NASA CR-120789

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

(NASA-CR-120789) ACOUSTIC TESTING OF A 1.5 PRESSURE RATIO, LOW TIP SPEED FAN (QEP FAN B SCALE MODEL) S.B. Kazin, et al (General Electric Co.) [1972] 111 p CSCL 01A N72-21994
G3/01 Unclas 24153

by

S.B. Kazin, W.R. Minzner, and J.E. Paas

GENERAL ELECTRIC COMPANY

prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA-Lewis Research Center
Contract NAS 3-12430
James J. Kramer, Project Manager

CAT. 01

Requests for copies of this report should be referred to:

National Aeronautics and Space Administration
Office of Scientific and Technical Information
Attention: AFSS-A
Washington, D.C. 20546

1. Report No. NASA CR-120789	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle ACOUSTIC TESTING OF A 1.5 PRESSURE RATIO, LOW TIP SPEED FAN (QEP FAN B SCALE MODEL)		5. Report Date
		6. Performing Organization Code
7. Author(s) S.B. Kazin, W.R. Minzner and J.E. Paas		8. Performing Organization Report No.
		10. Work Unit No.
9. Performing Organization Name and Address General Electric Company Aircraft Engine Group Evendale, Ohio 45215		11. Contract or Grant No. NAS3-12430
		13. Type of Report and Period Covered Contractor Report
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes

Project Manager, James J. Kramer, V/STOL & Noise Division, NASA Lewis Research Center, Cleveland, Ohio

16. Abstract

A scale model (0.484 scale factor) of a single stage fan designed for a 1.5 pressure ratio and 1160 ft/sec (353.6 m/sec) tip speed was tested to determine its noise characteristics. The fan had 26 blades and 60 outlet guide vanes, with vanes spaced two rotor blade aerodynamic chords from the blades. The effects of speed, exhaust nozzle area and fan frame acoustic treatment on the scale model's noise characteristics were investigated.

Level flyover projections to a full scale engine of 22,000 pounds (97,900 newtons) static thrust indicates single fan noise levels of 98.6 PNdB at approach [370 ft (112.8 m) altitude, flight Mach number 0.25, 4900 pounds (21,805 newtons) net thrust] and 98.4 PNdB at takeoff [1000 ft (304.8 m) altitude, flight Mach number 0.25, 16,000 pounds (71,200 newtons) net thrust] for the untreated fan with nominal nozzle. The corresponding configuration with acoustic treatment in the fan frame resulted in 94.3 PNdB at approach and 94.6 PNdB at takeoff. The noise reductions occurred at the blade passing frequency and harmonic tones as well as in the broadband noise.

Runs with exhaust nozzle 16% oversized and 6% undersized showed similar results.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Experimental Quiet Engine Program Turbofan frame acoustic treatment Turbofan noise	Unclassified - unlimited

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

*For sale by the National Technical Information Service, Springfield, Virginia 22151

PRECEDING PAGE BLANK NOT FILMED

TABLE OF CONTENTS

I. ABSTRACT

A scale model (.484 scale factor) of a single stage fan designed for a 1.5 pressure ratio and 1160 ft/sec (353.6 m/sec) tip speed was tested to determine its noise characteristics. The fan had 26 blades and 60 outlet guide vanes, with vanes spaced two rotor blade aerodynamic chords from the blades. The effects of speed, exhaust nozzle area and fan frame acoustic treatment on the scale model's noise characteristics were investigated.

Level flyover projections to a full scale engine of 22,000 pounds (97,900 newtons) static thrust indicates single fan noise levels of 98.6 PNdB at approach [370 ft (112.8 m) altitude, flight Mach number 0.25, 4900 pounds (21,805 newtons) net thrust] and 98.4 PNdB at takeoff [1000 ft (304.8 m) altitude, flight Mach number 0.25, 16,000 pounds (71,200 newtons) net thrust] for the untreated fan with nominal nozzle. The corresponding configuration with acoustic treatment in the fan frame resulted in 94.3 PNdB at approach and 94.6 PNdB at takeoff. The noise reductions occurred at the blade passing frequency and harmonic tones as well as in the broadband noise.

Runs with exhaust nozzles 16% oversized and 6% undersized showed similar results.

II. 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 full scale Fan B, simulated the bypass flow region through the fan.

The scale model was tested to determine the effects of speed, exhaust nozzle area and fan frame acoustic treatment on the fan's noise characteristics. Acoustic data was recorded at ten speed points covering a range from 30% to 100% sea level static 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 run with and without acoustic treatment in the fan frame. This frame treatment consisted of ½ inch (1.25 cm) thick Scottfelt covered with a 22½% porosity plate.

The data obtained at each of these test points was scaled up to full scale to evaluate the projected effectiveness of the design in reducing the noise of the fan system. Projections of a full scale, uninstalled, 22,000 pounds (97,900 newton) static thrust engine with nominal nozzle indicate the following single fan, maximum Perceived Noise Levels (PNL) for a level flyover:

FAN B LEVEL FLYOVER PROJECTIONS
MAXIMUM PERCEIVED NOISE LEVELS
SINGLE FAN

	Untreated	Treated
Takeoff 1000 ft (304.8 m) altitude M_o=.25	98.4 PNdB	94.6 PNdB
Approach 370 ft (112.8 m) altitude M_o=.25	98.6 PNdB	94.3 PNdB

The 200 foot (61.0 m) sideline, maximum PNL's for all three fan exhaust nozzles, treated and untreated, at approach and takeoff thrust are summarized below for a single full scale Fan B.

Full Scale Fan B
200 Foot (61.0 M) Sideline, Maximum PNL

	Approach*	Takeoff**
Nominal nozzle, untreated	104.4 PNdB	116.6 PNdB
Nominal nozzle, treated	100.2 PNdB	112.4 PNdB
Large nozzle, untreated	106.0 PNdB	117.2 PNdB
Large nozzle, treated	100.8 PNdB	113.6 PNdB
Small nozzle, untreated	106.8 PNdB	117.5 PNdB
Small nozzle, treated	101.6 PNdB	113.6 PNdB

* 6,684 pounds (29,744 newtons) static fan thrust
**17,140 pounds (76,277 newtons) static fan thrust

The nozzle size variations did not produce any appreciable new low noise operating points for approach or takeoff rated fan thrust. However, thru the mid-thrust region, the large nozzle resulted in the lowest sideline PNL in both the treated and untreated configurations.

III. 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.

Fan B was incorporated into the NASA/GE Quiet Engine Program to investigate the noise generating and radiating characteristics of a low speed, moderately loaded, single stage fan. The Fan B scale model, the first scaled fan tested, was approximately a half scale version (48.4%) of the full size fan and it essentially reproduced the bypass flow region through Fan B.

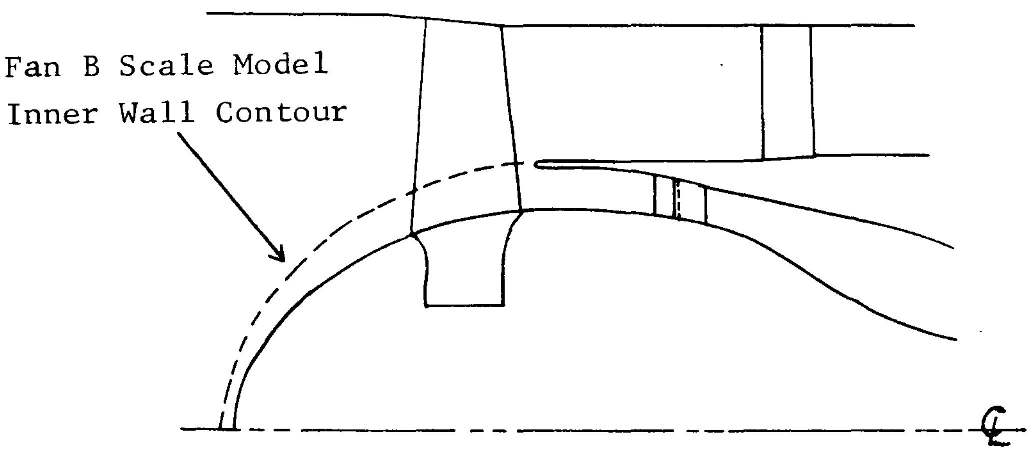
The effects on the scale model's noise characteristics of speed, exhaust nozzle area and fan frame acoustic treatment were examined during the first phase of testing. Acoustic data was recorded at speed points corresponding to a range from 30% to 100% sea level static thrust. The fan was tested with 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. Further, each set of tests was run for two configurations, designated untreated and treated, to determine the effectiveness of the fan frame acoustic treatment. The data obtained at each test point was scaled up to full scale to evaluate the projected effectiveness of each design in reducing the noise of the fan system.

IV. 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, essentially simulated the bypass portion (outer 84.5% of flow) of the full size Fan B, 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. Figures 2 and 3 show the scale model Fan B aerodynamic characteristics - pressure ratio vs corrected weight flow and corrected weight flow vs percent corrected fan speed, respectively - for three nozzle sizes. Some other pertinent scale model and full scale characteristics are shown in Table II.

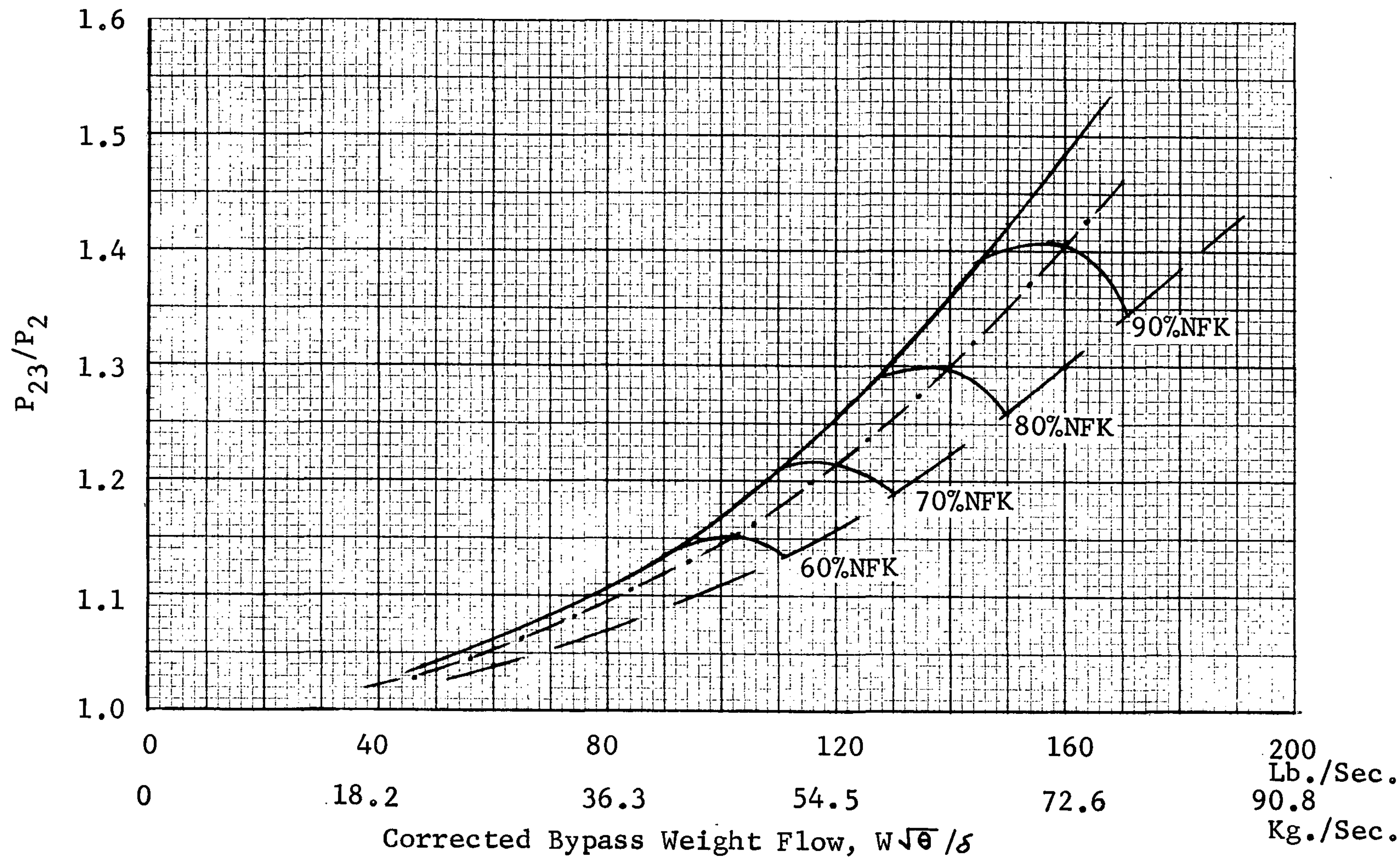
The effects of varying the fan operating line were investigated with the scale model by running three nozzle sizes, consisting of 372 sq. in. (.24 m^2), 396 sq. in. (.26 m^2), and 460 sq. in. (.30 m^2), or about 6% less than nominal, nominal and 16% greater than nominal, with the nominal nozzle being equivalent to a 1700 in^2 (1.10 m^2) nozzle on the full scale fan. The nozzle variations were run on both treated and untreated configurations.



Schematic of Fan B

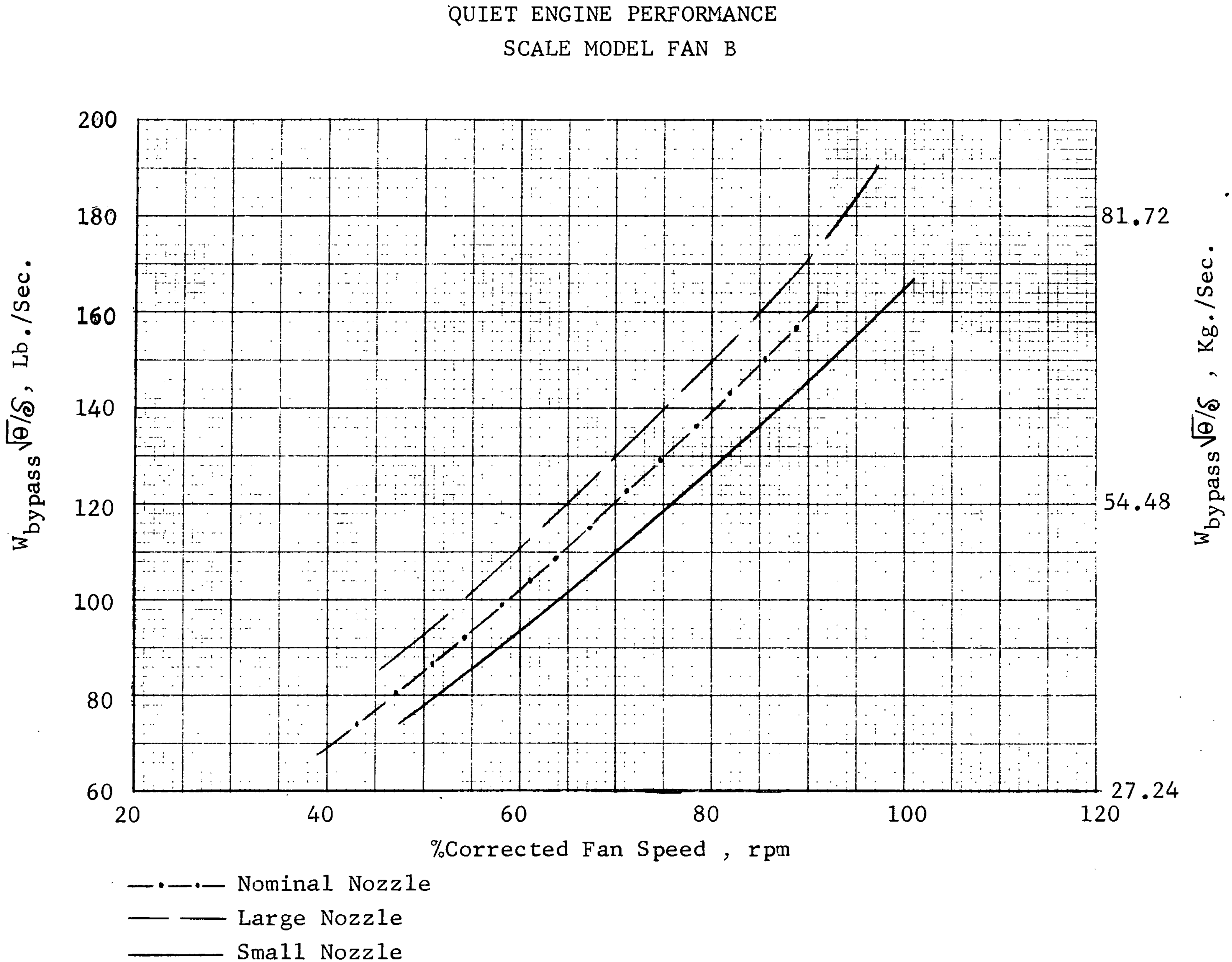
Figure 1

QUIET ENGINE PERFORMANCE
SCALE MODEL FAN B



	Fan Nozzle Area	
Nominal Nozzle Operating Line	936 in^2	(.26m^2)
Large Nozzle Operating Line	460 in^2	(.30m^2)
Small Nozzle Operating Line	372 in^2	(.24m^2)

Figure 2



QUIET ENGINE PERFORMANCE
SCALE MODEL FAN B
$W_{bypass}\sqrt{\theta}/\delta$, Lb./Sec.
200
180
160
140
120
100
80
60
20
40
60
80
100
120
%Corrected Fan Speed , rpm
81.72
54.48
27.24
$W_{bypass}\sqrt{\theta}/\delta$, Kg./Sec.
Nominal Nozzle
Large Nozzle
Small Nozzle

Figure 3

TABLE I

QEP FAN B

FULL SCALE AND SCALE MODEL CHARACTERISTICS

SEA LEVEL STATIC, STD. DAY

TAKEOFF POWER - 91% FAN SPEED

	Full Scale	Scale Model
100% Speed, RPM	3625	7488
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, Lbs (Newtons)	17,140 (76,277)	4010 (17,844)
Rotor Inlet Tip Diameter, Inches (M)	73.35 (1.9)	35.5 (.9)
Inlet Hub/Tip Ratio	.465	.579
Number of Rotor Blades	26	26
Number of OGV's	60	60

The acoustic treatment of the fan frame area was scaled from the full scale fan and incorporated in the scale model. Figure 4 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 III. 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 poylurethane foam material, having suppression characteristics similar to the Multiple-Degree-of-Freedom resonator 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%.

For the untreated configurations, the treatment was neutralized by covering with an adhesive backed foil tape.

FAN B SCALE MODEL
CROSS SECTION INDICATING LOCATION OF ACOUSTIC TREATMENT

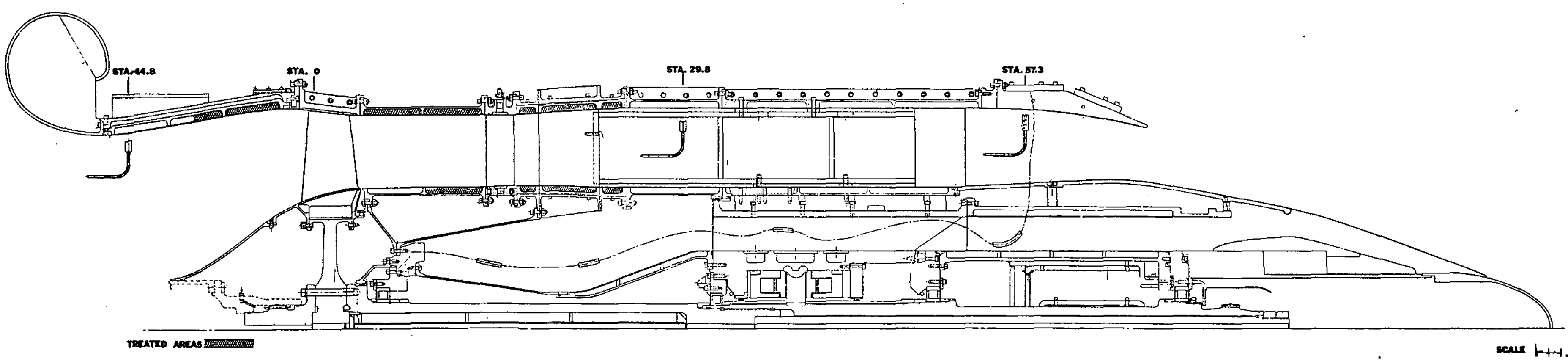


Figure 4

TABLE II

QEP SCALE MODEL FAN B

ACOUSTIC TREATMENT AREAS

LOCATION	AREA	
Inlet	812 in^2	5240 cm^2
Rotor - OGV's		
Inner Wall	315 in^2	2030 cm^2
Outer Wall	1007 in^2	6500 cm^2
Aft of OGV's		
Inner Wall	417 in^2	2690 cm^2
Outer Wall	668 in^2	4310 cm^2
Total	3219 in^2	20,770 cm^2
	22.4 ft^2	2.08 m^2

V. 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 5 and 6. Testing was performed on Site 4B, using a G.E. LM1500 stationary gas turbine as the drive system. Figure 7 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.

A. Farfield Data Acquisition

The acoustic data was taken 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. (76.2 m) arc of crushed stone.

Data was recorded on FM with a Sangamo 28 channel recorder, Model 4700. A tape speed of 60 ips (1.5 m/sec) was used to provide a flat frequency response through the 20 KHz 1/3 octave band. Data was recorded for a minimum of 60 seconds, with all angles being recorded simultaneously.

Each microphone system consisted of the following equipment:

Component	Manufacturer	Model
Microphone	B & K	4133 ½ inch (1.3 cm)
Cathode Follower	B & K	2615
Power supply	B & K	2801

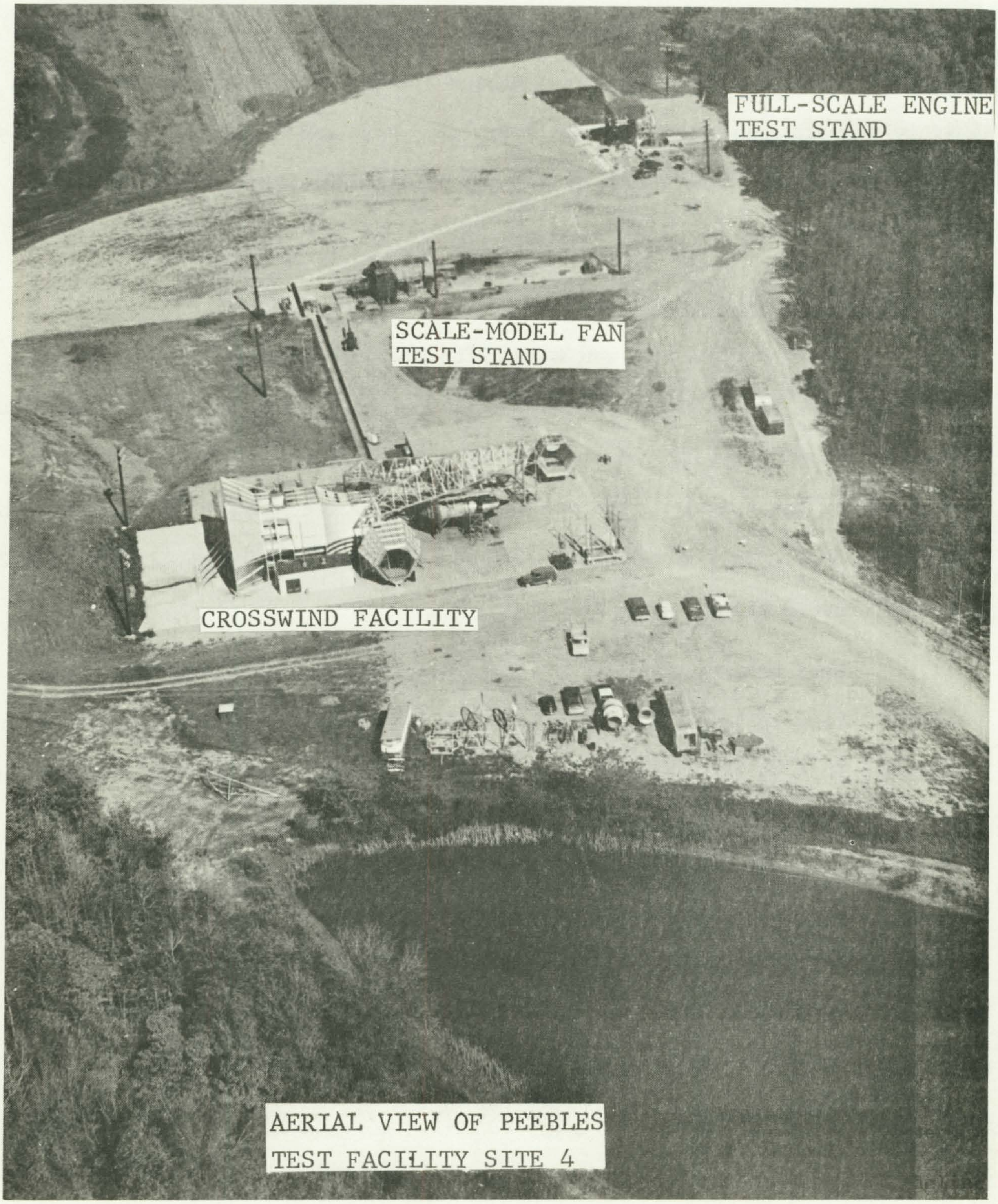

FULL-SCALE ENGINE
TEST STAND
SCALE-MODEL FAN
TEST STAND
CROSSWIND FACILITY
AERIAL VIEW OF PEEBLES
TEST FACILITY SITE 4

FIGURE 5

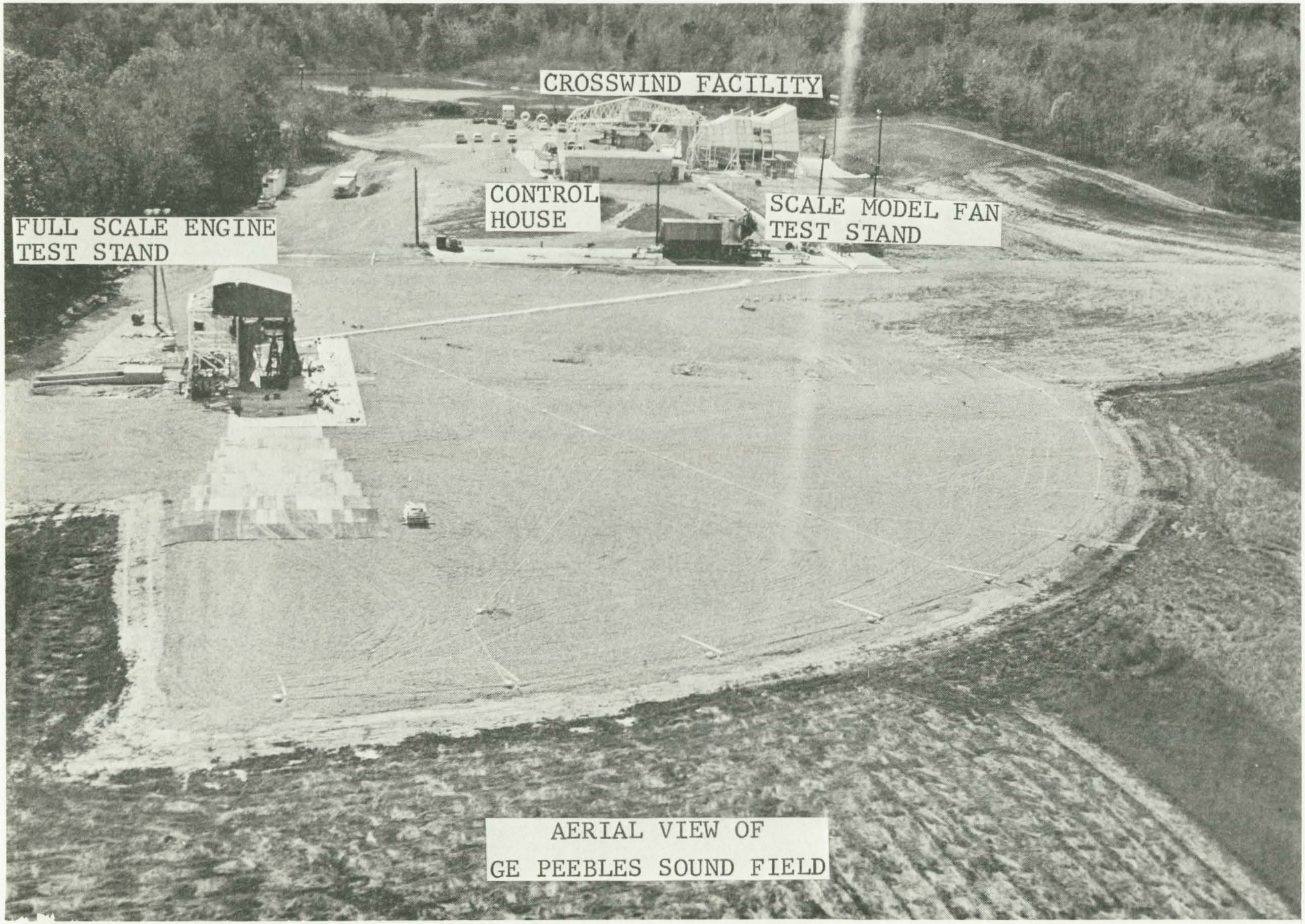
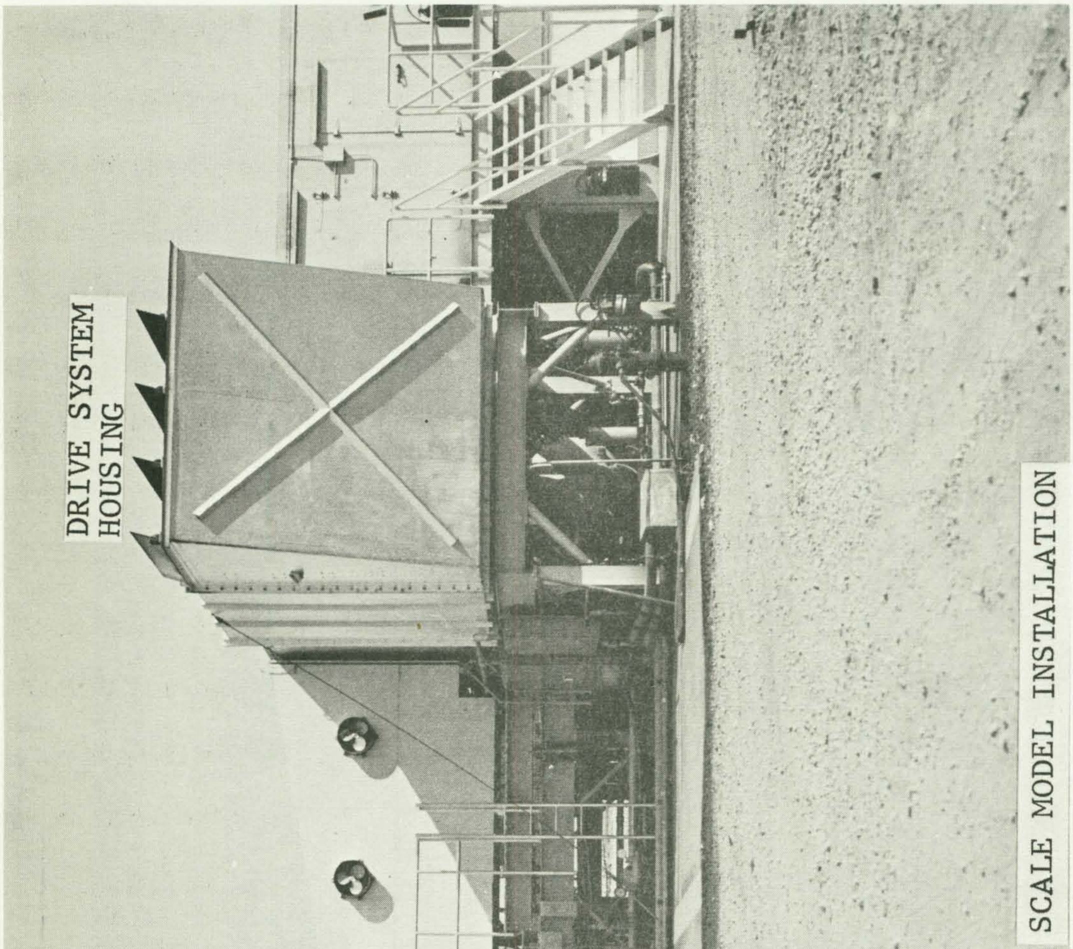

CROSSWIND FACILITY
CONTROL HOUSE
FULL SCALE ENGINE TEST STAND
SCALE MODEL FAN TEST STAND
AERIAL VIEW OF GE PEEBLES SOUND FIELD

Figure 6



SCALE MODEL INSTALLATION

Prior to testing, the frequency response of the system was determined by removing the microphone head and inputting a constant voltage at various frequencies throughtout the range of interest. For a range of 50 Hz to 25 KHz, this was performed at frequencies of 50, 250, 1000, 5K, 8K, 10K, 12.5K, 16K, 20K and 25KHz. The voltage input was chosen at 10 millivolts, approximately the equivalent to 94 dB for a ½ inch (1.3 cm) microphone and an approximation of the levels encountered during an actual test.

The loss through each system was measured by removing the microphone head and inputting one volt RMS at the microphone preamplifier at a frequency of 250 Hz, to correspond with the pistonphone frequency. If the system loss was not within a specified limit, based on the specifications of the components, then the system was checked and/or changed before continuing.

With the 124 dB pistonphone on the microphone, the voltage output was compared with the calculated output based on the system losses and the microphone sensitivity. If the actual voltage output agreed within ½ dB (approximately 5%) of the calculated output, the microphone was functioning properly. Microphone cartridges falling outside this limit were set aside for repair and/or recalibration prior to reuse.

The amplifiers, tape recorder, and data reduction facilities were checked by recording a broadband electrical signal of known amplitude, known as "pink noise." Reduction of this signal provided a measure of the frequency response of these components.

In addition to these system checks, a pre and post test calibration was recorded on each channel using the 124 dB pistonphone (B&K model 4220).

B. <u>Testing Schedule</u>

Acoustic tests were conducted at ten speed points, with three nozzle sizes, for both the untreated and treated configurations. Table IV summarizes the configurations for which data was obtained.

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.

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.

TABLE III

QEP FAN B

TEST DATA ACCUMULATED ON SCALE MODEL

TREATED AND UNTREATED WITH NOZZLE VARIATIONS

	Untreated Configurations				Treated Configurations		
Run No.	3	4	5	6	13	14	17
Test Date	8/14/70 8/17/70	8/20/70	8/21/70	8/24/70	9/19/70	9/19/70	10/6/70
Nozzle Size	Nom.	Large	Small	Nom.	Small	Large	Nom
Fan Speed	Reading No's				Reading No's		
	19	39	60	--	218	--	261
4040 RPM	23	44	67	--	229	--	271
	20	40	61	--	219	239	262
4474 (Approach)	24	45	68	--	230	244	272
	21	42	62	--	220	--	263
4700	25	46	69	--	231	--	273
	22	43	63	--	221	240	264
4907	26	47	70	--	232	245	274
	27	48	64	--	222	--	265
5505	30	51	71	--	233	--	275
	28	49	65	--	223	241	266
5990	31	52	72	--	234	246	276
	29	50	66	--	224	--	267
6354	32	53	73	--	235	--	277
	33	54	74	79	226	242	268
6526	34	56	--	82	236	247	278
	--	55	75	80	227	--	269
6649	--	57	77	83	237	--	279
	--	58	76	81	228	243	270
6845 (Take-off)	--	59	78	84	238	248	280

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

VI. Acoustic Data Reduction & Acoustic Scaling Procedure

A. One Third Octave Data

The acoustic data reduction system, schematically illustrated in Figure 8 , was designed specifically to perform time-averaged spectral analysis using a 30 second averaging time with a 1/3 octave bandwidth parallel filter system. Data was recorded on FM analog magnetic tape. This tape was played back through an amplifier/attenuator to provide the optimum signal input level to utilize the 50 dB dynamic range of the 1/3 octave filter system. The output of each filter was directly connected to a detector/integrator circuit which had built-in "hold" capabilities. The "hold" capability enabled the system to accumulate average signal amplitudes for each of the 1/3 octave bands and to hold them until they were processed through the analog-to-digital converter. The digital signal was then input to the DDP-116 Computer which provided a digital magnetic tape used for further computations and an on-line "quick-look" printout of sound pressure level spectra (temperature and humidity corrected to Standard Day). The "quick-look" information was used as a quality check prior to addition data reduction.

Additional data reduction included "Standard Data Reduction" and "Scaled Data." The former consisted of PNL, OASPL, PWL, OAPWL and D.I., as well as extrapolations to various sideline distances via the DDP-116 Computer. The latter, used for scale model data, provided the same type of data for both scale model and scale model projected to full size by methods described in the following section.

The 1/3 octave scale model data used to prepare this report are presented in the Appendix, Section IX.

