74.6	76.8	77.3	78.8	79.3	78.6	76.8	75.2			125.9
TWET 25 DEG F	800	73.0	72.2	72.8	71.	71.6	71.8	72.0	72.4	73.4	74.6	76.9	76.9	75.9	74.8	73.1			124.
(270. DEG K)	1000	69.7	71.3	73.0	72.	71.5	71.3	72.1	73.3	75.5	77.3	79.6	80.2	77.6	75.6	74.0			125.9
MACT 2.45 GM/M3	1250	69.4	70.6	73.0	72.	72.2	71.5	72.1	73.0	75.2	76.8	80.7	81.3	79.3	76.0	74.0			126.5
(.00245 KG/M3)	1600	7[illegible]	72.6	73.5	72.5	72.3	72.4	72.8	74.1	75.5	78.3	81.2	82.2	79.8	76.6	74.1			127.4
NFA 4880 RPM	2000	77.5	82.6	84.4	83.	80.9	80.4	79.8	80.3	80.7	82.6	83.2	85.8	84.9	85.4	82.5			133.2
(511. RAD/SEC)	2500	71.2	76.5	77.9	76.1	74.5	74.0	73.5	74.3	77.0	76.9	78.2	82.2	81.9	78.9	75.6			128.1
NFK 5022. RPM	3150	69.0	76.2	76.0	74.	72.2	73.9	73.8	76.1	75.2	79.2	79.2	83.5	80.0	76.1	74.5			128.3
(526 RAD/SEC)	4000	76.2	83.5	86.4	83.5	80.6	80.0	77.4	77.	8[illegible]	80.3	83.9	87.1	84.8	82.5	79.1			133.
NFD 7488. RPM	5000	72.5	79.	80.7	76.8	79.3	76.2	75.1	76.6	79.2	78.7	81.7	85.3	91.9	8[illegible].4	76.5			131.
(784. RAD/SEC)	6300	74.	83.4	84.6	83.7	80.2	80.2	77.6	78.9	79.7	82.2	84.3	87.9	83.7	80.8	78.3			134.0
NO. BLADES 26	8000	74	83.	84.5	82.4	81.3	79.6	77.0	78.3	80.4	80.4	82.2	85.6	82.9	82.3	78.0			133.7
	10000	74.	84.5	88.0	84.5	82.2	81.5	77.3	78.0	79.9	80.5	81.9	85.1	82.2	81.9	78.3			135.
	12500	74.	84.4	86.2	84.	81.6	81.0	76.6	76.6	77.6	79.0	80.7	83.0	81.2	81.7	77.8			135.4
	16000	73.5	84.	86.1	83.2	81.9	80.7	76.0	75.7	75.1	77.7	79.3	82.1	80.5	81.7	77.9			136.9
	20000	72.	84.1	89.6	82.	80.6	79.3	74.8	74.6	73.9	76.6	78.2	80.7	79.7	80.5	77.5			138.6
OVERALL MEASURED		88.1	93.2	95.1	92.	91.1	90.5	89.3	90.2	91.4	92.6	94.4	96.8	94.7	94.4	92.8			
OVERALL CALCULATED		86.8	93.8	95.3	93.3	91.4	90.8	88.9	89.8	91.0	92.2	94.0	96.5	94.5	94.1	92.1			145.5
PNDB		99.2	105.1	107.1	105.0	103.0	102.6	101.1	101.8	104.0	104.5	107.0	109.6	107.6	106.1	103.6			

TABLE A6

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 82.2% N_{fc} ; NOMINAL NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 2 HR. 14.2

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	75.9	76.6	76.1	77.	75.4	74.5	75.2	77.0	76.9	78.3	78.6	79.5	82.6	86.4	89.4			129.7
(30. M)	63	71.4	81.4	74.3	75.	73.7	73.9	74.9	77.8	76.6	77.6	78.7	79.8	82.7	86.4	89.2			129.6
VEHICLE .5 FAN	80	70.0	71.3	73.3	73.	72.2	73.5	74.9	76.4	76.8	78.3	79.4	80.3	82.8	85.9	87.4			128.9
CONFIG FAN B	100	76.5	77.3	77.1	77.2	75.5	77.6	77.6	78.1	78.2	79.9	81.4	81.5	82.8	85.6	85.5			129.9
LOC PT3	125	71.7	72.2	74.5	73.	71.7	72.8	73.	74.9	75.1	76.8	77.6	78.1	79.4	81.0	79.6			126.0
DATE 1/23/71	160	71.	70.7	72.4	70.0	71.4	70.2	71.8	72.7	73.2	75.2	76.1	77.6	79.5	82.3	82.4			125.6
RUN 31B. PT. 494	200	70.8	72.3	75.4	75.	74.4	75.0	76.1	77.3	78.1	82.9	82.0	82.7	85.2	87.4	87.1			130.9
TAPE S.267.	250	71.5	77.2	76.5	76.7	76.5	77.8	79.3	80.8	81.9	83.6	85.1	86.5	89.3	90.2	88.5			133.6
BAR 28.9 HG	315	76.5	75.9	79.4	78.	78.2	81.5	81.2	82.4	84.1	85.5	87.1	88.2	89.2	89.7	86.8			134.8
(97561. N/M2)	400	77.3	78.2	80.1	78.	78.7	77.7	79.4	80.1	82.3	84.3	85.2	88.1	85.9	84.9	82.8			132.7
TAMB 30. DEG F	500	76.4	76.6	76.6	76.	75.6	75.	76.0	76.3	77.	79.6	81.4	83.2	83.8	84.0	81.2			129.5
(272. DEG K)	630	75.4	75.3	76.8	75.5	76.2	77.4	79.5	81.2	82.8	84.1	85.7	86.3	86.1	84.5	82.2			132.5
TWET 26. DEG F	800	74.7	75.	77.3	76.9	77.1	76.9	77.8	78.8	80.5	81.5	82.8	83.2	82.5	81.5	79.5			130.2
(270. DEG K)	1000	73.9	74.7	76.7	76.	76.0	76.1	77.4	78.9	81.4	83.3	85.4	86.1	83.2	81.7	79.6			131.5
HACT 2.45 GM/M3	1250	73.3	74.	76.6	76.2	76.5	76.8	77.1	77.9	80.7	82.4	85.8	86.4	83.6	81.1	79.0			131.5
(.00245 K3/M3)	1600	73.7	75.6	76.9	76.	76.3	75.9	77.3	78.3	80.3	83.3	86.2	87.3	83.9	80.9	76.9			132.0
NFA 6006. RPM	2000	74.5	77.	78.7	78.1	77.5	78.5	79.2	80.2	82.2	84.1	85.6	88.0	84.2	81.6	79.5			132.8
(628. RAD/SEC)	2500	81.5	89.	91.5	88.7	88.7	87.2	85.8	84.4	85.8	84.5	87.6	91.5	88.5	59.5	83.7			138.5
NFK 6175. RPM	3150	73.7	81..	81.0	79.7	78.0	79.5	79.3	80.8	80.4	84.5	85.3	88.2	83.4	91.3	79.3			133.3
(647. RAD/SEC)	4000	77.8	83.	84.0	82.	80.1	81.3	80.5	80.7	85.7	85.	[illegible]	90.0	86.9	84.1	81.6			135.9
NFD 7493. RPM	5000	78.0	85.1	84.9	84.5	85.7	82.7	82.5	83.2	86.1	86.2	89.4	91.2	86.1	86.9	82.6			137.3
(784. RAD/SEC)	6300	77.2	86.	85.9	84.5	81.9	83.0	82.2	83.6	85.1	88.3	90.0	92.7	86.3	84.7	81.9			138.1
NO. BLADES 26	8000	77.4	86.4	87.3	86.	84.9	84.1	82.9	83.5	86.1	86.8	88.4	91.2	86.6	86.7	82.1			138.5
	10000	77.2	86.6	87.5	86.9	84.8	84.8	82.6	82.9	85.4	86.7	88.2	90.6	85.7	85.2	81.7			139.1
	12500	75.7	85.8	87.1	85.8	83.8	83.9	82.1	81.4	83.3	85.3	86.7	88.6	84.8	84.1	80.6			139.0
	16000	74.7	85.5	86.7	84.7	83.9	83.5	81.4	80.2	80.3	83.9	85.3	87.7	84.0	83.5	80.1			140.1
	20000	73.0	84.6	85.9	84.2	82.5	82.2	80.1	79.1	78.9	82.5	83.8	86.1	83.1	81.9	79.4			141.4
OVERALL MEASURED		91.1	96.5	98.2	96.2	95.5	94.9	94.9	95.5	97.2	98.6	100.4	102.2	100.3	100.7	99.4			
OVERALL CALCULATED		96.0	96.4	97.6	96.2	95.3	95.0	94.3	94.7	96.6	98.1	100.0	101.9	99.4	99.8	98.4			149.8
PNDB		103.1	109.	110.	108.9	108.4	107.9	107.3	107.3	109.3	110.9	112.6	114.5	111.8	111.9	108.4			

TABLE A7

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 91.1% N_{fc} ; NOMINAL NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 2 HR. 14.2

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160 (2.79)	( ) ( )	PWL
RADIAL 100. FT.	50	76.7	76.1	79.3	76.[illegible]	76.5	77.0	78.4	79.7	80.0	81.2	81.9	92.9	86.4	91.2	94.3		133.5
(30. M)	63	76.1	81.2	76.8	78.8	76.6	77.6	77.8	80.7	80.9	81.9	83.0	84.3	87.5	91.8	94.7		134.3
VEHICLE .5 FAN	80	72.0	73.9	75.5	76.8	75.9	76.5	77.9	79.6	80.8	81.7	82.7	84.1	87.2	90.7	92.7		133.3
CONFIG FAN B	100	76.0	75.8	77.6	77.9	77.3	77.7	79.9	79.9	81.6	83.3	82.8	85.7	86.8	90.1	90.1		133.1
LOC PTO	125	74.7	74.6	76.2	75.7	75.7	75.5	77.8	78.0	79.7	81.5	81.3	83.4	83.6	86.0	84.9		130.3
DATE 1/23/71	160	73.4	72.2	74.1	72.7	73.7	73.8	75.0	75.3	77.4	78.6	80.1	82.3	84.0	87.3	87.4		129.9
RUN 318, PT. 497	200	75.0	74.9	76.1	79.7	79.3	78.4	79.7	80.2	81.6	82.7	85.6	87.6	90.2	92.6	92.1		135.1
TAPE S1257?	250	76.0	76.8	80.2	81.6	81.2	82.1	83.2	84.4	85.7	87.0	89.5	91.3	93.4	95.1	93.6		138.2
BAR 28.9 HG	315	80.2	79.5	83.7	82.[illegible]	82.9	84.0	84.7	86.0	87.6	89.0	91.0	92.4	93.6	94.1	91.6		138.8
(97551. N/M2)	400	80.8	80.2	82.4	80.6	81.8	81.3	83.1	83.9	86.1	87.3	88.7	89.8	89.5	88.7	87.0		136.0
TAMB 30. DEG F	500	79.2	78.6	79.0	78.9	79.2	79.5	79.3	80.2	82.3	83.7	86.3	88.0	89.0	89.1	86.4		134.1
(272. DEG K)	630	77.5	77.1	79.0	77.8	79.1	80.5	82.3	83.7	85.7	86.7	88.8	89.6	90.3	88.3	86.1		135.7
TWET 26. DEG F	800	77.7	78.1	79.3	79.[illegible]	80.1	79.7	81.0	82.2	84.0	84.5	85.7	86.7	86.8	85.4	83.2		133.5
(270. DEG K)	1000	76.9	77.1	78.9	79.6	79.7	78.8	80.5	81.6	84.2	85.3	87.4	87.7	86.3	85.1	83.1		133.9
HACT 2.45 GM/M3	1250	75.8	76.2	78.7	79.0	79.3	78.8	79.3	80.1	82.2	83.3	85.8	86.3	85.1	83.6	81.5		132.6
(.00245 KG/M3)	1600	75.6	76.7	79.2	79.2	78.6	78.4	79.0	80.3	82.0	83.1	85.0	85.3	84.2	82.9	81.0		132.2
NFA 5650. RPM	2000	76.0	78.2	79.6	79.7	78.3	78.8	79.9	80.9	83.1	83.9	85.0	86.5	84.1	82.5	81.1		132.8
(696. RAD/SEC)	2500	79.1	83.5	86.0	91.1	84.0	84.8	82.7	81.9	85.0	84.4	85.9	88.2	85.3	86.1	81.8		136.3
NFK 6844. RPM	3150	83.3	88.4	91.1	97.5	88.7	90.2	87.4	86.3	87.9	88.9	89.9	90.7	88.4	90.2	84.9		141.1
(717. RAD/SEC)	4000	76.8	80.4	82.7	81.6	79.9	81.1	80.9	81.1	85.7	85.8	88.3	87.9	85.6	83.3	81.3		135.2
NFD 7488. RPM	5000	75.6	82.4	82.8	81.2	82.8	82.0	82.7	82.7	85.5	85.4	88.3	89.3	84.1	84.0	80.6		135.9
(784. RAD/SEC)	6300	78.5	88.5	88.5	86.4	84.9	87.8	87.7	86.4	87.8	91.0	91.7	93.7	88.1	86.6	83.6		140.4
NO. BLADES 26	8000	75.7	83.5	85.3	84.0	84.1	83.4	83.6	84.9	88.0	88.7	89.9	91.2	86.7	85.2	81.5		138.8
	10000	75.2	82.9	84.8	84.4	82.7	83.5	83.3	84.1	87.0	87.9	88.9	90.2	85.6	83.5	80.7		138.8
	12500	73.9	82.6	85.0	84.2	82.1	82.6	81.9	82.8	86.4	87.0	87.7	88.6	84.6	82.7	79.7		139.0
	16000	72.6	82.7	84.2	82.6	81.6	81.6	80.6	81.2	82.4	84.9	88.2	87.2	83.3	81.7	78.8		139.4
	20000	70.5	80.7	82.8	81.5	79.9	79.9	79.1	79.8	80.3	83.3	84.3	85.4	82.1	79.8	77.5		140.3
OVERALL MEASURED		92.5	95.9	97.7	99.7	96.6	98.9	96.9	97.4	99.8	100.7	102.2	103.5	103.1	104.2	103.8		
OVERALL CALCULATED		91.5	95.7	97.4	99.8	95.8	96.6	96.4	96.8	98.9	100.2	101.6	102.9	102.1	103.1	102.6		151.0
	PNDB	109.2	109.4	111.5	114.9	109.9	110.8	109.8	109.6	111.6	112.7	114.0	115.5	113.3	114.0	110.9		

