R73AEG148

NASA CR-134501

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ACOUSTIC TESTING OF A SUPERSONIC TIP SPEED FAN WITH ACOUSTIC TREATMENT AND ROTOR CASING SLOTS

(Quiet Engine Program Scale Model Fan C)

by

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GENERAL ELECTRIC COMPANY

Prepared For

National Aeronautics and Space Administration

NASA Lewis Research Center

Contract NAS3-13430

1 Report No.	2. Government Accession No	3 Recipient's Catalog No
NASA CR-134501		

4 Title and Subtitle	5 Report Date
ACOUSTIC TESTING OF A SUPERSONIC TIP SPEED FAN WITH ACOUSTIC TREATMENT AND ROTOR CASING SLOTS (Quiet Engine Program Scale Model Fan C)	October 1973
	6 Performing Organization Code
7. Author(s) S.B. Kazin	8. Performing Organization Report No R73AEG148
	10. Work Unit No
9. Performing Organization Name and Address General Electric Company Aircraft Engine Group Evendale, Ohio 42515	11. Contract or Grant No NASA3-12430
	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

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NASA Lewis Research Center
Cleveland, Ohio

16 Abstract

Acoustic tests were conducted on a high tip speed (1550 ft/sec, 472.44 m/sec) single-stage fan with varying amounts of wall acoustic treatment and with circumferential slots over the rotor blade tips. The slots were also tested with acoustic treatment placed behind the slots. The wall treatment results showed that the inlet treatment is more effective at high fan speeds and aft duct treatment is more effective at low fan speeds. Maximum PNL's on a 200-foot (60.96 m) sideline showed the untreated slots to have increased the rear radiated noise at approach. However, when the treatment was added to the slots the inlet radiated noise was decreased, resulting in little change relative to the solid casing on an EPNL basis.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Acoustics, Turbofan Source Noise Reduction	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	91	$3.00

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

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I. SUMMARY

An acoustic test program was conducted on a 36 inch (91.44 cm) in diameter scale model (0.527 linear scale) of the outer flowpath of the high tip speed, single-stage Fan C of the NASA Quiet Engine Program. The fan had a design point pressure ratio of 1.6 at a tip speed of 1550 ft/sec (472.44 m/sec). Six configurations were tested with varying amounts of acoustic treatment and with slots above the rotor blade tips.

Table I summarizes the front and rear quadrant maximum 200-foot (60.96 m) sideline PNL's for each configuration. Full nacelle treatment (typical of present day quiet engines, i.e., CF6) reduced the front maximum noise by 8.3 PNdB at takeoff power (90% corrected fan speed). At approach power (57.5% corrected fan speed) the front reduction was 7.2 PNdB. The aft duct suppression was more effective at approach than at takeoff.

A massive aft suppressor was added to isolate the inlet radiated noise. The results show that the noise in the front quadrant is totally inlet radiated even without the suppressor.

Finally, a circumferentially slotted tip casing was employed in order to determine the acoustic effect of slots designed to improve fan stall margin. Acoustic treatment was also placed behind the slots to determine if any suppression could be obtained. As Table I shows the slots increased the aft quadrant noise over the frame treatment solid casing levels, particularly at approach. The addition of the treatment reduced the levels slightly.

The noise levels extrapolated to level flight produced results similar to Table I for the treated configurations. In the case of the slotted tip casing, however, the reduction in front radiated noise with the treated slots at approach (2.1 PNdB relative to frame treatment in Table I) results in little EPNdB increase. Table II summarizes the result of EPNL extrapolation.

Table I. Maximum 200-Foot (60.96 m) Sideline PNL (Full Scale, Nominal Operating Line).

	Takeoff		Approach	
Configuration	Aft	Front	Aft	Front
Untreated	119.7	123.1	105.8	105.3
Frame Treatment	117.2	120.4	102	102.6
Full Nacelle Treatment	112	114.8	96.2	98.1
Massive Aft Suppression	110.5	114.9	94.5	98.3
Slotted Tip (Untreated)*	118	120	104.2	101.4
Slotted Tip (Treated)*	117.3	119.8	103.7	100.5

*Slotted configurations include Frame Treatment. The Slotted Tip (Treated) implies treatment behind the slots.