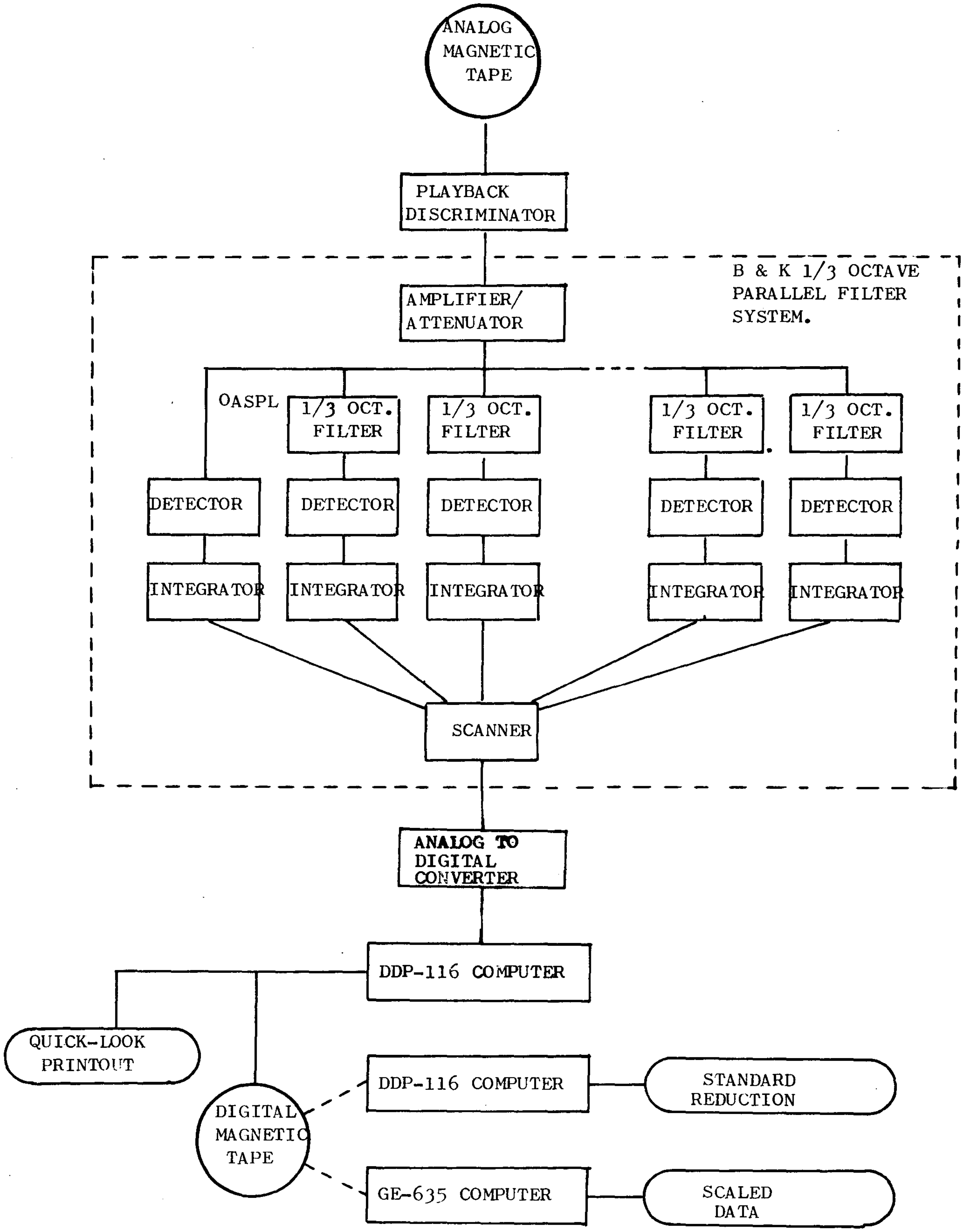

ANALOG MAGNETIC TAPE
PLAYBACK DISCRIMINATOR
B & K 1/3 OCTAVE PARALLEL FILTER SYSTEM.
AMPLIFIER/ ATTENUATOR
OASPL
1/3 OCT. FILTER
1/3 OCT. FILTER
1/3 OCT. FILTER
1/3 OCT. FILTER
DETECTOR
DETECTOR
DETECTOR
DETECTOR
DETECTOR
INTEGRATOR
INTEGRATOR
INTEGRATOR
INTEGRATOR
INTEGRATOR
SCANNER
ANALOG TO DIGITAL CONVERTER
DDP-116 COMPUTER
QUICK-LOOK PRINTOUT
DIGITAL MAGNETIC TAPE
DDP-116 COMPUTER
STANDARD REDUCTION
GE-635 COMPUTER
SCALED DATA

Figure 8

B. Scaling Procedure

In addition to providing comparative data on noise reduction features, the scale model results were used to predict the full scale fan noise levels. In order to scale up the results, the frequency dependent atmospheric absorption corrections were removed from the scale model spectra to form an ideal spectra. This ideal spectra was then shifted as follows: the jet noise below the 1/3 octave band preceding the fundamental was shifted by the square root of the airflow ratio; the fan spectra were shifted by the ratio of the fan fundamental frequencies; and, a size adjustment of 10 $\log_{10}$ of the airflow ratio was added to all frequencies. The resulting spectra were then extrapolated, using the attenuations of the shifted frequencies, to various arc and sideline distances.

For example:

1. Adjustment for Fan Frequency Shift

Fundamental Frequency = Number of blades x RPM/60

f_1 scale model = 26 x 6845/60 = 2970 Hz

f_1 full scale = 26 x 3320/60 = 1440 Hz

The scale model fundamental appeared in the 3150 Hz 1/3 O.B. The full scale fundamental appeared in the 1600 Hz 1/3 O.B. Hence, the fan spectra was shifted three 1/3 octave bands.

2. Adjustment for Jet Noise Frequency Shift

$$\text{Shift factor} = \sqrt{\text{airflow ratio}} = \sqrt{\frac{\text{flow, full scale}}{\text{flow, scale model}}}$$

$$= \sqrt{4.26}$$

$$= 2.07$$

Therefore, levels at 200 Hz were shifted by 200/2.07 to 97 Hz or to the 100 Hz 1/3 octave band. Thus, the jet noise was shifted three 1/3 octave bands.

3. Adjustment for Size

To account for the size difference, a general adder of $10 \log_{10}$ airflow ratio or $10 \log_{10} 4.26 = 6.3$ dB, was added at all frequencies.

4. Adjustment for Atmospheric Absorption

The model spectrum data was increased by an atmospheric absorption number (which increases with frequency) before frequencies were shifted for scaling. After shifting, atmospheric absorption numbers for the shifted frequencies were subtracted to account for the fact that the shifted frequencies showed less absorption.

Table V shows the scaling technique applied to a typical scale model spectra.

C. Narrow Band Data

Narrow Band frequency analysis was performed by means of a Federal Scientific Ubiquitous Spectrum Analyzer, Model UA-6A, in conjunction with an Option 12913 High Resolution Digital Averager. The analyzer was capable of Fourier-analyzing all frequencies, within a selected frequency range, in real time. This analysis could be performed on continuous and intermittent signals as well as one time transients.

TABLE IV

QEP FAN B

SCALE MODEL

SCALING TECHNIQUE

1/3 Octave Band Center Frequency (Hz)	① Scale Model 100' (30.5m) Arc W/Std. Day Corr.	② Atmospheric Attenuation per 100'(30.5m)	③ ① + ②	④ Shifted Spectra	⑤ ④ + 6.3 dB Weight flow Adder=6.3 dB	⑥ ⑤ - ② Full Scale Spectra 100' (30.5m) Arc W/Std. Day Corr.
50	82.0	0	82.0	83.8	90.1	90.1
63	84.1	0	84.1	83.3	89.6	89.6
80	83.2	0	83.2	80.7	87.3	87.3
100	83.8	0	83.8	84.7	91.0	91.0
125	83.3	0	83.3	89.3	95.6	95.6
160	80.7	0	80.7	91.9	98.2	98.2
200	84.7	0	84.7	89.3	95.6	95.6
250	89.3	0	89.3	86.2	92.5	92.5
315	91.9	0	91.9	88.7	95.0	95.0
400	89.2	.1	89.3	86.3	92.6	92.5
500	86.1	.1	86.2	87.7	94.0	93.9
630	88.6	.1	88.7	86.5	92.8	92.7
800	86.2	.1	86.3	87.8	94.1	94.0
1000	87.6	.1	87.7	86.5	92.8	92.7
1250	86.3	.2	86.5	86.2	92.5	92.3
1600	87.6	.2	87.8	91.7	98.0	97.8
2000	86.2	.3	86.5	88.7	95.0	94.7
2500	85.8	.4	86.2	89.8	96.1	95.7
3150	91.2	.5	91.7	93.2	99.5	99.0
4000	88.0	.7	88.7	90.8	97.1	96.4
5000	88.9	.8	89.8	89.1	95.4	94.5
6300	92.0	1.2	93.2	87.5	93.8	92.6
8000	89.1	1.7	90.8	84.9	91.2	89.5
10000	86.6	2.5	89.1	84.5	90.8	88.3
12500	83.6	3.9	87.5			
16000	79.0	5.9	84.9			
20000	76.0	8.5	84.5			
	114.7 PNdB					121.7 PNdB

The Averager accumulated the short-term spectra (produced by the Ubiquitous Analyzer) and obtained the mean spectrum characteristics in real time. Successive spectra were summed digitally over a selected period of time and the resultant average was displayed via an X-Y plotter. Averaging resulted in signal-to-noise ratio enhancement and was useful for detecting spectrum components which are "buried" in noise.

Narrow Band analysis performed for this report consisted of a frequency range of 20 to 10K Hz with a nominal filter band width of 20 Hz. The integration time used was 12.8 seconds, with 256 scans during this time period.

VII. ACOUSTIC DATA ANALYSIS

A. NOISE VARIATIONS WITH SPEED

Figures 9 - 13 show the noise characteristics at several speeds for the untreated configuration of scale model Fan B with the nominal nozzle. 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 9 and 10 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 arc SPL values. The fundamental at approach was 10.7 dB PWL lower than at takeoff and the second harmonic was 8.5 dB PWL lower at approach than at takeoff thrust. The maximum fundamental tones occurred in the front quadrant for both takeoff and approach thrusts while the maximum second harmonic occurred in the rear quadrant for both power settings.

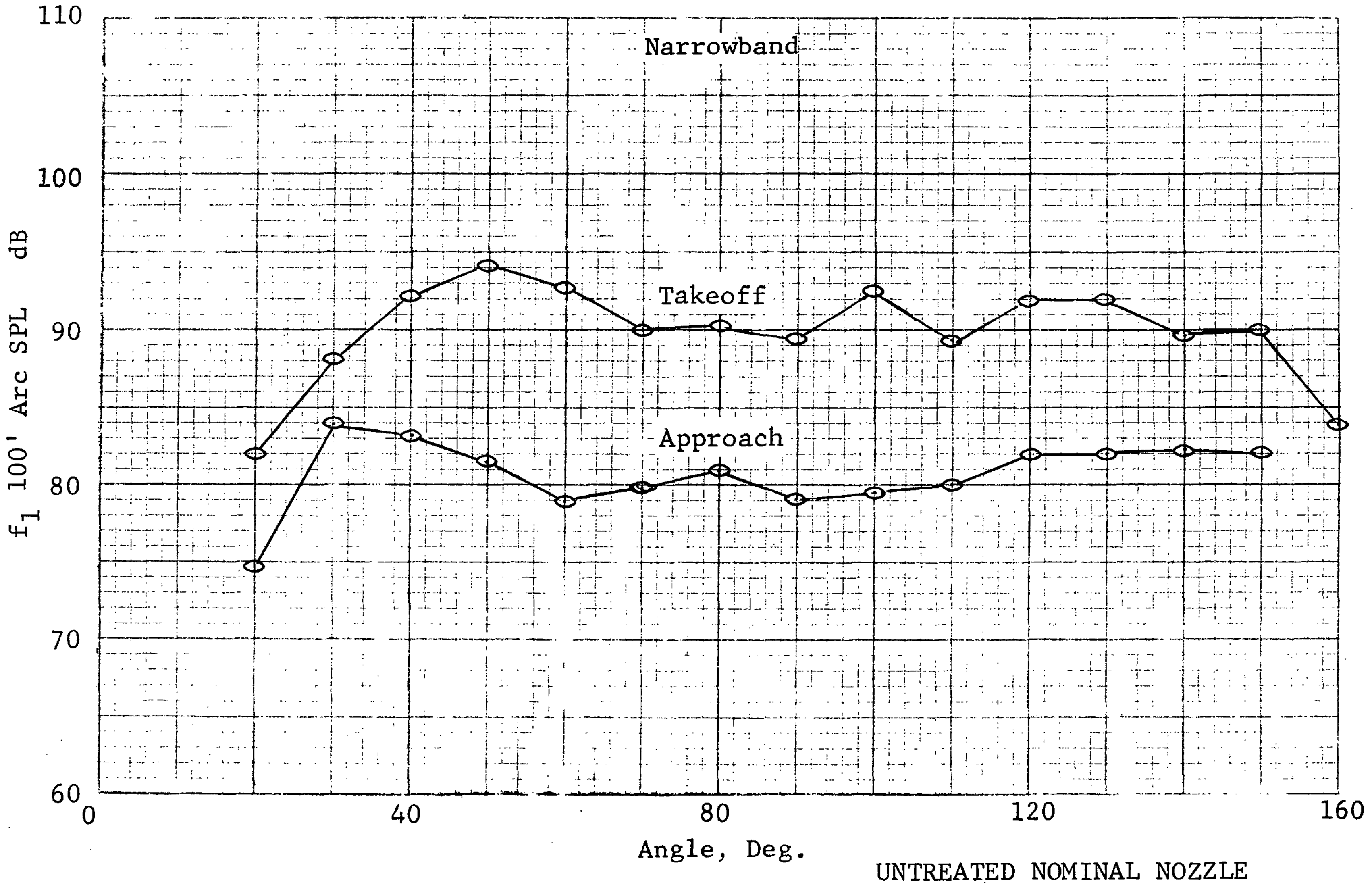
Figures 11 and 12 present the 1/3 octave spectrum at 50° and 120° respectfully, for 60%, 70%, 80% and 90% corrected fan speeds. (The 1/3 octave scale model data is presented in the Appendix for all angles). Although the blade passing frequency occurred in different 1/3 octave bands for different fan speeds, it can be seen that the fundamental increased with increasing speed at both angles. Further, the noise level below 1600 Hz generally increased with speed.

The second harmonics likewise increased with increasing speed with the exception of the one at 50° for 90 $\%N_{f_c}$ which was lower than the second harmonics for this angle at 70% and 80 $\%N_{f_c}$. Note that the difference between 60% and 70% speeds was markedly greater than between any other pair of adjacent speeds.

Figure 13 contains 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. Note the 60 $\%N_{f_c}$ PWL was quite a bit lower than the 70 $\%N_{f_c}$ PWL while the 70%, 80% and 90% PWL's were rather closely grouped - approximately 7 dB difference between the 60% and 70% fundamental while only 2½ dB between the 70% and 90% fundamental.

SCALE MODEL FAN B

FUNDAMENTAL - STANDARD DAY



UNTREATED NOMINAL NOZZLE

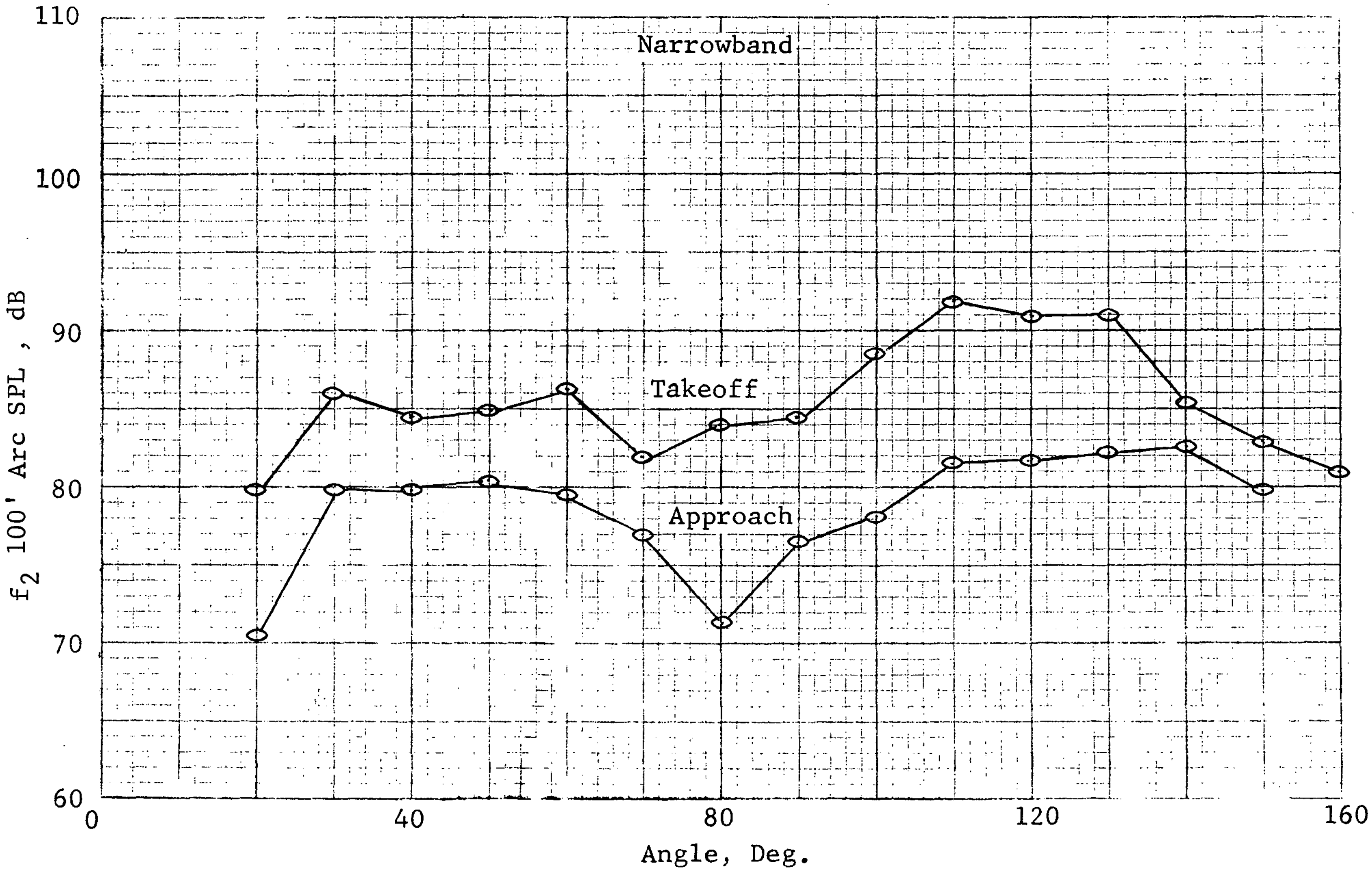
Figure 9

Approach - PWL=131.5 dB

Takeoff - PWL=142.2 dB

SCALE MODEL FAN B

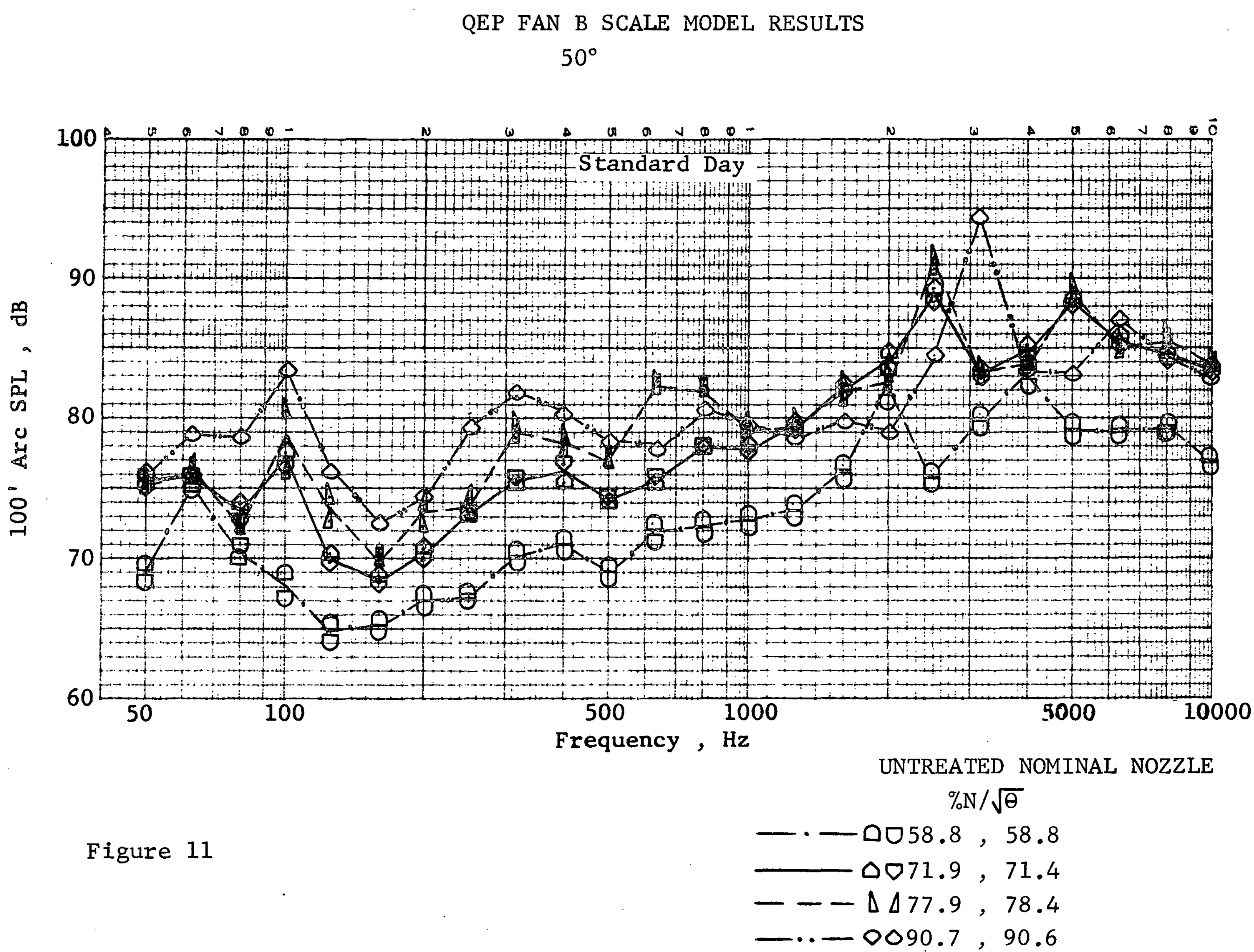
SECOND HARMONIC - STANDARD DAY



UNTREATED NOMINAL NOZZLE

Figure 10

Approach - PWL=130.7 dB
Takeoff - PWL=139.5 dB



QEP FAN B SCALE MODEL RESULTS
50°
Standard Day
100
90
80
70
60
100' Arc SPL , dB
50
100
500
1000
5000
10000
Frequency , Hz
UNTREATED NOMINAL NOZZLE
%N/√θ
58.8 , 58.8
71.9 , 71.4
77.9 , 78.4
90.7 , 90.6

Figure 11

QEP FAN B SCALE MODEL RESULTS
120°

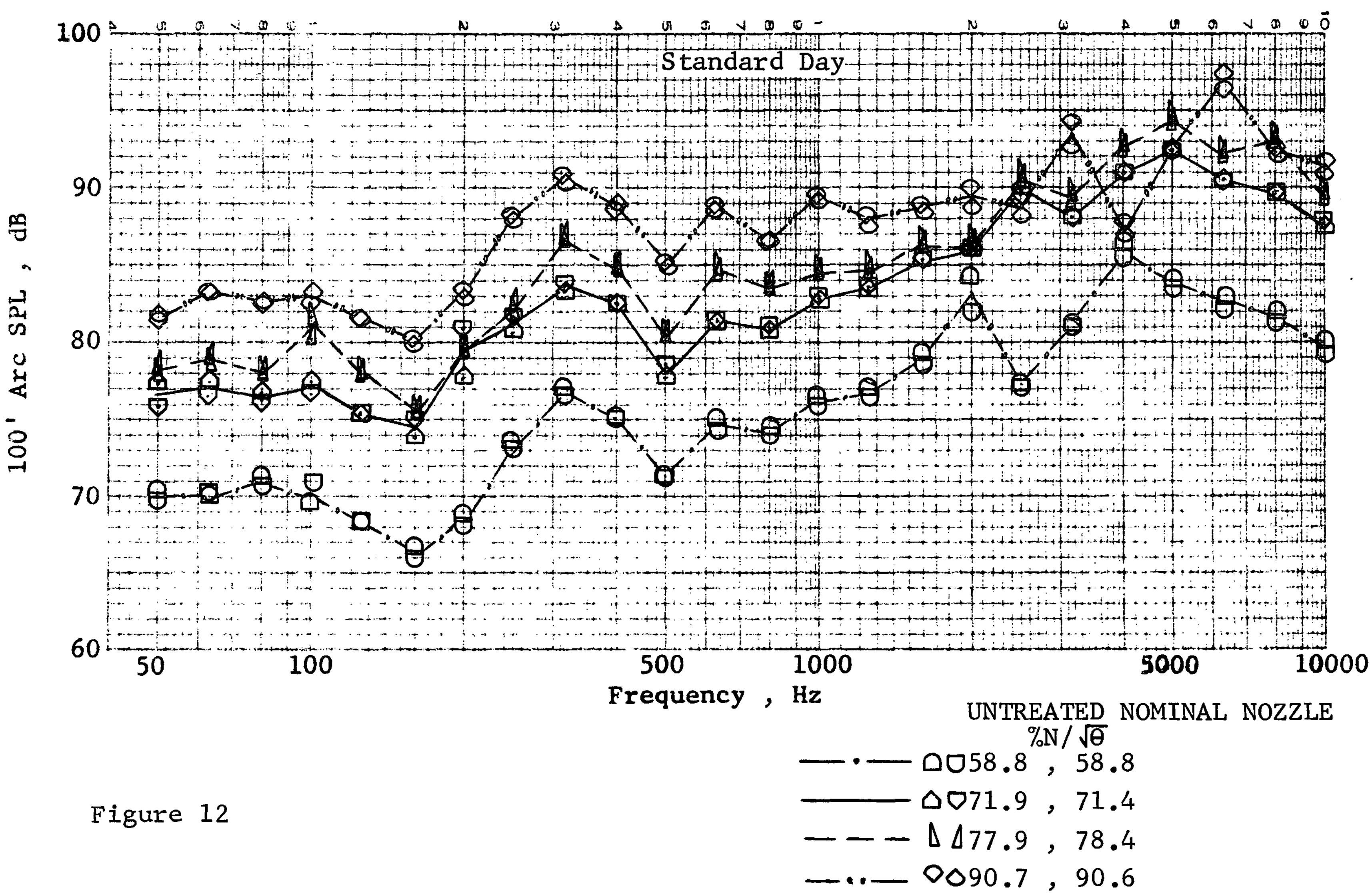


Figure 12

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS

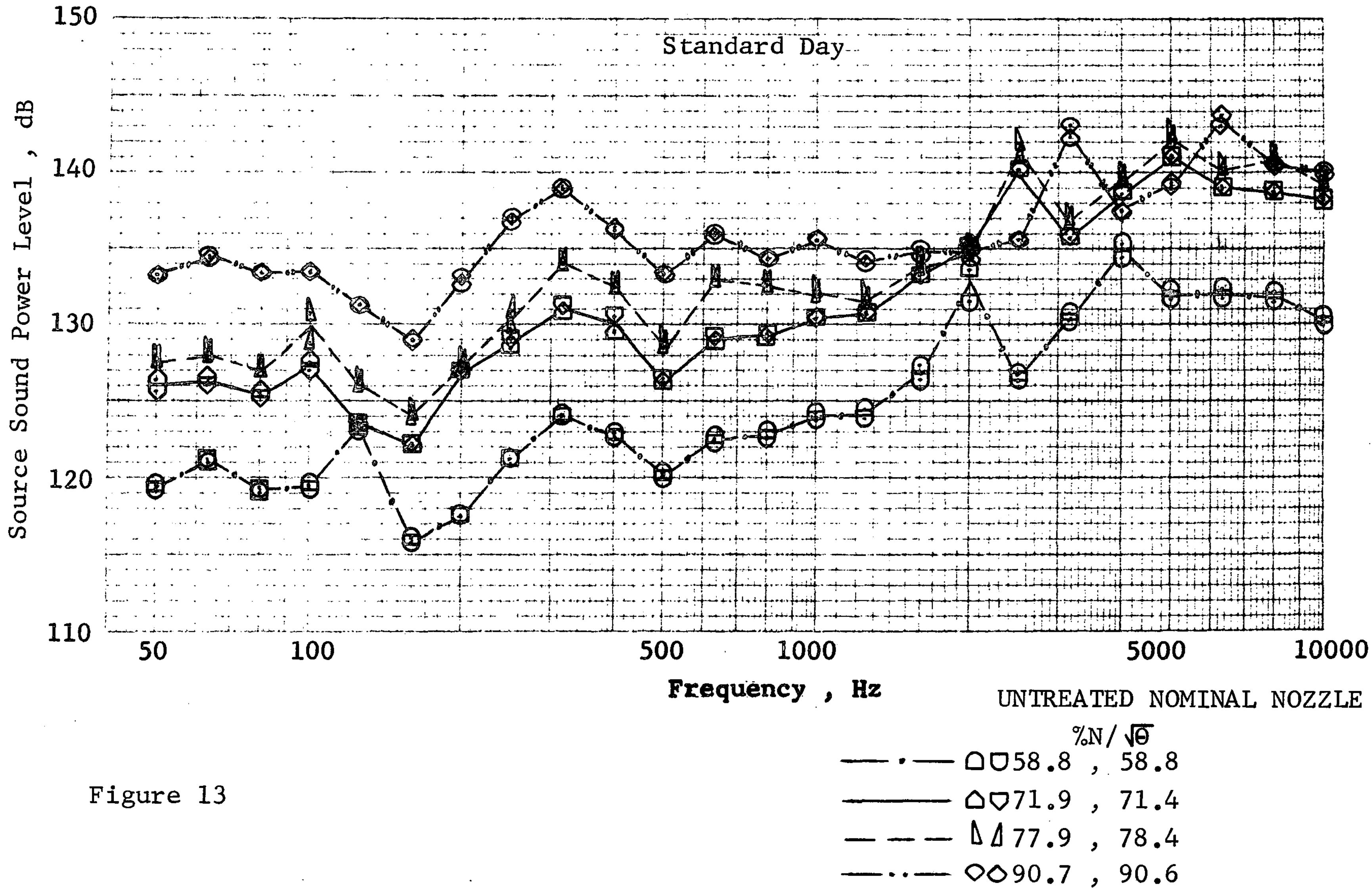


Figure 13

B. NOISE VARIATIONS WITH FAN NOZZLE AREA

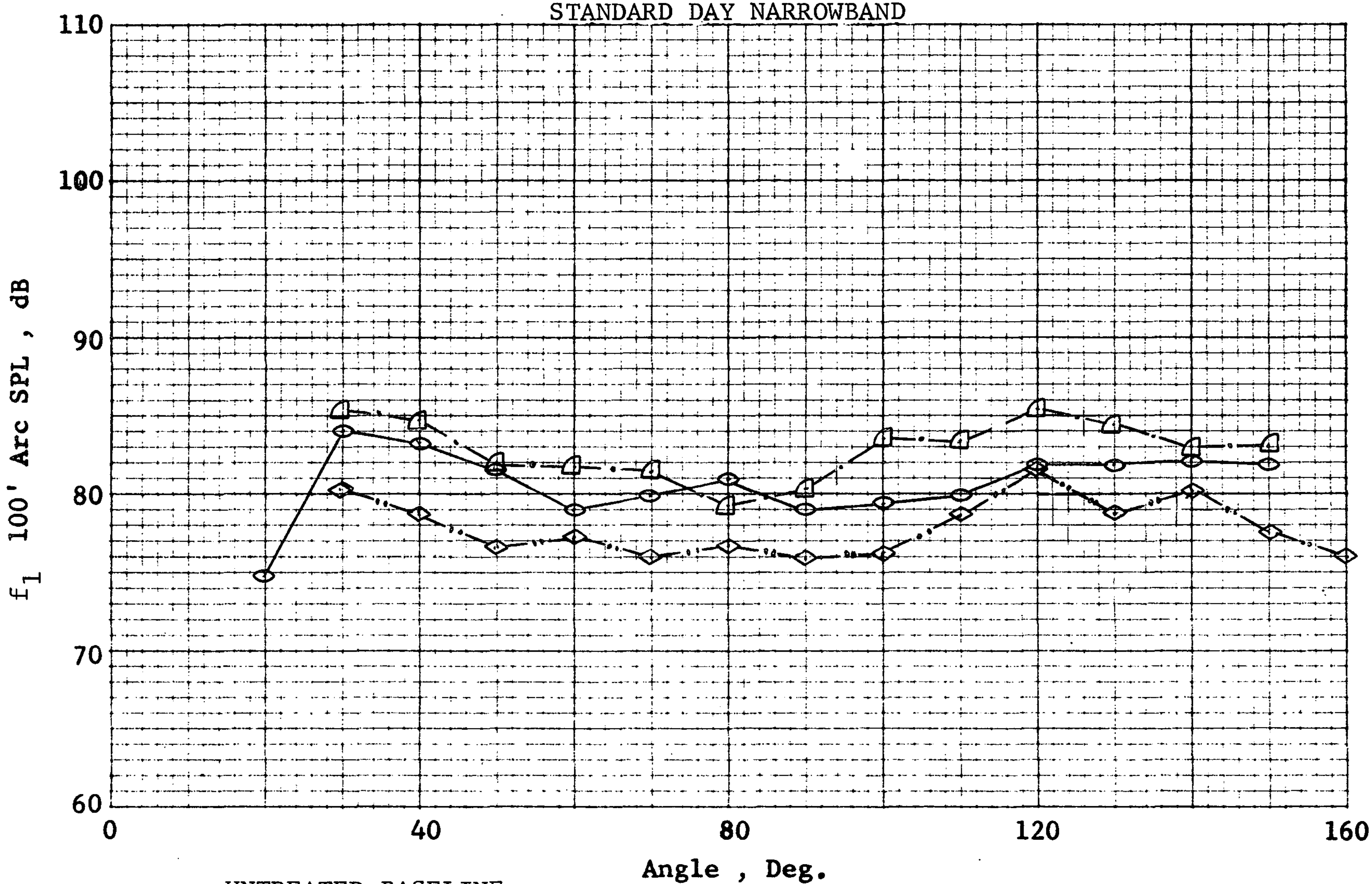
Figures 14 - 23 present the noise characteristics of the untreated scale model configuration at approach and takeoff thrusts with three different fan nozzles. These nozzles were designated small, 372 square inches ($.24\ m^2$); nominal, 396 sq. inches ($.26\ m^2$); and large, 460 sq. inches ($.30\ m^2$). The data presented in these figures are for a 100 foot (30.5 m) arc.

The distribution around the arc of the fundamental and the second harmonic of the fan with three nozzles is shown in Figures 14 and 15 for approach thrust and in Figures 16 and 17 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. In each of the four cases, the tone level of the large nozzle was the highest while that of the small nozzle was the lowest. The sound power level of the fundamental at approach differed by 2.1 dB PWL between the large and nominal nozzles and by 2.1 dB PWL between the nominal and small nozzles, respectively. The PWL of the second harmonic at approach was very similar for the large and nominal nozzles, while the small nozzle was 2.2 dB PWL lower than the nominal nozzle. However, at takeoff thrust, the PWL of the tones for the nominal and small nozzle were both similar amounts lower than the large nozzle. The maximum tones for each of the four cases occurred in the rear quadrant, although the rear to front quadrant difference is slight for the fundamental at approach.

The 1/3 octave spectra for approach thrust at 50° and 120° (Figures 18 and 19) likewise indicate that the tone levels of the small nozzle were less than those of the other nozzles. However, these figures also indicate that the broadband noise of the small nozzle was substantially higher than the broadband noise of the other nozzles from 315 Hz to 10 KHz at 50° and from 315 Hz to 2000 Hz at 120°. The broadband noise was generally higher for the small nozzle at takeoff thrust from 315 Hz to 10 KHz as well, as indicated by Figure 20 for 50° and by Figure 21 for 120°.

Figure 22 contains sound power levels versus frequency for the three nozzles at approach thrust. Again, the broadband noise for the small nozzle is shown to be significantly higher than the other two nozzles from 315 Hz to 4000 Hz. Figure 23 contains the PWL spectra at takeoff thrust for the three nozzles. The broadband noise was also higher at this thrust level for the small nozzle than for the other nozzles, although the difference was not as great as that at approach thrust.