TABLE A8

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 59.0%N_{fc} ; LARGE NOZZLE ; BASELINE

PAGE 1 NASA QUIET FAN PROC. DATE - MONTH 10 DAY 15 HR. 11.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	PNL
RADIAL 100. FT.	50	71.9	69.2	67.2	70.0	69.0	60.1	68.2	70.6	69.7	69.6	70.6	70.6	72.2	74.1	119.7
(30. M)	63	66.2	66.5	66.3	77.3	69.3	62.6	67.3	76.4	69.3	69.8	72.4	72.1	74.6	74.1	122.0
VEHICLE .5 FAN	80	64.8	65.1	65.6	66.2	67.4	62.9	67.0	67.7	69.3	69.7	71.7	71.5	72.1	73.0	118.8
CONFIG FAN B	100	74.9	72.7	75.8	69.7	71.7	68.5	66.9	67.7	72.8	75.0	75.5	72.1	73.0	72.6	122.4
LOC PTO	125	67.0	66.1	66.7	66.0	68.0	64.3	66.8	67.5	66.9	67.7	69.1	68.7	69.2	70.1	117.4
DATE 9/19/70	160	64.7	64.8	64.8	66.4	67.5	64.2	64.7	66.6	65.7	66.4	66.1	67.2	68.3	67.8	116.1
RUN 14. PT. 239	200	64.8	65.3	62.9	68.3	64.8	64.2	64.0	68.5	66.3	68.1	68.9	70.2	71.5	71.9	117.8
TAPE S1158.	250	65.2	65.6	65.0	67.5	67.0	67.2	68.9	70.0	70.7	71.5	73.6	74.1	74.7	75.2	121.0
BAR 29.0 HG	315	66.7	68.4	69.2	70.0	69.2	70.8	70.2	72.1	72.8	73.8	75.7	75.8	75.9	75.7	122.9
(97780. N/M2)	400	67.8	69.4	70.7	69.4	69.0	70.1	69.6	71.0	72.0	72.9	74.4	73.4	72.5	72.3	121.6
TAMB 73. DEG F	500	68.1	70.2	69.4	67.4	67.4	69.5	67.6	67.6	68.7	68.4	70.1	70.4	70.4	69.7	119.1
(294. DEG K)	630	66.6	68.9	67.7	67.5	67.0	69.8	69.0	69.2	70.7	71.3	73.2	73.4	73.3	71.3	120.7
TWET 63. DEG F	800	66.9	67.6	67.3	68.1	69.1	70.1	68.1	69.4	69.8	70.5	71.8	70.7	70.8	70.4	119.9
(290. DEG K)	1000	66.7	67.8	69.2	67.5	68.0	69.4	68.4	68.9	70.2	71.1	73.2	72.9	72.4	70.6	120.6
HACT12.62 GM/M3	1250	66.5	67.7	68.2	67.5	67.9	69.2	67.0	67.8	69.2	70.1	73.1	72.6	73.1	69.7	120.2
(.01262 KG/M3)	1600	68.5	72.1	70.5	69.6	69.8	71.2	68.2	69.7	70.9	72.3	74.0	74.3	75.9	72.8	122.3
NFA 4460. RPM	2000	78.2	84.5	82.7	80.3	81.1	80.4	75.8	77.8	77.7	80.3	80.0	82.2	85.3	83.0	131.6
(467. RAD/SEC)	2500	63.5	68.1	68.6	66.4	66.0	67.2	65.3	65.6	67.3	69.0	69.2	72.4	72.9	69.2	119.2
NFK 4413. RPM	3150	64.1	72.1	73.0	70.5	67.9	69.6	69.0	68.7	70.1	70.5	73.7	75.4	74.3	72.7	122.3
(462. RAD/SEC)	4000	72.3	81.9	82.0	80.0	77.8	78.9	74.8	74.7	76.0	77.5	81.1	83.4	81.1	80.6	130.2
NFD 7488. RPM	5000	67.7	74.5	73.8	72.5	72.6	72.6	68.5	71.4	73.5	75.7	77.5	80.4	80.7	74.6	126.6
(784. RAD/SEC)	6300	68.5	77.3	77.9	76.0	74.6	74.8	71.3	71.7	73.0	76.3	78.3	81.0	81.3	76.0	128.2
NO. BLADES 26	8000	67.1	76.4	77.5	76.0	73.9	75.0	70.8	71.7	72.4	74.0	76.6	80.2	78.2	75.8	127.7
	10000	65.8	76.0	75.4	74.0	73.2	74.0	68.8	69.6	71.1	73.8	75.3	77.1	77.0	73.2	126.9
	12500	63.4	72.5	73.6	71.2	70.3	70.3	65.6	66.9	67.7	69.5	71.2	73.5	72.0	70.4	124.6
	16000	60.3	69.0	70.2	66.7	66.7	67.4	62.9	64.6	63.4	65.9	67.7	69.4	69.0	66.1	123.1
	20000	60.6	66.4	67.5	64.5	64.1	65.8	61.9	65.3	62.0	64.6	65.9	66.6	67.6	63.6	123.6
OVERALL MEASURED		85.4	90.3	90.1	88.2	87.7	87.9	84.9	86.2	87.0	88.6	90.5	92.3	92.6	90.1	
OVERALL CALCULATED		83.6	88.9	88.6	87.2	86.3	86.3	83.5	85.2	85.6	87.3	89.0	90.6	90.9	88.9	138.8
PNDB		96.4	102.2	102.3	100.7	99.5	100.0	96.9	97.7	98.7	100.3	102.8	104.6	104.2	102.2	

TABLE A9

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 64.9%N_{fc} ; LARGE NOZZLE ; BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC. DATE - MONTH 10 DAY 31 HR. 16.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	( )	( )	( )	PWL
RADIAL 100. FT.	50	73.1	70.2	68.2	71.0	69.9	61.1	70.1	72.0	71.7	71.4	71.8	72.6	74.8	77.3				121.5
(30. M)	63	66.7	67.0	67.7	77.3	69.4	64.3	68.5	76.4	70.3	71.9	73.4	73.4	76.1	77.2				122.9
VEHICLE .5FAN	80	64.5	65.2	66.6	67.0	66.0	58.6	66.5	68.2	70.4	73.4	72.9	72.4	74.0	75.0				120.2
CONFIG FANB	100	75.2	71.3	74.2	74.5	76.1	72.6	70.8	71.4	70.5	71.0	72.2	73.7	74.8	73.9				122.9
LOC PTO	125	68.3	68.7	67.9	67.4	68.3	66.1	68.5	68.2	69.0	69.6	70.7	70.8	71.5	72.3				119.2
DATE 9/19/70	160	69.6	70.8	68.5	69.0	69.2	67.6	69.4	70.2	68.8	68.1	68.9	69.8	70.7	71.4				119.3
RUN 14. PT. 240.	200	63.5	63.8	63.2	67.8	63.9	65.0	65.6	69.2	68.5	70.2	72.0	72.5	74.7	75.4				119.8
TAPE S1157.	250	65.9	65.9	67.3	69.6	69.1	70.1	71.9	73.7	74.4	75.6	77.8	78.0	78.6	79.1				124.7
BAR 29.0 HG	315	69.0	69.3	71.1	70.8	70.7	72.1	72.1	74.1	75.3	77.0	79.0	79.0	79.6	79.1				125.7
(97780. N/M2)	400	69.6	70.9	72.2	71.2	71.1	71.3	71.4	72.6	74.0	74.9	76.5	75.6	75.6	74.7				123.6
TAMB 70. DEG F	500	69.7	72.1	70.9	69.0	69.3	71.1	69.2	69.2	70.3	70.7	72.8	73.3	73.6	72.7				121.2
(294. DEG K)	630	67.9	69.2	68.9	65.5	68.9	71.3	70.3	71.3	72.8	73.7	75.8	76.0	76.0	73.8				122.9
TWET 63. DEG F	800	68.4	69.0	69.2	69.7	70.7	72.3	70.2	71.4	72.5	73.5	74.5	73.3	73.7	72.5				122.3
(290. DEG K)	1000	67.8	68.6	70.0	69.0	69.4	71.3	70.1	71.2	72.5	73.9	75.9	75.2	75.0	72.8				122.8
HAC 12.62 GM/M3	1250	67.8	68.9	69.9	69.4	69.8	71.3	69.1	70.4	71.8	73.0	76.1	75.5	75.6	72.1				122.5
(.01262 KG/M3)	1600	69.6	71.4	70.6	70.1	70.2	72.2	69.5	71.0	72.6	74.0	76.1	76.9	76.7	73.4				123.7
NFA 4910. RPM	2000	78.7	85.2	83.5	82.0	82.0	82.5	76.0	78.1	79.5	79.7	80.8	83.1	85.0	86.1				132.5
(514. RAD/SEC)	2500	69.3	75.5	74.6	72.6	72.5	73.5	69.3	70.0	71.6	72.8	73.9	76.3	77.1	76.2				124.3
NFK 4859. RPM	3150	65.1	72.7	74.1	72.1	69.3	71.4	71.1	71.0	72.3	72.7	75.9	77.1	76.2	73.7				124.1
(509. RAD/SEC)	4000	74.6	82.9	82.7	82.9	81.3	81.4	77.0	79.3	79.4	79.5	81.7	85.8	84.0	81.6				132.7
NFD 7488. RPM	5000	70.1	77.0	76.4	76.1	75.8	76.2	72.1	74.9	76.6	78.8	80.6	83.1	83.2	77.0				129.5
(784. RAD/SEC)	6300	70.5	79.5	80.0	78.1	77.2	78.1	75.3	74.5	75.8	79.5	81.6	83.7	83.6	78.0				130.9
NO. BLADES 26	8000	69.1	77.5	79.2	75.3	77.0	77.9	73.6	74.9	75.7	77.5	79.8	83.2	80.6	77.5				130.4
	10000	67.6	77.5	77.7	76.5	75.7	76.7	72.2	72.7	74.1	76.7	78.7	79.0	79.1	75.0				129.5
	12500	65.1	74.4	75.6	73.9	73.3	77.5	69.2	69.9	70.9	73.0	74.8	76.6	74.5	72.6				127.5
	16000	61.8	71.1	72.7	69.7	70.0	70.7	66.3	66.7	66.4	69.1	71.3	72.7	71.5	68.6				126.0
	20000	61.8	68.2	69.8	67.2	66.8	68.1	64.1	66.3	64.1	67.1	68.1	69.4	69.0	65.7				128.0
OVERALL MEASURED		86.1	91.4	91.1	93.4	89.7	93.2	86.6	88.6	89.4	90.7	92.7	94.6	94.6	92.6				
OVERALL CALCULATED		84.8	90.1	89.9	89.3	88.5	88.9	85.7	87.4	88.0	89.3	91.2	93.0	92.8	91.4				141.0
PNDB		97.6	103.6	103.5	103.3	102.2	102.6	99.2	101.0	101.6	102.5	104.5	107.0	106.3	104.7				