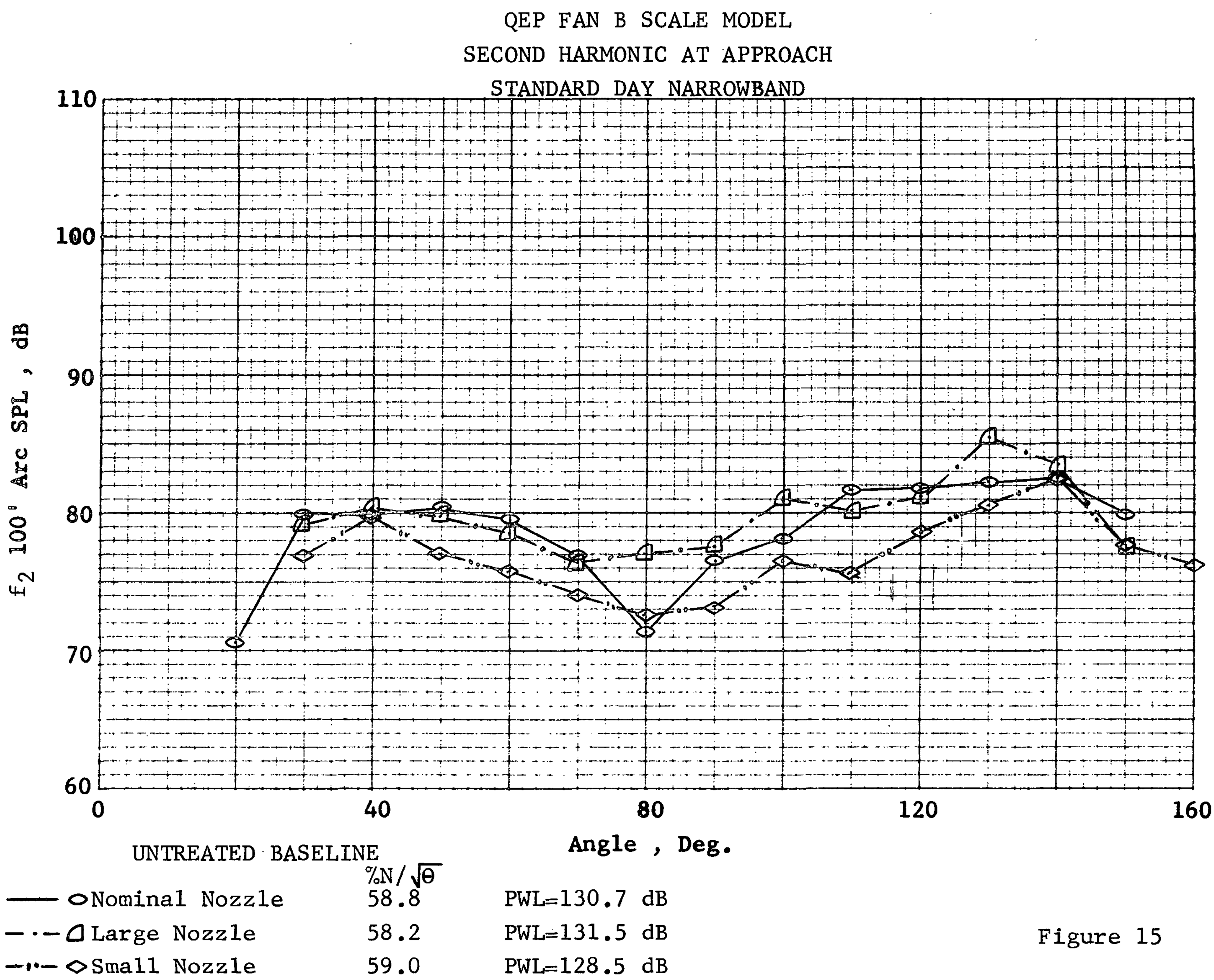
QEP FAN B SCALE MODEL
FUNDAMENTAL AT APPROACH
STANDARD DAY NARROWBAND



UNTREATED BASELINE

	$\%N/\sqrt{\theta}$	
—— ○ Nominal Nozzle	58.8	PWL=131.5 dB
—·— ◁ Large Nozzle	58.2	PWL=133.6 dB
—··— ◇ Small Nozzle	59.0	PWL=128.9 dB

Figure 14



QEP FAN B SCALE MODEL
SECOND HARMONIC AT APPROACH
STANDARD DAY NARROWBAND
110
100
90
80
70
60
0
40
80
120
160
f_2 100' Arc SPL , dB
Angle , Deg.
UNTREATED BASELINE
%N/$\sqrt{\theta}$
Nominal Nozzle 58.8 PWL=130.7 dB
Large Nozzle 58.2 PWL=131.5 dB
Small Nozzle 59.0 PWL=128.5 dB

Figure 15

QEP FAN B SCALE MODEL
FUNDAMENTAL AT TAKEOFF
STANDARD DAY NARROWBAND

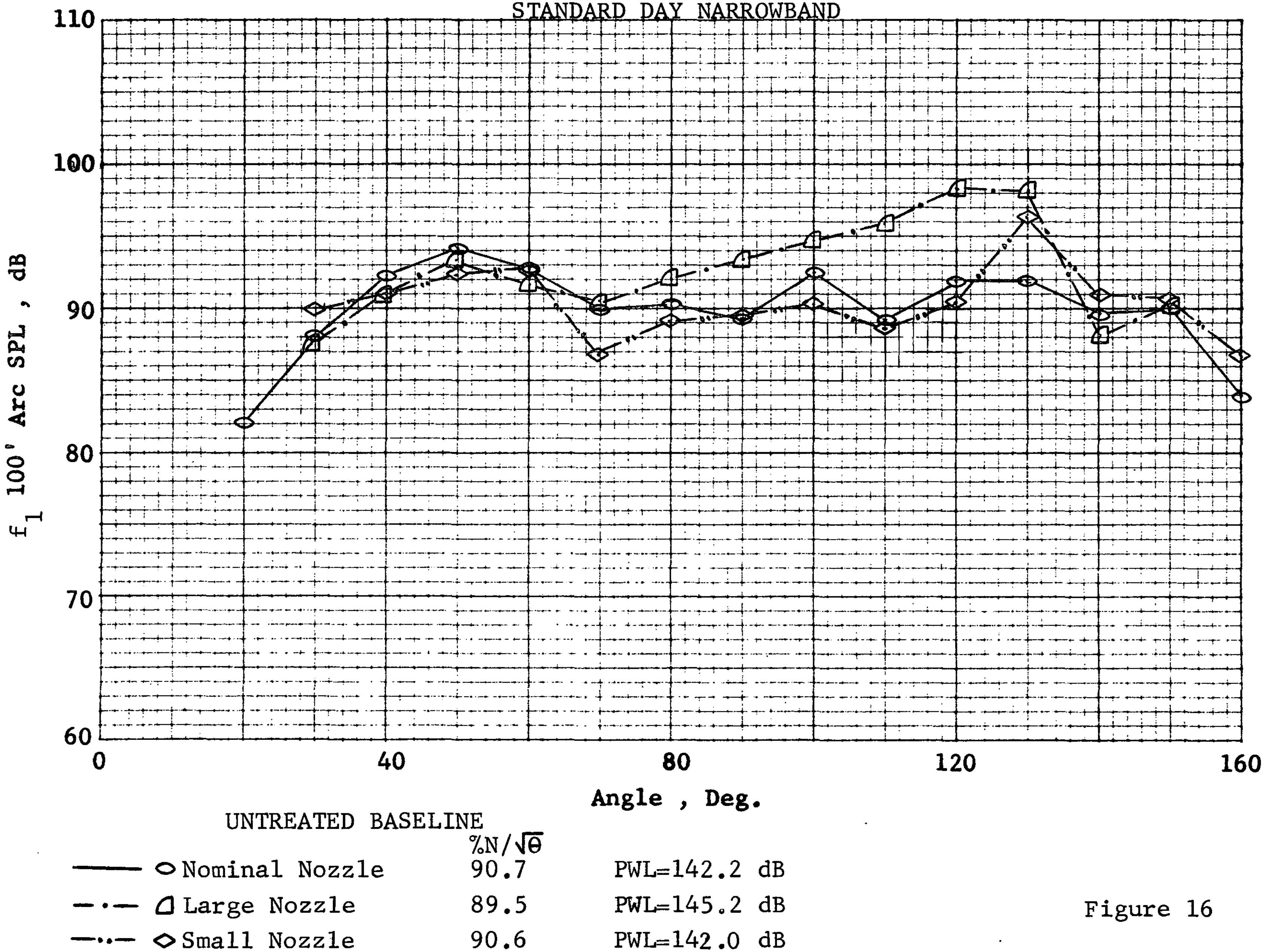


Figure 16

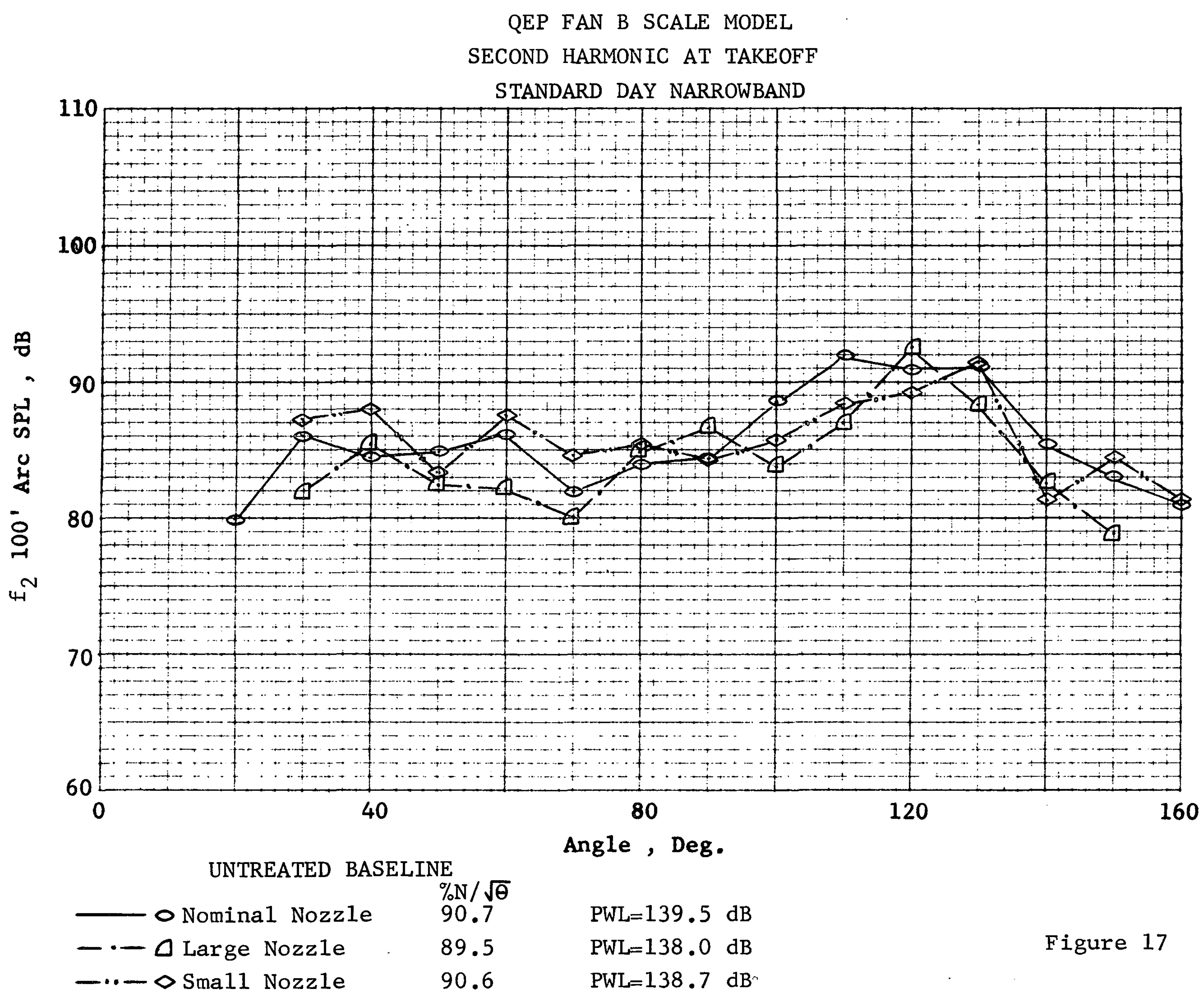

QEP FAN B SCALE MODEL
SECOND HARMONIC AT TAKEOFF
STANDARD DAY NARROWBAND
110
100
90
80
70
60
f_2 100' Arc SPL , dB
0
40
80
120
160
Angle , Deg.
UNTREATED BASELINE
%N/√θ
Nominal Nozzle 90.7 PWL=139.5 dB
Large Nozzle 89.5 PWL=138.0 dB
Small Nozzle 90.6 PWL=138.7 dB

Figure 17

QEP FAN B SCALE MODEL RESULTS
50° AT APPROACH

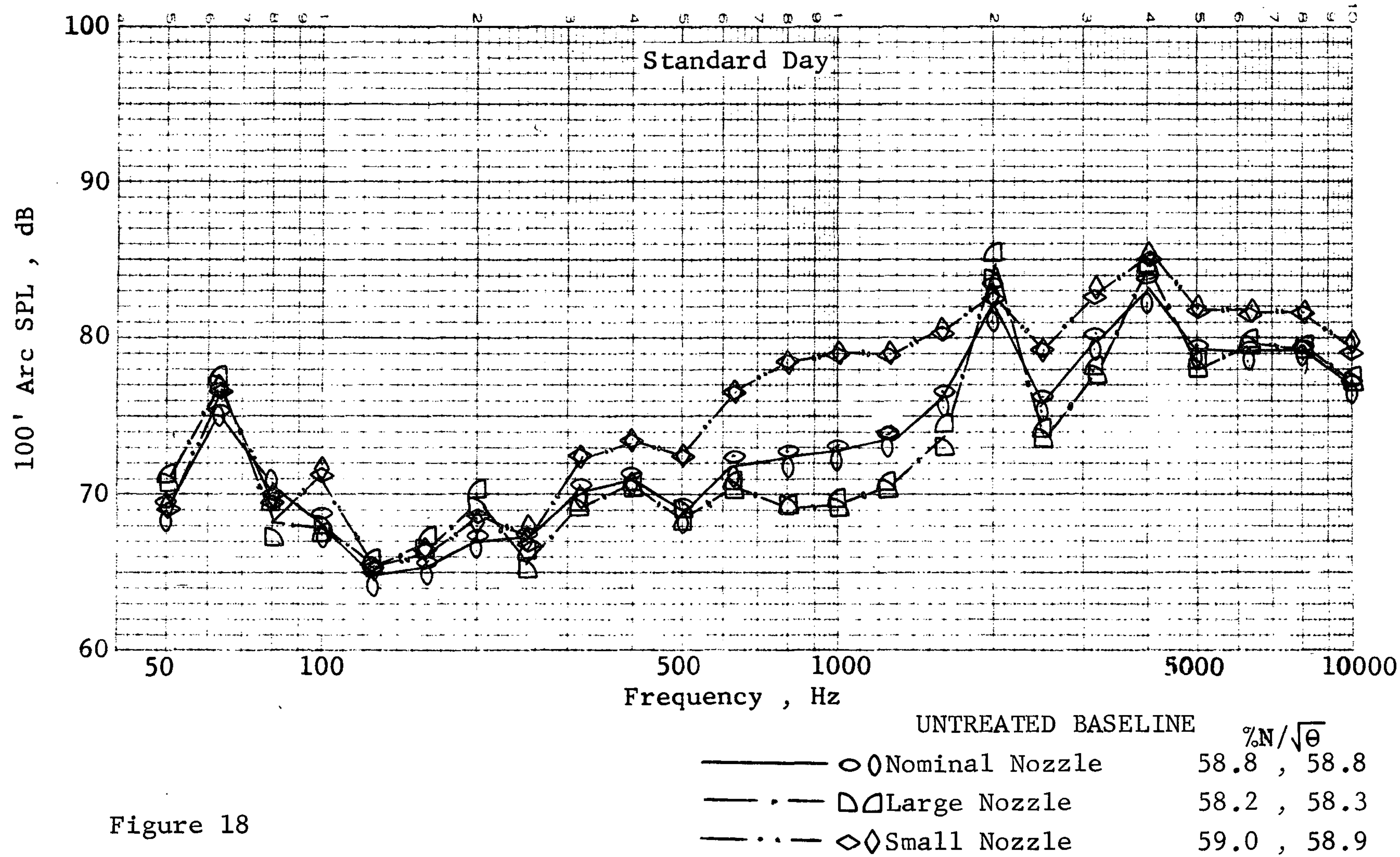


Figure 18

QEP FAN B SCALE MODEL RESULTS
120° AT APPROACH

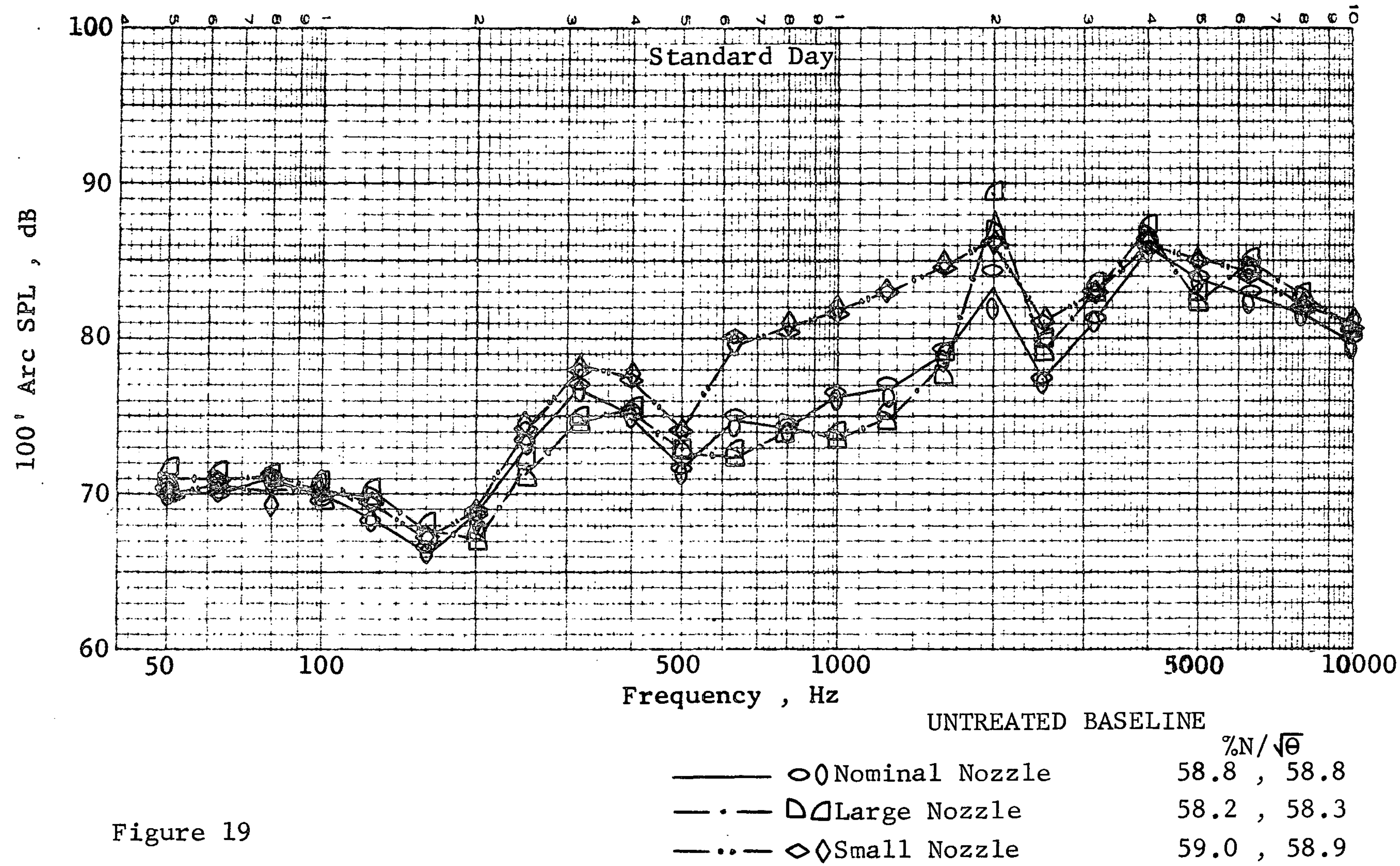


Figure 19

QEP FAN B SCALE MODEL RESULTS

50° AT TAKEOFF

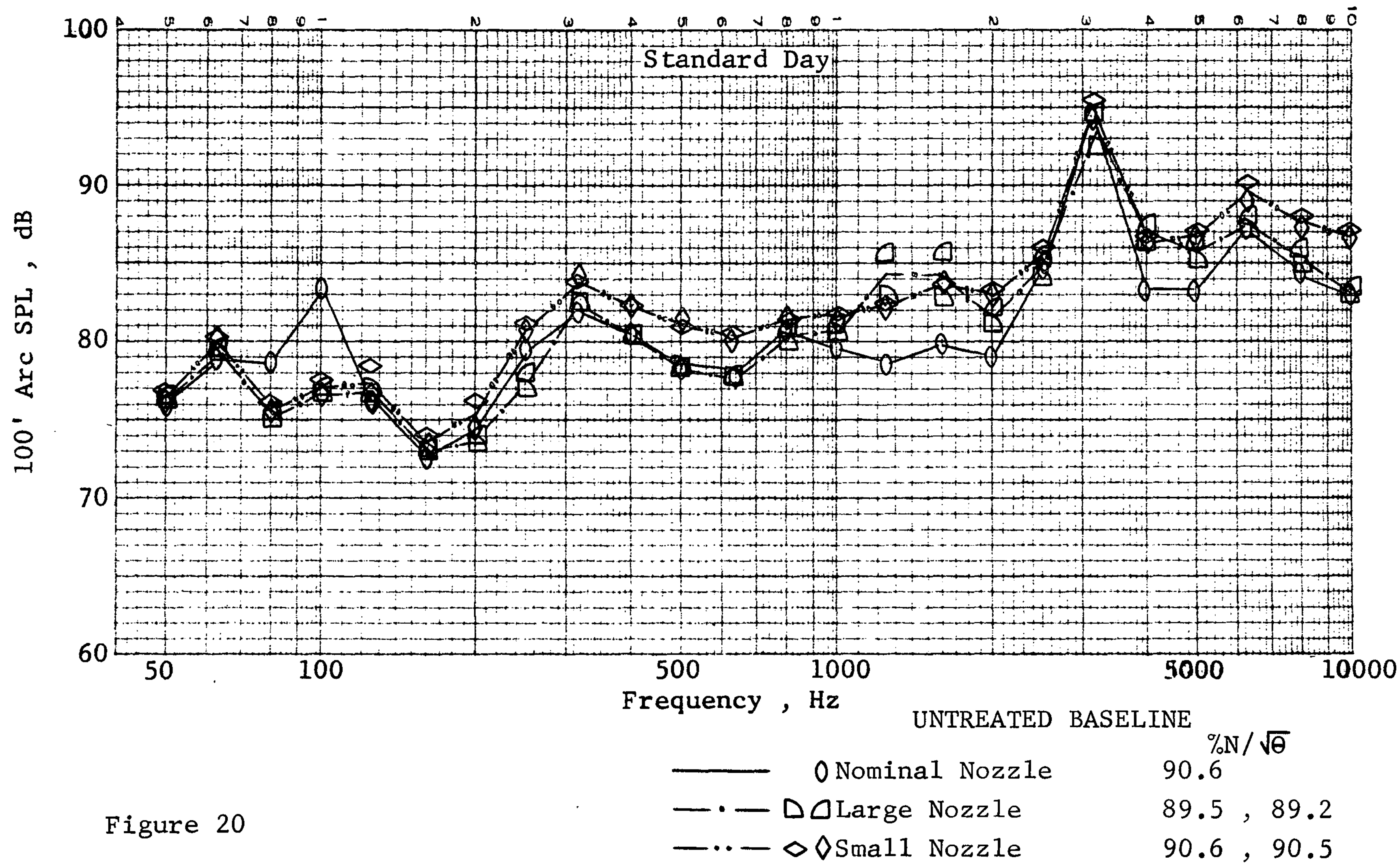


Figure 20

QEP FAN B SCALE MODEL RESULTS

120° AT TAKEOFF

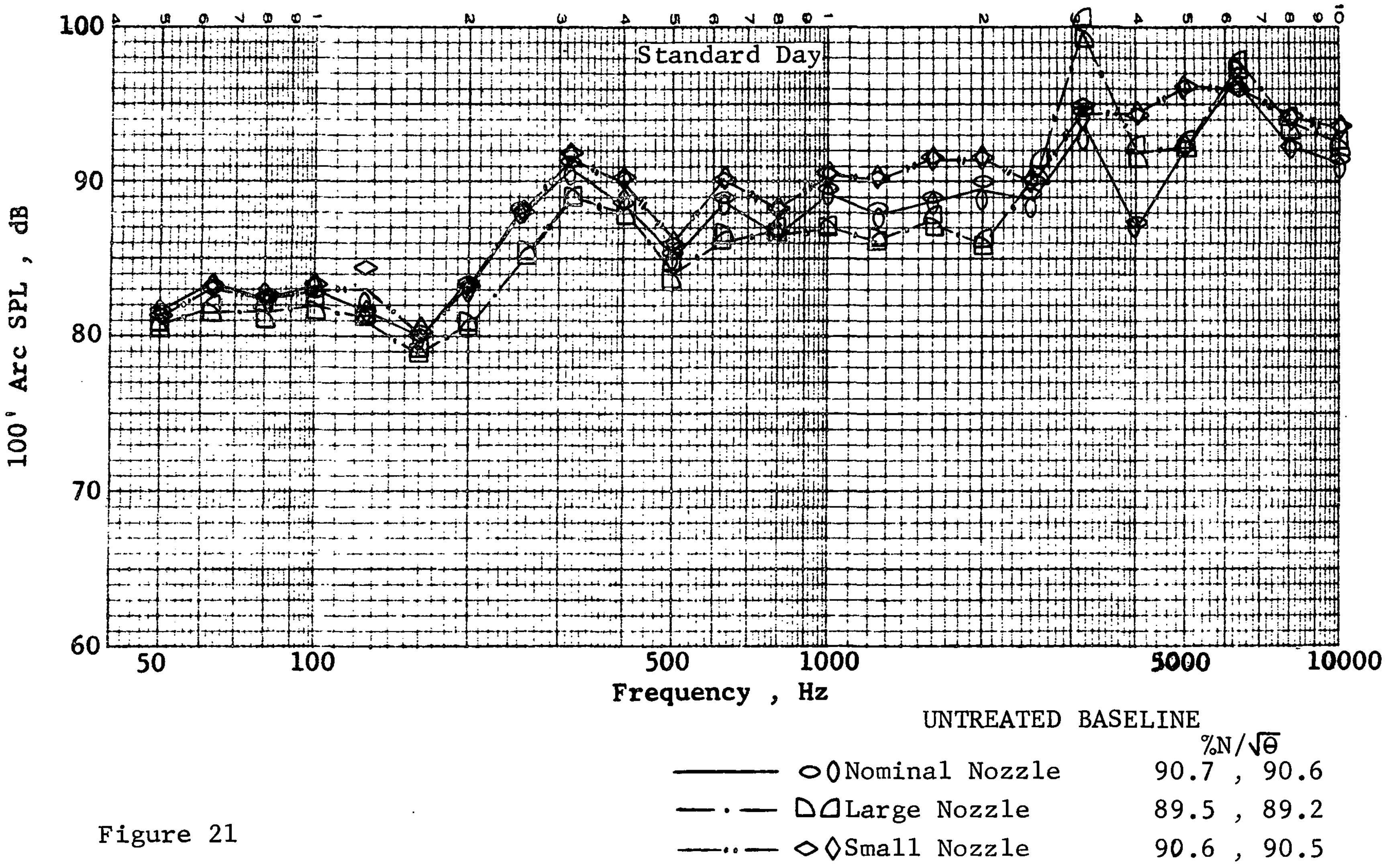


Figure 21

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS AT APPROACH

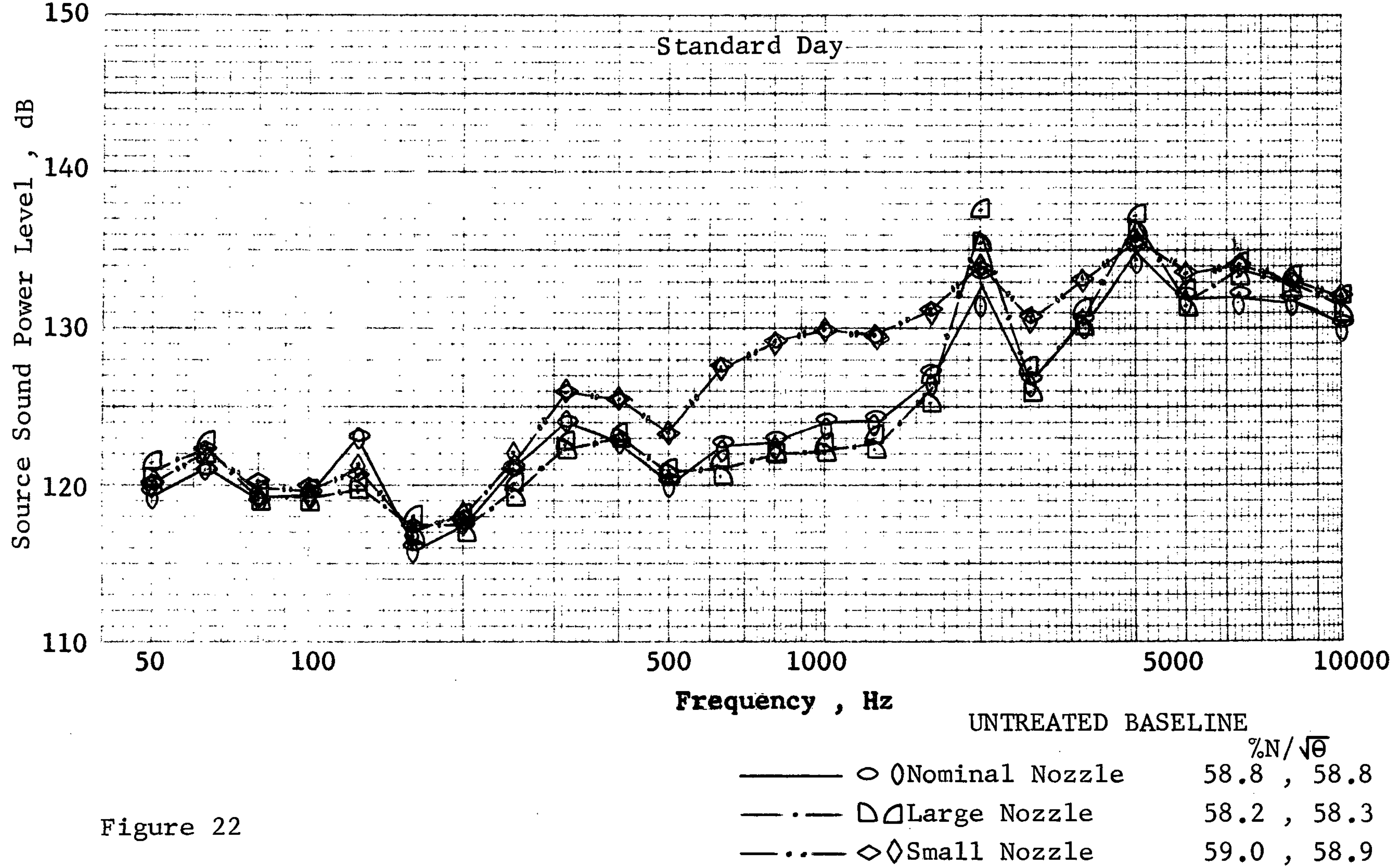


Figure 22

QEP FAN B SCALE MODEL RESULTS

SOUND POWER LEVELS AT TAKEOFF

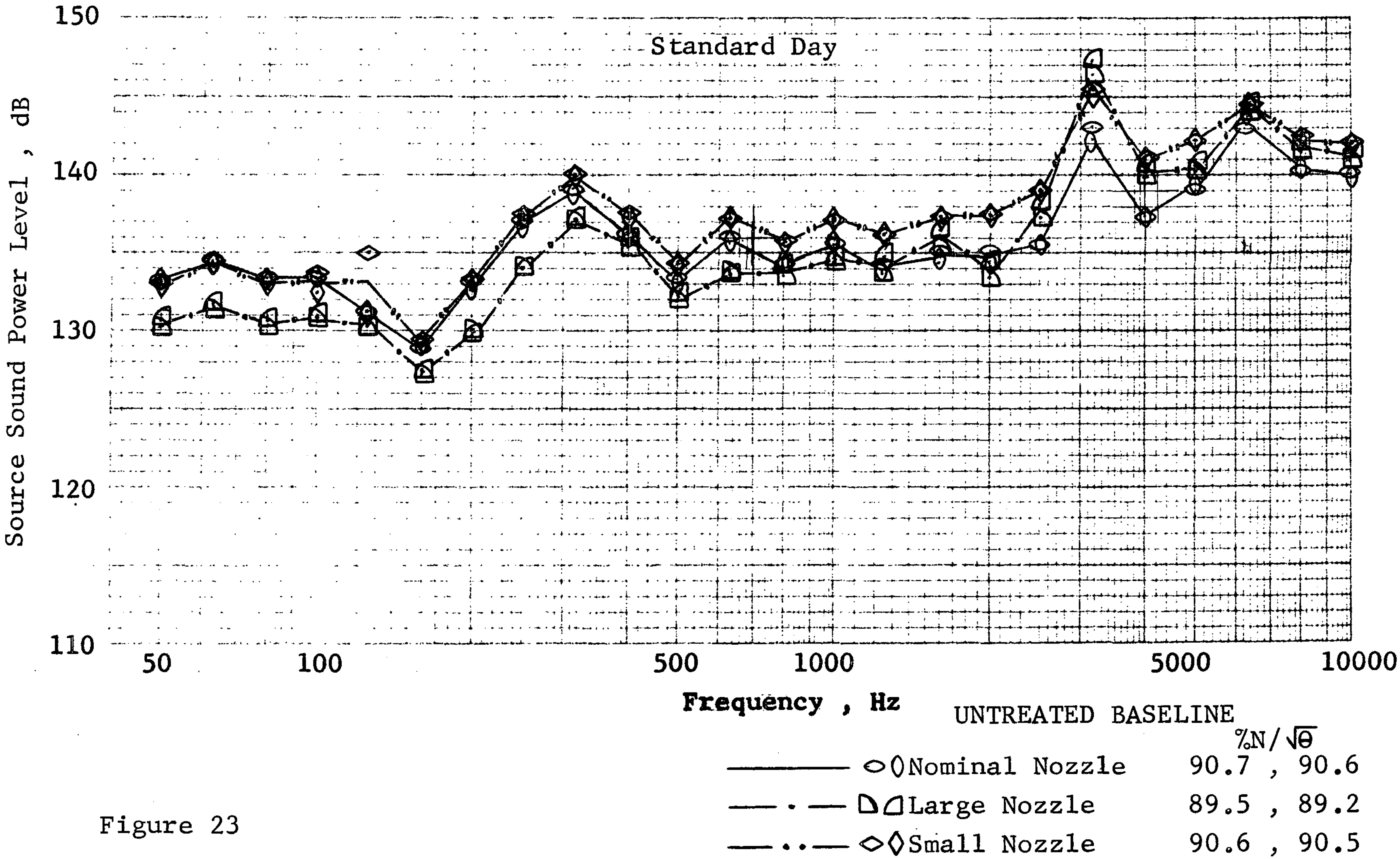


Figure 23

C. ACOUSTIC TREATMENT EFFECTS

Comparisons of the untreated and the treated configurations of the scale model fan with the nominal nozzle are presented in Figures 24 - 33. The acoustic treatment of the frame area is described in the Test Vehicle Description, Section IV. To produce the untreated configuration, this acoustic treatment was neutralized by covering it with tape.