TABLE A10

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 79.5%N_{fc} ; LARGE NOZZLE ; BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC. DATE - MONTH 10 DAY 31 HR. 16.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	( )	( )	( )	PWL
RADIAL 100. FT.	50	76.2	74.0	73.8	73.6	73.6	64.2	74.3	75.5	76.4	77.2	77.9	78.4	81.0	84.8				127.0
(30. M)	63	70.5	71.4	73.0	75.9	73.5	65.9	74.2	76.9	76.9	77.7	79.2	79.5	81.8	85.1				127.6
VEHICLE .5FAN	80	67.1	69.3	70.4	71.2	70.5	63.5	73.3	74.3	75.6	76.4	78.3	79.2	81.2	83.9				126.3
CONFIG FANB	100	79.2	76.3	78.1	78.5	78.8	71.9	77.0	77.6	77.4	81.0	82.4	85.2	84.8	83.5				130.2
LOC PTO	125	72.9	72.2	73.1	72.5	73.1	69.4	73.7	74.2	74.3	75.5	77.1	77.3	78.4	80.3				125.1
DATE 9/19/70	160	70.6	69.8	70.1	67.9	70.7	66.2	71.6	71.6	72.0	73.6	75.1	75.8	77.6	79.4				123.4
RUN 14. P- 24.	200	77.9	72.6	69.2	70.7	69.3	72.8	71.7	73.8	74.3	77.0	80.1	80.7	82.8	84.2				127.5
TAPE 1159.	250	69.3	71.1	72.9	[illegible]	73.8	75.6	76.9	78.3	79.5	81.1	83.5	84.3	86.0	87.4				131.0
BAR 29.0 HG	315	74.1	74.9	77.5	75.6	77.6	78.1	78.8	80.3	81.7	83.4	85.4	85.8	86.7	87.5				132.6
(97800. N/M2)	400	75.1	76.3	77.2	76.0	76.6	74.9	77.6	78.8	80.6	81.8	83.5	83.2	82.9	82.6				130.3
TAMB 70. DEG F	500	74.6	75.4	74.7	75.4	[illegible]	75.7	74.5	74.8	75.9	77.2	79.4	80.3	81.3	81.0				127.5
(294. DEG K)	630	72.5	74.7	[illegible]	75.0	75.6	77.6	77.2	78.1	80.9	81.2	83.0	82.9	83.6	81.4				130.0
TWET 63. DEG F	800	72.3	73.5	74.4	75.1	75.8	78.2	76.9	77.4	79.8	81.3	81.2	80.2	80.6	79.6				128.9
(270. DEG K)	1000	72.5	74.4	74.5	74.7	75.1	77.2	76.0	77.1	78.5	79.9	81.6	81.1	80.8	79.7				128.6
HACT12.62 GM/M3	1250	71.7	73.2	73.7	73.7	74.6	76.6	74.6	75.5	76.9	78.3	80.4	79.7	80.1	78.0				127.5
(.01262 KG/M3)	1600	72.4	75.1	74.7	74.4	75.1	77.4	74.7	76.1	77.5	78.7	80.0	80.2	80.2	78.2				127.9
NFA 6015. RPM	2000	71.0	74.5	74.3	73.5	74.3	76.3	73.6	75.8	76.8	78.2	79.8	80.2	79.0	76.4				127.?
(630. RAD/SEC)	2500	79.6	87.3	91.1	87.1	86.8	85.8	84.1	80.9	80.8	81.7	83.9	85.9	84.9	87.4				136.2
NFK 5952. RPM	3150	69.4	76.6	79.8	77.0	75.0	76.6	76.6	75.9	77.0	77.5	81.3	81.0	79.3	78.4				128.8
(623. RAD/SEC)	4000	73.4	78.4	78.1	77.7	76.3	78.8	76.9	78.2	80.1	81.6	83.9	85.4	82.1	79.3				131.5
NPD 7488. RPM	5000	79.0	87.0	86.2	85.6	86.5	85.5	81.0	83.0	85.0	86.1	88.4	90.3	88.2	84.9				137.4
(784. RAD/SEC)	6300	71.7	79.5	80.4	75.6	78.5	79.4	78.1	78.9	80.6	84.3	86.6	87.1	83.4	79.9				133.8
NO. BLADES 26	8000	73.6	82.7	84.0	83.6	81.8	82.9	80.2	81.0	81.8	83.5	86.5	88.1	83.0	82.8				135.7
	10000	70.4	80.4	80.9	77.8	79.2	80.5	77.5	78.3	79.9	82.4	84.5	85.1	81.8	78.9				134.1
	12500	67.6	76.1	77.7	76.2	76.0	76.7	74.1	75.4	76.7	78.7	80.5	81.5	77.4	75.7				131.6
	16000	63.5	72.3	74.3	71.5	72.2	73.5	70.5	71.3	72.0	74.4	77.0	77.4	74.2	71.3				129.7
	20000	62.8	69.1	71.1	68.7	68.7	7?.4	67.2	68.7	69.7	70.8	73.3	73.6	71.0	67.9				128.9
OVERALL MEASURED		89.8	94.8	96.3	94.5	94.4	94.4	92.8	93.2	94.7	96.3	98.4	99.4	98.4	98.0				
OVERALL CALCULATED		86.?	93.1	94.7	92.9	92.7	92.8	91.3	91.9	93.2	94.8	96.9	97.9	95.9	96.9				145.6
	PNDB	101.1	106.9	10?.1	106.8	106.5	104.4	105.0	105.0	106.6	108.0	110.2	111.4	109.9	109.2				

TABLE A11

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 90.5%N_{fc} ; LARGE NOZZLE ; BASELINE

PAGE 1 NASA QUIET FAN PROC. DATE - MONTH 10 DAY 15 HR. 11.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	( )	( )	( )	PWL
RADIAL 100. FT.	50	78.2	76.3	74.2	75.5	75.7	66.4	76.9	78.5	79.5	80.1	81.2	82.3	85.1	89.6				130.6
(30. M)	63	76.2	75.0	75.1	78.1	76.0	69.1	77.2	79.7	80.1	81.3	82.9	83.9	85.9	90.0				131.5
VEHICLE .5 FAN	80	71.1	73.1	73.5	74.6	74.3	69.1	76.4	77.8	79.6	80.3	81.6	82.6	85.2	88.9				130.4
CONFIG FAN B	100	73.3	74.8	73.6	76.1	75.3	72.0	77.4	77.9	79.5	80.5	81.6	83.4	85.0	87.9				130.4
LOC PTO	125	74.4	75.3	75.5	75.3	75.2	73.1	76.5	77.1	79.5	80.6	81.2	83.2	83.0	85.1				129.4
DATE 9/19/70	160	72.6	72.4	72.7	72.4	73.2	70.3	74.0	74.1	75.4	77.2	78.9	80.4	82.3	84.8				127.4
RUN 14. PT. 243	200	72.2	73.3	71.7	73.4	73.2	75.2	75.2	77.2	78.7	80.8	83.1	85.2	87.8	90.0				131.9
TAPE S1159.	250	74.1	76.2	76.6	78.3	78.0	80.0	80.5	81.9	83.6	85.2	88.0	89.5	91.4	92.8				135.8
BAR 29.0 HG	315	78.5	79.6	80.8	81.2	80.7	82.4	82.7	84.6	86.6	88.0	90.4	91.5	92.8	93.5				137.8
(97800. N/M2)	400	78.8	80.2	80.9	79.5	80.0	81.4	81.7	83.2	85.3	86.4	87.9	88.[illegible]	88.6	88.6				135.1
TAMB 70. DEG F	500	78.8	81.0	80.1	77.8	78.1	80.2	78.5	78.5	80.4	82.1	84.1	85.5	86.4	86.1				132.2
(294. DEG K)	630	75.6	77.7	77.7	77.6	78.5	81.5	80.6	82.4	85.0	85.6	87.4	87.4	88.5	86.8				134.4
TDEW 63. DEG F	800	76.9	79.3	79.4	79.1	80.1	82.3	81.1	82.2	84.0	84.7	85.9	85.0	85.7	84.9				133.4
(290. DEG K)	1000	76.5	78.8	79.6	79.8	79.5	81.6	80.4	81.9	83.9	85.6	87.4	86.6	86.3	85.1				133.7
HACT12.62 GM/M3	1250	75.9	79.4	80.8	78.9	80.7	82.0	79.5	80.9	82.6	83.5	86.1	85.5	85.9	83.9				133.2
(.01262 KG/M3)	1600	78.6	81.6	81.6	82.0	82.7	83.4	80.5	81.2	83.4	84.4	85.7	85.6	86.0	84.6				133.9
NFA 6848. RPM	2000	77.1	81.6	80.8	80.4	82.0	83.0	78.9	80.1	82.4	83.7	84.1	85.7	84.5	82.6				133.1
(717. RAD/SEC)	2500	76.9	83.1	85.4	83.8	82.2	83.3	81.0	79.5	81.3	82.5	84.9	85.6	83.3	84.6				133.8
NFK 6777. RPM	3150	84.5	91.6	94.7	93.3	90.4	91.4	89.6	87.0	88.2	87.7	92.7	91.9	89.9	93.8				141.9
(710. RAD/SEC)	4000	77.6	84.8	85.6	83.8	84.5	86.7	83.9	84.1	86.3	87.1	89.1	[illegible]9.0	85.7	86.3				137.3
NFD 7486. RPM	5000	78.1	84.7	84.9	84.2	85.4	86.0	82.2	84.0	86.3	88.5	90.0	[illegible].1	86.6	85.0				137.7
(784. RAD/SEC)	6300	78.3	86.8	88.6	86.5	86.7	88.3	85.6	85.0	88.3	90.9	93.0	[illegible]2.5	89.2	86.8				140.5
NO. BLADES 26	8000	74.4	82.8	85.1	84.3	83.5	85.3	83.0	84.1	85.8	87.4	8[illegible]	90.5	85.6	84.9				138.3
	10000	72.8	82.4	83.5	82.4	82.5	84.2	81.0	82.3	84.8	86.8	88.[illegible]	88.3	85.4	83.1				137.8
	12500	69.5	78.5	80.8	79.3	79.3	80.2	77.7	79.6	82.1	84.2	85.4	85.7	81.5	80.0				135.9
	16000	65.1	74.5	76.8	74.1	74.8	76.2	73.6	74.8	77.0	79.5	82.0	81.6	78.9	75.8				133.8
	20000	62.9	7[illegible].5	72.7	70.3	70.9	72.0	69.4	71.3	73.3	75.3	79.0	78.5	77.7	73.7				133.1
OVERALL MEASURED		92.4	98.0	99.6	98.7	97.7	99.0	97.1	97.3	99.4	100.9	103.0	103.2	102.5	103.3				
OVERALL CALCULATED		91.2	96.4	98.2	97.2	96.2	97.4	95.6	96.0	98.0	99.4	101.6	101.8	101.2	102.2				1[illegible].9
PNDB		105.6	111.5	113.5	112.5	111.0	112.1	110.3	109.6	111.3	112.4	115.1	115.0	113.6	115.3				

TABLE A12

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 61.3% N_{fc} ; LARGE NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 3 HR. 12.1

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	69.9	70.7	66.2	67.4	65.2	67.3	67.9	70.7	68.8	70.0	70.9	71.2	73.1	75.2	77.3			120.3
(30. M)	63	64.6	78.7	62.4	73.1	68.8	69.6	70.0	74.6	69.7	69.8	71.1	70.6	73.6	75.3	76.8			121.9
VEHICLE .5 FAN	80	66.7	68.3	70.1	69.0	67.3	67.9	[illegible]	[illegible]	72.1	71.3	70.8	70.7	72.2	74.2	75.0			120.9
CONFIG FAN B	100	72.9	70.2	69.6	70.6	70.4	70.1	[illegible]	[illegible]	69.9	69.6	70.4	71.1	72.2	73.3	72.6			120.6
LOC PTO	125	67.7	69.8	70.7	67.1	69.0	68.6	[illegible]	70.7	67.7	68.2	68.8	69.2	69.8	71.2	69.2			119.2
DATE 1/23/71	160	69.9	66.2	65.8	64.0	64.2	63.6	[illegible]	66.3	64.9	66.3	67.1	66.6	68.6	69.9	70.3			116.3
RUN 32. PT. 510	200	64.7	64.6	63.2	64.3	63.3	65.1	[illegible]	68.6	68.4	69.8	70.5	71.1	72.4	74.1	73.7			119.0
TAPE T8108.	250	45.7	65.6	67.8	67.7	67.5	68.6	[illegible]	72.1	73.1	73.8	75.1	75.9	76.1	77.0	75.8			122.8
BAR 28.9 HG	315	68.1	67.0	70.3	69.0	69.2	70.1	[illegible]	72.5	74.0	75.1	76.3	76.5	76.6	76.7	74.2			123.6
(97537. N/M2)	400	70.5	70.3	72.8	70.8	7 .2	70.7	[illegible]	71.5	73.4	74.8	76.3	75.1	74.2	73.9	72.3			123.1
TAMB 29. DEG F	500	69.4	69.8	69.7	67.1	67.3	67.2	66.9	67.6	68.4	68.8	70.6	71.4	71.1	70.9	69.2			119.1
(271. DEG K)	630	68.4	66.8	67.0	68.8	66.4	66.7	68.7	69.9	71.1	71.6	73.7	74.0	73.4	71.9	70.3			120.8
TWET 25. DEG F	800	66.4	66.5	66.8	67.2	67.6	66.9	67.2	67.7	68.8	69.9	70.8	70.9	70.2	69.7	68.2			118.9
(269. DEG K)	1000	66.9	66.7	67.6	66.6	66.6	68.8	66.5	67.6	69.4	70.7	72.6	72.8	71.3	70.0	68.3			119.6
MACT 2.31 GM/M3	1250	66.3	65.9	67.3	66.7	66.4	66.0	66.1	67.0	68.8	69.7	72.7	72.9	71.8	69.3	67.4			119.4
(.00231 KG/M3)	1600	66.9	69.7	70.0	68.0	67.6	67.2	67.2	68.1	69.6	71.3	73.2	73.8	73.4	71.3	69.1			120.8
NFA 4465. RPM	2000	74.8	82.9	82.8	78.3	79.1	77.4	75.3	75.8	76.3	78.3	78.8	79.9	81.4	82.4	79.1			129.7
(467. RAD/SEC)	2500	65.4	69.1	76.1	68.2	67.4	66.9	66.5	67.6	71.4	70.7	72.3	75.7	75.9	70.8	68.1			121.6
NFK 4600. RPM	3150	64.3	71.1	81.2	69.7	66.9	69.2	68.9	71.0	70.8	74.3	75.0	76.7	75.9	71.1	69.8			123.6
(482. RAD/SEC)	4000	71.2	80.4	82.4	80.9	74.6	77.6	74.7	73.5	78.9	77.3	81.3	83.6	81.8	79.4	76.7			130.3
NFD 7488. RPM	5000	67.3	73.8	84.8	78.5	72.6	70.6	70.6	72.0	75.4	76.0	77.9	81.2	79.8	75.6	71.7			126.8
(784. RAD/SEC)	6300	68.6	79.5	77.8	77.6	74.1	75.2	73.5	74.3	76.1	79.0	80.8	84.6	81.9	76.6	73.6			130.2
NO. BLADES 26	8000	88.7	78.0	77.1	77.9	76.2	79.0	72.6	73.7	76.9	77.3	79.1	82.5	80.8	77.2	73.2			129.8
	10000	88.9	79.1	77.9	78.7	76.2	76.1	72.1	72.9	75.9	77.2	78.3	81.7	79.1	75.9	72.8			130.2
	12500	67.7	78.9	79.8	78.8	76.6	79.2	71.3	71.1	73.2	74.9	76.4	78.4	77.2	75.2	72.2			130.0
	16000	67.3	77.1	77.9	77.1	75.8	74.9	78.7	70.3	70.4	73.3	74.7	77.2	75.8	75.0	71.8			131.3
	20000	66.9	79.5	80.4	77.7	75.6	74.6	70.4	69.9	69.9	72.8	75.9	76.2	75.4	74.5	72.3			133.8
OVERALL MEASURED		84.3	89.9	90.5	88.2	86.8	86.4	85.7	86.8	87.5	88.6	90.2	92.1	91.4	90.2	88.6			
OVERALL CALCULATED		83.0	89.9	90.4	88.4	86.9	88.4	84.9	85.7	87.0	88.3	89.9	92.1	91.0	89.6	87.7			141.8
PNDB		95.1	101.7	102.7	101.0	98.3	98.8	97.4	97.6	99.9	100.8	103.4	105.4	104.1	102.1	99.6			