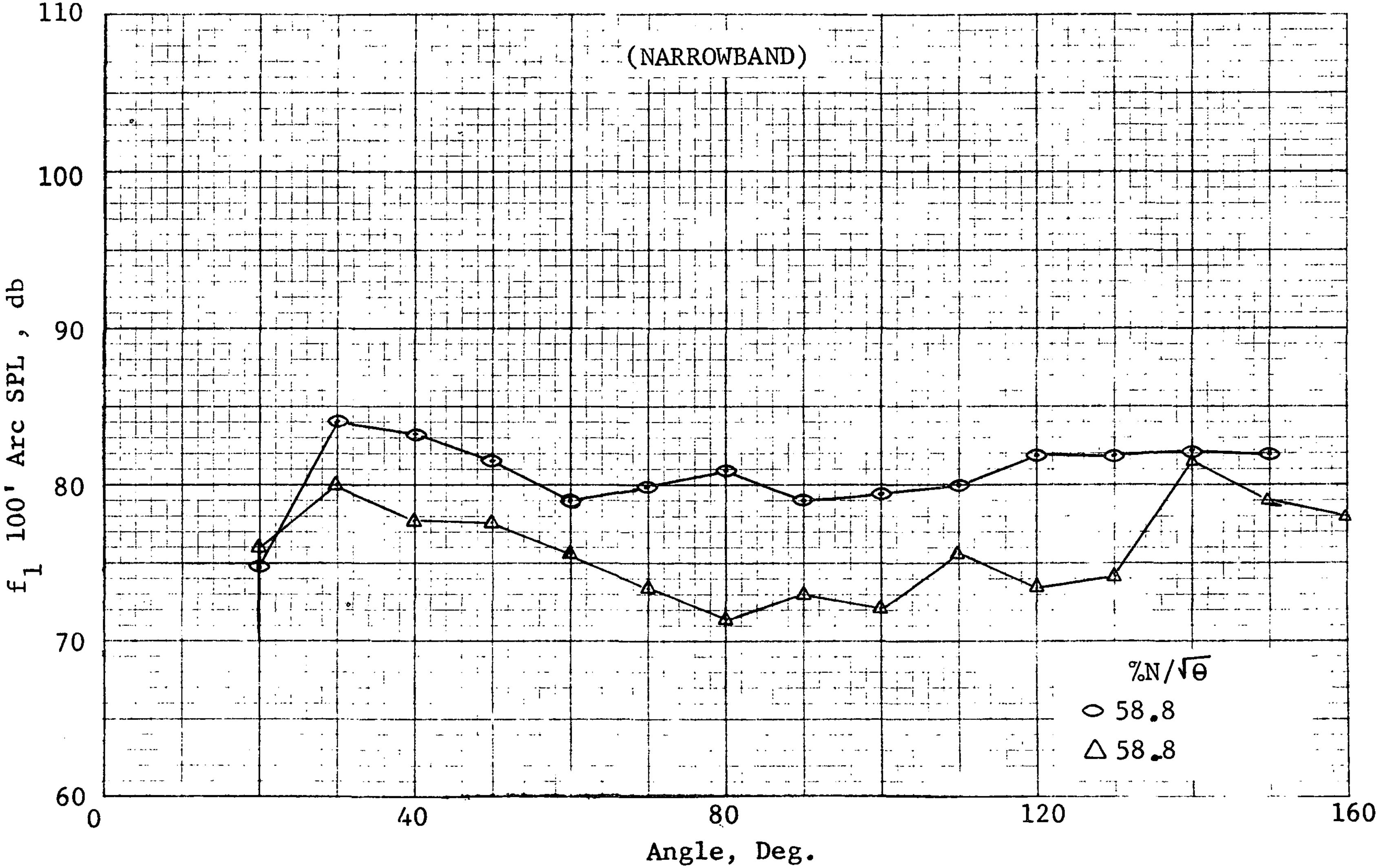
Figures 24 - 27 show the distribution of the fundamental and second harmonic around the 100 foot (30.5 m) arc as derived from narrowband data which have been corrected to Standard Day conditions. At approach thrust, (Figures 24 and 25), both tones have been significantly reduced due to the acoustic treatment - the fundamental by 4.5 dB PWL and the second harmonic by 5.2 dB PWL. The fundamental reduction was noticeable around most of the arc while the second harmonic reduction was most significant in the aft quadrant. At takeoff thrust, the tones also showed a noise decrease in the aft quadrant, however, the fundamental showed a noise increase in the front quadrant. Figure 26 shows a split PWL, computed by segmenting the arc into front quadrant at angles less than 85 degrees and aft quadrant at angles greater than 85 degrees. The front fundamental noise increased by 3.8 dB PWL while the aft decreased 1.9 dB PWL. The total, accordingly, showed an increase with treatment. In the case of the second harmonic, (Figure 27), there was a sizable decrease of 5.8 dB PWL in the aft quadrant but effectively no change in the front.

The one third octave data clearly indicates that not only have the tones been reduced at approach thrust but the broadband noise between the tones has been decreased as well by the acoustic treatment.

At 50° (Figure 28), the greatest reduction occurred in the 2500 Hz and 3150 Hz bands. At 120° (Figure 29), the broadband noise was decreased 5 dB or more from 2 to 10 KHz. The 120° results for takeoff thrust indicate similar broadband noise reductions for the treated configuration as indicated in Figure 31. However, the 1/3 octave data at 50° (Figure 30) indı ates the broadband noise of the two configurations was generally the same across the spectrum except at 1600 Hz where the treated data shows some increase. Upon examination of narrowband data, this increase appears to be attributable to multiple pure tones occurring with the treated configuration. The present hypothesis is that this noise increase is attributed to the increase turbulence generated by the presence of the treatment close to the rotor.

Figure 32 contains the sound power level spectra for the two configurations at approach thrust, showing the noise reduction for the treated fan at the tones and for the broadband noise from 1.6 to 10 KHz. The PWL spectra for takeoff thrust (Figure 33) indicates less noise reduction of broadband noise and the second harmonic tone along with a 2 dB PWL increase at the fundamental tone.

SCALE MODEL FAN B
FUNDAMENTAL AT APPROACH
STANDARD DAY



△ Treated ; PWL=127 dB
○ Untreated ; PWL=131.5 dB
(nominal nozzle)

Figure 24

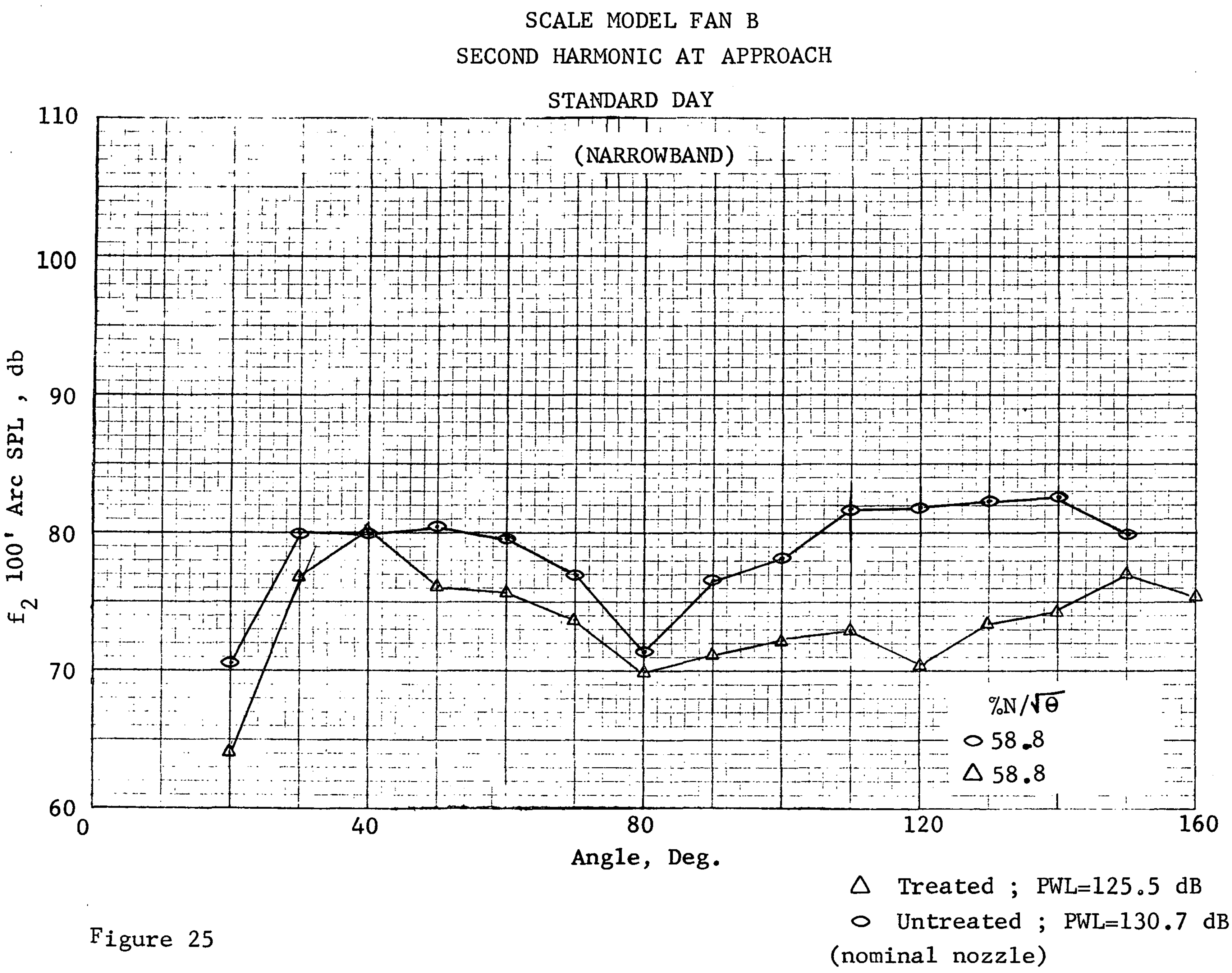

SCALE MODEL FAN B
SECOND HARMONIC AT APPROACH
STANDARD DAY
(NARROWBAND)
110
100
90
80
70
60
0
40
80
120
160
f_2 100' Arc SPL , db
Angle, Deg.
%N/√θ
○ 58.8
△ 58.8
△ Treated ; PWL=125.5 dB
○ Untreated ; PWL=130.7 dB
(nominal nozzle)

Figure 25

SCALE MODEL FAN B
FUNDAMENTAL AT TAKEOFF
STANDARD DAY

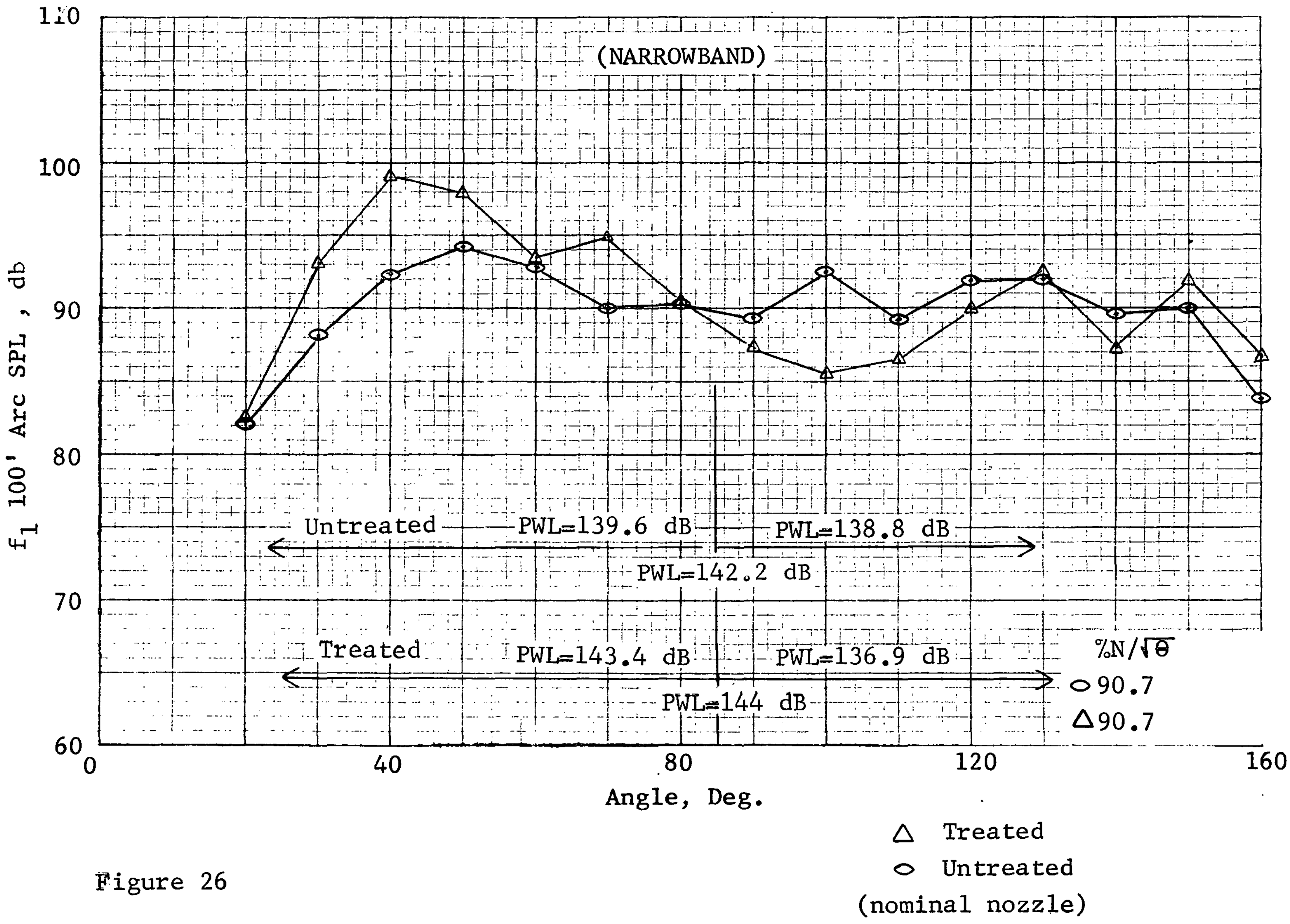


Figure 26

SCALE MODEL FAN B
SECOND HARMONIC AT TAKEOFF

STANDARD DAY

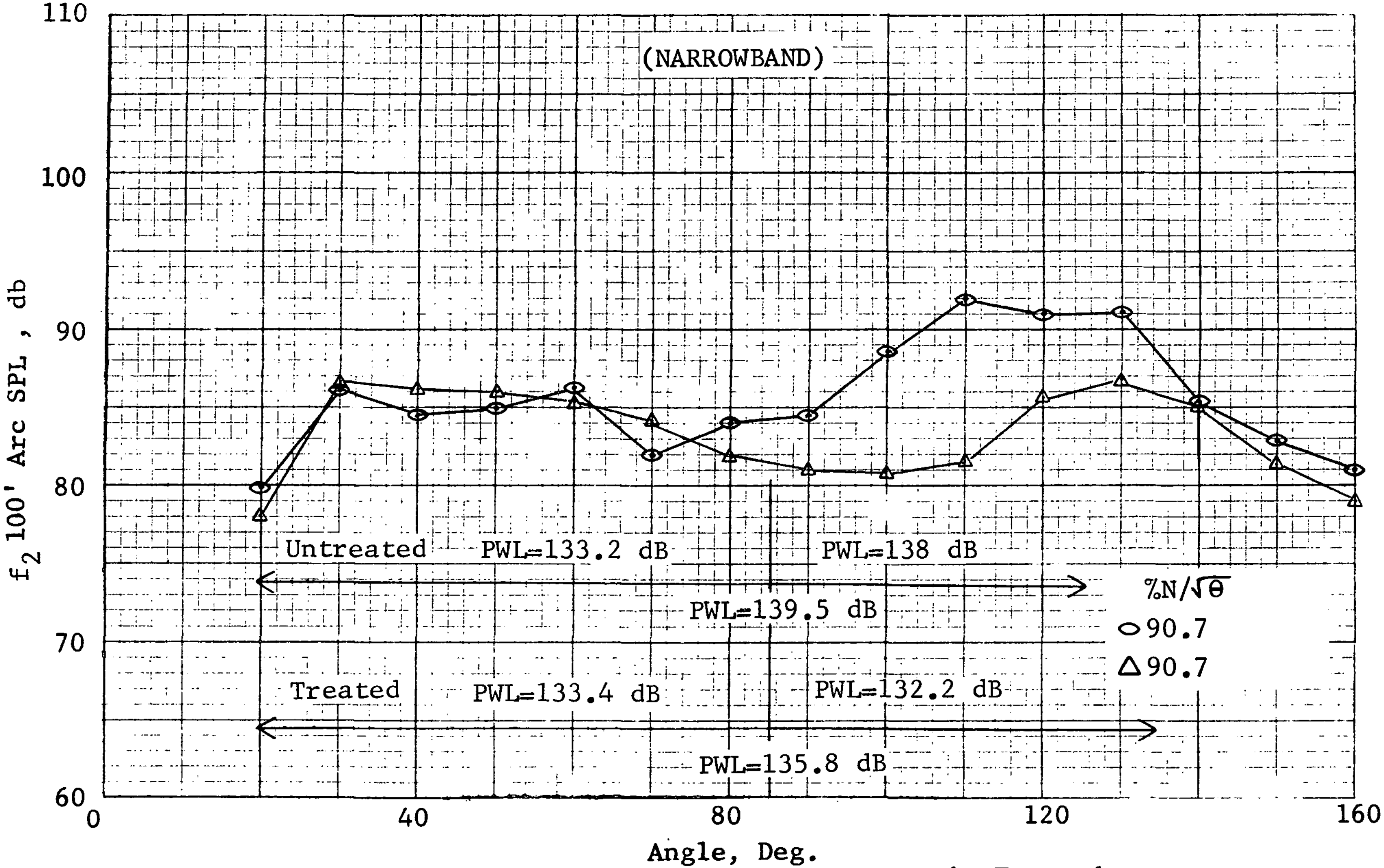


Figure 27

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

TREATED VS UNTREATED

APPROACH

50°

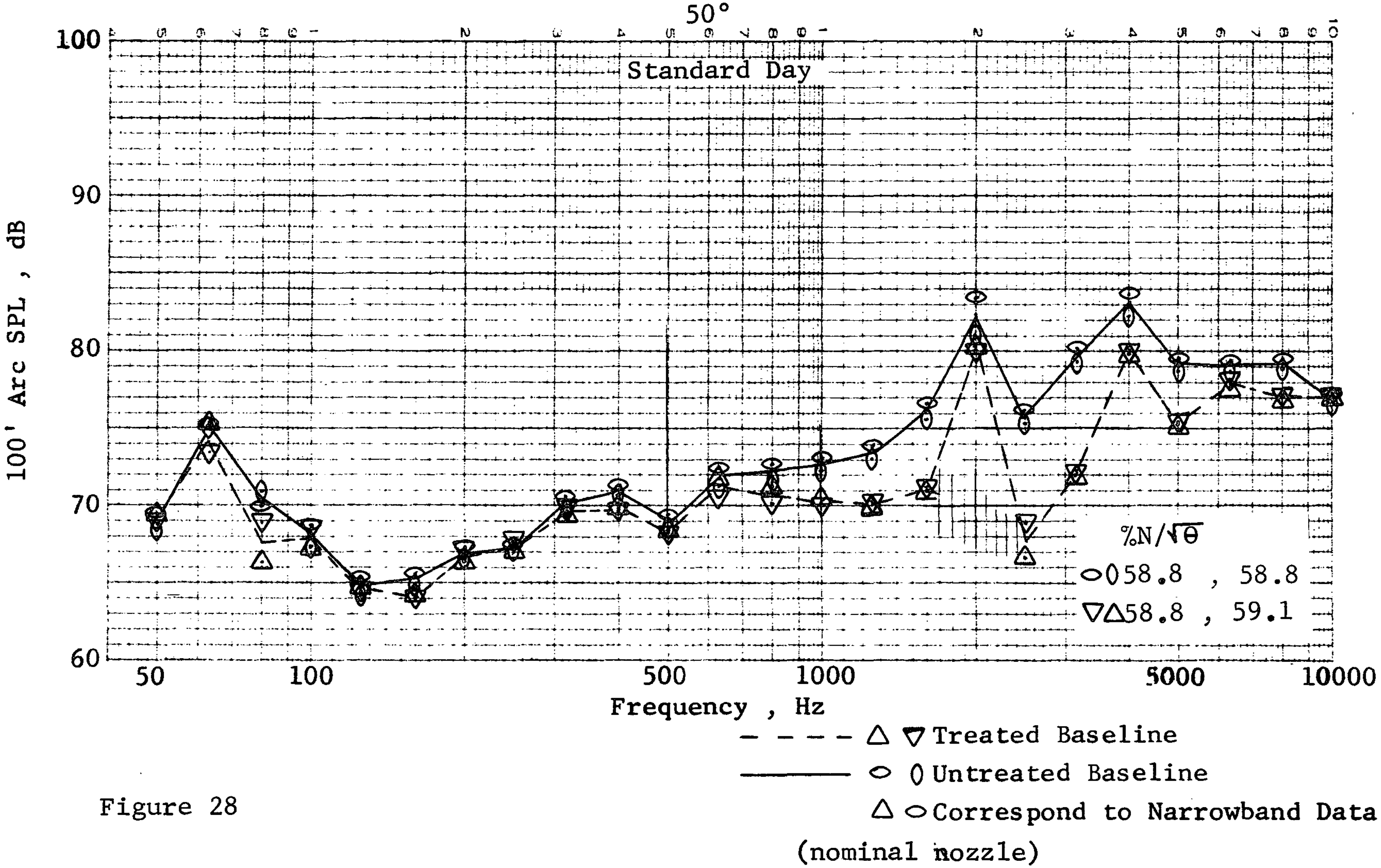


Figure 28

QEP FAN B

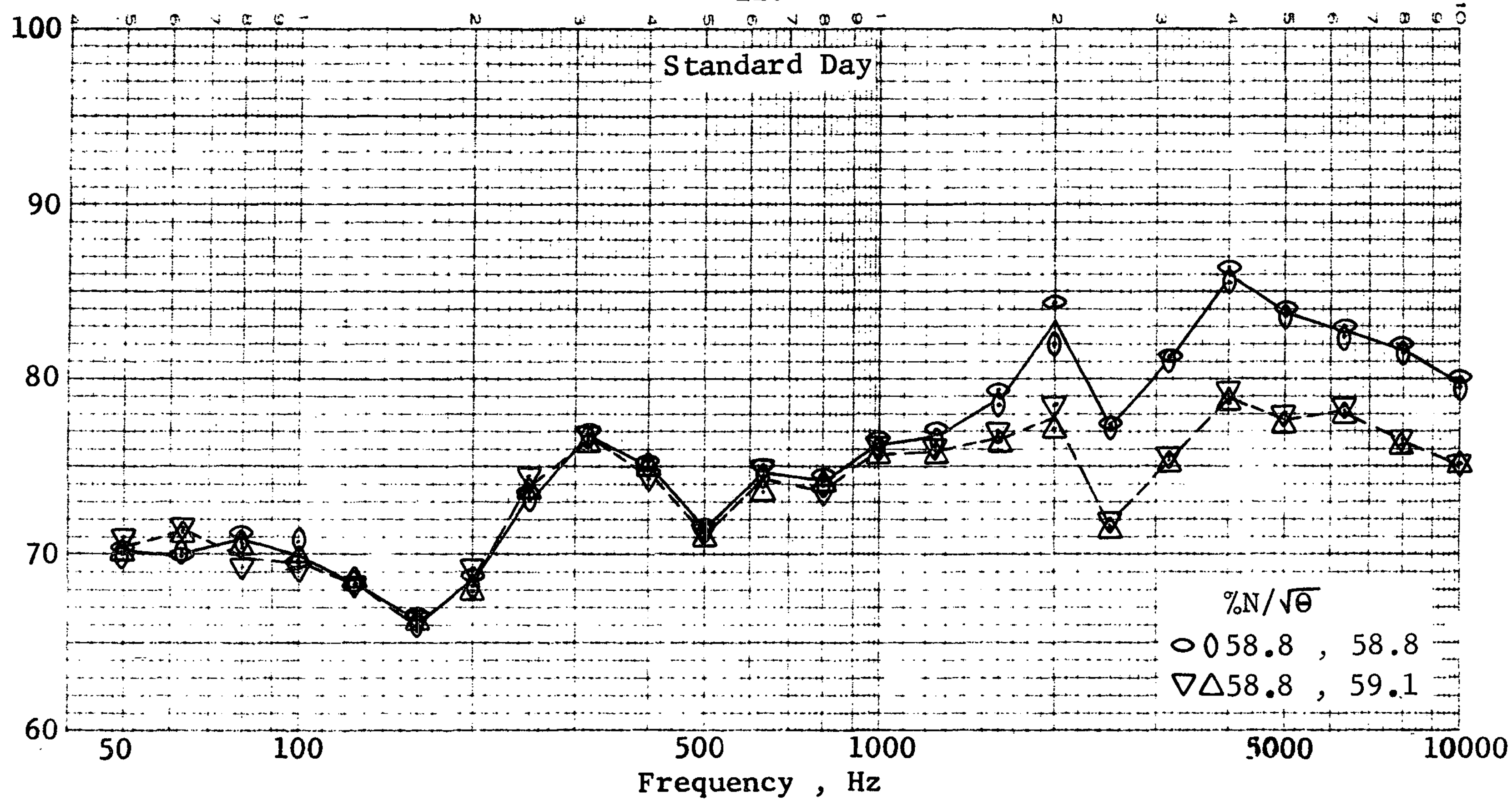
SCALE MODEL RESULTS

100' ARC SPL

TREATED VS UNTREATED

APPROACH

120°



---- △ ▽ Treated Baseline

——— ○ 0 Untreated Baseline

△ ○ Correspond to Narrowband Data (nominal nozzle)

Figure 29

QEP FAN B

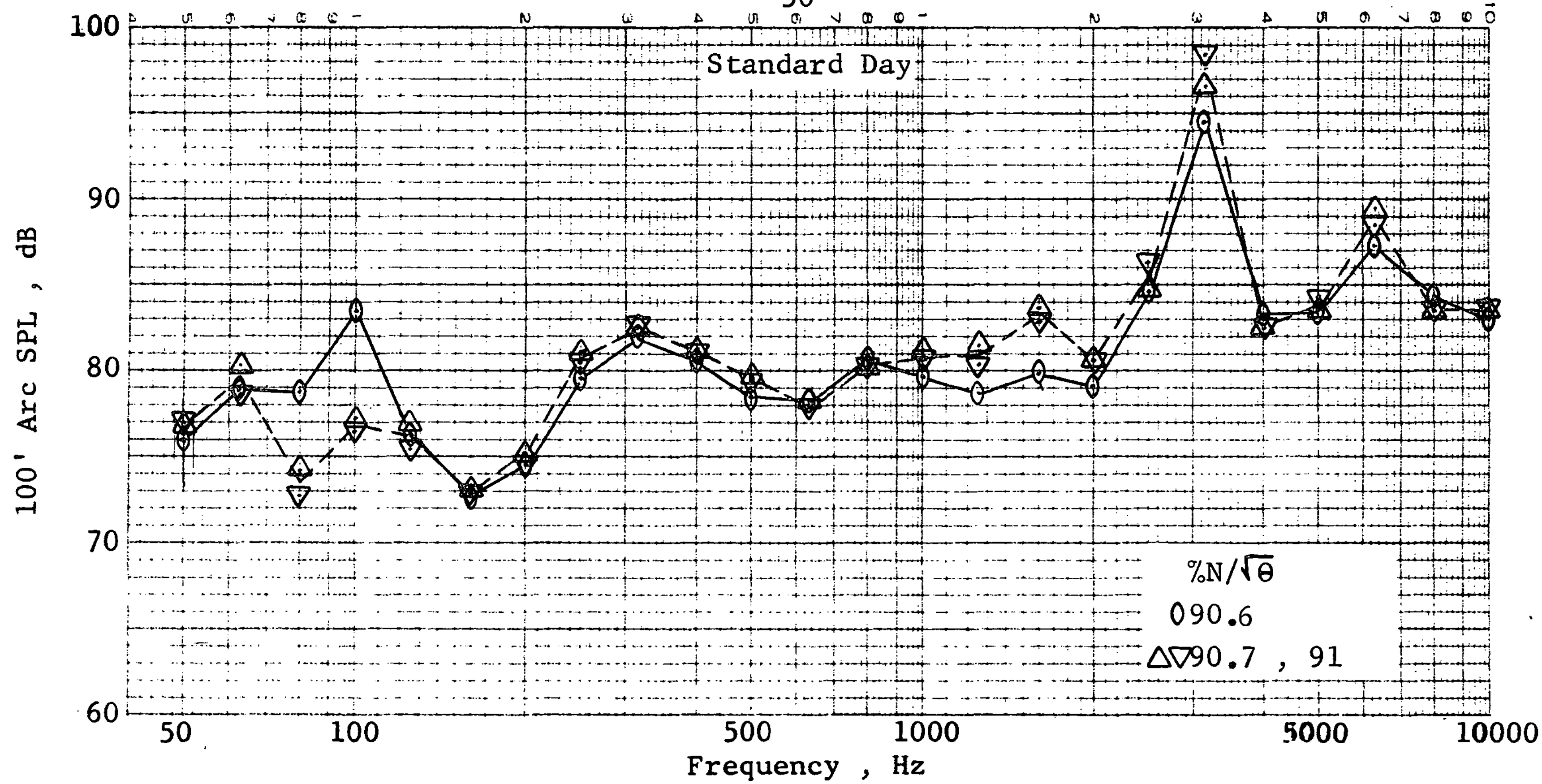
SCALE MODEL RESULTS

100' ARC SPL

TREATED VS UNTREATED

TAKEOFF

50°



- - - △ ▽ Treated Baseline

——— 0 Untreated Baseline

△ 0 Correspond to Narrowband Data (nominal nozzle)

Figure 30

QEP FAN B

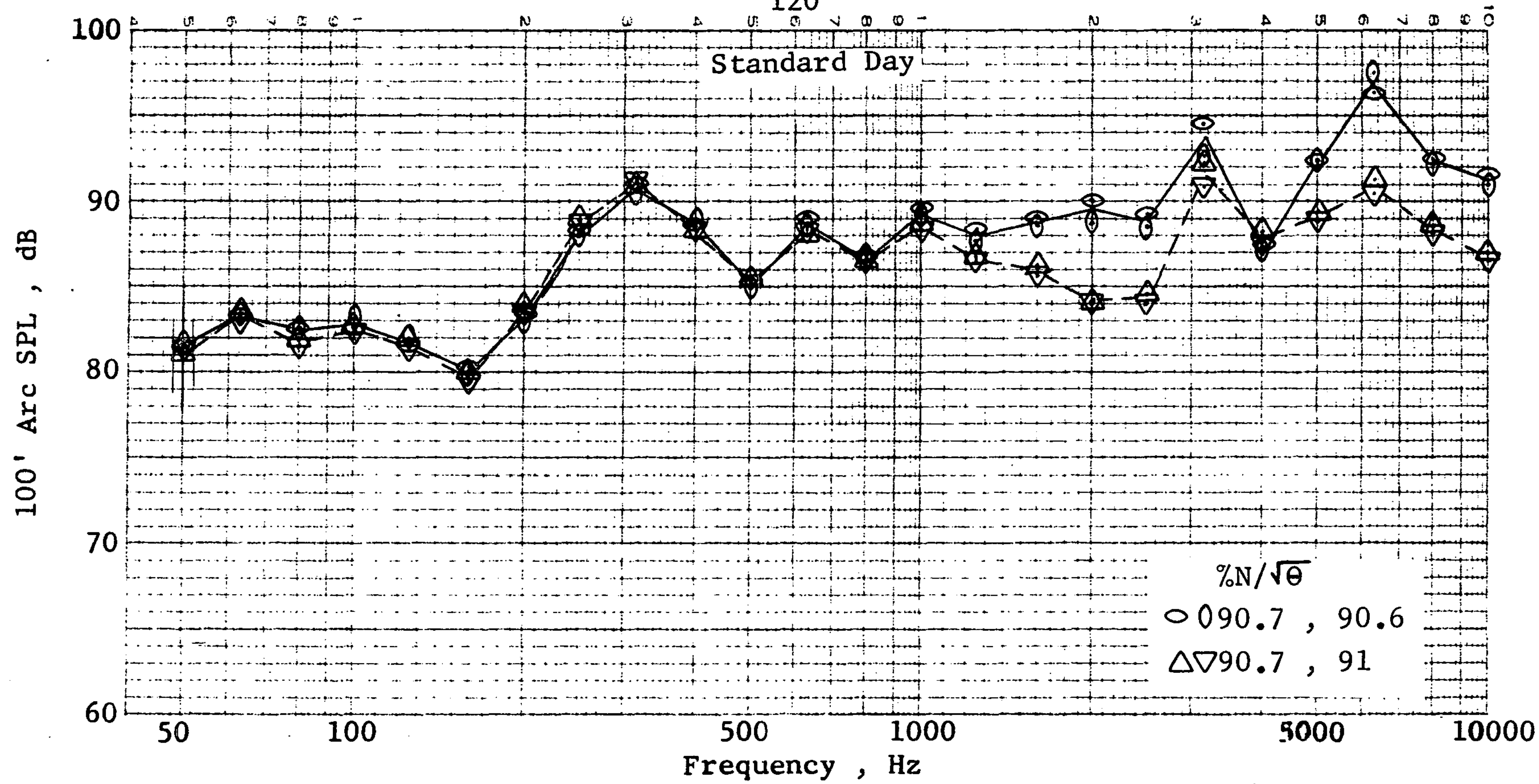
SCALE MODEL RESULTS

100' ARC SPL

TREATED VS UNTREATED

TAKEOFF

120°



— — — △▽ Treated Baseline

——— ○ 0 Untreated Baseline

△ ○ Correspond to Narrowband Data

(nominal nozzle)

Figure 31

QEP FAN B SCALE MODEL RESULTS
SOUND POWER LEVELS AT APPROACH
TREATED VS UNTREATED

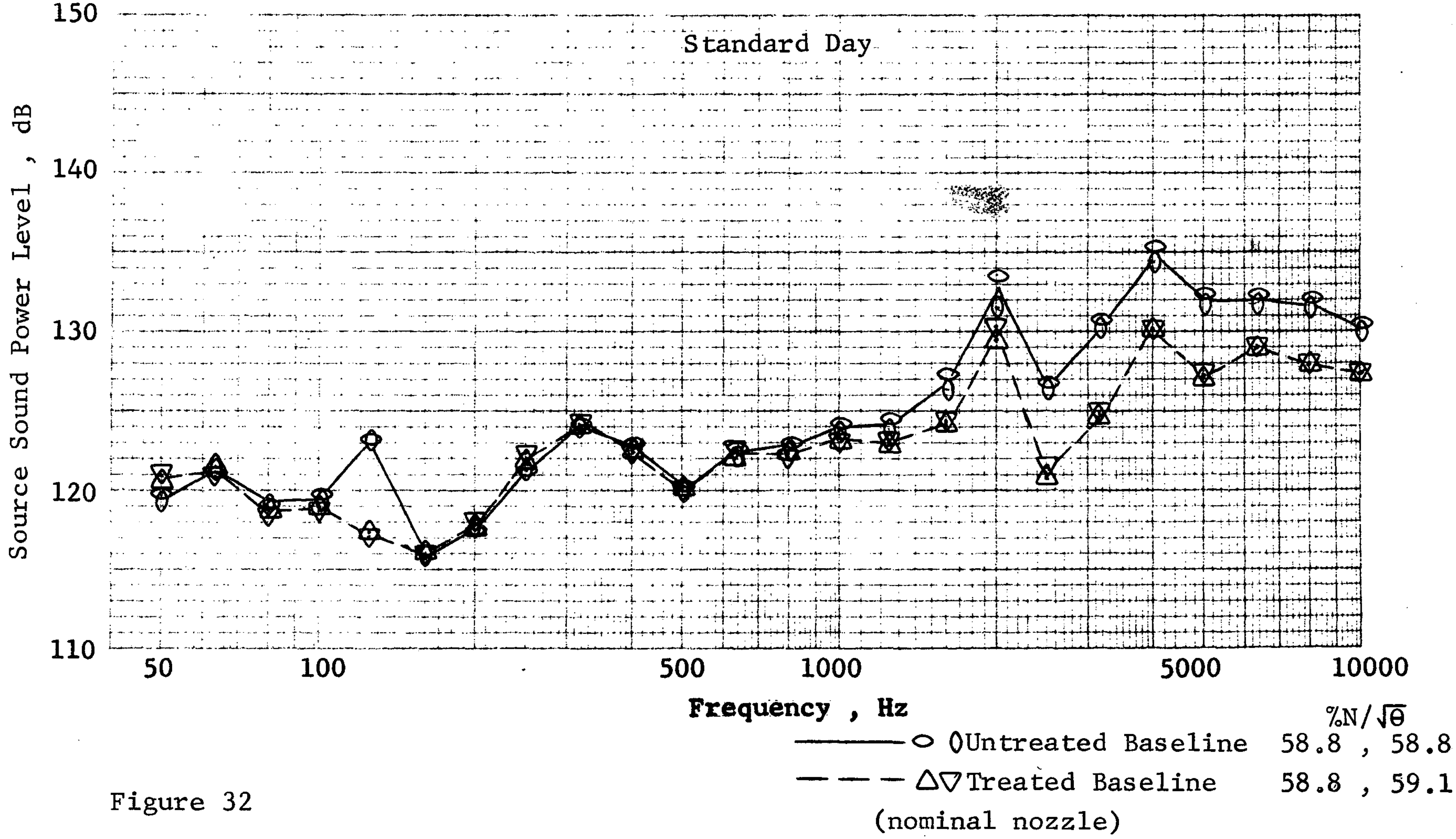


Figure 32

QEP FAN B SCALE MODEL RESULTS

SOUND POWER LEVELS AT TAKEOFF

TREATED VS UNTREATED

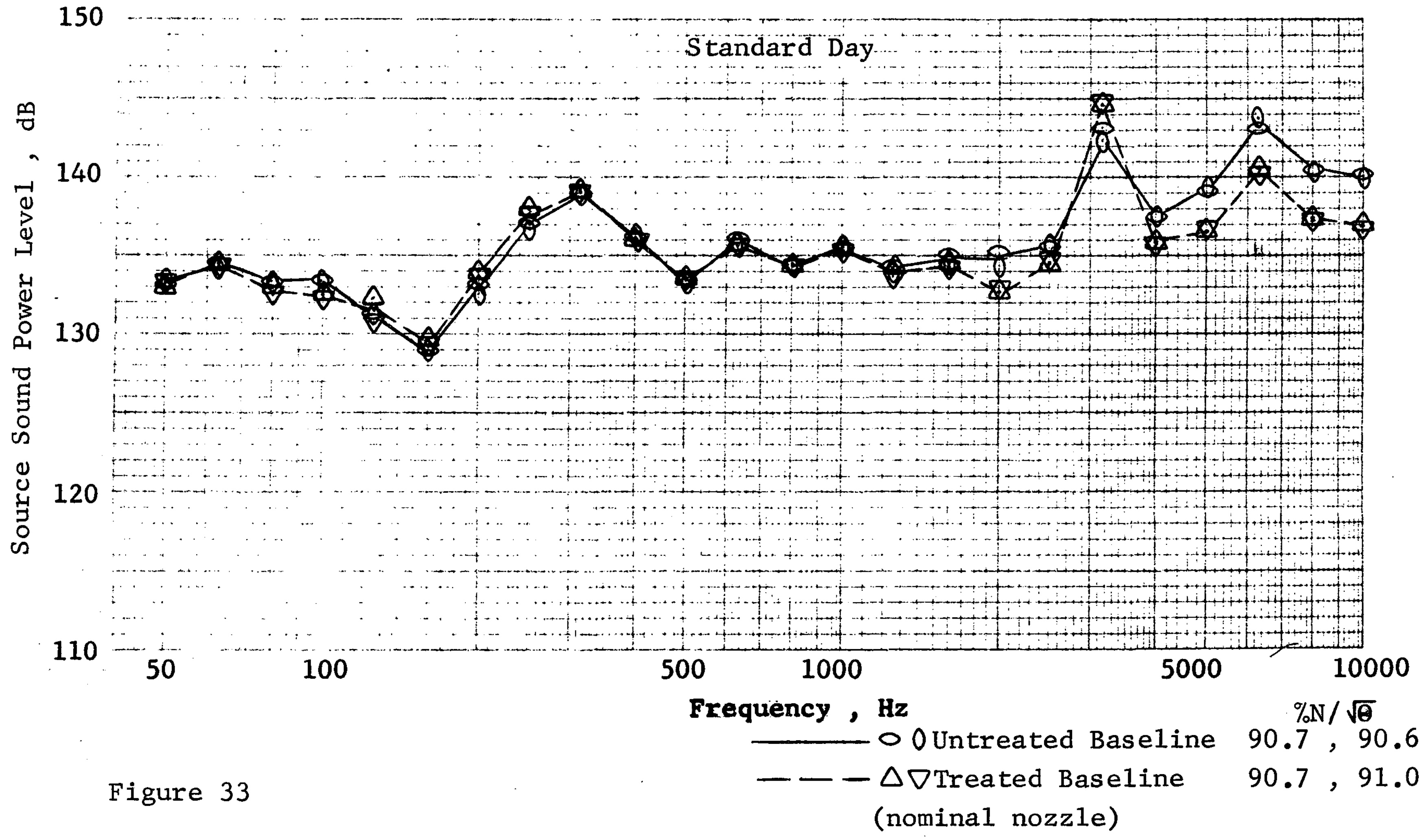


Figure 33

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 (see Section VI-B for details of the scaling procedure). Figures 34 - 39 present 200 foot (61.0 m) sideline perceived noise levels for both the treated and untreated configurations at approach and takeoff thrust levels for each of the three fan nozzle sizes tested. There was a definite noise reduction around the arc for all three nozzles at approach thrust due to the acoustic treatment, with noticeably greater reduction occurring in the rear quadrant. At takeoff thrust, the noise reduction was less in the aft quadrant for the three nozzles while no reduction occurred in the front quadrant for the large and small nozzle sizes. The treated fan with nominal nozzle resulted in a 3 dB increase in 200 foot (61.0 m) sideline PNL at 40^{o}.

In all cases, the fan noise was aft noise dominant with the aft peak being more pronounced for the untreated case at high speed. It is also observed that the fan frame acoustic treatment as it was designed was more effective in the rear quadrant.

Figures 40 - 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. There has been a noise reduction over the entire speed range for each of the three nozzles.

It is interesting to note the dip in the results from the unsuppressed fan with the nominal nozzle at about 85% corrected speed. This, in part, may account for the less than expected suppression results at takeoff thrust. The suppressed perceived noise level increased smoothly with increasing speed so that at 85% corrected speed, where the unsuppressed results decreased, the delta between the two configurations was reduced. Whereas with the large nozzle, the reduction due to the treatment was consistent over the entire speed line. Although a slight fall off was noticeable around 79% fan speed, it was not as severe as with the nominal nozzle. Likewise, the suppression varied smoothly with speed with the small nozzle, the amount of suppression gradually decreasing with increasing speed.

Another data presentation which provides more insight into the thrust maximum PNL situation is an iso-noise map. Figure 43 presents this information for the untreated case. Lines of constant maximum PNL, fan speed, and 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.

At 80% thrust, the large nozzle produces the lowest noise. Traversing the line of constant thrust, it can be seen that the noise decreases from more than 117 PNdB with the small nozzle to less than 115 PNdB with the large nozzle. However, the important approach and takeoff thrust levels do not show this trend.

The iso-noise map, Figure 44, shows basically the same result as in the untreated case. At approach static thrust, the constant thrust, speed and PNL lines are for all practical purposes parallel. At takeoff thrust, movement off the nominal nozzle increases noise. Thus, nozzle variations do not provide a means of noise reduction at these critical points.

Figure 45 shows the PNL for a level flyover of a single uninstalled fan at 370 feet (112.8 m) with a flight speed of 279 feet per second (85.0 m/sec), flight Mach number .25.

The PNL directivity shows a maximum angle noise reduction of 4.3 PNdB. Also included in Figure 45 are the maximum PNL predictions made before testing began. The suppressed level is very close to that measured while the unsuppressed level differs by about 1.7 PNdB. The suppression effectiveness was less than expected being 4.3 PNdB as opposed to a predicted level of 5.6 PNdB.

Figure 46 presents the PNL for a 1000 foot (304.8 m) level flyover of a single uninstalled fan at Mach number 0.25. At this condition, a noise increase is noted in the front, but peak PNL has been reduced 3.8 PNdB. The unsuppressed prediction is very close to that measured. However, the power suppression resulted in a 3.5 PNdB difference in the suppressed maximum.

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

TREATED VS UNTREATED

APPROACH - SINGLE FAN

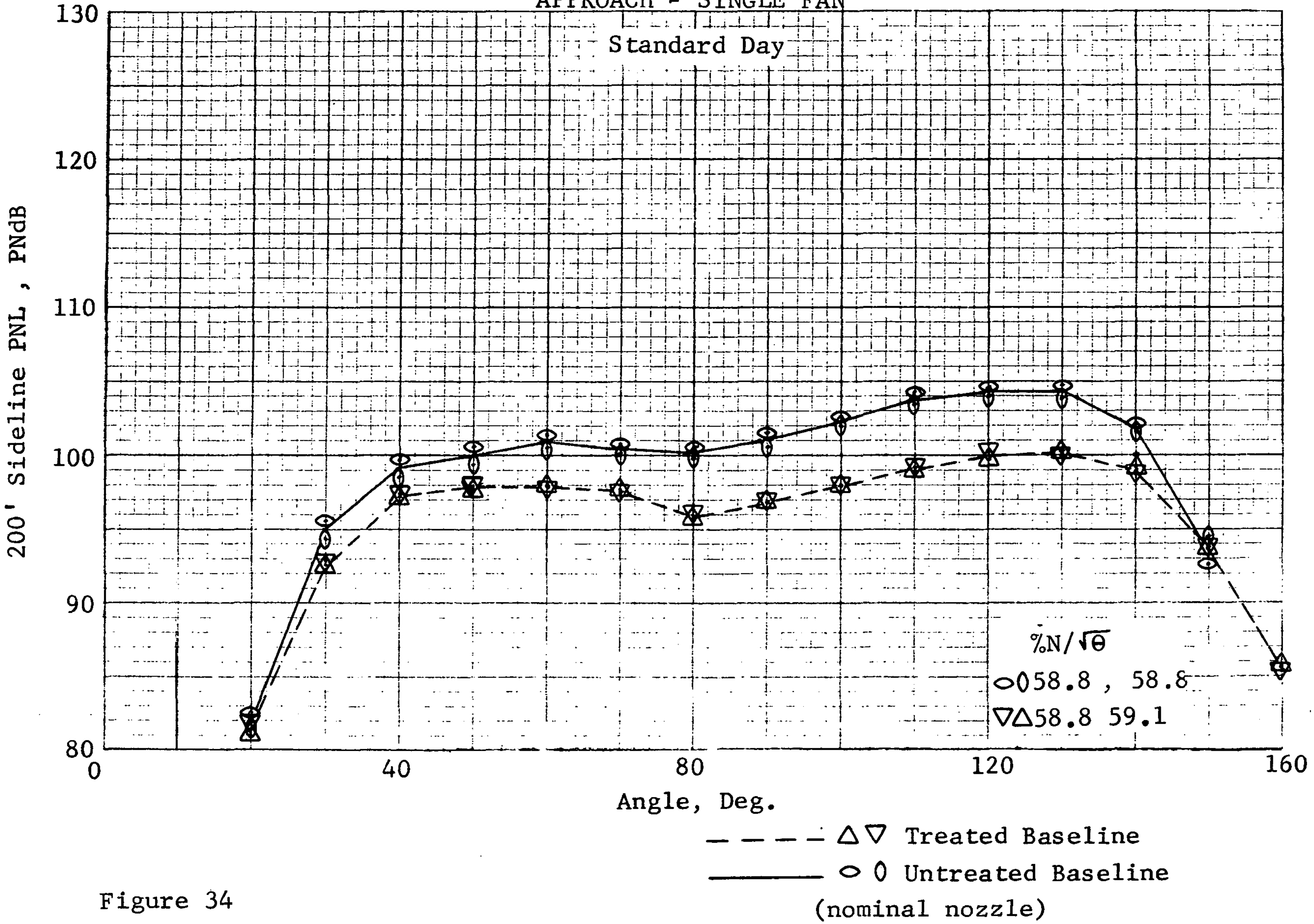


Figure 34

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

TREATED VS UNTREATED

TAKEOFF - SINGLE FAN

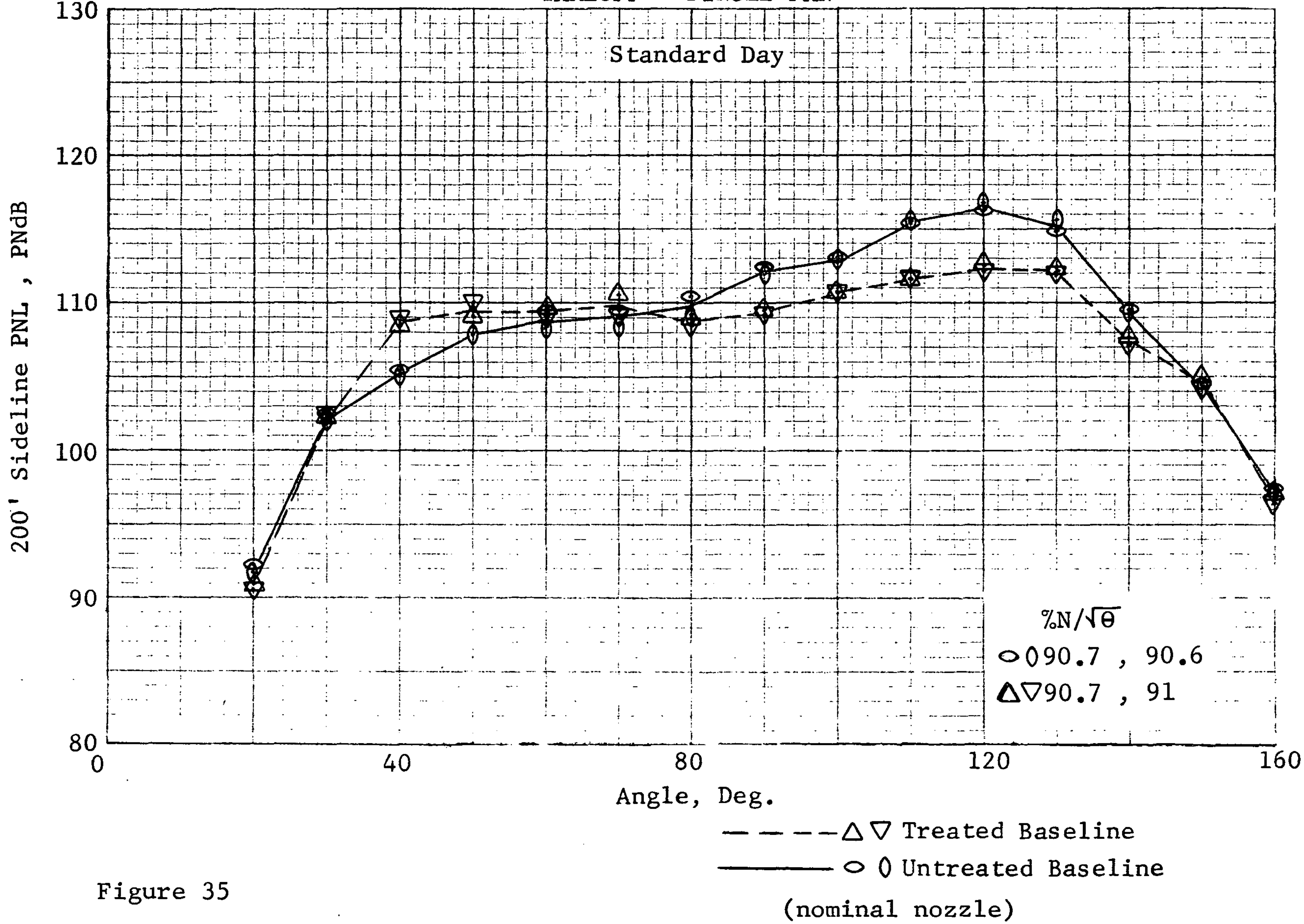


Figure 35

QEP FAN E

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

TREATED VS UNTREATED

APPROACH - SINGLE FAN

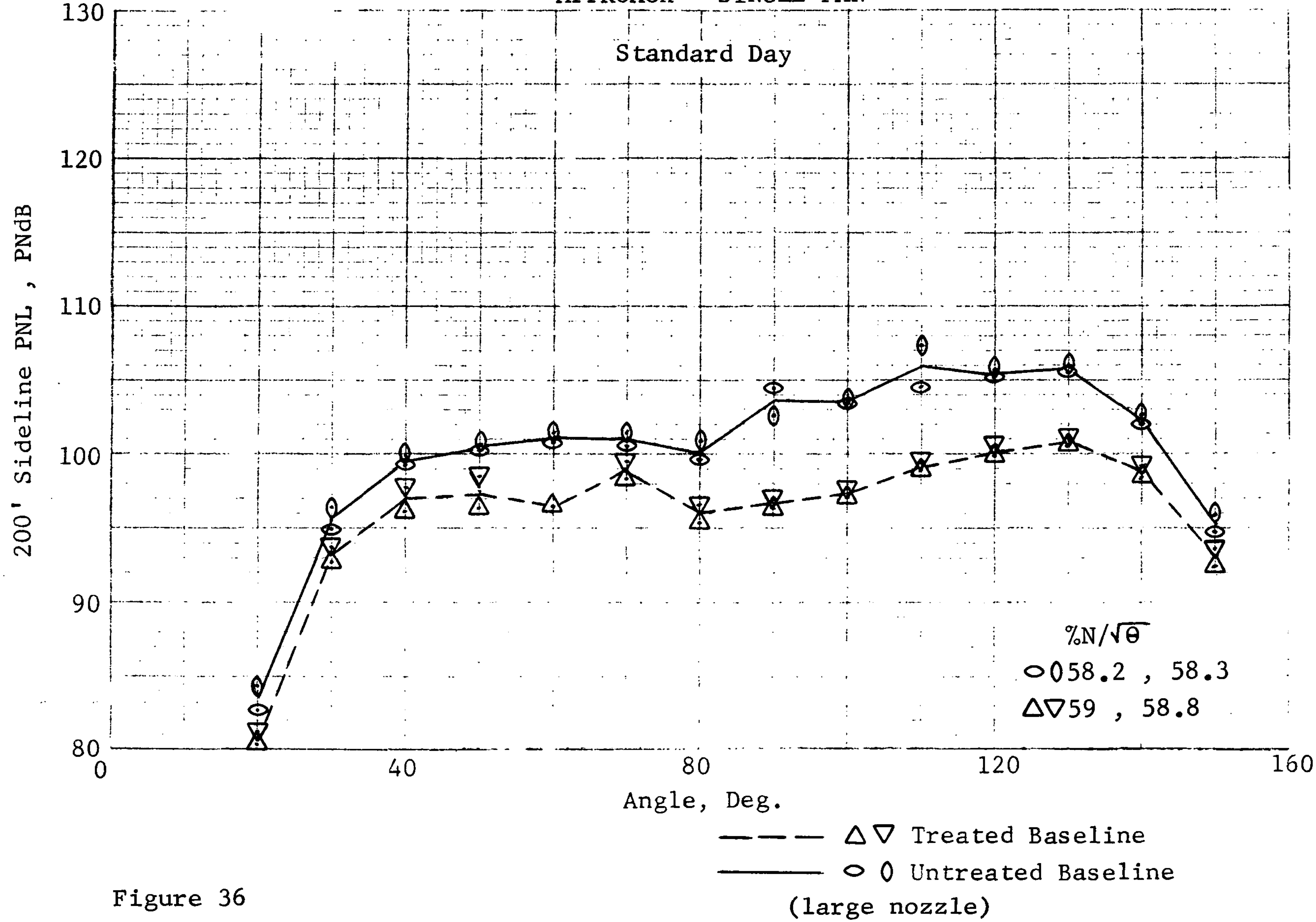


Figure 36

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

TREATED VS UNTREATED

TAKEOFF - SINGLE FAN

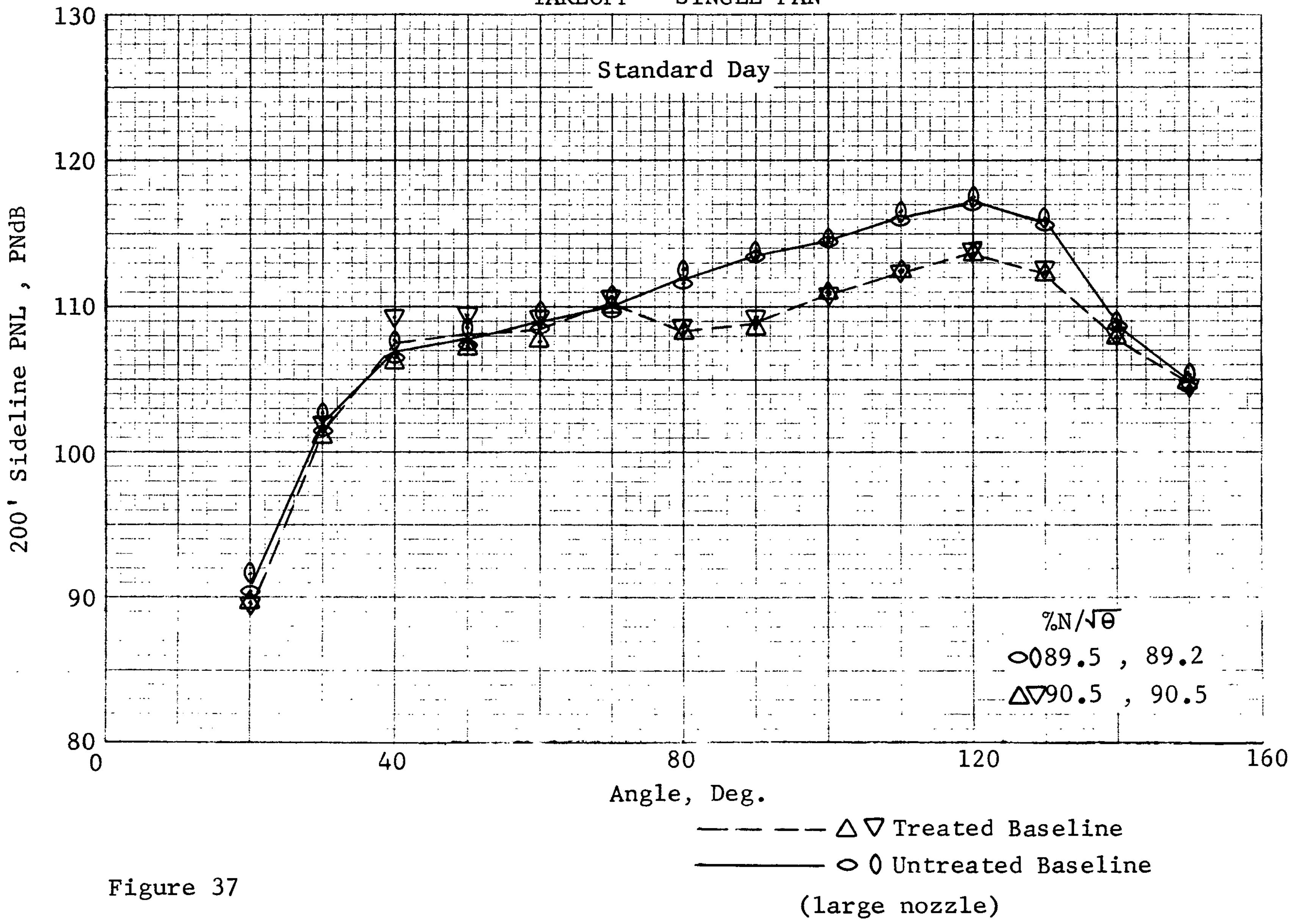


Figure 37

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

TREATED VS UNTREATED

APPROACH - SINGLE FAN

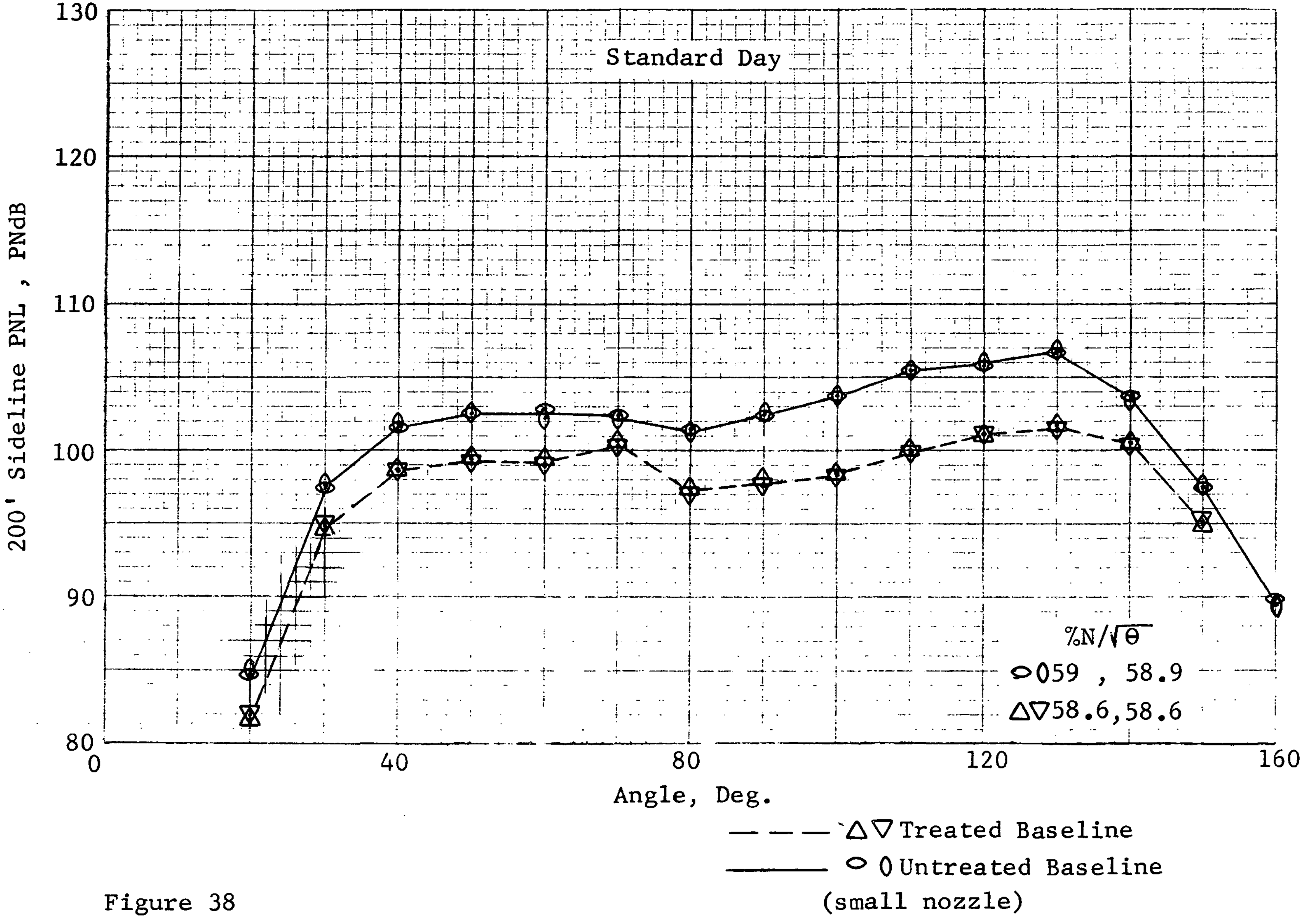


Figure 38

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE PNL

TREATED VS UNTREATED

TAKEOFF - SINGLE FAN

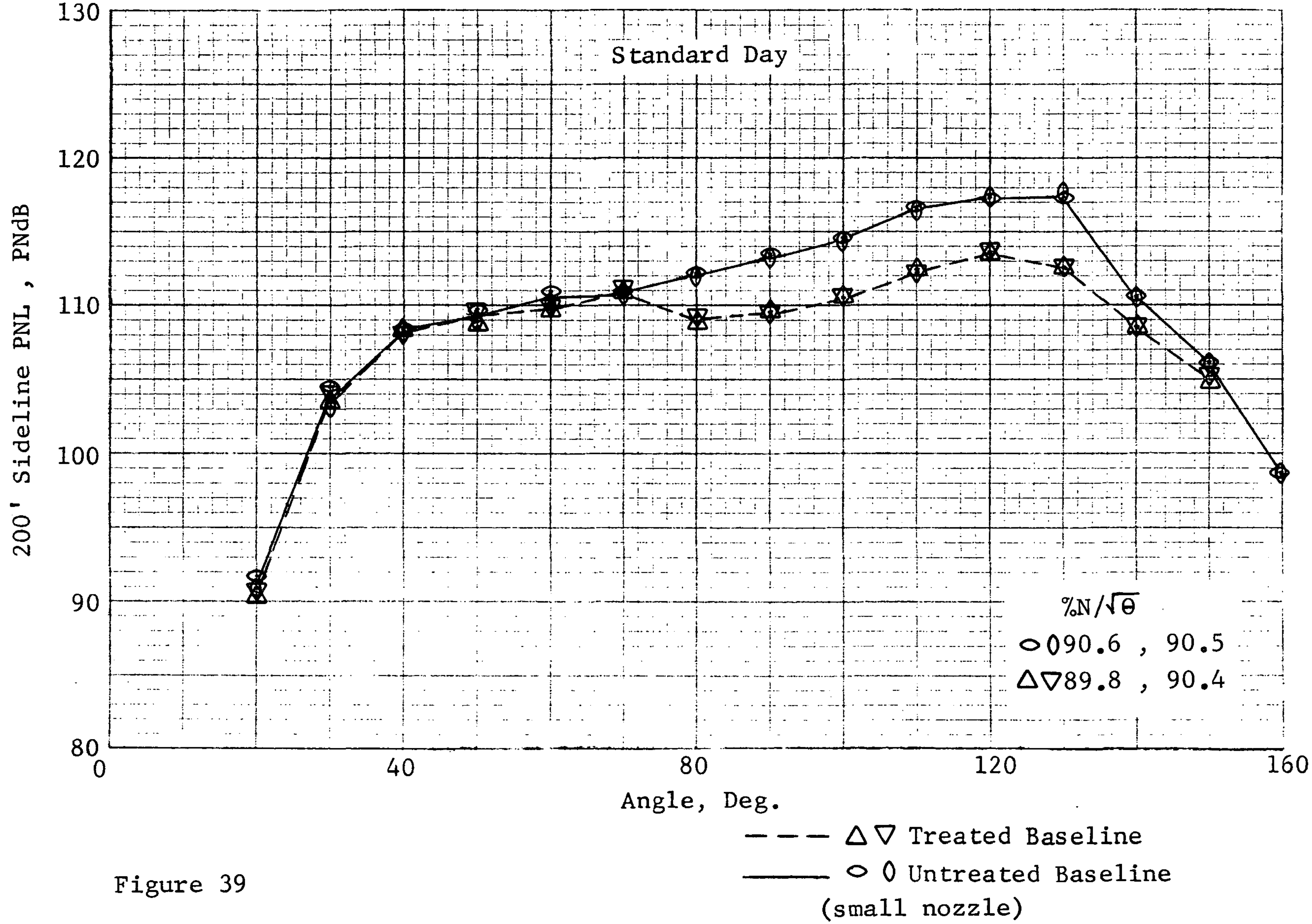


Figure 39

QEP FAN B

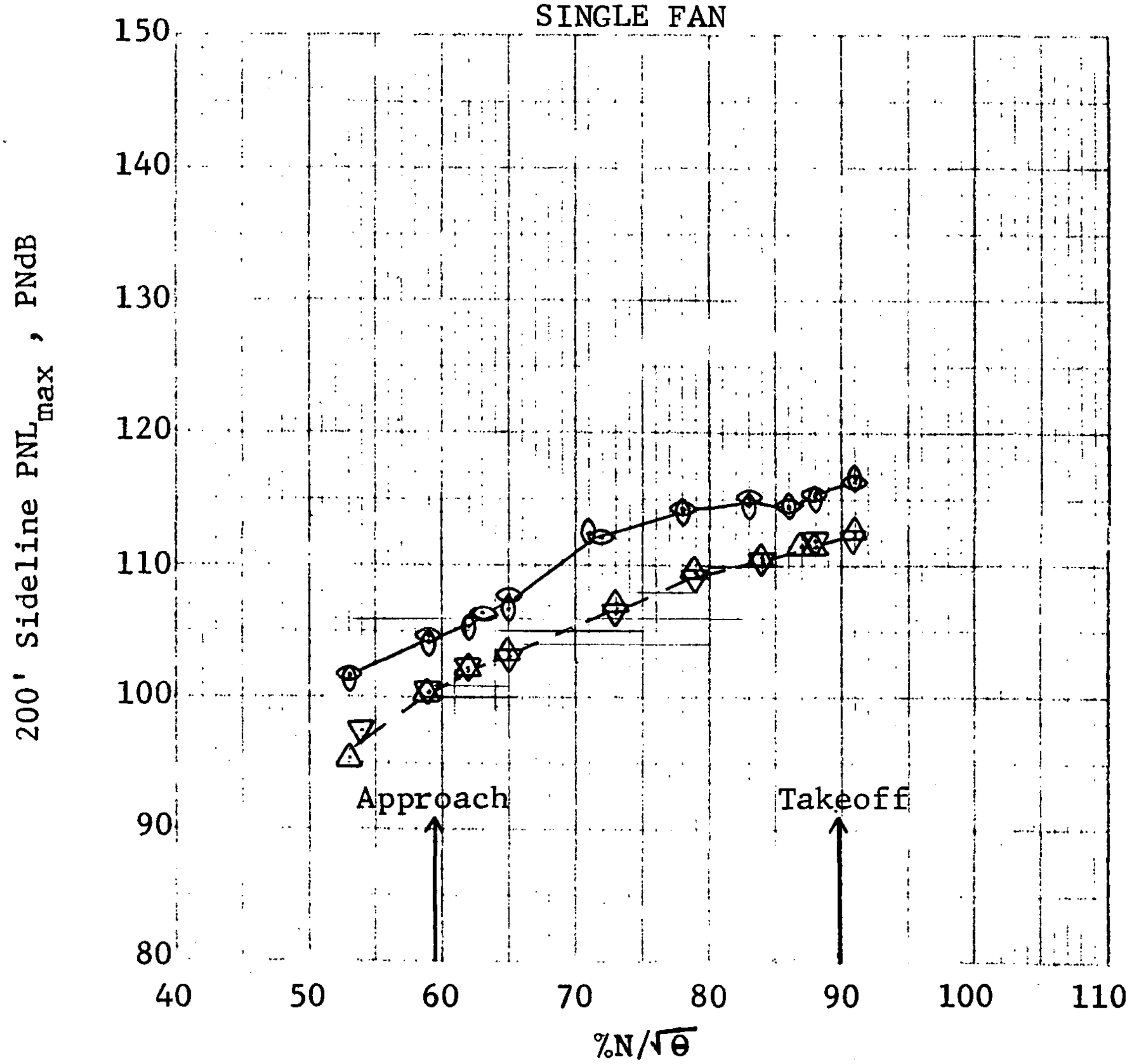
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE MAX PNL

TREATED VS UNTREATED

STANDARD DAY

SINGLE FAN



100%=3625 rpm

– – – △▽Treated

——— ⬭ ()Untreated

(nominal nozzle)

Figure 40

QEP FAN B

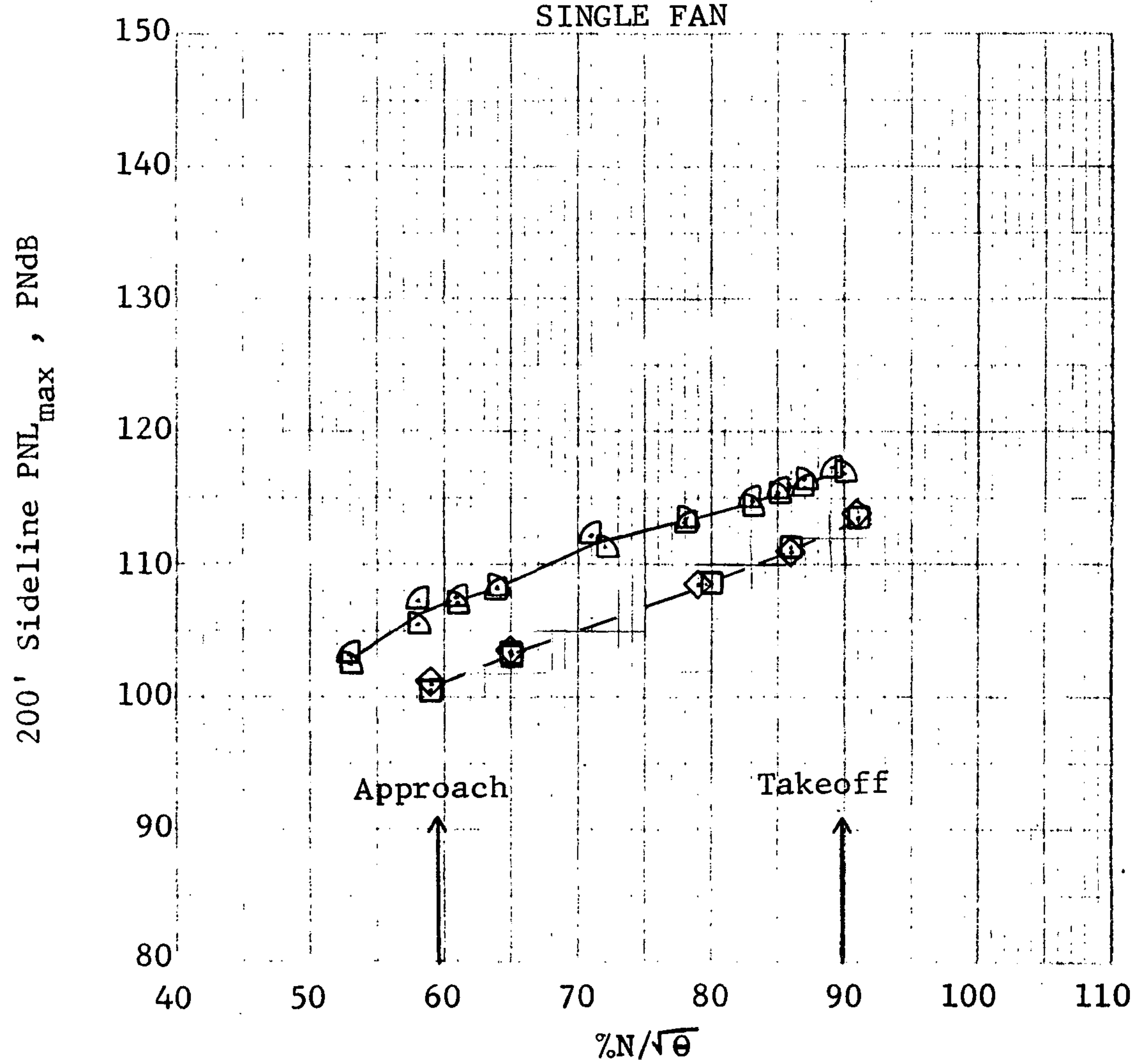
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE MAX PNL