TABLE A13

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 67.4% N_{fc} ; LARGE NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 2 HR. 15.1

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 200. FT.	50	72.1	72.5	69.1	70.1	69.3	70.2	70.4	72.3	72.0	72.9	73.0	73.9	76.1	79.0	81.4			123.3
(30. M)	63	68.8	79.5	68.5	74.3	68.8	70.0	70.4	75.2	71.3	72.4	73.5	74.0	76.6	78.9	80.9			124.2
VEHICLE .5 FAN	80	67.8	69.5	72.4	75.3	73.0	73.9	75.9	74.3	75.8	73.2	72.8	73.5	75.2	77.3	78.7			124.8
CONFIG FAN B	100	72.0	69.6	70.4	69.9	70.0	69.7	70.4	71.8	71.7	72.8	73.1	73.6	75.0	76.3	76.1			122.1
LOC PTO	125	67.3	67.1	68.9	67.0	67.4	68.0	68.8	69.6	69.1	70.4	71.1	71.7	72.0	73.3	72.8			119.9
DATE 1/23/71	160	73.0	67.5	66.7	69.0	69.0	67.0	69.2	72.7	67.7	70.8	70.5	72.1	72.2	74.4	75.4			120.7
RUN 32. PT. 512	200	66.3	65.5	64.7	66.1	65.5	67.6	68.1	70.2	70.6	72.4	73.1	74.4	76.1	77.9	78.0			121.9
TAPE S1269.	250	66.2	67.3	69.6	71.3	70.5	71.7	73.0	74.3	75.9	77.0	78.4	79.2	79.6	81.0	79.6			129.1
BAR 28.9 HG	315	70.0	69.9	72.5	71.6	72.0	73.0	74.5	75.9	77.4	78.6	80.1	80.4	80.5	80.6	78.0			127.1
(97537. N/M2)	400	72.1	72.0	74.4	72.1	71.9	72.0	73.0	73.9	75.9	77.0	78.4	78.1	77.1	76.3	75.0			125.3
TAMB 29. DEG F	500	71.5	72.9	71.9	69.6	70.3	70.5	70.3	70.5	71.7	72.4	73.5	74.6	74.6	74.9	72.3			122.4
(271. DEG K)	630	69.3	69.3	69.8	69.4	68.4	69.7	71.2	72.4	74.3	74.9	76.6	76.9	76.8	79.1	73.2			123.7
TWET 25. DEG F	800	68.0	68.4	69.0	69.3	69.9	69.4	70.2	70.8	72.9	75.0	73.8	73.8	73.5	72.6	70.9			121.8
(269. DEG K)	1000	67.7	68.3	69.1	68.5	68.6	68.4	69.3	70.4	72.7	73.7	75.5	75.6	73.8	72.7	70.9			122.2
HACT 2.31 GM/M3	1250	67.0	67.4	68.9	68.6	68.4	68.3	68.6	69.3	71.4	72.3	75.2	75.4	73.8	71.8	69.7			121.7
(.00231 KG/M3)	1600	67.8	69.7	70.0	69.1	68.9	68.9	69.4	70.4	72.0	73.5	75.7	76.1	74.5	72.3	70.6			122.5
NFA 4912. RPM	2000	77.5	83.6	85.0	83.0	81.2	79.3	78.1	77.1	79.4	79.7	80.7	82.6	82.6	86.6	81.4			132.1
(514. RAD/SEC)	2500	69.6	75.7	76.5	74.5	73.1	71.8	71.3	71.2	74.8	74.1	75.9	79.2	77.7	77.6	73.2			125.7
NFK 5061. RPM	3150	65.7	73.2	72.2	70.8	68.9	71.1	71.4	73.6	73.3	77.3	77.6	81.0	77.4	72.3	71.0			125.8
(530. RAD/SEC)	4000	74.1	80.6	84.1	83.2	81.0	79.5	78.1	75.3	80.0	79.3	83.4	85.8	84.2	80.4	77.4			132.5
NFD 7488. RPM	5000	69.3	75.4	76.7	75.7	75.8	73.6	73.6	74.9	78.4	78.7	81.1	83.7	81.3	77.8	74.1			129.4
(784. RAD/SEC)	6300	73.0	81.1	81.1	79.7	77.3	78.0	76.8	77.5	79.6	83.0	84.1	87.3	82.8	77.9	76.1			132.4
NO. BLADES 26	8000	70.4	79.7	80.3	79.0	78.1	76.9	75.6	76.6	79.6	80.3	81.8	85.1	81.7	78.9	75.1			132.8
	10000	70.9	80.7	81.3	80.6	78.8	78.6	75.6	76.2	79.0	80.2	81.5	83.7	80.4	77.9	75.1			132.9
	12500	69.7	80.4	81.2	79.9	77.8	77.8	74.6	74.2	78.1	78.0	79.4	81.4	78.7	77.0	74.0			132.4
	16000	68.9	80.4	81.2	78.8	78.1	77.6	74.1	73.2	73.4	76.4	77.7	80.0	77.6	76.8	73.8			133.5
	20000	67.6	79.7	80.6	78.5	76.7	76.2	72.8	71.9	71.7	74.9	76.1	78.0	76.3	75.3	73.3			134.9
OVERALL MEASURED		86.0	91.1	92.1	90.8	89.3	88.8	88.1	89.0	90.4	91.5	92.9	94.9	93.3	93.3	91.6			
OVERALL CALCULATED		85.1	91.2	92.0	90.8	89.3	88.7	87.8	88.2	90.0	91.1	92.7	94.8	92.9	92.6	90.7			143.2
PNDB		97.4	102.7	104.6	103.7	102.1	101.2	99.8	100.0	102.9	103.9	105.8	108.0	106.3	105.3	102.0			

TABLE A14

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 82.3% N_{fc} ; LARGE NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 2 HR. 14.6

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	PNL
RADIAL 130. FT.	50	75.[illegible]	74.6	73.2	74.[illegible]	74.2	74.9	75.7	77.3	77.5	78.9	79.4	80.1	[illegible]	86.9	90.0	130.0
(30. M)	63	[illegible]	78.9	72.9	75.[illegible]	73.4	73.2	74.6	77.4	76.7	78.0	79.1	80.8	82.5	85.9	88.6	129.3
VEHICLE .5 FAN	80	69.[illegible]	71.6	72.6	73.6	72.6	73.9	74.9	76.0	77.4	78.5	79.4	80.2	82.4	85.2	86.9	128.7
CONFIG FAN B	100	[illegible]	8[illegible].1	76.0	8[illegible].3	75.9	76.0	76.9	79.3	80.4	81.3	81.2	83.3	84.8	85.1	84.8	130.[illegible]
LOC PTO	125	[illegible]	72.1	72.8	73.	72.1	72.3	73.2	74.1	74.6	76.5	77.6	78.1	79.1	80.9	79.7	125.[illegible]
DATE 1/28/71	160	[illegible]	69.7	70.7	69.5	70.1	70.1	71.2	71.5	73.0	75.1	76.1	77.7	79.4	81.9	82.0	125.3
RUN 32. PT. 514	200	[illegible]	72.8	73.8	74.	73.3	76.9	75.9	76.6	78.2	79.4	81.7	82.3	84.3	85.6	86.6	130.1
TAPE 31263.	250	[illegible]	72.8	75.5	76.[illegible]	76.2	77.3	78.9	80.4	81.9	83.2	84.9	86.2	87.4	89.1	87.8	133.0
BAR 28.9 HG	315	[illegible]	76.6	78.9	80.	82.8	82.2	82.9	82.3	85.2	86.0	87.0	87.8	88.5	89.4	86.4	135.0
(97537. N/M2)	400	77.3	77.4	79.5	79.[illegible]	79.6	77.1	78.8	79.8	81.9	84.2	84.8	85.5	94.6	83.6	82.4	132.0
TAMB 29. DEG F	500	75.7	76.9	75.2	75.3	75.1	76.3	75.9	76.2	77.4	79.1	81.2	82.4	83.0	83.4	80.1	129.1
(271. DEG K)	630	75.7	74.9	75.5	75.3	75.3	76.4	78.4	79.6	81.6	82.6	84.2	84.6	84.4	83.4	80.8	131.1
THET 25. DEG F	800	[illegible]	74.2	75.3	75.[illegible]	76.[illegible]	75.9	76.3	76.8	78.9	80.2	81.7	81.6	81.1	80.5	78.6	128.8
(269. DEG K)	1000	[illegible]4.1	74.5	75.4	77.4	76.3	77.0	77.3	78.[illegible]	80.2	82.1	84.7	84.0	83.4	81.2	78.8	130.[illegible]
HACT 2.31 GM/M3	1250	[illegible]2.[illegible]	74.2	76.1	74.6	74.9	74.7	75.4	75.4	77.3	78.3	80.9	81.1	80.4	79.6	77.7	128.[illegible]
(.00231 KG/M3)	1600	[illegible]2.9	73.8	74.6	74.4	74.8	75.1	74.8	75.4	77.2	78.5	80.1	80.5	80.0	79.2	76.6	127.[illegible]
NFA 8030. RPM	2000	[illegible]2.[illegible]	75.7	78.3	75.5	74.4	75.4	75.4	76.6	78.2	79.2	80.4	81.8	79.4	78.7	76.7	128.4
(826. RAD/SEC)	2500	[illegible]8.[illegible]	9[illegible].1	88.2	[illegible]	86.0	85.7	84.9	82.1	83.6	83.1	88.0	91.4	85.3	85.7	81.8	137.5
NFK 6181. RPM	3150	[illegible].0	78.	77.0	77.7	74.8	76.4	76.8	78.2	77.8	81.1	82.1	84.0	79.3	77.5	75.5	129.9
(647. RAD/SEC)	4000	[illegible]3.9	78.5	79.1	78.[illegible]	76.1	77.1	77.2	77.8	82.0	82.0	85.3	86.4	81.8	79.4	77.4	132.1
NFB 7416 RPM	5000	[illegible]5.9	83.	82.4	81.5	83.0	80.1	80.7	81.6	85.8	87.1	86.4	90.9	83.2	84.4	80.7	135.[illegible]
(784. RAD/SEC)	6300	72.9	8[illegible].5	80.4	79.5	77.9	79.6	79.7	81.9	84.1	87.0	88.2	90.2	83.4	80.7	78.8	135.[illegible]
NO. BLADES 26	8000	73.5	82.4	82.2	81.6	81.1	80.6	80.4	82.3	85.7	85.3	87.1	89.7	84.3	83.3	79.2	136.4
	10000	72.3	80.4	81.5	81.6	79.7	80.5	79.8	81.6	84.7	84.8	86.2	86.3	82.9	80.9	77.9	136.1
	12500	69.7	79.	88.4	79.7	77.7	78.7	77.9	79.2	81.2	82.6	83.8	85.4	80.8	78.6	75.5	135.0
	16000	68.3	78.6	79.5	78.1	77.2	77.6	76.5	77.6	78.1	80.7	82.0	83.9	79.5	77.7	74.7	135.4
	20000	67.0	78.2	79.1	77.9	76.1	76.3	75.3	76.3	76.5	79.4	80.5	82.2	78.6	76.4	74.2	130.8
OVERALL MEASURED		89.9	94.6	94.1	94.8	93.2	93.1	93.3	94.3	96.1	97.3	98.8	100.5	98.7	99.4	95.9	
OVERALL CALCULATED		88.7	94.1	93.6	94.2	92.6	92.6	92.6	93.3	95.5	96.7	98.2	100.1	97.6	98.2	97.5	147.5
	PNDB	101.1	108.4	107.5	108.5	106.1	106.1	105.9	105.4	108.1	109.4	110.8	113.1	109.1	107.1	106.6	