TREATED VS UNTREATED

STANDARD DAY

SINGLE FAN



100%=3625 rpm

— — — □ ◇ Treated

——— ◺ ◿ Untreated

(large nozzle)

Figure 41

QEP FAN B

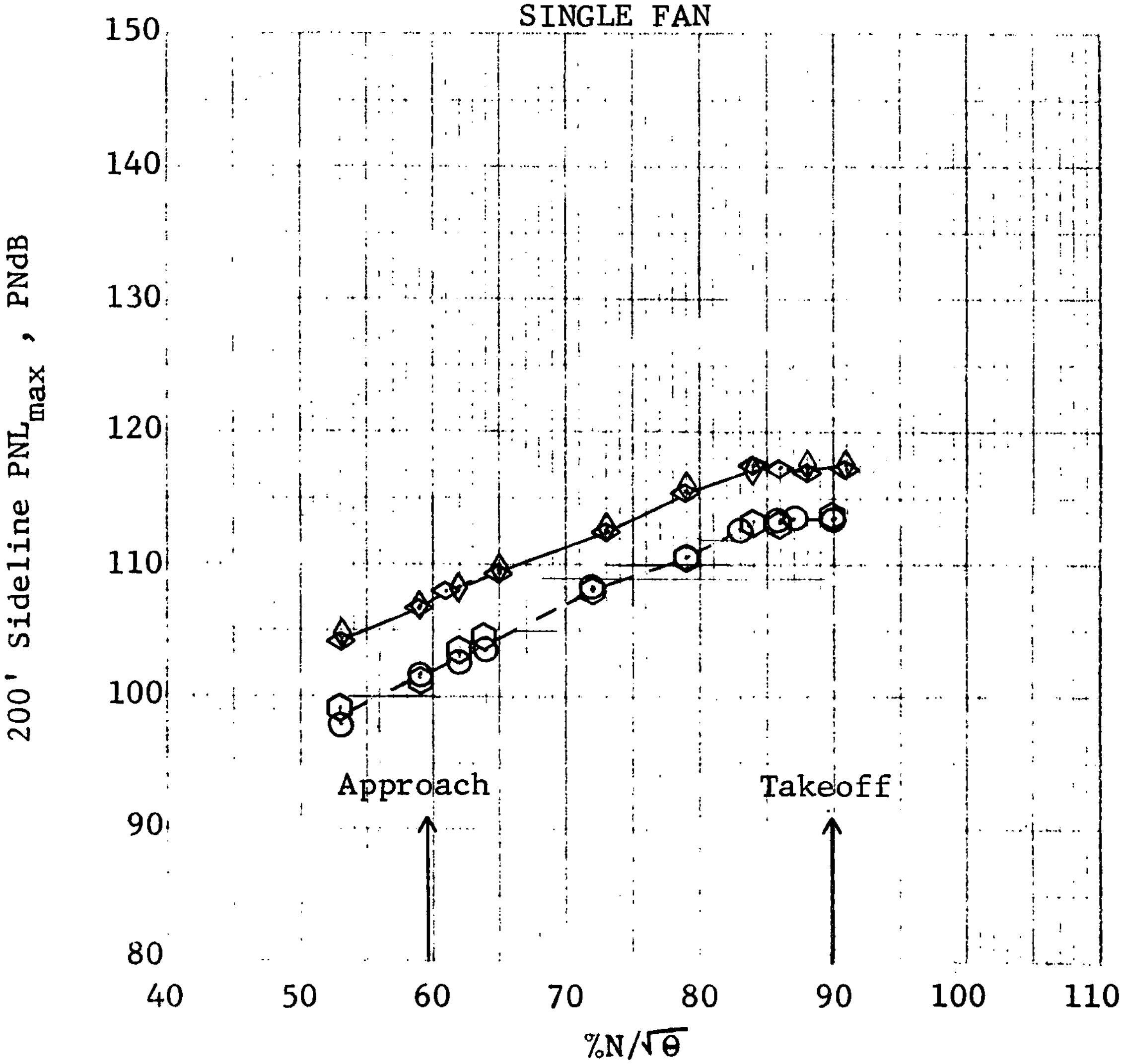
FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

200' SIDELINE MAX PNL

TREATED VS UNTREATED

STANDARD DAY

SINGLE FAN



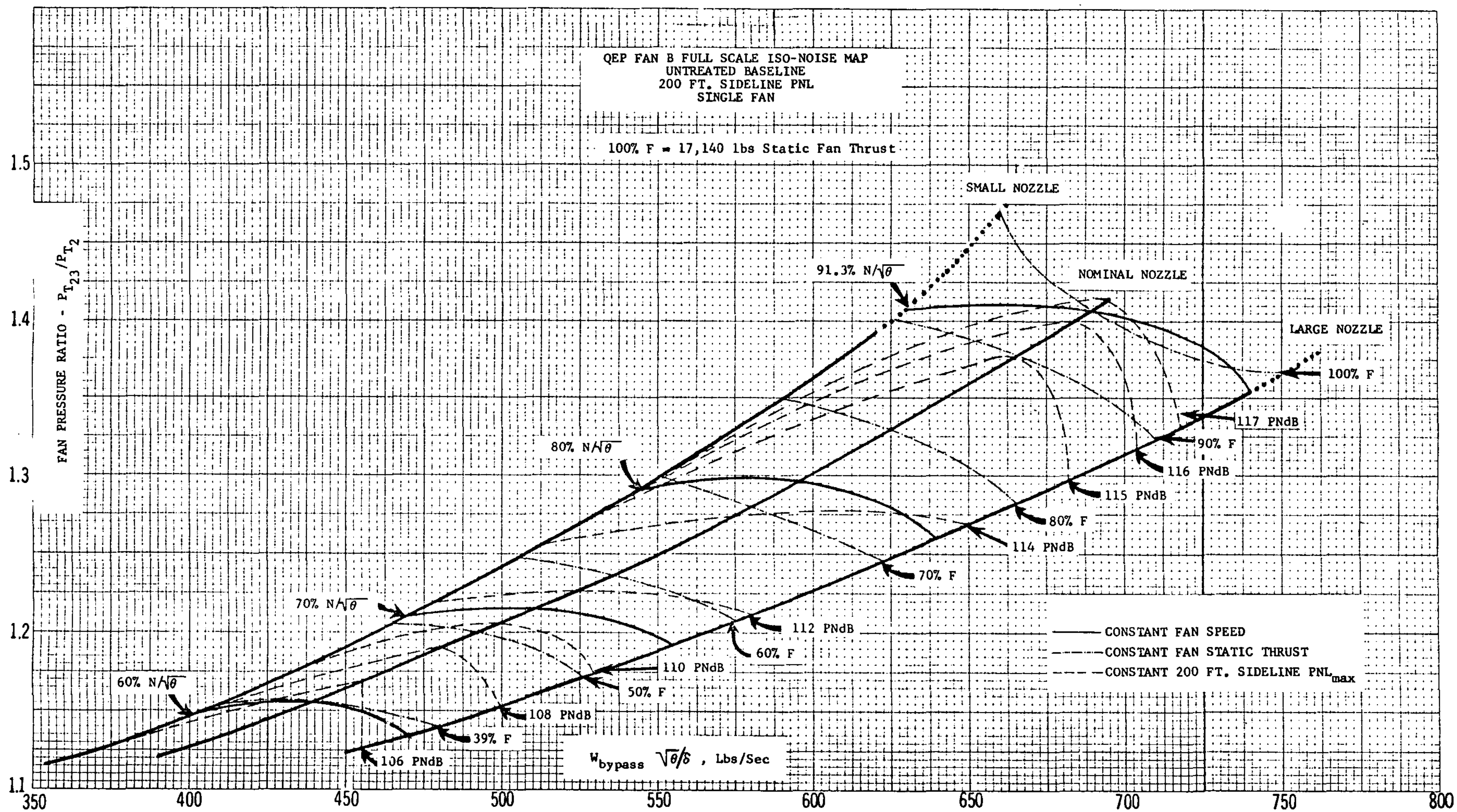
100%=3625 rpm

— — — ○ ⬡ Treated

——— ◇ ◊ Untreated

(small nozzle)

Figure 42



QEP FAN B FULL SCALE ISO-NOISE MAP
UNTREATED BASELINE
200 FT. SIDELINE PNL
SINGLE FAN
100% F = 17,140 lbs Static Fan Thrust
SMALL NOZZLE
NOMINAL NOZZLE
LARGE NOZZLE
91.3% $N/\sqrt{\theta}$
80% $N/\sqrt{\theta}$
70% $N/\sqrt{\theta}$
60% $N/\sqrt{\theta}$
100% F
117 PNdB
90% F
116 PNdB
115 PNdB
80% F
114 PNdB
70% F
112 PNdB
60% F
110 PNdB
50% F
108 PNdB
39% F
106 PNdB
CONSTANT FAN SPEED
CONSTANT FAN STATIC THRUST
CONSTANT 200 FT. SIDELINE PNL_{max}
FAN PRESSURE RATIO - $P_{T_{23}}/P_{T_2}$
$W_{bypass}\ \sqrt{\theta}/\delta$, Lbs/Sec
1.1
1.2
1.3
1.4
1.5
350
400
450
500
550
600
650
700
750
800

Figure 43

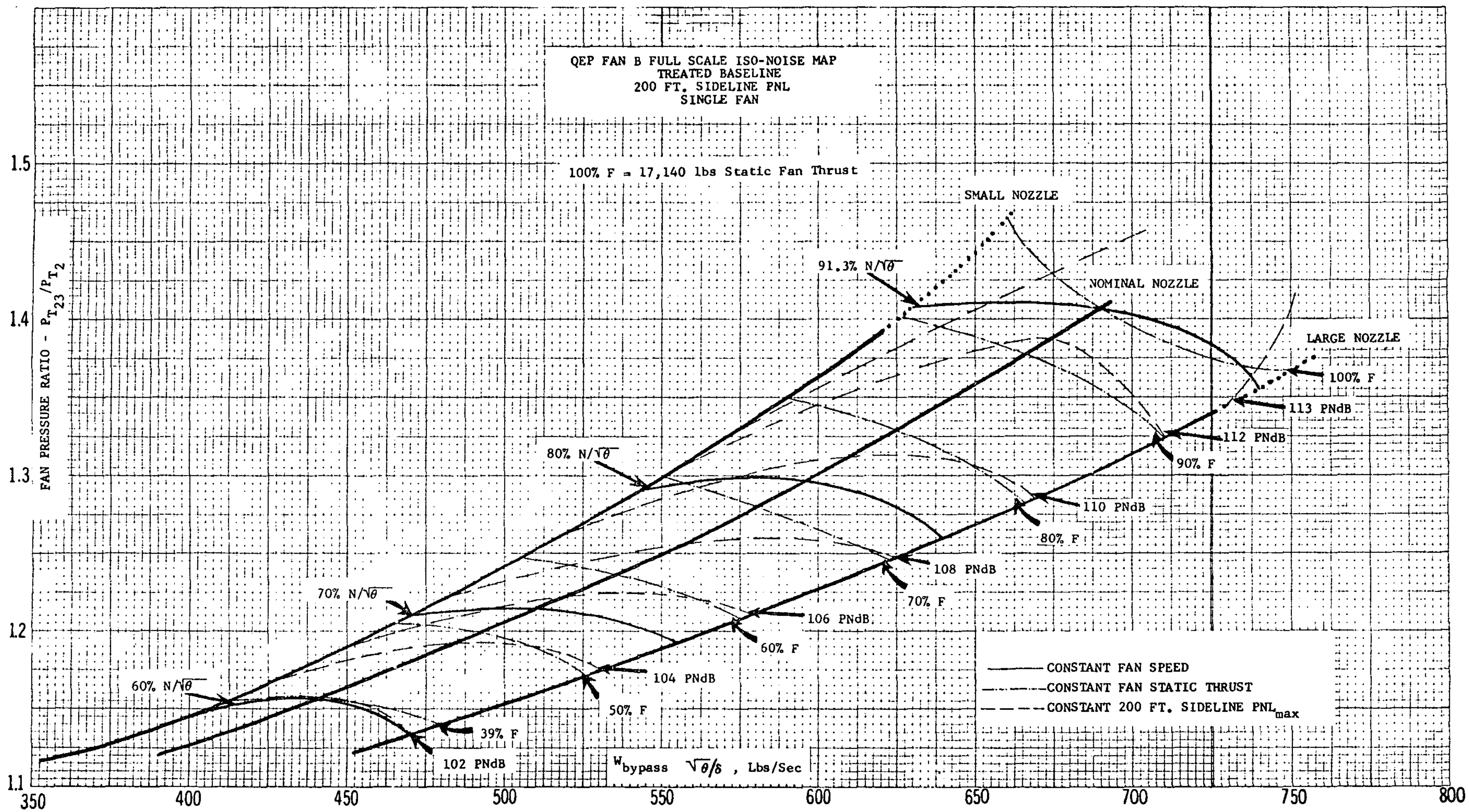

QEP FAN B FULL SCALE ISO-NOISE MAP
TREATED BASELINE
200 FT. SIDELINE PNL
SINGLE FAN
100% F = 17,140 lbs Static Fan Thrust
SMALL NOZZLE
NOMINAL NOZZLE
LARGE NOZZLE
91.3% N/√θ
80% N/√θ
70% N/√θ
60% N/√θ
100% F
90% F
80% F
70% F
60% F
50% F
39% F
113 PNdB
112 PNdB
110 PNdB
108 PNdB
106 PNdB
104 PNdB
102 PNdB
CONSTANT FAN SPEED
CONSTANT FAN STATIC THRUST
CONSTANT 200 FT. SIDELINE PNLmax
FAN PRESSURE RATIO - PT23/PT2
Wbypass √θ/δ , Lbs/Sec
1.1
1.2
1.3
1.4
1.5
350
400
450
500
550
600
650
700
750
800

Figure 44

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

LEVEL FLYOVER

77°F DAY

APPROACH

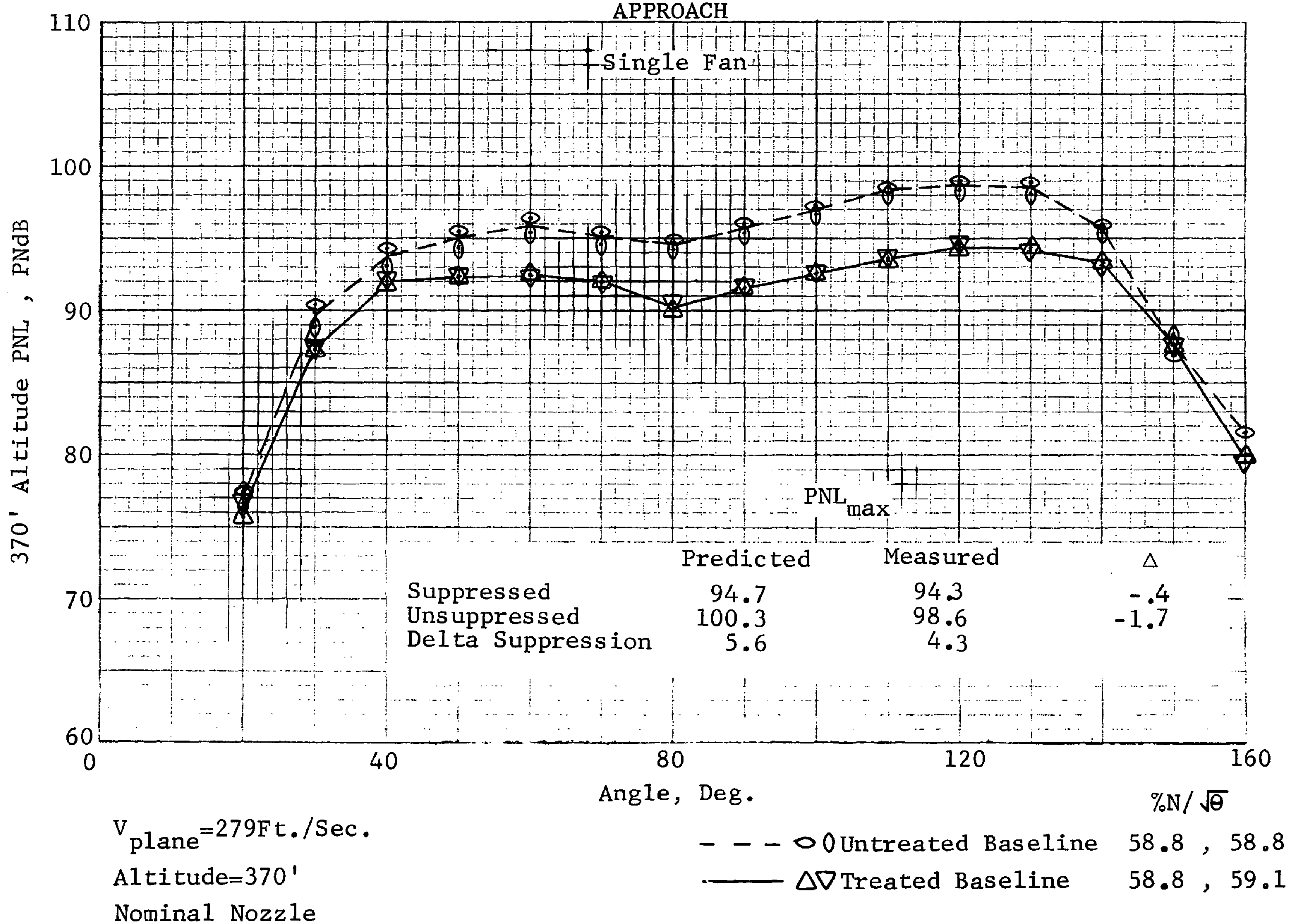


Figure 45

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS

LEVEL FLYOVER

77°F DAY
TAKEOFF

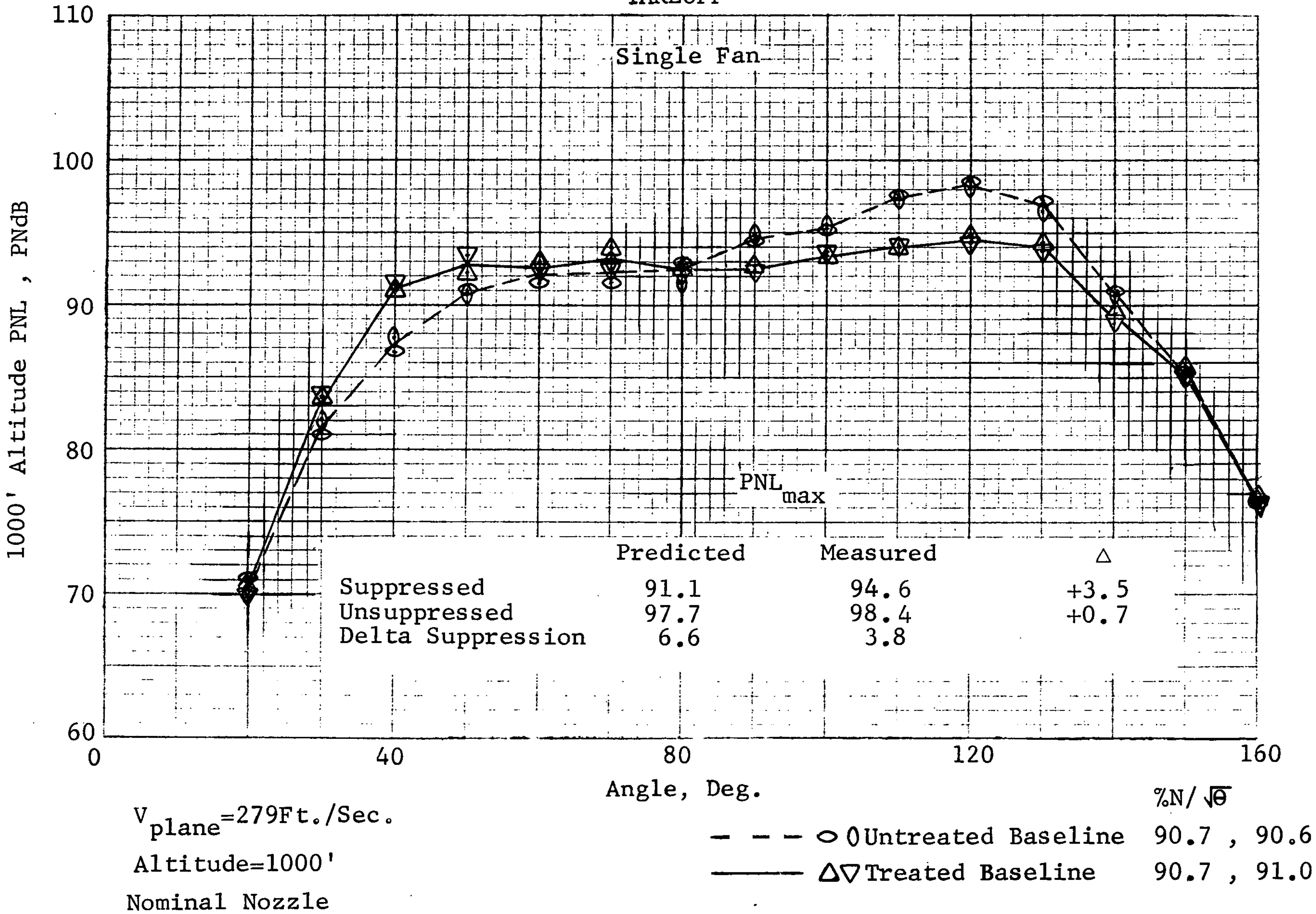


Figure 46

VIII. CONCLUSIONS

From these data, it can be concluded:

1. On this fan exhaust nozzle area, changes did not reduce noise at takeoff and approach thrust levels; although the large nozzle (16% oversized) did show the lowest noise in the mid-thrust range.

2. Fan frame acoustic treatment was effective in reducing maximum sideline PNL. The suppression obtained was over a wide frequency range, 1 - 10 KHz.

3. Pretest flyover noise predictions agreed quite well with test results for unsuppressed noise.

Summarizing the results, projections of full scale Fan B with nominal nozzle indicate the following single fan, maximum Perceived Noise Levels (PNL) for a level flyover:

FAN B LEVEL FLYOVER PROJECTIONS
MAXIMUM PERCEIVED NOISE LEVELS
SINGLE FAN

	Untreated	Treated
Takeoff 1000 ft (304.8 m) altitude $M_o = .25$	98.4 PNdB	94.6 PNdB
Approach 370 ft (112.8 m) altitude $M_o = .25$	98.6 PNdB	94.3 PNdB

The 200 foot (61.0 m) sideline maximum PNL's for a single full stage Fan B were as follows:

Full Scale Fan B
200 Foot (61.0 M) Sideline, Maximum PNL

	Approach*	Takeoff**
Nominal nozzle, untreated	104.4 PNdB	116.6 PNdB
Nominal nozzle, treated	100.2 PNdB	112.4 PNdB
Large nozzle, untreated	106.0 PNdB	117.2 PNdB
Large nozzle, treated	100.8 PNdB	113.6 PNdB
Small nozzle, untreated	106.8 PNdB	117.5 PNdB
Small nozzle, treated	101.6 PNdB	113.6 PNdB

*6684 pounds (29,744 newtons) static thrust

**17,140 pounds (76,277 newtons) static thrust

IX. 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 untreated configuration with nominal nozzle for speeds as close as possible to 60, 70, 80 and 90% corrected fan speed. Tables A5 - A8 present the data for the treated configuration 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.

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 16 HR. 7.2

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)	PWL
RADIAL 100. FT.	50	72.0	69.1	66.3	69.6	67.0	67.2	68.6	70.4	69.6	69.7	70.4	70.9	73.2	70.9	119.5
(30. M)	63	69.2	65.7	64.8	75.3	66.3	66.0	66.7	75.2	69.8	69.9	69.9	70.7	75.1	72.5	121.0
VEHICLE .5 FAN	80	66.6	66.0	66.9	69.9	67.6	67.9	68.2	67.9	69.1	69.8	71.2	70.9	72.3	68.9	119.0
CONFIG FAN B	100	71.1	64.3	73.2	68.8	65.9	67.7	66.7	69.0	68.7	70.3	69.6	73.0	72.2	68.8	119.6
LOC PPG	125	66.9	66.5	66.2	65.3	66.0	65.5	65.5	66.6	66.7	67.3	68.4	83.9	69.3	66.6	123.2
DATE 8/14/70	160	66.1	65.5	64.3	65.6	66.4	64.6	64.2	66.6	65.2	66.7	66.6	68.1	69.0	65.3	116.1
RUN 3. PT. 20	200	64.1	64.2	62.3	67.2	62.2	64.2	63.4	68.2	66.3	68.5	68.6	70.4	72.8	69.0	117.6
TAPE S1080.	250	64.8	64.8	64.3	67.6	66.0	67.2	69.1	70.3	71.0	72.6	73.7	74.7	75.6	72.4	121.2
BAR 28.9 HG	315	67.3	68.0	69.3	70.6	70.3	70.5	71.6	73.3	74.3	75.9	77.0	77.3	77.9	73.8	124.1
(97659. N/M2)	400	68.3	70.5	72.1	71.2	70.4	69.4	71.2	72.3	73.2	74.0	75.3	75.3	75.1	72.0	122.9
TAMB 75. DEG F	500	70.0	71.9	70.8	69.4	69.4	69.1	68.8	68.4	69.1	69.7	71.7	72.3	72.0	68.5	120.3
(297. DEG K)	630	68.8	69.6	69.7	72.5	69.6	65.6	69.3	70.5	72.1	73.3	75.0	76.3	75.6	70.2	122.8
TWET 71. DEG F	800	70.4	72.0	72.7	72.8	72.0	71.3	70.8	73.4	73.1	73.2	74.5	74.7	74.0	70.5	123.1
(295. DEG K)	1000	70.4	71.5	74.6	73.1	72.5	71.2	71.0	71.9	73.4	74.8	76.5	77.4	76.0	72.1	124.2
HACT 17.86 GM/M3	1250	69.0	72.8	75.3	73.9	72.3	71.2	70.9	71.5	73.0	74.0	77.1	77.3	76.6	71.5	124.4
(.01786 KG/M3)	1600	71.4	76.3	77.9	76.7	74.6	74.4	74.4	74.1	75.7	77.0	79.3	80.0	79.2	79.1	127.4
NFA 4472. RPM	2000	76.8	84.8	85.6	83.4	81.8	81.7	83.0	61.2	82.3	83.0	84.3	84.9	85.1	76.1	133.7
(468. RAD/SEC)	2500	68.4	75.7	77.1	76.2	75.0	73.0	75.7	73.9	75.1	76.1	77.5	79.8	78.4	74.3	128.8
NFK 4405. RPM	3150	71.7	76.7	77.2	80.1	79.3	77.0	74.7	77.9	79.3	80.7	81.3	83.6	83.8	81.9	130.8
(461. RAD/SEC)	4000	75.7	83.9	84.3	83.8	83.4	81.8	77.1	81.5	83.4	65.9	86.4	87.7	86.1	80.0	135.3
NFD 7488. RPM	5000	71.3	80.9	81.6	79.5	79.0	78.1	76.9	78.5	80.1	81.7	84.0	85.6	83.1	77.7	132.2
(784. RAD/SEC)	6300	71.0	81.1	82.5	79.4	79.3	77.4	78.3	77.7	78.6	80.5	83.0	85.1	83.9	77.2	132.3
NO. BLADES 26	8000	69.6	80.3	80.2	79.5	79.2	77.3	75.5	76.7	77.9	80.6	82.0	84.2	83.1	75.5	132.1
	10000	67.2	79.0	80.1	77.2	76.7	74.6	73.4	74.2	75.4	77.4	80.0	81.3	79.5	73.1	130.5
	12500	64.3	75.7	76.0	74.3	74.3	72.2	69.7	70.3	71.2	74.3	75.9	77.0	75.4	68.9	128.0
	16000	61.4	72.4	73.5	70.7	70.7	68.5	66.0	66.4	66.3	69.2	71.7	73.0	71.8	66.0	125.2
	20000	60.0	68.6	69.6	67.3	66.6	64.5	62.3	63.6	62.2	65.5	67.2	68.7	67.5	62.2	124.8
OVERALL MEASURED		85.9	92.7	93.5	92.4	91.4	90.2	89.6	90.5	91.8	93.5	94.9	96.6	95.8		
OVERALL CALCULATED		84.5	91.1	92.0	90.8	89.9	88.7	88.2	89.0	90.1	91.8	93.2	94.9	94.1	08.8	142.5
PNDB		97.9	104.8	105.5	104.9	104.1	102.8	101.8	103.1	104.4	106.4	107.4	109.0	108.7	103.2	

TABLE A1

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 71.9%N_{fc} ; NOMINAL NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 16 HR. 7.3

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)	PWL
RADIAL 100. FT.	50	77.0	77.5	76.2	76.1	73.8	72.9	73.8	74.7	75.0	75.9	77.3	77.4	79.5	82.4	126.4
(30. M)	63	71.5	70.0	70.8	75.8	71.9	72.4	73.2	76.3	76.5	76.2	77.5	78.1	81.1	83.1	126.5
VEHICLE .5 FAN	80	69.8	69.2	70.8	73.9	71.3	64.3	75.1	75.3	75.7	75.7	76.8	77.5	79.9	81.7	125.6
CONFIG FAN B	100	75.3	73.8	76.4	77.6	74.9	76.3	78.7	77.9	77.9	76.8	77.4	77.9	80.6	81.4	127.6
LOC PPG	125	70.4	69.6	70.2	70.2	70.6	70.7	71.5	72.2	73.1	74.1	75.3	77.2	76.7	77.8	123.6
DATE 8/17/70	160	69.5	70.0	69.8	68.8	68.7	70.1	70.9	71.1	71.2	72.4	73.9	74.1	75.6	76.0	122.1
RUN 3. PT. 27	200	85.5	73.0	70.3	70.8	72.8	74.3	73.1	73.9	73.3	75.1	77.8	77.7	80.4	81.5	126.9
TAPE S1096.	250	68.7	70.6	71.2	73.1	72.4	73.0	74.9	76.0	77.7	79.2	80.7	82.3	83.4	84.2	128.6
BAR 28.8 HG	315	72.2	73.3	74.8	75.3	73.8	76.3	77.2	79.0	80.1	82.2	83.3	84.2	85.1	85.0	130.8
(97351. N/M2)	400	74.1	75.2	76.4	75.4	76.0	75.4	76.7	78.4	80.1	81.0	82.5	82.4	82.0	80.6	129.5
TAMB 83. DEG F	500	74.3	76.2	75.5	74.0	74.1	73.4	73.9	73.9	75.5	76.2	77.8	79.1	78.8	78.1	126.2
(301. DEG K)	630	73.7	75.4	75.7	75.3	74.6	74.7	75.4	77.4	78.9	79.7	81.3	82.9	82.1	79.8	128.9
TWET 77. DEG F	800	76.0	78.4	79.6	77.9	78.6	77.2	76.7	77.7	79.7	79.7	80.8	80.7	80.1	78.4	129.2
(298. DEG K)	1000	75.0	77.8	79.7	78.1	77.9	77.0	77.2	78.0	79.6	81.5	82.7	83.5	81.3	79.5	130.3
HACT 21.24 GM/M3	1250	74.0	78.0	80.6	79.7	78.9	77.2	77.9	77.9	79.9	80.8	83.3	83.9	81.4	78.8	130.7
(.02124 KG/M3)	1600	76.4	81.1	83.3	82.4	81.2	80.2	79.7	80.8	82.5	83.1	85.3	86.5	83.3	81.3	133.2
NFA 5510. RPM	2000	76.1	82.8	85.5	84.5	83.9	82.2	82.1	83.5	85.1	83.9	86.0	88.9	83.4	82.4	135.1
(577. RAD/SEC)	2500	85.4	90.1	91.8	89.3	89.7	88.2	87.3	88.3	89.4	88.5	89.9	93.2	88.1	88.0	140.2
NFK 5387. RPM	3150	75.2	83.5	83.5	83.5	83.1	82.1	82.5	82.8	83.7	87.1	88.1	87.6	87.9	82.5	135.8
(564. RAD/SEC)	4000	78.2	86.7	88.2	85.2	85.5	84.7	85.5	85.4	87.5	89.3	90.9	91.0	88.2	84.9	138.7
NFD 7488. RPM	5000	79.8	88.8	91.9	88.7	88.9	88.2	87.7	87.8	88.9	90.6	92.5	94.2	85.2	87.0	141.0
(784. RAD/SEC)	6300	75.5	86.0	87.6	85.9	85.2	85.0	84.3	84.4	86.8	88.2	90.4	92.2	87.4	84.5	138.9
NO. BLADES 26	8000	75.9	87.1	87.5	84.8	85.1	82.7	83.8	84.3	85.3	87.7	89.6	90.3	86.4	83.7	138.6
	10000	73.9	85.9	88.2	83.8	84.4	82.1	82.1	82.4	83.8	86.0	87.4	89.1	84.5	82.2	138.1
	12500	71.6	83.9	84.2	81.1	81.3	80.0	79.1	79.1	80.3	83.1	84.6	85.3	80.7	79.5	136.2
	16000	68.1	81.2	82.0	78.0	78.3	76.5	75.6	75.3	75.9	78.9	81.6	81.9	78.1	76.5	134.9
	20000	65.3	77.5	78.6	75.0	74.3	72.5	71.5	70.8	71.4	74.9	77.0	77.9	74.0	72.4	133.6
OVERALL MEASURED		90.6	98.2	100.1	97.8	97.8	96.8	96.7	97.4	98.6	99.8	101.6	103.0	99.7	98.2	
OVERALL CALCULATED		91.5	97.0	98.7	96.4	96.3	95.2	95.1	95.6	97.0	98.3	100.0	101.4	97.9	96.8	149.1
PNDB		105.1	110.4	112.0	110.0	110.0	108.8	108.8	109.4	110.7	111.8	113.6	115.0	111.3	110.0	

TABLE A2

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 77.9%N_{fc} ; NOMINAL NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 16 HR. 7.3

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)	( )	( )	( )	PWL
RADIAL 100. FT.	50	74.9	75.4	74.7	75.5	74.3	74.1	75.0	75.6	76.0	76.9	78.0	79.0	82.0	84.9				127.6
(30. M)	63	68.3	71.7	72.3	76.4	73.6	74.2	74.8	77.7	77.7	77.6	78.7	79.7	83.0	85.4				128.2
VEHICLE .5 FAN	80	69.4	70.4	70.8	72.4	71.9	72.4	73.8	74.5	75.8	76.8	78.0	79.6	82.0	84.2				127.0
CONFIG FAN B	100	82.8	72.2	79.3	80.6	82.2	81.8	79.1	79.3	79.8	80.3	81.7	81.0	82.3	84.2				130.8
LOC PPG	125	75.6	72.3	74.0	74.4	75.5	75.2	74.4	75.1	65.9	76.8	78.2	79.1	79.6	81.2				126.3
DATE 8/17/70	160	70.8	71.0	71.2	69.9	71.3	70.5	71.7	72.2	72.8	74.6	75.6	76.8	78.3	79.8				124.2
RUN 3. PT. 28	200	73.1	71.2	70.2	72.3	69.9	73.3	72.2	74.0	74.0	76.5	79.7	79.9	83.1	84.6				127.5
TAPE S1096.	250	68.7	70.5	67.3	73.3	70.9	74.0	74.1	77.7	77.1	77.5	82.0	81.1	85.8	87.5				129.8
BAR 28.8 HG	315	74.9	76.1	78.8	79.5	79.1	79.5	79.7	81.7	82.9	84.6	86.6	87.4	88.5	88.8				134.0
(97351. N/M2)	400	76.7	79.9	82.2	78.6	78.4	78.1	79.0	80.3	82.1	83.6	84.8	85.3	86.0	84.3				132.4
TAMB 84. DEG F	500	77.5	78.4	77.7	76.9	76.3	76.7	75.7	76.1	77.7	79.2	80.4	82.3	81.6	81.1				128.9
(302. DEG K)	630	78.7	81.1	78.8	82.4	79.9	79.7	80.2	82.1	82.7	83.2	84.9	85.9	85.7	83.3				132.9
TWET 77. DEG F	800	77.9	80.3	81.0	81.9	82.1	81.1	80.4	81.5	83.4	83.3	83.5	85.0	83.2	81.5				132.6
(298. DEG K)	1000	76.7	79.1	80.9	79.5	79.6	79.4	79.2	80.3	81.7	83.3	84.7	85.5	83.2	81.5				132.2
HACT 20.94 GM/M3	1250	74.8	78.2	80.3	79.7	79.3	79.0	78.5	79.7	81.3	82.3	84.8	85.4	82.7	80.3				131.9
(.02094 KG/M3)	1600	76.8	81.2	82.6	82.3	81.9	81.2	80.8	62.2	83.7	84.3	86.6	87.8	84.3	82.2				134.1
NFA 5970. RPM	2000	75.8	81.6	83.4	83.0	82.9	82.0	82.1	83.7	85.4	84.2	86.6	89.5	83.3	81.8				135.0
(625. RAD/SEC)	2500	84.0	92.5	92.9	91.4	91.7	90.4	89.2	90.2	91.5	90.7	90.9	94.5	90.0	89.0				141.9
NFK 5831. RPM	3150	76.5	84.6	83.7	83.6	83.6	83.5	83.8	84.4	85.5	88.6	89.6	89.4	88.8	83.5				137.1
(611. RAD/SEC)	4000	78.5	86.7	88.9	84.1	84.8	84.9	84.3	87.0	89.0	91.1	92.8	92.5	88.8	85.3				139.7
NFD 7488. RPM	5000	81.2	89.9	91.5	89.4	89.8	89.4	89.1	89.3	90.7	92.4	94.5	95.9	89.7	88.4				142.3
(784. RAD/SEC)	6300	75.8	86.0	86.8	85.3	84.9	85.5	85.4	87.8	88.8	90.2	92.3	93.9	88.0	85.3				140.3
NO. BLADES 26	8000	77.4	88.6	88.2	85.8	86.3	85.5	86.2	86.8	88.0	90.6	91.2	92.9	87.8	85.6				141.0
	10000	74.3	86.3	87.6	84.0	84.5	83.5	83.7	84.4	85.8	88.2	89.8	90.7	85.4	83.0				139.5
	12500	71.9	84.1	83.7	81.0	81.4	81.2	80.8	81.2	82.8	85.7	87.0	87.5	81.9	80.2				137.8
	16000	67.8	81.0	81.2	77.8	78.4	77.7	77.5	77.6	78.5	81.7	84.6	84.5	79.7	77.3				136.6
	20000	64.7	76.9	77.5	74.6	74.3	73.4	73.1	72.9	73.9	77.9	80.3	81.0	75.8	73.1				135.2
OVERALL MEASURED		93.0	99.5	100.2	98.8	99.0	98.5	98.3	99.2	100.6	101.8	103.6	103.2	101.3	100.1				
OVERALL CALCULATED		91.4	98.1	98.8	97.3	97.4	96.8	96.5	97.6	98.9	100.3	102.1	103.1	99.8	98.7				150.7
PNDB		104.9	112.0	112.6	111.4	111.5	110.8	110.2	111.3	112.5	113.7	115.6	116.8	112.8	111.5				

TABLE A3

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 9 DAY 3 HR. 7.0

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)	PWL
RADIAL 100. FT.	50	75.9	75.9	71.8		75.3	76.7	77.8	78.5	79.4	79.4	81.6	82.7	86.4	90.8	94.3	133.3
(30. M)	63	76.4	75.4	75.4		77.1	78.9	73.3	80.0	80.6	81.0	83.3	84.5	87.6	92.0	95.3	134.6
VEHICLE 15 FAN	80	73.1	75.1	74.9		76.2	77.1	76.3	79.0	80.2	80.8	82.6	83.6	87.1	90.9	93.3	133.4
CONFIG FAN B	100	77.4	77.9	76.5		79.5	80.1	81.0	80.6	81.0	81.6	82.5	84.6	87.2	90.3	90.8	133.4
LOC PPG	125	75.9	76.0	75.6		76.5	76.3	77.4	78.6	79.3	80.7	81.6	84.3	85.5	87.0	86.5	131.2
DATE 9/24/70	160	73.3	74.3	72.9		74.2	73.6	75.5	75.4	25.1	78.6	80.3	81.3	83.3	85.3	85.7	128.9
RUN 5. PT. 81	200	73.1	75.2	73.2		74.6	76.8	77.1	78.0	79.5	82.0	83.7	85.8	88.6	90.3	90.0	133.2
TAPE T9720	250	75.6	77.5	75.1		79.3	80.6	82.0	83.1	84.5	86.6	88.3	90.1	92.6	93.7	91.6	137.1
BAR 28.8 HG	315	80.8	81.3	82.2		74.4	83.4	84.1	85.9	87.7	89.1	91.1	92.3	94.2	94.7	93.6	139.1
(97338. N/M2)	400	80.8	81.4	81.7		81.4	80.1	82.6	83.6	86.0	87.0	88.7	89.5	90.3	90.1	87.8	136.2
TAMB 68. DEG F	500	79.8	80.4	78.7		79.2	79.0	78.5	79.2	81.5	83.4	85.4	86.9	88.6	87.6	84.8	133.4
(293. DEG K)	630	77.7	79.1	78.4		79.1	80.0	81.3	83.2	85.1	87.0	89.1	90.0	90.9	89.2	86.0	136.1
TMET 61. DEG F	800	78.8	80.9	79.3		81.9	82.2	81.2	82.3	84.3	85.0	86.9	87.3	87.4	85.9	83.9	134.3
(289. DEG K)	1000	79.2	80.5	79.9		80.7	80.7	82.0	83.5	85.7	87.3	89.6	89.5	88.0	86.3	84.4	135.7
HACT 11.69 GM/M3	1250	78.1	80.3	81.5		80.3	80.9	83.6	81.7	83.1	85.1	88.3	88.0	86.2	84.4	82.3	134.3
(.01169 KG/M3)	1600	79.8	81.0	80.8		80.7	81.0	81.7	82.7	84.0	85.9	89.1	86.6	86.0	84.6	83.1	135.0
NFA 6850. RPM	2000	79.4	81.7	80.9		79.6	80.6	81.7	82.9	84.1	87.0	90.0	89.3	84.4	82.9	82.4	135.4
(717. RAD/SEC)	2500	78.5	81.5	83.0		84.7	83.7	82.9	82.8	84.4	85.4	89.2	89.6	84.9	83.5	80.8	135.7
NFK 6791. RPM	3150	84.6	90.1	93.2		94.5	93.2	91.2	90.7	92.6	91.1	94.6	93.0	93.0	92.3	86.5	143.1
(711. RAD/SEC)	4000	76.8	83.1	83.9		83.1	84.4	85.7	87.0	88.7	88.7	87.5	89.1	88.1	85.7	82.7	137.5
NFD 7488. RPM	5000	79.1	84.8	84.3		83.1	82.8	85.6	87.7	88.8	90.3	92.3	92.2	86.4	84.5	84.0	139.1
(784. RAD/SEC)	6300	84.0	89.7	88.1		90.1	86.5	87.9	90.2	90.2	94.5	96.3	95.8	90.6	87.7	86.5	143.1
NO. BLADES 26	8000	78.2	83.8	85.5		83.3	83.6	85.0	85.3	88.9	90.7	92.5	93.3	88.4	85.1	82.0	140.4
	10000	75.7	83.7	84.4		83.3	82.2	83.7	86.3	86.9	89.8	91.6	91.3	87.0	83.7	81.5	140.0
	12500	74.0	80.5	81.6		80.2	80.1	81.3	83.2	87.6	87.5	88.4	89.8	84.4	81.3	78.4	139.1
	16000	68.6	77.9	77.5		76.4	76.1	76.9	79.4	80.4	83.2	86.8	84.9	81.4	78.0	76.6	137.2
	20000	65.9	75.2	73.3		71.9	71.4	71.9	74.4	75.5	79.1	81.1	81.9	77.9	74.9	76.1	135.5
OVERALL MEASURED		94.4	98.5	98.9		99.6	98.8	97.0	100.0	101.4	103.0	105.2	105.3	104.2	104.4	103.4	
OVERALL CALCULATED		92.9	96.7	97.5		98.1	97.3	97.5	98.6	100.1	101.6	103.7	103.9	102.9	103.1	102.8	151.7
	PNDB	106.7	111.0	112.6		113.3	112.6	112.1	112.6	114.1	115.0	117.1	117.0	115.7	115.0	111.9	

TABLE A4

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	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	86.3	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	68.5	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	61.6	65.4	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 T9541.	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	68.4	69.1	69.4	68.2	68.4	69.4	69.7	71.0	71.8	71.2	71.9	69.9			120.1
(296. DEG K)	630	67.6	68.6	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	70.0	72.2	73.3	75.7	75.7	76.1	73.0	71.5			122.9
(.00952 KG/M3)	1600	70.4	71.0	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
NFA 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	65.7	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	78.9	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	81.6	78.4			130.1
NFD 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	73.6	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	70.4	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	77.0	74.7	73.5	69.2	70.2	72.1	72.9	75.0	75.4	76.4	73.8	71.1			127.3
	12500	66.1	73.2	75.6	74.2	72.7	71.1	66.6	66.8	68.3	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	68.1	65.8			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	88.6	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	87.7	86.3	85.5	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 A5

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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)	( )	( )	PWL
RADIAL 100, FT,	50	74.9	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	70.3	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	74.1	74.7	74.8	76.7	76.2	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	80.7	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	75.0	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	80.3	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	76.8	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	80.5	78.6	77.1			128.9
(.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	74.5	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
NFK 5469, RPM	3150	69.2	80.4	79.1	73.1	78.1	77.3	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
NFD 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	86.3	85.0	84.2	81.3			135.3
(784, RAD/SEC)	6300	75.2	82.6	82.7	82.2	81.3	79.9	78.5	79.1	80.5	82.3	85.1	87.4	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	76.8	79.8	82.3	83.5	85.6	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	75.6	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	69.0	68.7	69.9	67.9	68.6	68.4	66.6			128.7
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	93.0	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	106.4	105.2	104.1	102.8	104.0	105.4	107.2	108.4	110.4	108.2	108.1	105.6			

TABLE A6

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 79.3%N_{fc} ; NOMINAL NOZZLE ; TREATED

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)	( )	( )	PWL
RADIAL 100. FT.	50	76.2	74.8	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	75.7	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	72.0	71.1	70.5	72.9	75.2	76.8	77.5	78.5	79.5	82.3	84.9	87.3			128.4
CONFIG FANB	100	73.8	72.1	75.9	77.4	76.6	78.4	79.2	78.6	77.8	81.1	83.9	85.4	85.2	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 10/6/70	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. 266	200	75.7	72.8	71.5	72.0	71.0	74.0	72.8	75.2	76.0	79.3	79.8	82.0	84.0	86.4	86.0			129.5
TAPE 19889.	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	78.8	79.5	80.0	82.0	83.3	84.9	86.6	87.6	86.5	88.7	86.4			134.2
(97760. N/M2)	400	76.5	77.7	79.1	78.4	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	80.9	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	77.6	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	80.9	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	79.0	77.6			130.6
(628. RAD/SEC)	2500	81.7	91.7	89.1	88.8	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	70.8	79.9	81.6	80.1	79.6	79.3	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	83.0	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	82.8	80.1	81.1	81.8	84.8	86.3	87.9	83.2	84.3	80.0			136.2
	10000	72.6	81.3	83.8	83.5	81.6	81.2	78.5	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	72.8	70.7	69.6	69.3	67.5			129.8
	OVERALL MEASURED	91.0	96.9	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	89.3	95.3	95.5	94.9	94.5	93.3	92.4	93.4	94.7	96.4	98.3	99.7	97.9	98.4	98.0			147.2
	PNDB	102.7	110.0	109.3	108.8	108.9	106.8	106.0	106.1	107.6	109.4	111.5	113.0	109.8	110.7	108.4			

TABLE A7

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	74.7	76.8	79.3	79.9	81.0	81.4	82.3	85.9	90.0	93.8			133.0
(30. M)	63	74.5	77.8	77.4	80.3	77.2	76.8	77.7	80.4	80.9	81.9	83.6	84.6	87.7	91.7	95.1			134.6
VEHICLE .5FAN	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	79.2	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	86.8	86.2	87.0	85.8			132.2
DATE 10/6/70	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. 270	200	72.4	73.6	72.8	75.2	75.8	77.1	77.0	78.6	80.0	82.1	84.0	86.6	89.2	91.9	90.7			134.0
TAPE T9889.	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	92.6	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	78.7	78.2	79.1	81.0	81.5	83.8	85.5	86.8	88.6	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	86.0	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			135.6
HACT 9.50 GM/M3	1250	78.4	80.1	82.5	81.5	81.5	81.7	81.1	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	83.5	81.5	81.3	80.7	82.4	84.4	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	81.1	82.7	83.6	84.1	85.3	84.8	82.9	81.3			132.8
(717. RAD/SEC)	2500	76.9	84.2	85.0	84.7	83.5	83.9	82.2	81.3	81.6	82.2	84.5	87.5	82.8	83.8	80.9			134.5
NFK 6791. RPM	3150	84.6	94.2	98.6	96.6	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	88.2	88.1	84.5	85.2	82.6			135.9
NFD 7488. RPM	5000	77.5	82.9	85.3	83.6	82.7	82.5	81.4	83.3	85.5	87.4	89.4	88.3	85.3	84.1	82.8			136.6
(784. RAD/SEC)	6300	82.5	89.4	90.2	89.4	89.0	87.1	86.4	86.3	87.6	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	84.3	80.7			137.4
	10000	73.1	80.7	84.2	83.7	82.8	82.3	80.7	82.5	84.3	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	75.1	73.2	72.3	73.9	76.2	77.6	79.7	77.2	75.2	75.0	72.9			132.1
	20000	66.7	67.4	74.1	72.2	71.3	72.8	68.1	70.4	73.0	73.5	77.0	73.5	73.2	74.2	73.3			131.7
OVERALL MEASURED		93.7	99.2	101.9	100.5	99.8	99.8	98.2	98.5	99.6	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	115.6	112.9			

TABLE A8

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 58.2%N_{fc} ; LARGE NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 17 HR. 18.8

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	71.8	70.3	68.8	70.6	68.9	68.1	69.7	70.5	69.4	70.3	70.5	70.8	72.8	74.1			120.3
(30. M)	63	70.2	66.8	67.2	77.0	67.1	67.0	67.5	75.6	68.7	69.7	70.7	70.8	75.7	74.1			121.8
VEHICLE .5 FAN	80	67.6	66.0	66.3	67.2	67.0	67.3	67.8	67.8	69.0	69.5	71.0	71.3	71.9	73.3			119.1
CONFIG FAN B	100	70.3	66.4	70.0	68.0	68.5	67.4	66.9	67.8	68.5	69.6	69.6	70.9	71.2	71.8			119.0
LOC PPG	125	66.9	65.1	66.1	65.4	66.0	65.9	66.2	67.3	68.2	69.0	69.8	77.1	70.1	70.7			119.6
DATE 8/20/70	160	65.5	64.6	65.1	66.5	65.7	64.6	65.4	67.7	66.2	67.7	67.1	68.2	69.0	68.4			116.7
RUN 4. PT. 40	200	64.0	63.9	62.0	69.1	62.2	63.6	62.6	69.1	64.2	67.4	66.9	68.2	70.6	70.7			117.0
TAPE T9590.	250	64.7	64.5	63.9	65.1	64.2	65.3	66.7	67.5	68.2	70.2	71.1	72.3	73.2	74.3			119.3
BAR 28.8 HG	315	65.9	66.7	67.6	69.1	68.4	68.9	69.1	71.2	72.0	73.8	74.5	75.0	75.5	75.6			122.2
(97192. N/M2)	400	67.0	69.2	71.4	70.2	70.6	69.5	70.6	72.0	73.6	74.6	75.3	75.0	74.4	74.0			122.9
TAMB 86. DEG F	500	68.6	70.5	70.1	68.8	68.4	69.0	68.4	69.3	70.9	71.7	72.8	72.4	71.0	70.7			120.6
(303. DEG K)	630	66.4	68.0	68.8	70.2	68.5	68.5	67.1	68.0	69.5	71.9	72.3	73.2	73.5	71.8			120.6
TWET 77. DEG F	800	67.8	69.7	69.2	69.2	70.7	67.4	68.4	69.7	73.0	73.1	74.5	75.2	72.9	71.3			122.0
(298. DEG K)	1000	69.6	69.0	71.7	69.2	70.1	68.4	68.4	68.8	70.8	73.0	73.6	76.2	73.9	71.6			122.0
HACT20.36 GM/M3	1250	67.1	69.7	71.6	70.4	69.8	68.5	68.5	69.4	71.0	72.8	74.7	75.6	74.2	71.3			122.2
(.02036 KG/M3)	1600	70.1	75.0	75.0	73.1	72.5	72.0	70.8	72.3	73.6	76.1	77.8	77.8	76.6	73.9			125.2
NFA 4470. RPM	2000	79.4	86.9	86.7	83.8	84.1	83.5	81.5	82.1	84.3	86.3	87.0	86.4	85.9	84.4			135.5
(468. RAD/SEC)	2500	68.1	74.0	75.0	73.6	72.3	71.4	72.4	73.0	75.3	75.7	79.1	78.3	76.8	73.4			125.9
NFK 4356. RPM	3150	71.1	75.1	76.1	77.7	76.8	75.5	76.4	77.6	80.7	79.7	82.9	83.3	80.6	77.9			130.2
(456. RAD/SEC)	4000	76.3	84.5	85.1	84.4	83.4	82.1	80.7	82.4	84.5	86.4	86.7	89.8	88.4	83.4			136.3
NFD 7488. RPM	5000	70.2	78.7	80.9	78.1	77.4	76.7	74.8	77.2	79.4	82.1	82.2	84.5	83.8	78.0			131.4
(784. RAD/SEC)	6300	70.8	80.3	82.6	79.7	79.0	78.3	76.7	78.1	80.3	82.0	84.7	86.3	84.5	79.2			133.2
NO. BLADES 26	8000	70.0	78.2	80.3	79.3	78.5	76.8	74.5	76.9	79.0	81.0	82.6	84.9	83.9	77.8			132.4
	10000	67.0	76.1	79.3	77.1	76.0	75.0	72.8	74.3	76.7	78.6	80.6	82.3	80.8	75.8			130.9
	12500	64.2	72.9	75.1	73.8	73.2	71.5	69.1	70.1	72.4	74.5	76.9	77.5	75.8	71.4			128.1
	16000	60.1	68.2	71.6	69.8	68.8	67.8	65.0	65.8	68.3	68.7	72.6	73.1	71.8	67.9			125.8
	20000	57.5	63.4	66.9	65.5	64.5	63.3	60.3	60.8	65.1	63.6	67.7	67.8	67.0	63.4			123.7
OVERALL MEASURED		86.0	92.6	93.4	91.7	91.2	90.2	88.9	90.3	92.4	94.2	95.4	97.0	95.7	92.1			
OVERALL CALCULATED		84.8	91.1	91.9	90.4	89.7	88.8	87.5	89.0	90.9	92.6	93.8	95.3	94.0	90.6			142.8
	PNDB	98.1	104.5	105.4	104.5	103.7	102.6	101.5	103.2	105.1	106.8	107.7	109.8	108.5	104.6			

TABLE A9

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 71.8%N_{fc} ; LARGE NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 17 HR. 18.8

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	73.4	73.4	72.0	73.4	70.8	71.3	72.2	73.3	73.1	74.4	74.9	75.7	78.3	81.0		124.4
(30. M)	63	70.3	68.9	69.6	77.4	70.5	70.8	71.2	76.0	73.1	74.4	74.9	76.1	79.7	81.0		125.0
VEHICLE .5 FAN	80	67.5	67.8	68.3	70.1	69.2	70.1	71.9	73.4	74.2	74.6	74.6	75.7	77.8	80.1		123.8
CONFIG FAN B	100	71.1	69.1	72.6	73.5	73.1	74.0	76.2	77.9	78.2	76.9	76.4	78.2	78.9	79.9		126.4
LOC PPG	125	68.7	68.6	69.9	69.9	69.5	69.5	70.2	71.3	72.4	73.4	74.2	77.8	75.8	76.9		122.9
DATE 8/20/70	160	67.8	67.9	68.9	69.8	68.6	69.3	69.3	69.7	70.1	71.8	72.4	73.2	74.4	75.0		121.1
RUN 4, PT. 48	200	68.1	70.9	71.6	75.4	70.3	75.9	72.2	71.1	72.0	76.8	74.3	75.9	78.3	79.4		124.8
TAPE T9590'	250	66.1	68.3	70.1	70.4	69.9	72.2	73.8	74.6	76.1	77.8	78.3	80.1	81.1	82.3		126.7
BAR 28.7 HG	315	70.0	71.0	73.3	73.9	74.3	74.9	75.3	77.5	78.9	80.3	81.2	82.1	82.8	82.9		128.9
(97084. N/M2)	400	71.7	72.9	75.5	74.5	77.7	75.2	75.1	77.9	79.6	80.0	80.6	81.1	80.8	80.7		128.6
TAMB 65. DEG F	500	72.5	73.9	74.8	74.2	74.0	72.5	74.4	73.4	75.2	76.6	77.4	77.4	77.2	76.7		125.5
(303. DEG K)	630	69.8	72.2	72.2	72.9	72.3	72.7	73.2	75.1	76.7	78.1	78.7	78.7	79.4	77.7		126.3
TWET 75. DEG F	800	72.0	72.7	73.3	72.5	73.8	73.1	73.3	74.9	77.8	77.4	79.1	79.3	78.0	76.4		126.5
(297. DEG K)	1000	71.2	72.6	74.8	74.6	74.3	73.1	73.1	74.5	76.6	78.1	78.9	80.4	78.3	76.6		126.8
HACT18.68 GM/M3	1250	70.1	73.2	75.0	73.9	73.9	73.3	72.5	73.6	75.1	77.1	79.2	79.8	77.4	75.4		125.3
(.01868 KG/M3)	1600	71.7	76.1	77.3	75.8	75.0	74.8	73.6	75.1	76.4	78.9	80.7	81.3	78.5	76.7		127.9
NFA 5513. RPM	2000	72.3	78.8	80.7	78.1	77.5	76.7	75.8	77.1	78.1	80.6	82.1	82.6	79.8	78.2		129.9
(577. RAD/SEC)	2500	81.9	89.3	91.6	88.8	88.7	86.9	86.3	86.7	87.3	89.2	92.0	92.2	88.8	87.4		139.8
NFK 5380. RPM	3150	72.9	75.9	77.5	78.9	78.1	78.4	80.3	81.5	84.2	82.8	86.2	86.7	82.4	80.0		133.1
(563. RAD/SEC)	4000	74.6	80.2	81.7	81.3	80.4	80.8	81.2	83.4	84.9	86.9	87.2	89.1	85.9	81.3		135.5
NFD 7488. RPM	5000	77.9	85.9	89.1	86.7	85.3	85.9	84.6	85.5	87.2	90.3	90.2	94.6	90.1	85.7		139.9
(784. RAD/SEC)	6300	73.5	80.2	82.8	81.5	80.4	80.3	81.5	83.6	85.6	86.5	89.9	90.5	85.2	81.9		136.9
NO. BLADES 26	8000	74.4	80.7	83.8	83.6	82.0	81.0	81.2	83.8	85.5	86.6	89.0	89.8	86.4	82.4		137.4
	10000	70.9	79.3	83.2	81.2	79.9	79.4	79.5	80.9	82.6	84.2	86.9	88.5	83.7	80.3		136.3
	12500	68.2	75.8	78.8	77.9	77.0	75.9	76.3	77.3	79.2	81.0	84.1	83.6	79.9	76.5		133.8
	16000	64.7	71.5	76.0	74.5	73.0	72.7	72.6	73.4	75.0	75.9	80.7	80.4	76.8	73.5		132.2
	20000	62.5	65.3	71.1	70.2	68.7	68.3	67.9	68.4	70.3	71.0	76.8	76.0	72.8	69.1		130.4
	OVERALL MEASURED	88.7	94.8	97.2	95.5	94.6	94.1	94.0	95.3	96.9	98.6	100.0	101.7	98.5	96.3		
	OVERALL CALCULATED	87.3	93.2	95.7	93.9	93.2	92.6	92.5	93.8	95.3	96.9	98.7	100.2	96.9	94.9		147.2
	PNDB	101.6	107.6	109.8	108.0	107.6	106.7	106.4	107.5	108.6	110.7	112.3	114.2	110.7	108.5		

TABLE A10

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 78.1%N_{fc} ; LARGE NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 16 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)	( )	( )	PWL
RADIAL 100. FT.	50	74.8	75.2	74.1	75.5	74.4	75.1	75.7	76.6	77.1	78.0	78.5	79.3	81.7	85.0				127.9
(30. M)	63	72.1	72.6	73.2	78.7	74.3	74.7	75.8	78.1	76.8	78.1	79.2	79.8	82.7	85.3				128.4
VEHICLE .5 FAN	80	70.4	71.3	71.9	73.3	72.4	73.1	74.6	75.4	76.3	77.6	78.2	79.0	81.4	83.6				126.9
CONFIG FAN B	100	81.9	76.7	78.5	79.7	79.9	80.7	79.4	80.6	78.3	79.2	82.7	83.4	82.5	82.6				130.6
LOC PPG	125	74.6	72.5	73.9	74.4	74.3	74.0	74.2	74.5	74.9	76.3	77.8	79.7	76.7	79.8				125.1
DATE 8/20/70	160	71.1	71.0	71.2	71.4	71.3	70.6	71.9	72.3	72.8	74.8	75.7	76.3	77.6	79.4				124.1
RUN 4. PT. 49	200	75.6	77.3	75.0	73.6	72.5	73.3	73.0	74.6	75.0	77.0	80.4	80.0	83.4	85.3				128.3
TAPE T9053.	250	68.8	70.9	72.6	73.8	73.2	75.5	77.2	78.3	79.3	81.3	82.8	84.2	85.3	86.6				130.7
BAR 28.7 HG	315	73.3	74.4	76.3	77.6	78.5	79.7	79.7	81.6	82.8	84.7	85.8	87.3	87.6	87.6				133.5
(97084. N/M2)	400	74.8	76.4	78.3	75.8	77.7	79.1	78.4	80.1	81.6	82.9	83.4	83.9	83.7	83.1				131.1
TAMB 85. DEG F	500	75.0	76.6	77.1	76.0	75.4	74.8	74.8	75.2	76.8	79.0	79.8	81.3	81.2	81.5				128.2
(303. DEG K)	630	73.1	76.0	77.0	77.0	77.9	77.4	77.6	79.7	81.9	82.8	83.9	84.0	83.7	82.5				131.2
TWET 75. DEG F	800	74.6	75.1	76.6	76.2	77.4	76.0	76.6	77.9	80.0	80.6	81.5	82.0	81.1	80.2				129.4
(297. DEG K)	1000	74.5	77.6	79.8	79.0	77.0	76.4	77.3	78.4	80.0	82.3	83.3	84.6	82.2	81.2				130.8
HACT18.68 GM/M3	1250	72.3	75.8	78.4	75.9	75.5	75.5	75.5	76.1	77.4	79.9	81.8	83.1	80.3	75.7				127.0
(.01868 KG/M3)	1600	73.9	78.7	80.6	78.1	78.0	77.4	77.0	77.6	78.6	81.0	82.6	84.3	80.9	79.7				130.5
NFA 5991. RPM	2000	72.3	79.0	80.2	79.1	77.7	77.5	77.0	78.1	78.6	81.5	82.6	84.1	79.9	78.3				130.5
(627. RAD/SEC)	2500	84.7	91.3	92.8	91.9	91.3	90.5	92.3	90.3	91.4	92.8	96.1	96.0	91.1	89.1				143.2
NFK 5846. RPM	3150	75.1	79.7	81.0	81.8	81.4	81.6	83.6	84.3	86.3	85.6	89.1	89.4	84.4	82.7				135.9
(612. RAD/SEC)	4000	75.2	81.9	82.5	82.1	82.0	82.6	83.0	85.4	86.0	88.5	88.8	90.4	85.4	82.4				136.9
NFD 7488. RPM	5000	79.8	89.3	91.9	88.7	88.2	88.1	86.8	88.5	89.3	93.1	93.8	95.3	90.2	88.0				142.2
(784. RAD/SEC)	6300	74.0	82.6	84.2	82.0	82.0	82.2	83.5	86.0	87.0	89.0	91.9	92.1	85.8	83.5				138.7
NO. BLADES 26	8000	76.6	84.9	86.8	85.5	85.6	84.2	84.3	86.8	87.7	90.2	91.7	92.8	86.2	84.9				140.3
	10000	72.2	81.6	84.5	81.8	81.5	80.9	81.7	84.0	84.9	87.3	89.1	90.6	84.7	82.2				139.4
	12500	68.5	78.5	80.1	79.5	76.7	77.6	78.2	80.2	81.0	84.2	85.8	86.6	80.7	78.1				135.0
	16000	64.9	74.9	77.1	75.2	74.9	74.2	74.3	76.7	77.1	80.4	83.1	83.1	77.9	75.1				134.6
	20000	62.5	70.7	72.9	71.1	70.8	69.9	69.7	72.2	72.4	77.1	79.2	79.4	74.2	71.0				133.3
OVERALL MEASURED		91.8	97.5	99.4	97.9	97.4	97.1	97.7	98.3	99.4	101.5	103.3	104.4	100.3	99.3				
OVERALL CALCULATED		90.3	95.8	97.7	96.2	95.8	95.5	96.2	96.8	97.8	99.9	101.8	102.8	98.8	97.9				149.6
	PNDB	104.3	110.1	111.7	110.6	110.2	109.8	110.8	110.6	111.7	113.5	115.8	116.5	112.3	110.8				

TABLE A11

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 89.5%N_{fc} ; LARGE NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 10 DAY 16 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)	( )	PWL
RADIAL 100. FT.	50	76.5	76.8	74.6	75.1	75.0	75.4	77.3	78.3	78.6	79.4	80.8	82.0	84.4	88.6			130.2
(30. M)	63	76.3	75.4	75.6	79.3	76.6	77.3	77.5	79.9	79.3	80.4	81.5	82.9	86.1	89.6			131.4
VEHICLE .5 FAN	80	71.3	73.4	73.9	74.9	74.4	75.4	77.1	78.4	78.9	80.2	81.0	82.6	85.1	88.3			130.3
CONFIG FAN B	100	72.3	75.1	74.3	76.5	75.3	77.5	78.3	79.4	80.6	81.0	81.7	82.9	85.1	87.5			130.7
LOC PPG	125	73.9	76.4	75.8	77.0	75.8	78.5	78.7	79.8	81.7	81.2	81.3	83.0	83.4	85.2			130.4
DATE 8/20/70	160	72.7	71.8	73.4	72.9	73.4	73.0	74.6	75.4	76.2	77.6	78.8	80.0	81.3	83.6			127.3
RUN 4, PT. 58	200	72.7	72.9	72.2	73.6	72.7	74.8	74.2	75.7	76.7	78.9	80.9	83.2	85.8	86.1			130.1
TAPE T9443.	250	73.8	74.3	76.1	77.1	76.8	78.6	79.3	80.5	81.4	83.9	85.6	87.6	89.6	91.2			134.1
BAR 28.7 HG	315	78.1	78.0	80.1	82.5	81.0	81.9	83.8	85.5	85.8	88.0	89.0	90.2	91.8	92.7			137.1
(97014. N/M2)	400	78.4	79.3	81.1	80.5	80.3	80.3	82.5	84.0	85.5	86.8	87.9	88.7	89.1	89.0			135.5
TAMB 83. DEG F	500	78.3	79.3	79.3	73.5	77.8	78.3	79.0	79.7	81.0	82.5	83.7	85.3	85.3	85.0			131.9
(301. DEG K)	630	75.9	77.8	78.5	77.8	78.4	79.2	80.0	82.2	83.9	85.6	86.7	87.1	87.0	86.3			133.9
TWET 75. DEG F	800	76.0	78.9	79.6	79.8	79.7	79.7	81.0	82.4	84.3	84.9	86.5	86.4	85.7	84.4			133.6
(297. DEG K)	1000	76.8	79.2	80.8	80.6	81.4	80.9	81.4	82.7	84.5	86.1	87.1	88.6	85.4	84.0			134.5
HACT19.26 GM/M3	1250	76.1	79.1	83.0	83.0	82.0	80.8	80.9	81.4	82.4	84.5	86.3	87.2	84.1	82.6			133.8
(.01926 KG/M3)	1600	77.3	82.7	86.7	82.3	84.9	86.0	82.9	82.7	83.1	85.4	87.2	87.2	84.7	83.9			135.4
NFA 6857. RPM	2000	74.8	81.5	82.6	81.2	81.0	82.0	80.3	81.3	82.0	84.8	85.9	86.3	82.8	81.4			133.5
(718. RAD/SEC)	2500	77.5	82.4	84.1	84.1	83.8	84.0	86.2	86.2	87.3	87.6	90.6	90.1	83.7	84.5			137.3
NFK 6704. RPM	3150	85.9	89.5	92.0	92.7	92.9	92.9	95.0	95.6	96.2	96.4	99.3	99.3	91.8	93.7			146.3
(702. RAD/SEC)	4000	78.7	85.2	86.6	86.3	85.9	86.2	86.6	88.9	89.4	91.6	91.6	92.5	87.8	86.1			139.9
NFD 7488. RPM	5000	77.5	85.5	87.6	85.3	84.9	85.4	85.9	88.6	88.9	92.2	92.1	93.5	87.7	85.3			140.2
(784. RAD/SEC)	6300	78.8	88.1	89.9	87.2	87.8	87.8	89.3	91.2	92.7	94.5	97.3	96.7	90.3	88.4			143.9
NO. BLADES 26	8000	75.9	83.3	85.1	85.0	84.6	84.6	85.8	88.5	89.4	92.1	93.4	94.2	83.5	85.1			141.5
	10000	73.4	82.2	84.4	83.0	82.4	82.8	84.5	86.9	87.8	90.7	92.2	93.0	87.1	84.1			140.9
	12500	70.6	79.3	80.5	80.1	79.7	79.7	81.8	84.3	85.6	89.3	90.0	90.0	83.8	80.7			139.7
	16000	66.6	75.7	77.4	76.5	75.3	75.9	77.8	80.7	81.3	84.5	86.8	86.4	80.7	77.9			137.9
	20000	63.2	71.8	73.0	72.0	70.9	71.1	73.2	76.3	76.6	80.6	82.4	82.0	76.9	73.9			136.1
OVERALL MEASURED		92.7	97.3	99.6	98.9	98.9	99.1	100.4	101.7	102.6	104.1	106.0	106.4	102.5	102.9			
OVERALL CALCULATED		91.4	96.1	98.0	97.5	97.4	97.7	99.0	100.3	101.2	102.8	104.6	105.0	101.2	101.7			152.4
PNDB		106.2	110.5	112.6	112.6	112.5	112.8	114.2	115.3	116.0	117.1	119.2	119.6	114.5	115.0			

TABLE A12

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	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	65.8	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	69.8	71.0	72.0	72.9	74.4	73.4	72.5	72.3				121.6
TAMB 70. 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
TNET 63. DEG F	800	66.9	67.6	67.3	68.1	69.1	70.1	68.1	69.4	69.8	70.5	71.6	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	70.6	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	72.8	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				130.5
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				125.6
(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	73.5	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	65.6	67.6	63.6				123.8
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 A13

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	74.6	73.9	122.9
LOC PTO	125	68.3	68.7	67.9	67.4	68.8	66.1	68.5	69.2	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	66.9	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	70.7	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	68.3	68.5	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
HACT12.62 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	122.8
(.01262 KG/M3)	1600	69.6	71.4	70.6	70.1	70.2	72.2	69.3	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	80.3	83.1	85.0	86.1	132.5
(514. RAD/SEC)	2500	69.3	75.5	74.6	72.8	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	52.9	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	75.1	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	78.3	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	79.9	79.1	75.0	129.5
	12500	65.1	74.4	75.6	73.9	73.3	73.5	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	126.0
	OVERALL MEASURED	86.1	91.4	91.1	90.4	89.7	90.2	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
	PNDS	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 A14

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	77.5	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 FAN9	100	79.2	76.3	78.1	76.5	76.8	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	72.3	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	68.2	71.6	71.6	72.0	73.6	75.1	75.8	77.6	79.4				123.4
RUN 14. PT. 241.	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 S1159.	250	69.3	71.1	72.9	74.6	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	78.6	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	76.9	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	74.6	75.7	74.5	74.8	75.9	77.2	79.4	80.3	81.3	81.0				127.5
(294. DEG K)	630	72.3	74.7	74.3	73.0	75.6	77.6	77.2	78.1	80.9	81.2	83.0	82.9	53.6	81.4				130.0
TWET 63. DEG F	800	72.3	73.5	74.4	75.1	75.8	78.2	76.9	77.9	79.8	81.3	81.2	80.2	80.6	79.6				128.9
(290. DEG K)	1000	72.5	74.4	74.5	74.7	75.1	77.2	76.0	77.1	73.5	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	75.0	76.8	78.2	78.8	80.2	79.0	76.4				127.2
(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	79.4	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
NFD 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	73.6	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	79.8	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	75.2	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	70.6	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	70.4	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		88.4	93.1	94.7	92.9	92.7	92.8	91.3	91.9	93.2	94.8	96.9	97.9	96.9	96.9				145.6
PNDB		101.1	106.9	109.1	105.8	106.5	106.4	105.0	105.0	106.6	108.0	110.2	111.4	109.9	109.2				