TABLE A15

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 91.1% N_{fc} ; LARGE NOZZLE ; SERRATED ROTOR

PAGE 1 FULL SCALE DATA REDUCTION PROGRAM PROC. DATE - MONTH 2 DAY 2 HR. 14.7

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	76.3	76.4	75.6	75.8	76.2	76.6	77.8	79.3	79.4	81.0	81.5	82.5	85.9	90.7	94.2			133.2
(30. M)	63	73.0	79.9	75.6	77.2	76.0	76.7	76.9	79.4	79.4	80.9	82.1	82.9	85.8	90.1	93.2			132.9
VEHICLE .5 FAN	80	71.9	73.0	75.2	76.1	75.5	75.7	77.3	78.8	79.7	80.9	82.5	83.6	86.2	89.5	91.4			132.3
CONFIG FAN B	100	73.2	75.7	79.9	78.9	77.6	77.3	79.6	79.7	80.7	83.9	82.6	85.5	86.0	88.9	89.0			132.
LOC PTO	125	73.4	74.2	76.5	74.5	75.8	75.3	77.3	77.3	77.9	81.7	80.5	83.0	82.8	85.0	84.1			129
DATE 1/23/71	160	73.3	73.6	73.3	72.	73.5	73.0	73.9	74.9	75.8	78.0	79.3	80.6	82.4	85.5	85.3			128.4
RUN 32. PT. 517	200	76.9	76.	74.7	77.7	80.4	79.8	77.5	81.6	79.3	82.1	84.7	86.3	87.9	90.5	90.3			133.6
TAPE 81268.	250	75.6	76.4	80.2	79.7	80.9	80.7	81.2	83.5	84.0	86.1	88.2	89.9	91.4	93.2	91.9			136.6
BAR 28.9 HG	315	[illegible]	79.4	83.1	81.	81.6	81.9	83.9	84.9	86.7	86.5	90.3	91.6	92.6	93.1	90.7			137.9
(97557. N/M2)	400	[illegible]	79.5	81.5	79.4	80.7	80.7	82.0	83.3	85.1	86.8	88.2	89.3	88.8	88.5	86.8			135.4
TAMB 27. DEG F	500	78.8	79.	78.8	78.7	79.8	79.4	79.1	79.5	80.6	82.2	84.5	86.5	86.9	87.0	83.3			132.6
(271. DEG K)	630	76.4	75.5	77.8	77.3	78.5	79.4	80.9	82.7	84.4	85.5	87.4	88.2	88.6	87.1	84.8			134.4
TWBT 25. DEG F	800	74.4	77.8	77.8	78.6	79.8	78.8	79.6	80.8	82.0	83.3	84.6	88.1	88.0	84.3	82.1			132.1
(269. DEG K)	1000	76.4	75.4	78.4	81.2	79.8	78.8	79.4	81.2	82.8	84.1	86.2	88.3	85.2	84.1	81.8			132.8
HACT 2.31 GM/M3	1250	75.8	76.2	79.5	80.5	80.2	78.4	78.7	79.1	80.6	82.0	84.4	84.6	84.0	82.8	80.6			131.7
(.0023. KG/M3)	1600	74.9	79.	82.2	79.2	78.8	78.6	78.6	79.6	80.3	82.2	83.6	83.8	83.1	82.5	80.8			131.4
NFA 6640. RPM	2000	76.3	78.5	81.7	81.3	77.8	79.2	79.2	80.4	81.8	82.9	84.1	85.4	82.9	81.8	81.9			132.2
(695. RAD/SEC)	2500	79.8	83.5	87.4	85.7	83.4	84.5	85.8	82.5	83.2	84.2	86.4	87.3	84.0	84.3	82.1			135.4
NFK 6841. RPM	3150	64.5	88.	92.9	91.2	88.8	89.9	91.3	87.4	85.2	89.2	90.8	90.2	86.9	87.9	85.6			140.2
(716. RAD/SEC)	4000	76.7	81.1	83.1	83.7	88.8	81.9	81.3	81.9	87.1	86.2	89.1	84.4	84.5	82.7	80.8			135.8
NFD 7488. RPM	5000	74.2	79.5	81.3	80.6	82.5	79.9	81.3	83.3	85.8	86.4	89.0	89.7	83.1	82.7	79.6			135.8
(784. RAD SEC)	6300	77.6	84.0	86.2	85.7	82.8	84.9	85.2	87.2	87.9	90.9	93.3	95.0	86.5	84.6	82.4			140.4
NO. BLADES 26	8000	73.7	80.6	82.2	81.6	81.8	82.4	82.8	84.7	87.5	88.0	90.5	91.3	85.9	84.1	80.4			138.3
	10000	73.5	80.8	82.6	82.3	81.2	82.7	82.1	84.1	86.5	87.7	89.0	90.1	84.9	82.6	79.8			138.3
	12500	71.4	80.	81.2	80.4	79.1	80.5	80.3	82.1	84.9	86.5	87.4	88.0	83.2	81.0	77.6			137.8
	16000	69.7	79.	80.3	78.7	78.5	79.2	79.1	80.6	81.1	84.3	85.8	86.4	81.8	79.8	76.7			138.0
	20000	67.8	77.7	79.2	77.9	76.9	77.3	77.4	79.1	79.2	82.7	83.9	84.5	80.7	77.9	75.6			138.9
	OVERALL MEASURED	92.2	94.9	97.9	96.6	96.8	96.0	97.0	97.4	98.5	100.2	101.7	102.9	101.9	103.0	102.9			
	OVERALL CALCULATED	91.[illegible]	94.4	97.3	96.[illegible]	94.9	95.7	95.5	96.7	98.0	99.7	101.6	102.5	100.7	101.7	101.5			150.2
	PNLB	1[illegible]5.5	108.7	122.3	111.1	109.2	111.3	111.3	109.9	110.7	112.5	114.5	115.6	112.0	112.3	110.5			

TABLE A16

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 58.67%N_{fc} ; SMALL NOZZLE ; BASELINE

PAGE 1 NASA QUIET FAN PROC. DATE - MONTH 10 DAY 15 HR. 11.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	( )	( )	( )	PNL
RADIAL 100. FT.	50	71.8	66.9	66.9	69.7	67.9	59.0	67.7	70.3	69.3	69.2	69.9	70.6	72.6	74.5				119.5
(30. M)	63	65.2	65.4	65.7	77.5	67.1	59.7	66.9	76.2	68.6	69.4	72.3	71.2	73.8	74.2				121.7
VEHICLE .5 FAN	80	64.6	65.6	66.8	67.3	69.9	60.6	67.4	68.2	68.8	68.9	69.5	69.8	71.4	73.2				118.3
CONFIG FAN B	100	76.8	67.4	70.5	71.6	70.0	66.8	67.7	68.0	69.3	71.7	71.9	72.1	72.7	73.0				121.4
LOC PTO	125	66.2	65.7	66.6	65.9	67.4	63.9	67.0	67.6	68.1	68.2	69.1	69.2	69.5	70.9				117.7
DATE 9/19/78	160	64.3	64.9	65.5	66.5	65.5	63.1	65.8	65.8	66.9	66.0	66.3	67.0	68.8	[illegible]				116.3
RUN 13. PT. 219	200	65.1	65.3	64.0	67.9	63.5	64.3	65.3	68.3	66.1	68.1	69.1	70.0	71.9	72.3				117.9
TAPE S1196.	250	66.0	67.0	66.4	68.4	67.8	67.9	70.0	71.0	71.8	72.6	74.7	75.0	75.7	76.3				122.1
BAR 28.9 HG	315	68.6	69.5	71.7	71.9	71.8	72.7	72.7	74.0	75.3	76.5	78.6	78.3	79.3	78.7				125.6
(97756. N/M2)	400	70.4	71.2	73.5	72.7	72.0	72.4	72.1	72.9	73.9	74.6	76.5	76.7	76.9	76.4				124.3
TAMB 78. DEG F	500	71.3	72.9	72.7	71.4	71.3	72.5	70.5	69.9	70.4	71.1	72.9	74.0	73.9	73.7				122.2
(299. DEG K)	630	71.3	72.5	73.7	75.4	73.4	74.1	72.6	73.0	75.0	75.7	78.0	78.9	78.8	76.3				125.7
TDEW 65. DEG F	800	72.9	75.6	76.2	75.1	74.6	75.9	73.7	74.6	75.7	76.2	78.1	77.6	78.0	77.6				126.3
(291. DEG K)	1000	71.2	73.5	75.3	74.4	73.9	75.6	73.5	74.0	75.8	77.4	79.7	79.9	79.8	78.2				127.0
HACT11.98 GM/M3	1250	70.2	72.9	74.2	73.2	73.2	74.3	72.8	73.6	75.2	76.3	79.8	79.5	80.5	76.8				126.6
(.01198 KG/M3)	1600	70.6	74.2	73.8	73.3	73.2	75.8	72.5	74.0	75.7	77.3	80.1	80.8	81.9	77.8				127.5
NFA 4466. RPM	2000	75.0	81.3	79.2	79.1	78.1	79.7	75.1	76.8	77.2	80.1	80.3	80.9	82.9	80.7				130.0
(468. RAD/SEC)	2500	65.8	71.2	72.6	70.6	69.8	70.8	68.7	68.8	70.4	72.2	73.2	75.9	77.2	73.5				123.0
NFK 4386. RPM	3150	64.2	74.9	77.0	75.3	71.4	72.7	71.7	70.8	71.6	72.3	75.3	77.0	77.1	76.5				125.1
(459. RAD/SEC)	4000	72.8	81.9	82.3	80.9	78.6	79.0	75.4	75.4	76.6	77.2	79.0	81.7	81.4	81.8				130.4
NFD 7:88. RPM	5000	70.5	78.2	77.8	76.1	76.6	75.8	70.9	73.2	74.7	76.2	78.6	82.1	82.3	78.0				128.7
(784. RAD/SEC)	6300	70.4	80.0	81.8	78.9	77.5	77.1	73.2	72.7	73.6	76.6	78.6	81.4	83.0	78.1				129.8
NO. BLADES 26	8000	69.2	79.2	80.6	79.4	77.0	77.9	72.6	73.1	73.1	74.4	76.9	80.3	79.3	78.2				129.5
	10000	68.2	79.4	79.4	78.1	77.0	75.9	71.8	71.3	72.0	73.9	75.7	77.3	79.1	76.1				129.0
	12500	65.7	76.2	77.5	75.7	74.3	74.2	68.8	68.4	68.6	70.1	72.2	74.2	74.0	73.7				127.4
	16000	62.7	73.1	74.5	71.8	71.0	70.8	64.9	65.8	64.7	66.5	69.1	70.4	71.4	69.5				126.1
	20000	62.7	70.2	71.5	68.9	67.8	69.6	63.8	66.3	63.6	65.6	68.6	67.8	70.3	66.4				126.6
OVERALL MEASURED		85.8	90.9	91.6	90.3	89.0	89.5	87.0	87.6	88.6	90.0	92.0	93.4	94.1	92.1				
OVERALL CALCULATED		84.5	89.7	90.4	89.4	87.9	88.3	85.5	86.6	87.3	88.7	90.6	91.9	92.6	90.8				140.5
	PNDB	96.5	103.3	103.9	102.8	101.0	101.4	98.8	99.1	100.1	101.2	103.1	105.0	105.3	104.3				

TABLE A17

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 72.3% N_{fc} ; SMALL NOZZLE ; BASELINE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC, DATE - MONTH 10 DAY 28 HR, 14.6

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	PWL
RADIAL 100. FT.	50	74.9	73.2	71.2	73.2	71.9	62.6	71.6	73.5	74.0	74.1	75.3	75.9	78.2	81.1	124.4
(30. M)	63	68.5	69.3	69.8	77.4	71.0	63.7	71.1	76.8	73.4	74.4	76.5	76.7	79.4	81.7	125.2
VEHICLE .5 FAN	80	67.1	69.0	69.2	70.7	70.0	64.6	71.1	72.4	73.6	74.4	75.4	76.2	78.7	80.7	123.9
CONFIG FAN B	100	74.6	72.9	72.2	74.9	74.7	71.2	73.[illegible]	73.5	75.1	75.2	76.2	77.1	78.9	80.1	125.3
LOC PTD	125	69.2	69.5	70.3	63.8	70.8	67.6	71.[illegible]	71.8	72.3	73.4	75.6	74.7	76.4	77.8	122.9
DATE 5/19/70	160	65.9	70.9	70.2	73.8	72.1	67.4	73.8	70.9	74.6	72.1	73.4	74.2	76.1	76.4	122.2
RUN 13. PT. 22	200	72.6	74.6	73.8	76.5	78.8	72.3	74.9	74.6	75.0	76.7	77.9	79.8	81.4	81.5	127.2
TAPE 8115	250	68.5	71.1	72.5	73.9	74.6	74.6	77.1	77.4	78.8	80.7	81.6	82.7	84.3	84.6	129.6
BAR 28.9 HG	315	72.7	74.3	76.4	77.0	77.1	78.2	78.7	80.0	81.0	82.8	84.3	84.9	85.9	85.6	131.7
(97756, N/M2)	400	75.2	76.5	78.2	77.2	77.1	78.4	78.4	78.8	80.1	81.4	83.2	83.6	83.4	82.5	130.5
TAMB 78. DEG F	500	75.5	77.2	77.4	76.1	76.0	76.3	74.7	74.8	76.1	77.1	79.6	80.2	81.3	79.8	127.8
(299, DEG K)	630	74.4	78.5	77.7	77.6	76.8	78.2	76.4	78.8	80.6	81.5	83.8	84.8	85.4	82.9	131.1
TWET 65. DEG F	800	70.3	[illegible]3.7	80.9	73.3	78.8	80.6	78.4	79.8	81.3	81.8	83.4	82.2	82.6	81.6	131.2
(291, DEG K)	1000	77.4	79.8	80.1	79.5	78.9	80.5	78.6	80.0	81.7	83.2	85.7	85.8	85.4	83.8	132.6
HACT11.90 GM/M3	1250	76.4	79.4	79.6	78.8	76.2	80.1	77.9	79.2	80.8	82.5	85.5	85.0	85.5	81.9	132.2
(.01190 KG/M3)	1600	75.7	79.7	79.1	75.6	78.6	80.6	78.3	79.7	81.5	83.4	85.9	80.8	86.3	82.4	132.6
NFA 5510. RPM	2000	74.7	79.6	78.3	78.0	79.0	80.8	77.6	79.4	81.2	82.9	84.5	85.6	85.6	81.3	132.4
(577, RAD/SEC)	2500	77.6	83.8	83.5	81.9	82.5	83.7	78.6	78.4	79.0	81.4	8[illegible].9	85.9	85.8	84.1	133.3
NFK 5412. RPM	3150	71.8	88.6	82.7	8[illegible].2	77.4	78.8	78.1	77.3	78.1	79.1	82.3	83.1	82.9	82.0	131.2
(567, RAD/SEC)	4000	76.2	84.1	84.[illegible]	83.1	81.4	82.5	79.3	79.9	91.3	52.8	85.0	86.6	86.3	84.6	134.3
NFD 7488, RPM	5000	76.3	85.9	85.[illegible]	83.1	85.1	84.8	79.[illegible]	81.3	8[illegible].4	84.3	86.9	89.5	88.0	85.4	136.4
(784, RAD/SEC)	6300	74.8	84.6	85.7	84.2	82.5	82.8	79.6	79.9	80.1	83.3	85.6	86.9	86.4	83.3	135.3
NO, BLADES 26	8000	74.7	84.9	86.0	85.1	82.9	84.[illegible]	79.5	79.[illegible]	79.8	8[illegible].5	83.9	86.3	83.7	84.0	135.5
	10000	73.6	85.3	85.1	83.9	83.1	82.4	78.0	78.0	78.[illegible]	81.8	82.7	83.8	82.8	82.1	135.2
	12500	71.1	82.2	83.2	81.5	80.5	80.6	75.3	75.2	75.7	77.6	[illegible]9.4	8[illegible].7	78.8	80.0	133.7
	16000	67.5	[illegible]4.1	80.2	77.4	77.2	77.2	72.0	71.4	71.4	73.7	75.8	76.9	75.7	75.8	[illegible]
	20000	65.0	73.7	76.7	74.1	73.3	73.9	68.9	69.1	68.4	70.3	72.1	73.2	7[illegible].1	71.4	[illegible]
OVERALL MEASURED		89.8	95.8	96.2	93.3	94.6	95.1	92.5	93.2	94.3	96.2	98.4	99.6	99.8	97.8	
OVERALL CALCULATED		86.7	94.6	95.2	94.3	93.5	93.9	91.2	92.1	93.2	94.8	96.9	98.1	97.9	96.6	[illegible]
	PNDB	101.3	107.7	107.8	107.2	106.7	[illegible]	103.8	104.7	105.8	107.5	109.7	111.5	110.9	109.1	

TABLE A18

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 78.6%N_{fc} ; SMALL NOZZLE ; BASELINE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 28 HR. 14.6

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	( )	( )	( )	PNL
RADIAL 100. FT.	50	76.5	75.2	74.7	73.4	73.4	64.8	73.6	75.2	75.5	76.2	77.5	77.4	81.1	84.0				126.7
(30. M)	63	70.1	71.5	72.2	73.2	72.7	65.9	73.2	77.8	75.8	76.8	78.9	78.6	82.1	84.7				127.4
VEHICLE .5 FAN	80	67.9	69.6	70.6	71.9	71.1	65.3	73.0	74.3	75.7	76.6	77.4	77.8	81.2	83.6				126.1
CONFIG FAN B	100	80.7	75.7	78.7	78.3	80.2	74.0	77.2	78.1	78.3	78.9	80.2	79.9	82.0	83.0				129.0
LOC PTC	125	73.3	72.1	73.5	73.0	74.2	70.0	73.7	74.7	74.9	75.9	77.8	77.4	80.4	80.7				125.5
DATE 9/19/70	160	70.3	70.7	70.9	70.5	71.4	68.8	72.0	72.3	72.3	73.6	75.6	76.2	79.5	79.0				124.0
RUN 13. PT. 223	200	71.4	72.4	69.7	71.3	71.8	73.8	75.4	73.7	74.4	82.1	81.9	81.8	84.3	84.2				129.0
TAPE S1156.	250	70.5	73.1	73.9	75.8	75.1	75.9	77.6	78.7	79.9	81.7	84.2	85.1	87.1	87.7				131.7
BAR 28.9 HG	315	75.5	78.1	79.7	80.7	79.9	80.4	80.4	82.8	83.1	84.7	87.0	86.3	89.1	89.0				134.6
(97756. N/M2)	400	79.0	79.2	81.3	80.2	79.8	80.1	80.1	81.0	83.1	84.7	[illegible]	85.8	86.7	85.6				133.3
TAMB 78. DEG F	500	78.0	79.7	79.3	78.6	79.1	79.0	77.3	77.4	78.4	79.8	82.4	83.0	84.5	82.6				130.5
(299. DEG K)	630	77.3	79.9	81.1	79.9	80.3	81.6	79.8	81.1	83.1	84.3	87.0	88.2	89.0	86.0				134.3
TWET 65. DEG F	800	81.0	83.9	83.4	82.0	81.7	82.8	81.1	82.1	83.9	84.7	86.2	85.4	85.8	84.8				134.0
(291. DEG K)	1000	80.0	82.6	82.7	82.3	81.1	83.0	81.3	82.6	84.1	85.8	88.1	88.0	87.6	85.9				135.1
HACT11.90 GM/M3	1250	79.6	82.8	82.5	82.3	81.5	82.9	80.8	82.0	84.1	85.5	88.8	87.8	88.2	84.9				135.2
(.01190 KG/M3)	1600	78.3	82.2	81.8	81.2	81.3	83.4	81.0	82.4	84.0	85.7	88.3	88.4	88.8	84.8				135.3
NFA 5990. RPM	2000	79.7	81.8	80.7	80.1	81.4	83.1	80.3	82.0	83.8	85.3	86.7	88.3	87.4	83.1				134.7
(627. RAD/SEC)	2500	79.3	87.5	89.4	85.9	84.6	85.8	82.1	80.4	82.2	83.7	85.7	87.5	87.1	86.4				136.1
NFK 5883. RPM	3150	74.5	83.3	85.3	84.3	80.8	82.2	81.3	80.2	81.0	81.7	85.2	85.7	85.1	84.5				134.0
(616. RAD/SEC)	4000	78.5	86.3	86.0	85.4	83.9	85.0	81.9	82.5	84.0	85.4	87.8	88.8	88.5	86.6				136.6
NFD 7488. RP	5000	80.0	87.5	87.5	85.9	87.3	86.7	81.7	83.7	85.1	86.9	89.5	91.2	85.9	86.8				138.4
(784. RAD/SEC)	6300	76.6	86.3	87.4	85.9	84.9	85.0	82.0	81.4	82.7	85.8	88.1	89.0	87.4	85.1				137.2
NO. BLADES 26	8000	76.8	86.9	87.9	87.1	85.5	86.7	82.3	82.4	82.5	84.3	86.5	88.7	85.4	85.9				137.6
	10000	75.5	87.0	86.7	85.7	85.0	84.6	80.6	80.4	81.2	83.4	85.0	85.8	84.4	83.8				137.1
	12500	73.0	84.1	85.0	83.2	82.6	82.7	78.0	77.8	78.6	80.2	82.2	83.4	81.0	81.7				135.9
	16000	69.2	81.0	82.0	79.2	79.3	79.3	74.8	73.9	74.1	76.3	79.5	80.3	79.0	77.6				134.5
	20000	66.5	77.6	78.4	75.8	75.3	75.7	70.9	71.0	70.7	72.5	77.7	78.0	78.2	73.1				134.1
OVERALL MEASURED		92.6	98.1	98.8	97.7	97.0	97.5	95.0	95.8	97.2	98.8	101.2	101.9	102.6	100.3				
OVERALL CALCULATED		91.3	97.0	97.7	96.5	95.8	96.3	93.7	94.5	95.7	97.4	99.7	100.4	100.2	99.1				148.6
	PNDB	103.5	109.8	110.8	109.3	109.0	109.1	106.4	107.1	108.4	110.1	112.5	113.8	112.7	111.4				

TABLE A19

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 89.8%N_{fc} ; SMALL NOZZLE ; BASELINE

PAGE 1 NASA QUIET FAN PROC, DATE - MONTH 10 DAY 15 HR, 11.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	PNL
RADIAL 100. FT.	50	78.4	76.8	75.4	76.1	75.7	67.0	77.3	78.8	79.3	79.7	80.5	81.3	84.5	89.0	130.3
(30. M)	63	73.8	76.6	77.2	79.5	76.8	69.4	77.5	80.0	79.6	80.5	82.6	82.9	85.7	90.2	131.5
VEHICLE .5 FAN	80	71.2	72.6	74.2	75.2	74.6	69.6	76.8	77.9	79.1	79.7	81.5	82.4	85.2	89.3	130.5
CONFIG FAN B	100	72.9	75.8	75.3	76.5	76.8	73.0	79.2	80.1	79.8	81.3	81.9	83.3	85.3	88.9	131.1
LOC PTO	125	75.8	77.4	77.8	75.8	76.8	74.6	81.2	81.9	78.9	82.2	81.3	83.8	83.9	87.0	131.0
DATE 9/19/70	160	73.6	73.6	73.6	73.2	74.2	71.3	74.6	74.8	75.6	77.0	79.1	80.5	82.4	84.9	127.7
RUN 13. PT. 228	200	72.4	73.9	72.8	75.4	75.9	76.8	76.2	77.5	78.9	80.8	83.6	85.3	88.2	90.7	132.4
TAPE S1197.	250	73.8	76.8	77.8	80.8	81.3	82.2	81.9	82.9	84.3	85.9	89.2	90.2	92.2	93.9	136.8
BAR 29.0 HG	315	80.7	82.5	84.3	83.9	84.1	84.2	85.3	86.2	86.9	88.7	91.1	92.3	94.0	94.5	138.9
(97780. N/M2)	400	81.3	82.7	84.2	83.1	83.0	83.4	83.7	84.4	85.9	87.0	89.1	89.1	89.5	89.4	136.4
TAMB 79. DEG F	500	80.4	81.8	81.5	81.0	81.1	82.0	80.1	80.4	82.3	84.0	86.2	87.4	87.9	87.5	134.0
(299. DEG K)	630	79.2	81.2	81.6	80.8	81.0	83.0	82.4	84.2	85.3	87.2	89.9	90.9	91.2	89.0	136.8
TWET 65. DEG F	800	81.4	84.1	83.6	83.4	83.7	85.4	83.5	84.8	86.2	86.9	88.3	87.9	88.1	87.7	136.2
(291. DEG K)	1000	80.5	83.0	83.9	82.8	82.7	85.2	83.4	85.0	86.8	88.3	90.7	90.2	88.4	87.7	137.1
HACT11.90 GM/M3	1250	80.0	83.2	83.8	82.7	83.3	85.4	82.7	84.3	86.0	87.7	90.4	89.6	88.5	86.0	136.7
(.01190 KG/M3)	1600	80.0	83.8	88.3	86.5	84.5	85.8	83.5	84.7	86.5	87.9	90.1	90.4	89.3	86.9	137.6
NFA 6850. RPM	2000	77.6	82.4	81.8	81.3	82.8	84.9	82.2	84.1	85.8	87.0	88.4	90.3	87.7	54.6	136.3
(717. RAD/SEC)	2500	75.9	83.3	86.0	83.5	82.3	83.7	81.6	81.6	83.0	85.1	86.5	88.8	85.3	84.2	135.2
NFK 6728. RPM	3150	80.9	92.0	96.2	93.0	90.8	90.5	88.1	86.7	86.8	90.6	91.9	93.1	90.0	92.3	142.0
(704. RAD/SEC)	4000	78.0	85.8	86.3	85.5	84.1	85.9	83.7	84.6	86.3	87.8	90.5	91.0	87.8	87.1	138.1
NFD 7488. RPM	5000	79.5	86.6	86.3	85.2	85.9	85.8	82.4	85.0	87.0	89.2	91.9	91.1	88.2	86.5	138.8
(784. RAD/SEC)	6300	79.7	89.5	90.8	88.9	89.1	88.6	85.5	85.6	86.4	89.5	91.5	91.9	89.2	87.8	140.5
NO. BLADES 26	8000	76.4	85.8	87.5	86.4	85.6	86.5	83.2	84.2	84.8	86.8	89.1	90.3	85.9	86.0	138.7
	10000	75.3	85.8	86.6	85.4	85.2	85.4	81.8	82.5	83.5	85.9	87.4	87.8	85.2	84.1	139.2
	12500	71.7	82.1	84.2	82.8	82.4	82.4	78.8	79.3	80.7	82.4	84.3	84.9	81.0	80.9	136.3
	16000	67.1	78.5	80.6	78.2	78.4	79.1	75.1	75.0	76.3	78.2	80.8	80.9	78.3	77.0	134.9
	20000	63.5	74.8	77.1	74.9	74.2	74.6	70.7	71.2	73.6	74.5	77.8	77.1	76.1	72.6	133.5
OVERALL MEASURED		93.5	99.4	101.6	99.7	99.1	99.7	97.9	98.7	99.9	101.8	104.0	104.5	103.7	104.1	
OVERALL CALCULATED		92.3	98.2	100.3	98.5	97.8	98.3	96.5	97.4	98.6	100.4	102.5	103.1	102.4	102.9	151.0
PNDB		104.9	112.7	125.4	113.3	112.1	112.3	110.4	110.4	111.2	113.8	115.6	116.4	114.5	115.3	