TABLE A15

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	88.2	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
TWET 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				133.9
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	85.8	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	85.8	84.5	86.7	83.9	84.1	86.3	87.1	89.1	89.0	85.7	86.3				137.3
NFD 7488. RPM	5000	78.1	84.7	84.9	84.2	85.4	86.0	82.2	84.0	86.3	88.5	90.0	90.1	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	92.5	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	89.9	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	88.4	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	70.5	72.7	70.3	70.5	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				149.9
	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 A16

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 59.0%N_{fc} ; SMALL NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC, DATE - MONTH 9 DAY 14 HR, 15,4

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)	160, (2,79)	( )	( )	PNL
RADIAL 100, FT,	50	72,3	68,7	65,7	69,5	66,2	66,0	68,1	69,9	68,4	69,4	70,0	70,6	72,9	74,3	76,9			120,2
(30, M)	63	70,4	66,1	67,4	76,9	67,8	67,2	68,0	76,1	69,3	69,6	71,0	71,3	76,9	74,4	76,6			122,5
VEHICLE .5 FAN	80	68,2	65,8	68,0	69,7	68,1	67,8	68,5	68,0	70,0	69,8	71,0	71,5	72,7	74,3	75,7			120,2
CONFIG FAN B	100	72,3	64,9	71,5	71,3	67,4	67,1	67,7	68,0	69,6	70,0	70,1	72,5	72,0	72,7	72,7			120,1
LOC PPG	125	68,2	65,9	65,6	65,8	66,2	65,8	66,5	67,6	67,8	68,6	69,7	79,2	70,3	71,6	69,9			120,7
DATE 8/21/70	160	66,6	66,5	65,3	86,5	67,0	65,5	65,4	68,1	67,0	67,1	67,0	68,1	70,3	69,7	68,7			117,5
RUN 5, PT, 61	200	64,7	64,5	62,7	68,9	62,3	59,6	63,9	69,6	65,8	68,1	25,0	70,1	72,4	72,0	72,5			118,0
TAPE S1106,	250	63,0	60,2	64,8	65,9	65,9	66,9	68,9	70,4	71,6	70,2	25,0	75,1	75,4	76,1	75,0			121,1
BAR 28,8 HG	315	71,3	68,9	71,7	72,2	72,1	72,0	73,0	74,3	75,5	77,0	78,4	79,1	79,2	79,0	75,9			125,9
(97203, N/M2)	400	72,1	72,7	74,4	73,2	72,4	71,9	72,3	73,7	74,9	75,7	77,5	78,5	78,3	77,9	75,1			125,5
TAMB 74, DEG F	500	73,2	74,2	73,9	72,3	71,9	71,1	70,8	70,3	71,2	72,1	74,1	75,9	75,3	74,5	73,5			123,3
(296, DEG K)	630	73,8	74,3	75,8	75,6	74,1	73,5	73,8	74,5	76,4	77,8	80,1	81,4	80,8	78,0	76,7			127,6
TWET 65, DEG F	800	76,3	78,8	80,2	75,4	77,9	77,4	75,3	76,8	77,7	78,0	80,7	82,1	80,2	79,1	78,8			129,2
(291, DEG K)	1000	74,9	77,3	80,1	75,9	78,6	77,5	76,2	76,6	76,2	80,5	81,7	83,0	81,5	79,7	78,7			129,9
HACT13,06 GM/M3	1250	74,0	77,0	80,1	75,9	77,8	75,9	76,4	76,0	76,3	79,6	83,1	82,2	81,1	78,7	77,4			129,6
(,01306 KG/M3)	1600	75,2	79,4	81,2	80,2	78,6	76,3	77,6	77,6	78,7	81,3	84,7	82,6	82,8	80,6	77,9			131,2
NFA 4460, RPM	2000	78,4	84,5	84,0	82,7	82,2	81,8	81,4	81,3	81,5	84,5	88,3	84,1	84,8	82,9	80,9			133,9
(467, RAD/SEC)	2500	70,9	76,2	79,0	79,2	77,8	76,5	76,4	76,4	78,1	81,5	81,1	85,9	82,7	78,6	76,8			130,8
NFK 4417, RPM	3150	72,3	78,4	81,5	82,8	80,5	78,6	76,8	78,8	81,2	80,5	83,0	88,3	86,3	80,7	79,5			133,2
(462, RAD/SEC)	4000	75,3	85,9	86,2	85,0	84,1	82,1	80,2	81,7	84,1	82,3	88,1	86,9	87,0	85,1	82,6			135,7
NFD 7468, RPM	5000	74,5	82,6	83,6	81,8	81,4	80,4	78,8	79,7	80,4	81,6	85,1	86,1	84,2	81,6	78,3			133,5
(784, RAD/SEC)	6300	72,9	83,0	82,9	81,4	80,7	79,4	78,2	78,2	79,1	83,5	84,1	87,3	86,2	80,7	78,9			134,1
NO, BLADES 26	8000	71,1	80,7	83,0	81,5	80,0	78,0	74,7	77,2	78,6	81,5	82,1	84,8	83,9	79,8	77,2			133,1
	10000	70,3	80,9	81,7	77,8	78,7	75,4	74,5	75,5	75,2	78,3	81,0	82,2	81,5	77,4	74,7			132,1
	12500	67,0	77,7	78,3	75,9	75,4	73,6	70,4	71,2	72,1	75,7	76,4	78,0	76,8	74,1	71,3			129,7
	16000	64,6	75,7	75,6	73,3	72,1	70,1	67,2	67,9	67,8	65,7	73,4	74,7	73,4	71,0	68,8			128,2
	20000	65,2	72,7	72,3	70,2	68,4	66,7	64,5	64,4	64,5	67,9	68,8	70,7	69,3	67,0	67,2			127,4
OVERALL MEASURED		88,0	93,9	95,2	94,3	93,2	91,9	90,9	91,6	91,2	94,5	96,7	98,2	97,6	94,4	92,6			
OVERALL CALCULATED		87,0	92,5	93,7	92,8	91,7	90,4	89,3	90,2	91,3	92,9	95,0	96,6	95,9	92,9	91,2			144,2
PNDB		99,7	105,7	107,6	105,7	105,6	104,1	102,8	104,0	105,6	105,9	108,3	110,9	110,3	107,0	104,9			

TABLE A17

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 72.7%N_{fc} ; SMALL NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 9 DAY 14 HR. 16.5

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	74.6	72.8	71.7	74.0	72.1	71.4	71.3	74.1	74.0	75.0	75.7	77.0	79.3	82.3	85.4			126.4
(30. M)	63	71.2	69.1	69.7	97.3	70.8	71.3	71.9	77.0	73.9	75.1	85.0	77.6	76.8	82.8	85.2			128.2
VEHICLE .5 FAN	80	69.4	68.8	70.2	72.5	69.6	72.1	74.1	75.3	75.8	75.8	76.0	77.4	79.7	81.9	83.6			126.2
CONFIG FAN B	100	75.2	72.3	74.5	97.2	74.5	77.5	77.9	79.1	79.1	78.0	77.0	78.7	80.9	81.5	81.5			128.2
LOC PPG	125	70.6	68.9	69.9	69.9	70.3	70.9	71.4	72.1	73.0	74.0	75.1	80.9	76.7	78.8	77.6			124.7
DATE 8/21/70	160	69.4	69.7	69.7	68.8	69.8	69.3	70.8	71.2	70.9	72.8	73.9	74.2	75.6	76.5	76.7			122.5
RUN 5, PT. 64	200	70.1	74.1	73.9	72.0	73.5	73.6	73.1	73.9	72.9	77.0	78.9	77.8	79.8	81.2	81.4			126.4
TAPE S1107.	250	71.2	72.1	73.4	75.4	74.1	74.9	75.7	76.8	75.0	79.3	81.1	82.7	83.5	84.6	83.5			129.5
BAR 28.8 HG	315	74.9	75.1	77.3	97.3	77.6	77.8	78.4	80.4	81.1	83.0	84.2	85.3	85.9	86.1	83.6			132.1
(97203. N/M2)	400	75.6	77.1	79.2	97.8	78.1	77.3	77.9	80.7	81.7	82.9	83.9	84.5	84.3	83.8	81.1			131.6
TAMS 72. DEG F	500	77.5	78.2	77.8	76.7	76.2	75.5	74.7	75.5	77.0	78.2	79.7	81.2	81.3	80.5	79.1			128.4
(295. DEG K)	630	77.4	78.7	80.2	80.1	25.0	77.5	77.6	80.4	82.2	83.2	85.0	86.3	86.6	84.2	82.3			132.6
TWET 64. DEG F	800	81.4	83.6	84.2	82.1	81.2	81.1	79.9	81.2	82.6	83.1	85.2	85.7	84.1	85.2	82.5			133.1
(291. DEG K)	1000	80.1	82.3	84.3	82.8	81.9	81.7	80.4	82.0	83.5	85.4	87.3	88.6	86.6	84.7	84.0			134.9
HACT12.84 GM/M3	1250	79.7	82.8	85.0	84.2	82.7	82.1	81.1	82.2	83.3	85.3	88.0	87.2	83.1	83.4	82.2			134.8
(.01284 KG/M3)	1600	79.9	84.4	85.6	85.3	83.6	83.9	83.2	83.5	84.4	87.0	90.2	87.6	86.1	84.4	82.1			135.3
NFA 5510. RPM	2000	79.0	84.8	85.8	85.2	84.7	84.7	84.0	84.6	85.6	85.3	90.3	88.4	86.3	84.4	82.3			137.0
(577. RAD/SEC)	2500	77.7	85.2	86.2	85.7	85.1	85.2	84.4	84.1	85.4	89.9	89.5	93.1	87.8	85.4	84.5			138.2
NFK 5442. RPM	3150	76.8	82.9	85.4	87.1	85.1	84.1	82.4	84.4	85.7	86.1	85.1	93.7	90.0	84.9	83.8			137.9
(570. RAD/SEC)	4000	80.0	87.7	89.2	88.2	87.3	86.7	85.1	86.9	87.1	87.3	91.6	91.2	91.0	87.9	89.2			139.7
NFD 7488. RPM	5000	80.0	89.3	89.2	87.7	87.0	87.1	85.8	88.8	87.7	88.7	92.6	92.8	91.1	86.9	84.0			140.3
(784. RAD/SEC)	6300	77.2	87.6	87.2	85.1	85.1	84.3	84.1	84.2	85.1	89.4	90.5	92.4	88.8	84.8	83.2			139.2
NO. BLADES 26.	8000	76.0	86.2	87.9	85.6	84.9	84.0	81.3	83.8	84.3	88.1	88.9	90.7	87.7	84.6	82.1			139.7
	10000	75.1	85.4	84.9	83.2	84.0	82.6	81.5	82.1	82.7	85.1	87.5	86.5	85.3	82.2	79.7			137.9
	12500	71.7	83.3	83.7	82.5	80.8	80.0	77.7	78.3	79.5	83.1	83.5	85.7	81.4	79.4	76.6			136.0
	16000	68.1	81.2	80.9	99.4	77.6	76.5	74.3	74.4	75.0	77.9	81.2	82.1	78.3	76.5	73.7			134.6
	20000	65.4	77.4	77.3	75.6	73.6	72.6	69.7	70.0	70.2	74.6	76.5	79.0	74.2	71.9	70.4			133.4
OVERALL MEASURED		92.5	98.7	99.5	98.8	97.7	97.4	96.5	97.5	98.9	100.5	102.7	103.8	101.4	99.4	98.0			
OVERALL CALCULATED		91.1	97.3	98.1	97.3	96.1	95.8	94.8	95.9	97.1	99.0	101.5	102.2	100.0	97.7	96.7			149.6
PNDB		103.9	110.5	111.9	110.8	109.5	109.3	108.2	109.0	111.2	112.2	114.4	115.9	113.7	111.0	109.4			

TABLE A18

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 79.0%N_{fc} ; SMALL NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE = MONTH 9 DAY 14 HR. 16.5

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	73.2	73.7	73.2	74.9	73.1	73.6	74.2	75.5	75.4	76.7	77.8	76.9	81.7	85.2	88.7			128.8
(30. M)	63	72.0	71.6	71.9	77.8	73.0	73.6	74.1	78.1	76.0	77.1	78.4	79.8	82.8	86.2	89.2			129.6
VEHICLE .5 FAN	80	70.1	70.1	70.6	72.3	71.3	72.4	74.0	74.9	75.9	76.8	78.2	79.6	82.0	84.8	86.8			128.2
CONFIG FAN B	100	78.4	76.6	75.2	76.1	77.0	77.0	78.5	79.4	77.4	78.3	79.9	82.7	83.0	85.0	86.9			130.1
LOC PPG	125	72.8	71.5	72.2	92.4	72.6	73.2	73.7	74.9	75.5	76.6	78.0	81.7	79.9	82.2	81.1			127.1
DATE 8/21/70	160	72.1	70.8	70.9	70.2	71.2	70.9	72.0	72.8	73.4	74.5	75.6	76.7	78.1	79.7	79.8			124.6
RUN 5. PT. 65	200	78.3	77.2	72.2	73.6	74.5	79.2	76.9	75.3	75.5	82.7	83.1	82.1	83.4	85.3	85.6			130.3
TAPE S1107.	250	71.7	72.9	74.5	76.3	75.4	78.4	77.9	78.9	79.9	81.8	83.6	85.7	87.1	88.1	86.7			132.3
BAR 28.8 HG	315	77.8	77.7	80.1	80.3	80.4	81.1	81.0	83.0	83.8	85.7	86.8	88.5	89.3	89.5	87.2			135.1
(97203. N/M2)	400	79.8	79.9	82.0	80.7	80.1	79.5	81.2	81.5	84.1	85.3	86.7	87.2	87.4	86.9	84.2			134.2
TAMB 72. DEG F	500	79.9	80.6	80.3	79.1	79.4	78.0	77.8	78.3	79.5	81.2	82.9	84.4	84.5	83.8	82.2			131.4
(295. DEG K)	630	80.9	83.5	84.8	83.6	83.9	82.2	81.7	82.9	84.7	86.2	86.6	90.2	89.9	87.6	85.9			136.3
TWET 64. DEG F	800	84.4	86.7	87.3	85.8	84.8	84.2	83.1	83.7	85.5	85.5	87.5	88.9	87.1	86.3	86.0			136.3
(291. DEG K)	1000	83.0	85.5	87.3	85.7	84.7	84.0	83.7	84.8	86.4	88.4	90.0	91.6	88.7	87.1	87.1			137.7
HACT12.84 GM/M3	1250	82.6	85.5	88.0	87.4	88.4	85.0	84.9	84.3	86.3	88.4	91.7	91.0	87.8	86.4	85.3			138.1
(.01284 KG/M3)	1600	82.5	86.7	88.2	88.7	87.4	87.3	86.3	86.4	87.3	89.4	92.8	90.6	88.4	87.0	84.9			139.1
NFA 5990. RPM	2000	81.3	86.8	87.9	87.5	87.7	87.5	87.7	87.9	88.4	90.9	92.9	91.2	88.1	86.5	84.6			139.6
(627. RAD/SEC)	2500	80.9	89.1	89.0	87.6	88.3	88.0	86.9	87.5	88.4	91.6	90.6	97.5	90.3	87.8	85.3			141.1
NFK 5916. RPM	3150	78.7	84.8	87.5	88.9	87.6	88.7	85.2	87.7	89.6	88.9	89.9	96.6	91.9	87.1	86.0			140.6
(619. RAD/SEC)	4000	81.6	88.9	90.7	89.8	89.1	88.7	87.6	89.9	91.7	89.8	94.0	93.6	92.4	89.8	87.0			141.9
NFD 7488. RPM	5000	81.8	89.6	90.9	89.8	89.1	89.2	88.7	89.8	91.0	91.7	95.5	95.3	90.0	88.8	85.7			142.5
(784. RAD/SEC)	6300	78.9	88.7	88.5	87.6	87.1	88.6	86.9	87.4	88.0	92.3	93.0	94.7	90.0	86.9	85.2			141.4
NO. BLADES 26	8000	77.9	87.6	89.8	89.3	87.3	88.1	84.3	87.3	88.5	91.4	92.0	93.7	89.5	87.0	84.3			141.5
	10000	76.9	87.5	89.5	85.8	86.0	84.5	84.3	85.3	85.8	88.0	90.2	90.9	85.9	84.5	81.9			140.2
	12500	73.5	84.3	85.4	84.1	82.9	81.9	80.6	81.8	83.0	86.5	86.6	88.4	83.5	81.6	73.7			138.5
	16000	69.8	82.1	82.5	81.1	79.8	78.5	77.3	78.1	78.6	81.7	84.6	85.1	80.9	78.6	75.7			137.3
	20000	66.6	78.0	79.1	77.4	75.9	74.6	72.7	73.6	73.7	79.2	80.8	80.4	77.6	74.3	72.2			136.0
	OVERALL MEASURED	95.2	100.4	101.7	100.9	100.3	99.9	99.3	100.4	101.7	103.2	105.4	106.8	103.5	102.1	100.7			
	OVERALL CALCULATED	93.6	99.0	100.3	99.4	98.8	96.3	97.7	98.8	100.0	101.7	103.7	105.2	101.9	100.6	99.7			152.2
	PNDB	105.0	112.0	113.4	112.7	112.1	111.6	111.0	112.5	113.9	114.6	117.1	118.9	115.5	113.6	111.7			

TABLE A19

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 90.6%N_{fc} ; SMALL NOZZLE ; UNTREATED

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 8 DAY 31 HR. 6.3

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	77.2	76.6	74.6	76.6	76.1	76.9	77.7	79.1	79.6	80.7	81.5	82.9	85.7	90.0	94.0	133.2
(30. M)	63	74.3	74.8	75.3	80.1	76.7	77.4	78.0	80.7	80.2	81.6	83.1	84.5	87.7	91.7	95.3	134.6
VEHICLE .5 FAN	80	72.6	73.8	74.3	75.9	75.3	76.2	77.3	78.7	79.9	81.0	82.6	84.2	87.3	90.9	93.4	133.5
CONFIG FAN B	100	76.1	75.6	74.6	77.7	77.6	76.4	79.3	80.0	82.6	83.7	83.4	87.2	87.5	90.3	90.9	133.8
LOC PPG	125	78.1	76.5	76.5	78.5	80.0	79.6	80.5	79.9	84.7	86.8	84.6	91.2	86.2	89.4	87.1	135.0
DATE 8/21/70	160	74.8	73.9	73.8	73.9	74.8	74.4	75.7	76.3	77.2	76.6	79.9	81.6	83.3	85.5	86.1	129.4
RUN 5, PT. 76	200	74.4	74.5	73.4	75.1	75.1	76.3	75.7	77.7	78.9	80.6	83.3	86.0	85.8	90.8	90.0	133.3
TAPE S1108.	250	76.7	77.2	78.6	81.0	80.2	80.8	81.2	83.0	84.3	86.1	88.2	90.5	93.0	94.4	92.5	137.6
BAR 28.8 HG	315	80.7	81.2	83.9	83.8	83.8	84.1	85.3	86.5	88.6	89.8	91.8	93.4	94.8	95.5	92.6	140.0
(97220. N/M2)	400	81.6	82.0	83.6	82.6	82.6	82.4	83.8	85.0	87.3	88.4	90.2	91.0	91.4	91.2	88.8	137.7
TAMB 70. DEG F	500	81.2	81.4	80.8	80.7	79.9	80.2	80.1	81.0	82.5	84.3	86.1	88.0	86.3	87.7	85.3	134.3
(294. DEG K)	630	78.6	80.4	80.6	80.5	80.1	81.2	81.8	84.2	86.5	87.7	90.0	91.5	91.9	89.8	87.0	137.2
TWET 63. DEG F	800	79.5	81.2	82.3	81.5	81.9	82.4	82.7	84.1	86.0	86.9	88.6	89.0	88.4	86.9	85.2	135.9
(290. DEG K)	1000	79.2	81.1	82.0	81.9	82.2	82.9	83.2	84.7	86.4	88.5	90.6	91.3	89.0	87.3	86.2	137.1
HACT 12.63 GM/M3	1250	78.4	80.6	83.4	82.2	82.5	82.9	83.0	83.6	84.9	87.1	90.2	89.6	87.3	85.6	84.0	136.2
(.01263 KG/M3)	1600	80.0	83.4	84.3	83.8	84.0	84.0	84.4	85.2	86.4	88.5	91.6	89.7	87.5	86.4	84.5	137.4
NFA 6860. RPM	2000	78.9	83.8	83.4	83.2	83.6	84.1	85.5	85.8	86.8	89.6	91.6	89.4	86.2	85.4	83.6	137.6
(718. RAD/SEC)	2500	78.0	84.1	85.4	86.1	85.3	84.5	85.0	85.8	87.1	90.3	90.1	95.3	87.3	85.5	84.0	139.1
NFK 6788. RPM	3150	84.2	90.9	94.6	95.5	94.6	91.3	90.7	92.2	93.2	92.7	94.9	101.1	95.0	92.6	90.6	145.5
(711. RAD/SEC)	4000	79.7	86.4	87.7	85.8	86.2	86.5	86.8	90.0	92.0	90.4	94.5	93.2	90.7	85.7	86.1	141.2
NFD 7488. RPM	5000	80.6	87.7	88.4	86.9	86.6	86.8	88.2	90.4	91.2	92.7	96.2	95.0	80.7	88.2	85.1	142.2
(784. RAD/SEC)	6300	82.1	91.9	91.7	90.1	90.6	89.1	90.3	90.6	91.7	95.7	96.0	97.8	91.5	90.0	87.7	144.5
NO. BLADES 26	8000	77.4	86.1	88.6	88.0	86.7	86.0	85.4	89.1	90.6	92.7	94.4	94.8	89.6	87.2	84.5	142.5
	10000	76.6	86.3	87.9	87.0	86.1	84.9	85.8	87.9	88.6	90.5	93.8	93.1	88.4	85.6	82.6	142.1
	12500	71.4	82.5	83.7	83.6	82.6	81.8	82.0	85.4	86.1	89.3	88.9	90.5	83.7	80.8	77.5	140.1
	16000	69.0	80.1	80.9	80.4	79.5	78.6	78.6	80.5	81.4	84.2	87.1	86.9	81.7	79.4	77.3	138.6
	20000	65.9	75.7	76.9	76.2	75.1	74.3	73.7	76.0	77.0	81.3	82.8	83.1	76.3	76.2	75.9	137.3
OVERALL MEASURED		94.5	99.9	101.4	101.2	100.8	99.7	100.2	101.8	103.1	104.6	106.7	108.5	105.3	105.2	104.2	
OVERALL CALCULATED		93.1	98.4	99.9	99.8	99.3	98.2	98.6	100.3	101.6	103.3	105.2	106.9	103.9	103.8	103.3	153.6
PNDB		106.8	112.3	114.6	114.9	114.3	112.6	112.7	114.2	115.5	116.6	118.4	121.6	117.3	115.9	114.2	

TABLE A20

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100' (30.5M) ARC ; 58.6%N_{fc} ; SMALL NOZZLE ; TREATED

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	71.8	68.9	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	64.8	65.6	66.8	67.3	65.9	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	76.5	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 9/19/70	160	64.3	64.9	65.5	66.5	65.5	63.1	65.8	66.8	66.9	66.0	66.3	67.0	68.8	69.1				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 S1156.	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
TWET 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
HACT11.90 GM/M3	1250	70.2	72.9	74.2	73.2	73.2	74.3	72.6	73.6	75.2	76.3	79.8	79.5	80.5	76.8				126.6
(.01190 KG/M3)	1600	70.6	74.2	73.8	73.3	73.2	75.0	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	72.4	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	66.2	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 7488. 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	81.0	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	71.0	71.3	72.0	73.9	75.7	77.3	78.1	76.1				129.0
	12500	65.7	76.2	77.5	75.7	74.3	74.2	68.0	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	69.4	63.8	66.3	63.6	65.6	68.5	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	84.6	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	98.6	99.1	100.1	101.2	103.1	105.0	105.3	104.3				

TABLE A21

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	62.0	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	74.5	74.7	71.2	73.7	73.5	75.1	75.2	76.2	77.1	78.9	80.1			125.3
LOC PT0	125	69.2	69.5	70.3	69.6	70.8	67.6	71.3	71.8	72.3	73.4	75.0	74.7	76.4	77.6			122.8
DATE 9/19/70	160	68.9	70.9	70.2	70.8	72.1	67.4	70.8	70.9	70.6	72.1	73.4	74.2	76.1	76.4			122.2
RUN 13. PT. 222	200	72.6	76.6	73.8	76.5	78.8	72.3	74.5	74.6	73.0	76.7	77.9	79.8	81.4	81.5			127.2
TAPE S1156.	250	68.5	71.1	72.5	75.9	74.8	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	78.3	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	76.5	77.7	77.6	76.8	78.2	76.4	78.8	80.6	81.3	83.8	84.8	85.4	82.9			131.1
TWET 65. DEG F	800	78.3	80.7	80.9	79.3	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	76.9	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	79.5	78.8	78.2	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	78.6	78.6	80.6	78.3	79.7	81.5	83.4	85.9	86.0	86.3	82.4			132.8
NFA 5510. RPM	2000	74.7	79.6	78.7	78.0	79.0	80.8	77.8	79.4	81.2	82.9	84.5	85.8	85.6	81.3			132.4
(577. RAD/SEC)	2500	77.6	83.8	83.5	81.9	82.3	83.7	78.6	78.4	79.0	81.4	82.9	85.9	85.8	84.1			133.3
NFK 5412. RPM	3150	71.8	80.6	82.7	81.2	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	84.1	83.1	81.4	82.5	79.2	79.9	81.3	82.8	85.0	86.6	86.3	84.6			134.3
NFD 7488. RPM	5000	78.3	85.9	85.7	85.1	85.1	84.8	79.5	81.3	82.4	84.3	86.5	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	79.0	80.1	83.3	85.6	86.9	86.4	83.3			135.2
NO. BLADES 26	8000	74.7	84.9	86.0	85.1	82.9	84.1	79.5	79.7	79.8	81.5	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	78.7	81.0	82.7	83.8	82.8	82.1			133.2
	12500	71.1	82.2	83.2	81.5	80.5	80.6	75.3	75.2	75.7	77.6	79.4	80.7	78.8	80.0			133.7
	16000	67.5	79.1	80.3	77.4	77.2	77.2	72.0	71.4	71.4	73.7	75.8	76.9	75.7	75.8			132.1
	20000	65.0	75.7	76.7	74.1	73.3	73.9	68.5	69.1	68.4	70.3	72.1	73.2	72.1	71.4			131.2
OVERALL MEASURED		89.8	95.8	96.2	95.3	94.6	95.1	92.5	93.2	94.5	96.2	98.4	99.6	99.6	97.8			
OVERALL CALCULATED		88.7	94.8	95.2	94.3	93.5	93.9	91.2	92.1	93.2	94.8	96.9	98.1	97.9	96.6			146.2
	PNDB	101.3	107.7	107.8	107.2	106.7	106.9	103.8	104.7	105.8	107.5	109.7	111.5	110.9	109.1			

TABLE A22

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	76.5	75.2	74.7	75.4	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	75.2	72.7	65.9	73.2	77.8	75.6	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				125.8
DATE 9/19/70	160	70.3	70.7	70.9	70.5	71.4	65.8	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	76.5	78.1	79.7	80.7	79.9	80.4	80.4	82.8	83.1	84.7	87.0	88.3	89.1	89.0				134.6
(97756. N/M2)	400	78.0	79.2	81.3	80.2	79.8	80.1	80.1	81.0	83.1	84.7	86.4	85.8	86.7	85.6				133.3
TAMB 78. DEG F	500	76.0	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	79.6	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	76.7	81.6	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	88.0	86.6				136.6
NFD 7488. RPM	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	88.9	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				137.8
	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	95.5	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	105.1	106.4	107.1	108.4	110.1	112.5	113.6	112.7	111.4				

TABLE A23

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

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

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	78.4	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 S1157.	250	73.8	76.6	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 76. 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				135.7
(.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	84.6				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	85.6	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	81.3	82.5	83.5	85.9	87.4	87.8	85.2	84.1				135.2
	12500	71.7	82.1	84.2	82.8	82.4	82.4	78.8	79.5	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	115.4	113.3	112.1	112.3	110.4	110.4	111.2	113.0	115.6	116.4	114.5	115.3				

TABLE A24

X. NOMENCLATURE

A	Nozzle Area
B&K	B&K Instruments, Inc. - Bruel & Kjaer Precision Instruments
D.I.	Directivity Index, the sound pressure level at a particular position and frequency minus the spaced average sound pressure level at that frequency.
f_1	Fan blade passing frequency fundamental
f_2	Fan blade passing frequency second harmonic
F_n	Net engine thrust
M_o	Aircraft Mach Number
$N/\sqrt{\theta}$	Fan rotational speed, corrected to standard day
Nom.	Nominal
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.B.	Octave band
O.G.V.	Outlet guide vane
P_{T23}/P_{T2}	Ratio of fan bypass exit total pressure to fan inlet total pressure
PNL	Preceived noise level; a calculated, annoyance weighted sound level
PWL	Sound power level, Re 10^{-13} watts
QEP	Quiet Engine Program
RMS	Root mean square
SL	Sideline
SLS	Sea level static
SPL	Sound pressure level, Re .0002 dynes/cm^2
V_{plane}	Aircraft velocity
$\frac{W_{bypass}\sqrt{\theta}}{\delta}$	Bypass air flow, corrected to standard day

dB	Decibel
Hz	Hertz (cycles per second)
ips	Inches per second
PNdB	Preceived noise decibel

XI. REPORT DISTRIBUTION LIST

Addressee:			Number of Copies
1. NASA Lewis Research Center 21000 Brookpark Road Cleveland, Ohio 44135 Attention:			
Report Control Office	MS:	5-5	1
Technology Utilization Office	MS:	3-19	1
Library	MS:	60-3	2
Dr. B. Lubarsky	MS:	3-3	1
A. Ginsburg	MS:	5-3	1
M.J. Hartmann	MS:	5-9	1
W.A. Benser	MS:	5-9	1
T.F. Gelder	MS:	5-9	1
S. Lieblein	MS:	100-1	1
J.H. Povolny	MS:	60-4	1
L.W. Schopen	MS:	77-3	2
N.D. Sanders	MS:	100-1	1
J.C. Williams	MS:	500-111	1
James J. Kramer	MS:	7-1	1
A.A. Medeiros	MS:	7-1	20
2. NASA Headquarters 600 Independence Avenue, S.W. Washington, D.C. 20546 Attention:			
N.F. Rekos (RL)			1
R. Ziem (RL)			1
H. Rochen (RL)			1
3. FAA Headquarters 800 Independence Avenue, S.W. Washington, D.C. 20553 Attention:			
John Powers			1
W.C. Sperry			1
4. National Technical Information Service Department of Commerce Springfield, Virginia 22151			40

		Number of Copies
5. NASA Langley Research Center Hampton, Virginia 23365 Attention:		
Donald Baals	MS: 403	1
Harvey Hubbard	MS: 239	1
Mark Nichols	MS: 403	1
John Becker	MS: 186	1
I. E. Garrick	MS: 115	1
6. NASA Ames Research Center Moffett Field, California 94035 Attention:		
David Hickey	MS: 221-2	1
7. NASA Flight Research Center P. O. Box 273 Edwards, California 93523 Attention:		
Norman McLeod	Room 2100	1
Don Bellman	Room 2106	1
8. Office of Secretary of Transportation 800 Independence Avenue, S.W. Washington, D. C. 20590 Attention:		
Charles Foster	TRT-30	1
9. Naval Air Propulsion Test Center Aeronautical Engine Department Philadelphia, Pennsylvania 19112 Attention:		
Robert Benham		1
10. Naval Air Systems Command Washington, D. C. 20360 Attention:		
Eugene Lichtman	Code Aer 330E	1
11. U. S. Army Aviation Material Laboratory Fort Eustes, Virginia Attention:		
John White		1
12. Headquarters, USAF Wright Patterson AFB, Ohio 45433 Attention:		
Zeke Gershon	Building 18	1
J. L. Wilkins	SESOS	1
S. Kobelak	APTP	1
R. P. Carmichael	SESSP	1

			Number of Copies
13.	Department of Navy Bureau of Weapons Washington, D.C. 20525 Attention:		
	Robert Brown	RAPP14	1
14.	The Boeing Company 3801 South Oliver Street Wichita, Kansas 67210 Attention:		
	George Gregg	MS: 16-17	1
	Steve Storch	MS: 16-12	1
	Dean Nelson	MS: 16-31	1
15.	The Boeing Company Commercial Airplane Division Renton, Washington 98055 Attention:		
	J. F. McBride	MS: 47-35	1
	J. V. O'Keefe		1
16.	The Boeing Company P. O. Box 3707 Seattle, Washington 98124 Attention:		
	G. J. Schott	MS: 73-24	1
17.	Douglas Aircraft Company 3855 Lakewood Boulevard Long Beach, California 90801 Attention:		
	J. E. Merriman	C1-250	1
18.	Allison Division, GMC P. O. Box 894 Indianapolis, Indiana 46206 Attention:		
	L. Corrigan	Dept. 8890	1
	P. Tramm	Dept. 8894	1
	Library		1
19.	Pratt and Whitney Aircraft Division, UAC East Hartford, Connecticut 06108 Attention:		
	C. W. Bristol		1
	J. D. Kester		1
	A. A. Mikolajczak		1
	Library (UARL)		1

			Number of Copies
20.	Pratt and Whitney Aircraft Florida Research and Development Center West Palm Beach, Florida 33402 Attention:		
	H. D. Stetson		1
	B. A. Jones		1
21.	Lockheed Aircraft Corporation P. O. Box 551 Burbank, California 91503 Attention:		
	Harry Drell	Code 61-30	1
22.	Lockheed Missile and Space Company P. O. Box 879 Mountain View, California 94040 Attention:		
	Raymond Poppe	Dept. 80-91	1
23.	Lockheed Georgia Company Marietta, Georgia 30060 Attention:		
	H. S. Sweet	Dept. 72-71	1
24.	Northern Research and Engineering 219 Vassar Street Cambridge, Massachusetts Attention:		
	K. Ginwala		1
25.	Curtiss-Wright Corporation Wright Aeronautical Woodridge, New Jersey Attention:		
	S. Lombardo		1
26.	Air Research Manufacturing Company 402 South 36th Street Phoenix, Arizona 85034 Attention:		
	R. O. Bullock		1
27.	Air Research Manufacturing Company 8951 Sepulveda Boulevard Los Angeles, California 90009 Attention:		
	Linwood Wright		1

	Number of Copies
28. AVCO Corporation Lycoming Division 550 South Main Street Stratford, Connecticut 06497 Attention:	
David Knoblock	1
Clause Bolton	1
29. Ford Tractor Operations, FMC 2500 E. Maple Road Birmingham, Michigan 48012 Attention:	
Ver Ploeg	1
30. Teledyne Cae 1330 Laskey Road Toledo, Ohio 43601 Attention:	
Eli Bernstein	1
31. Solar San Diego, California 92112 Attention:	
P. A. Pitt	1
32. Williams Research Corporation P. O. Box 95 Walled Lake, Michigan Attention:	
J. Joy	1
33. Caterpillar Tractor Company Peoria, Illinois 61601 Attention:	
J. Wiggins	1
34. Iowa State University Dept. of Mechanical Engineering Ames, Iowa 50010 Attention:	
George Serovy	1
35. Cornell University Aerospace Engineering Department Ithaca, New York 14850 Attention:	
W. R. Sears	1

			Number of Copies
36.	California Institute of Technology Pasadena, California 91109 Attention: Duncan Rannie		1
37.	Massachusetts Institute of Technology Cambridge, Massachusetts 02139 Attention: J. L. Kerrebrock		1
38.	University of Toronto Institute of Aerospace Studies Toronto, Canada Attention: H. S. Ribner		1
39.	Ministry of Technology National Gas Turbine Establishment Pyestock, Farnborough, Hants. England Attention: Michael Neale		5
40.	Institute of Sound and Vibration Research The University, Southampton SO9 5NH England Attention: John Large		1
41.	Rolls-Royce Limited Aero Engine Division P. O. Box 31 Derby, England Attention: L. G. Dawson		1
42.	Rolls-Royce Limited Flight Test Establishment Hucknall, Nottingham, England Attention: J. S. B. Mather	Dept. 428F	1
43.	Rolls-Royce Limited Flight Test Establishment Hucknall, Nottingham, England Attention: M. E. House		1

Number of Copies

44. Hawker-Siddeley Aviation Ltd.
Hatfield, Hertz.
England
Attention:
E. D. G. Kemp — 1

45. Massport
Aviation Technical Service Division — 1
470 Atlantic Avenue
Boston, Massachusetts 02210
Attention: George Bender, Jr.