TABLE A20

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 61.0% N_{fc} ; SMALL NOZZLE ; SERRATED ROTOR

PAGE 1 PROC. DATE - MONTH 2 DAY 18 HR. 5.8

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PNL
RADIAL 100. FT.	50	72.0	67.3	67.2	68.5	66.3	67.2	67.9	71.2	69.4	69.9	70.5	70.9	73.1	75.6	77.6			120.5
(30. M)	63	71.1	64.8	66.2	73.2	65.4	66.5	67.5	74.3	69.2	69.1	70.3	70.6	73.4	74.7	76.6			120.8
VEHICLE .5 FAN	80	70.2	66.6	68.5	67.9	67.6	67.9	68.9	68.9	70.7	72.1	71.7	73.3	73.4	75.1	76.2			120.8
CONFIG FAN B	100	73.1	69.1	73.0	66.6	66.6	68.8	67.3	68.7	69.9	70.7	70.3	71.3	72.3	73.8	73.5			120.2
LOC PTO	125	69.3	65.2	66.4	65.0	66.4	66.2	66.8	67.7	66.8	68.1	69.9	70.1	69.9	71.6	70.4			118.0
DATE 2/6/71	160	68.7	65.7	65.8	64.1	64.5	63.7	65.7	66.1	65.1	66.8	67.9	67.6	69.3	70.0	69.8			116.6
RUN 34. PT. 538	200	67.3	65.4	64.3	65.4	64.5	65.9	66.3	67.8	67.3	68.7	69.6	70.7	71.8	73.3	73.1			118.5
TAPE S1278.	250	68.7	68.3	69.1	70.0	69.7	70.3	71.7	72.8	73.3	73.9	75.1	74.0	76.3	77.3	75.8			123.3
BAR 28.8 HG	315	70.8	70.9	73.7	71.8	73.1	72.9	73.0	74.8	75.9	76.7	78.4	78.9	79.3	79.1	76.3			125.9
(97415. N/M2)	400	71.8	71.8	74.1	72.2	72.3	71.2	71.8	73.0	73.4	75.2	76.6	77.2	77.3	77.3	75.3			124.5
TAMB 34. DEG F	500	71.0	72.6	71.9	70.0	70.5	69.9	69.3	69.6	70.8	71.6	73.3	74.6	74.3	73.6	72.9			121.9
(274. DEG K)	630	71.7	72.1	78.9	71.8	71.2	71.5	72.4	73.8	75.2	78.8	78.8	79.3	79.0	77.4	75.4			[illegible]
TWET 29. DEG F	800	71.3	73.9	73.5	73.3	72.8	73.1	72.7	73.9	74.4	75.8	78.5	79.9	77.9	77.4	76.1			125.9
(271. DEG K)	1000	70.8	73.0	74.0	73.1	72.2	72.7	73.0	74.6	76.5	78.8	81.9	82.9	81.2	78.6	76.6			128.0
HACT 2.57 GM/M3	1250	69.8	72.5	73.8	73.0	72.8	72.4	72.8	73.7	75.8	77.5	82.7	82.4	80.8	78.0	75.9			127.9
(.00257 KG/M3)	1600	70.4	74.3	74.4	73.6	73.0	73.1	73.2	74.6	75.9	78.9	83.6	83.0	81.7	78.7	75.5			128.7
NFA 4472. RPM	2000	75.4	82.1	81.1	79.8	78.8	79.1	76.7	77.8	78.1	80.1	83.9	84.7	84.3	82.0	80.2			131.5
(468. RAD/SEC)	2500	69.2	75.7	75.1	73.9	73.1	72.6	71.9	72.4	75.1	75.9	78.9	81.5	82.2	77.1	75.1			127.3
NFK 4584. RPM	3150	68.9	76.6	78.4	73.9	72.4	72.1	71.8	73.8	73.0	75.5	77.0	80.3	79.2	77.1	73.3			126.4
(480. RAD/SEC)	4000	74.4	82.9	82.5	[illegible]	75.3	78.3	75.5	75.0	76.9	79.0	81.0	84.3	83.5	82.1	78.9			131.2
NFD 7488. RPM	5000	70.3	78.1	78.0	76.6	77.3	73.4	71.5	73.2	74.7	75.3	80.5	81.3	80.6	77.4	74.8			128.4
(784. RAD/SEC)	6300	72.4	82.5	82.7	79.7	77.8	76.6	74.5	74.8	74.8	77.7	79.4	84.5	82.8	80.2	75.4			131.1
NO. BLADES 26	8000	71.3	81.5	81.5	79.7	77.2	76.2	72.8	73.5	74.5	75.8	78.9	81.1	81.2	78.1	74.6			130.2
	10000	71.9	82.8	82.3	81.1	79.0	77.7	73.4	73.2	74.0	75.8	77.5	80.1	79.9	78.1	74.2			131.3
	12500	71.2	81.9	82.8	79.8	77.4	76.4	72.1	71.3	71.4	73.5	75.6	78.1	78.0	77.3	73.0			131.2
	16000	70.5	81.6	81.9	78.8	77.1	75.5	71.1	70.2	69.7	71.9	73.9	76.7	76.6	76.6	72.7			132.4
	20000	70.2	81.6	81.9	79.1	76.8	74.9	70.3	69.8	69.3	71.4	73.1	75.8	76.2	75.7	72.7			134.7
OVERALL MEASURED		88.0	91.7	92.8	89.1	89.0	88.2	87.0	88.2	89.0	90.7	93.5	94.8	94.2	92.6	90.7			
OVERALL CALCULATED		85.6	92.2	92.2	90.3	88.6	88.1	86.3	87.3	88.0	89.8	92.7	94.2	93.6	91.9	89.8			142.7
	PNDB	97.9	104.4	104.3	102.7	100.2	100.8	99.0	99.5	100.7	102.6	105.1	107.4	106.7	105.0	102.3			

TABLE A21

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 66.9% N_{fc} ; SMALL NOZZLE ; SERRATED ROTOR

PAGE 1 PROG. DATE - MONTH 2 DAY 17 HR. 13.3

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	73.4	71.1	69.3	69.7	70.9	70.0	70.3	73.4	71.8	72.1	72.7	73.5	75.6	78.6	80.9			123.1
(30. M)	63	71.1	67.2	68.2	73.9	72.2	68.1	69.0	74.8	70.4	71.1	72.8	73.4	75.8	78.1	79.9			123.0
VEHICLE .5 FAN	80	71.9	71.4	73.9	77.9	74.7	73.7	74.0	75.1	76.6	76.8	74.8	74.8	76.8	77.9	79.5			125.4
CONFIG FAN B	100	72.8	68.6	74.0	71.1	71.4	69.4	70.7	71.9	71.4	72.4	72.8	76.6	75.6	76.9	76.9			122.7
LOC PTO	125	70.4	67.0	68.6	67.1	70.8	66.2	68.5	69.9	69.3	70.7	71.8	72.8	72.7	74.3	73.4			120.5
DATE 2/6/71	160	72.3	71.6	72.4	71.2	72.9	72.8	75.0	75.3	69.3	74.0	71.9	74.9	72.3	73.1	74.6			123.3
RUN 34. PT. 540	200	69.3	67.0	69.5	67.7	69.3	68.4	69.0	70.2	69.5	72.0	78.0	74.2	75.6	77.1	76.9			121.8
TAPE S1278.	250	70.6	70.4	71.9	74.0	75.0	74.5	75.3	75.8	75.9	77.0	78.2	79.7	80.2	80.9	79.6			126.8
BAR 28.8 HG	315	73.2	73.2	76.0	75.1	76.2	75.4	76.7	78.1	79.8	79.9	81.4	82.0	82.5	82.3	79.6			129.0
(97415. N/M2)	400	74.0	73.6	76.0	74.4	75.0	73.6	73.9	75.2	76.0	77.6	79.0	80.5	80.1	79.7	77.8			127.2
TAMB 34. DEG F	500	73.0	74.4	73.9	72.8	73.6	72.2	71.9	71.9	72.5	74.6	76.1	77.5	77.2	76.7	75.9			124.6
(274. DEG K)	630	72.7	73.5	75.5	76.6	74.2	73.7	75.0	77.0	78.3	79.5	81.5	82.2	82.0	80.0	78.0			128.5
TWET 29. DEG F	800	72.9	75.1	75.6	75.4	75.7	75.2	75.0	76.1	76.9	78.4	81.1	82.6	79.9	79.2	77.7			128.1
(271. DEG K)	1000	73.0	74.6	75.9	75.4	75.6	75.0	75.0	77.0	79.8	81.2	84.4	85.6	83.7	81.1	79.1			130.8
HACT 2.87 GM/M3	1250	71.9	74.4	76.1	75.4	75.7	74.8	75.0	76.0	78.6	80.0	83.0	84.9	82.9	79.9	78.2			128.2
(.00287 KG/M3)	1600	71.8	76.0	76.1	75.9	76.1	75.3	75.6	77.0	78.2	81.2	83.8	85.5	83.2	80.3	77.5			130.9
NFA 4902. RPM	2000	75.3	82.9	82.0	80.3	79.8	79.7	79.4	79.9	81.8	82.5	88.2	86.8	85.4	83.5	83.1			133.3
(513. RAD/SEC)	2500	71.3	78.7	78.1	77.8	77.1	75.8	75.1	75.7	78.8	79.2	81.9	84.9	84.6	79.9	78.3			130.4
NFK 5025. RPM	3150	70.5	79.0	79.0	76.9	76.6	74.9	74.8	77.0	76.8	78.7	79.8	83.6	82.8	79.5	76.0			127.4
(526. RAD/SEC)	4000	75.7	85.0	84.5	83.7	79.8	80.5	77.9	77.2	79.4	81.6	83.6	87.0	85.9	83.6	80.5			133.6
NFD 7488. RPM	5000	72.0	80.7	80.9	80.5	81.2	78.8	74.6	76.4	78.8	78.4	80.7	84.5	82.7	79.9	77.5			131.5
(784. RAD/SEC)	6300	73.9	84.7	84.8	83.2	81.3	79.9	77.4	77.9	78.8	81.1	82.5	87.6	84.3	82.4	78.0			133.9
NO. BLADES 26	8000	72.9	83.8	83.0	83.1	81.2	79.5	75.8	76.8	77.8	79.1	88.8	84.5	82.9	80.6	77.2			133.1
	10000	73.3	85.3	84.8	84.6	82.8	80.9	78.3	76.5	77.8	79.8	88.5	83.5	82.8	80.8	76.8			134.3
	12500	72.8	84.5	84.6	83.3	82.8	80.8	75.7	75.2	75.8	77.6	78.1	81.9	80.7	80.3	76.2			134.9
	16000	71.0	83.9	84.5	82.8	81.0	78.7	74.3	73.5	73.8	75.5	77.1	80.4	79.2	79.3	75.6			135.4
	20000	70.2	83.7	84.3	82.2	81.2	77.9	73.4	72.9	72.8	74.8	76.4	79.5	78.7	78.4	75.6			137.7
	OVERALL MEASURED	89.8	93.6	94.2	93.1	92.3	90.9	90.8	90.9	91.7	93.4	94.2	97.6	96.4	95.8	93.6			
	OVERALL CALCULATED	88.9	94.3	93.5	93.4	92.3	90.8	89.3	90.2	91.8	92.7	93.4	97.2	95.8	94.3	92.6			148.5
	PNDB	99.3	106.5	105.5	105.7	104.0	103.3	101.8	102.2	103.8	108.4	107.8	110.3	109.1	107.1	104.7			

TABLE A22

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 82.0% N_{fc} ; SMALL NOZZLE ; SERRATED ROTOR

PAGE 1 PROG, DATE - MONTH 2 DAY 17 HR, 13,3

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20, (0,35)	30, (0,52)	40, (0,70)	50, (0,87)	60, (1,05)	70, (1,22)	80, (1,40)	90, (1,57)	100, (1,75)	110, (1,92)	120, (2,09)	130, (2,27)	140, (2,44)	150, (2,62)	160, (2,79)	( )	PWL
RADIAL 100. FT.	50	74,2	75,7	73,6	73,9	73,1	73,1	74,5	76,0	75,[illegible]	76,9	78,0	79,0	81,8	85,7	88,5		128,7
(30. M)	63	71,6	71,3	72,4	75,3	72,8	72,3	73,8	76,9	75,[illegible]	76,6	77,9	78,9	81,8	85,4	87,8		128,4
VEHICLE ,5 FAN	80	71,2	71,5	72,2	72,9	71,9	72,6	74,4	76,0	76,[illegible]	77,2	78,4	80,1	82,4	85,3	87,1		128,4
CONFIG FAN B	100	76,0	74,3	76,2	78,4	76,6	77,2	79,4	80,7	76,[illegible]	78,6	81,6	82,6	83,6	85,3	86,1		130,3
LOC PTO	125	71,9	71,9	73,8	73,0	73,3	73,2	74,3	75,2	74,7	75,8	77,5	78,5	79,3	81,5	80,7		128,1
DATE 2/6/71	160	71,2	71,3	72,1	70,2	71,5	70,5	72,5	72,7	72,5	74,3	79,7	77,1	78,3	80,3	80,6		124,8
RUN 34, PT, 542	200	71,1	72,9	74,2	73,8	71,8	74,1	76,0	76,0	76,[illegible]	79,9	81,6	82,0	83,5	85,3	85,1		129,3
TAPE 31278.	250	73,0	75,4	77,3	78,2	77,4	78,1	79,7	80,8	81,[illegible]	82,5	84,4	86,2	87,5	89,1	87,7		133,1
BAR 28,8 HG	315	77,4	79,1	81,6	81,0	81,7	81,9	81,7	83,6	84,2	85,8	86,8	88,5	89,3	89,8	87,3		135,2
(97415, N/M2)	400	78,5	79,9	81,8	80,6	80,3	78,9	80,6	81,4	82,8	85,5	86,9	87,0	86,9	86,5	84,6		133,8
TAMB 34, DEG F	500	77,1	79,5	78,8	78,1	77,6	77,7	77,0	77,9	78,[illegible]	80,7	82,6	84,0	84,1	84,2	82,7		130,7
(274, DEG K)	630	76,6	79,4	81,3	79,8	79,3	80,1	82,0	83,4	84,7	86,5	88,6	89,2	88,9	87,5	85,7		135,3
TWET 29, DEG F	800	77,1	80,7	81,9	81,0	80,8	80,8	80,9	82,3	83,7	85,1	87,2	88,1	85,6	85,1	83,6		134,1
(271, DEG K)	1000	77,9	80,9	81,4	81,2	80,1	80,7	81,0	83,0	84,9	87,3	90,3	91,3	88,0	85,6	84,2		136,1
HACT 2,07 GM/M3	1250	77,2	80,0	81,1	81,2	80,8	80,7	80,7	81,9	84,[illegible]	86,4	91,4	91,0	87,9	85,4	83,4		136,2
(.00207 KG/M3)	1600	77,1	82,2	81,8	81,9	81,0	81,4	81,7	83,1	84,[illegible]	87,0	91,8	91,2	87,7	85,3	82,9		136,6
NFA 6009, RPM	2000	78,5	83,6	83,8	82,6	81,9	82,7	83,5	84,7	85,7	87,6	91,4	91,9	88,4	85,3	83,5		137,3
(629, RAD/SEC)	2500	79,6	89,1	89,7	88,1	88,2	85,9	84,0	84,3	86,5	87,1	87,6	92,3	90,3	89,8	85,8		138,8
NFK 6159, RPM	3150	76,2	85,1	85,1	83,4	81,9	81,8	81,7	83,8	83,[illegible]	85,7	88,9	90,0	87,1	85,9	82,0		135,8
(645, RAD/SEC)	4000	79,5	88,8	88,0	87,1	82,8	85,4	83,2	83,2	86,[illegible]	87,9	87,6	92,4	89,8	87,8	84,7		138,5
NFD 7486, RPM	5000	77,8	87,7	87,7	87,3	88,0	83,4	81,7	83,6	85,[illegible]	85,7	90,8	90,7	87,5	85,7	83,3		138,1
(784, RAD/SEC)	6300	78,4	90,0	81,7	87,6	85,4	85,4	83,4	84,3	84,[illegible]	87,6	87,0	92,8	87,7	87,6	82,9		139,2
NO. BLADES 26	8000	77,5	89,3	89,4	87,8	85,6	85,4	82,1	83,6	84,[illegible]	86,8	88,3	90,0	86,8	86,0	82,5		138,7
	10000	77,6	90,4	89,9	89,8	86,6	86,4	82,3	82,9	84,[illegible]	85,8	88,9	89,4	86,2	85,9	82,2		137,6
	12500	76,5	89,3	89,5	87,6	85,5	85,2	81,2	81,4	82,[illegible]	84,4	88,7	87,8	85,1	85,0	81,1		139,7
	16000	74,7	88,7	89,0	86,0	84,7	84,0	79,9	80,0	80,[illegible]	82,6	84,2	86,5	84,0	83,9	80,2		140,5
	20000	73,4	88,1	88,5	85,9	84,1	83,0	78,8	79,2	79,[illegible]	81,8	82,9	85,4	83,4	82,6	79,9		188,4
OVERALL MEASURED		92,1	99,1	99,3	98,0	97,1	96,4	95,7	96,9	97,[illegible]	99,7	102,4	103,6	101,7	101,5	100,4		
OVERALL CALCULATED		90,8	99,5	99,6	98,2	96,9	96,4	95,0	96,1	97,[illegible]	99,1	103,7	103,1	100,9	100,5	98,9		151,0
	PNDB	103,5	111,4	111,5	110,3	109,6	108,8	107,6	108,5	110,[illegible]	111,8	114,2	116,0	113,7	112,9	110,2		

TABLE A23

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5 M) ARC ; 90.7% N_{fc} ; SMALL NOZZLE ; SERRATED ROTOR

PAGE 1 PROC. DATE - MONTH 2 DAY 18 HR. 5.8

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( ) ( )	PNL
RADIAL 100. FT.	50	73.8	75.7	74.7	75.4	75.3	76.0	77.4	78.9	78.8	79.7	80.8	82.1	85.3	90.0	93.2		132.5
(30. M)	63	72.2	74.7	75.3	77.2	75.5	76.4	76.9	79.6	78.9	79.8	81.5	83.0	86.0	90.2	93.2		132.8
VEHICLE .5 FAN	80	70.3	74.1	74.6	75.7	74.7	75.8	77.2	78.8	79.5	80.7	82.1	83.5	86.5	90.3	92.5		132.7
CONFIG FAN B	100	71.0	80.1	80.2	77.0	80.5	81.0	83.6	83.6	85.0	87.7	84.3	89.2	88.5	91.1	90.7		135.5
LOC PTO	125	71.2	78.3	78.6	75.0	78.6	79.1	81.4	81.4	82.6	85.4	82.4	87.0	86.1	88.2	86.7		133.0
DATE 2/6/71	160	72.2	73.0	73.2	72.5	73.6	73.5	75.0	75.3	75.9	77.8	79.1	81.0	82.0	84.6	84.3		128.2
RUN 34. PT. 545	200	73.5	79.4	76.1	76.9	80.4	79.5	78.6	82.0	81.0	81.2	84.2	85.9	87.4	90.1	89.3		133.4
TAPE S1276.	250	73.9	79.8	80.2	81.4	81.6	82.1	82.8	84.5	84.8	86.1	88.5	90.4	91.9	93.3	91.8		137.1
BAR 28.8 HG	315	77.4	82.3	84.5	83.9	83.7	84.8	85.4	86.6	87.1	88.4	90.3	92.1	93.4	94.0	91.4		138.7
(97415. N/M2)	400	77.8	82.3	83.5	82.1	82.1	82.0	83.0	84.3	85.7	87.9	89.8	90.4	90.1	89.9	87.9		136.7
TAMB 35. DEG F	500	76.1	81.1	80.2	80.5	80.0	80.1	80.5	80.9	82.1	84.7	87.0	88.0	87.8	87.6	85.7		134.1
(275. DEG K)	630	75.3	80.5	81.7	80.6	80.5	81.9	83.7	85.5	87.1	88.8	91.2	91.7	91.9	90.2	87.7		137.7
THET 30. DEG F	800	76.4	82.3	82.1	82.5	82.4	82.6	83.5	85.3	86.4	87.7	90.1	91.0	88.6	88.1	86.3		136.8
(272. DEG K)	1000	76.0	81.8	82.3	82.5	81.7	82.5	82.9	85.0	87.0	89.4	92.7	93.6	90.1	87.9	86.0		138.2
HACT 3.04 GM/M3	1250	75.5	81.1	82.5	82.6	82.4	82.6	82.9	84.2	86.5	88.5	93.4	93.0	89.1	86.9	84.9		138.0
(.00304 KG/M3)	1600	75.9	83.3	83.1	93.2	82.9	83.1	83.8	85.2	86.4	89.2	94.1	93.4	89.2	87.0	85.0		138.7
NFA 6653. RPM	2000	75.9	84.8	84.9	84.1	83.7	84.5	85.5	86.7	87.7	89.3	93.6	93.7	89.2	86.9	85.3		139.1
(697. RAD/SEC)	2500	78.3	87.2	87.7	92.1	87.0	86.5	85.5	85.4	87.9	88.2	91.3	93.8	89.9	88.7	85.7		139.6
NFK 6812. RPM	3150	81.6	90.1	91.3	97.4	90.4	89.1	88.2	88.0	87.8	88.9	91.1	92.8	91.7	92.3	86.6		142.0
(713. RAD/SEC)	4000	78.0	89.2	88.2	87.2	82.5	86.2	85.5	85.5	88.6	90.1	91.9	93.6	89.6	88.7	85.9		139.8
NFD 7488. RPM	5000	76.4	88.7	88.1	96.6	87.0	84.3	84.0	86.1	88.0	88.2	93.7	92.4	87.8	87.0	84.5		139.6
(784. RAD/SEC)	6300	79.2	93.1	93.9	89.5	88.2	88.0	86.9	87.7	88.1	91.0	91.9	95.5	89.8	90.4	85.5		142.0
NO. BLADES 26	8000	76.3	89.0	89.4	88.0	86.2	86.3	84.7	86.0	87.2	88.6	90.9	92.4	88.3	87.2	83.8		140.3
	10000	76.1	89.9	89.5	88.7	86.7	86.7	84.8	85.6	86.8	88.3	89.7	91.8	87.7	86.9	83.0		140.9
	12500	74.7	88.4	89.0	87.3	85.4	85.4	83.6	84.0	85.0	86.9	88.5	90.1	86.3	85.6	81.6		140.7
	16000	73.2	87.4	88.2	85.8	84.5	84.2	82.4	82.6	83.0	85.1	87.0	88.7	85.3	84.3	80.7		141.4
	20000	71.9	86.8	87.5	85.5	83.9	83.3	81.5	82.0	82.2	84.1	85.6	87.6	84.6	82.9	80.1		143.1
OVERALL MEASURED		91.3	100.2	100.5	101.4	98.7	98.6	98.6	99.6	100.8	102.4	105.1	106.2	104.3	104.8	103.9		
OVERALL CALCULATED		90.3	100.3	100.5	101.4	98.3	98.2	97.9	98.9	100.0	101.7	104.4	105.6	103.3	103.6	102.5		153.0
	PNDB	104.1	113.2	113.4	116.3	112.0	111.6	111.2	111.8	112.8	114.4	117.0	118.2	115.8	115.9	112.6		

TABLE A24

VIII. Nomenclature

Bar.	Barometric pressure in inches of mercury (newtons/sq. meter)
f_1	Fan blade passing frequency fundamental
f_2	Fan blade passing frequency second harmonic
F_n	Net engine thrust
Freq.	1/3 octave band center frequencies
H	Absolute humidity in grams/cubic meter (kilograms/cubic meter)
Loc.	Location of testing
M_o	Aircraft Mach Number
$N/\sqrt{\Theta}$	Fan rotational speed, corrected to standard day
NFA	Actual physical fan speed in rpm (radians/second)
NFD	Design fan speed in rpm (radians/second)
NFK	Fan speed corrected to standard day in rpm (radians/second)
OAPWL	Overall sound power level calculated by summation of power level spectra from 50 Hz to 20K Hz.
OASPL	Overall sound pressure level calculated by summation of sound pressure levels at each 1/3 octave from 50 Hz to 20K Hz.
O.G.V.	Outlet guide vane
P_{T23}/P_{T2}	Ratio of fan bypass exit total pressure to fan inlet total pressure
PNL	Perceived noise level; a calculated, annoyance weighted sound level
PTO	Peebles Test Operation
PWL	Sound power level, Re 10^{-13} watts
QEP	Quiet Engine Program
Radial	Arc distance in feet (meters)
SL	Sideline
SLS	Sea Level static
SPL	Sound pressure level, Re .0002 dynes/cm^2
T_{amb}	Dry bulb ambient temperature in degrees Fahrenheit (degrees Kelvin)
T_{wet}	Wet bulb ambient temperature in degrees Fshrenheit (degrees Kelvin)
V_{plane}	Aircraft velocity
$\frac{W_{bypass}\sqrt{\Theta}}{\delta}$	Bypass air flow, corrected to standard day

dB	Decibel
Hz	Hertz (cycles per second)
PNdB	Perceived noise decibel