Table II. Level Flyover* EPNL, Fan and Predicted Core Jet, Single Engine.

Configuration	Takeoff 1000' (304.8 m) Alt	Approach 370' (112.8 m) Alt
Untreated	105.2	96.7
Frame Treatment	101.2	93.2
Full Nacelle Treatment	95.4	89.8
Slotted Tip (Untreated)	101.7	94.9
Slotted Tip (Treated)	100.9	93.6

* Flight Mach No. = 0.25

II. INTRODUCTION

From an engine system viewpoint, a high tip speed fan is desirable when high specific fan thrust is required. This is because the high speed fan can produce the needed pressure rise in a single stage and with fewer low pressure turbine stages. However, the high tip speed fan poses a unique noise problem in the form of shock or multiple pure tone (MPT) noise. Typical spectral characteristics of this type of noise are shown in Figure 1.

Recognizing this fundamental difference between the noise signatures of high and low tip speed fans, two basic fan designs were evolved for the Quiet Engine Program.[1,2] One of the low speed fans (two were designed) and the high tip speed fan were not only built in full scale (for 22,000 pound, 97,900 newtons, thrust engines), but also partially modeled in approximately one-half scale size.[3] In these scale models only the bypass flow portion of the fan flowpath was modeled.

This report is concerned with the high tip speed fan scale model - Fan C. Six configurations of this fan are considered:

1. No acoustic treatment
2. Fan frame treatment
3. Full nacelle wall treatment
4. Full nacelle wall treatment with a massive aft suppressor
5. Slotted tip casing (untreated)
6. Slotted tip casing (treated)

(A detailed description of each configuration is contained in the next section of this report.)

The untreated vehicle serves as a baseline for the test series. Fan frame treatment was an intermediate treatment configuration which was defined as that treatment which would normally be supplied by the engine manufacturer, as opposed to treatment applied to the inlet and exhaust nacelles which are usually associated with the installed engine. For the next level of suppression, the nacelle treatment was added. This treatment is as extensive as might be found in the newest generation of high bypass turbofan engines.

The nacelle treatment with the massive aft suppressor was utilized to determine the extent of the inlet radiation in this configuration. This suppressor was designed to effectively eliminate the aft generated noise radiated to the front quadrant.

Slots above the rotor had been demonstrated to improve fan stall margin.[4] However, the effect these slots would have on a fan noise generation were unknown. In addition, since the slots were above the rotor, it was determined that acoustic treatment could be placed behind the slots and possibly afford increased noise suppression. Thus, the slots were run with and without the treatment behind the slots.

III. VEHICLE AND TEST FACILITY DESCRIPTION

The relationship of the scale model to the full-scale fan is shown in Table III and Figure 2. Except for the radius ratio difference all dimensions and aerodynamic parameters obey the usual scaling rules. The radius ratio divergence is shown in Figure 2 by the dashed lines. Motive power for the fan is through a front shaft as shown in the photograph in Figure 3.

Figure 4 shows the sound field and the acoustically enclosed drive engine. Microphones are placed every 10 degrees from 30 degrees to the inlet axis around to 160 degrees. The microphone arc is 100 feet (30.48 m) centered at the fan inlet hub; while the field between the microphones and the vehicle is covered with asphalt.

Figure 2 also shows the location of the acoustic treatment for both the frame and nacelle treatment. The full nacelle includes the frame and nacelle treatments. In each segment the treatment is made up of 1/2 inch (1.3 cm) of polyurethene foam covered with a perforated plate having a porosity of 22-1/2%. The holes are 1/16 inch (0.2 cm) in diameter. For untreated configurations, these treated areas were made acoustically "hard" by covering them with metal impregnated tape.

Also shown in Figure 2 is the massive aft suppressor. This piece of hardware was employed to help isolate the front end noise by effectively eliminating the rear radiated noise. The suppressor is 43 inches (109.22 cm) long and contains a 20-inch (50.8 cm) splitter. All surfaces are treated with polyurethene foam covered with a perforated face plate. The suppressor was designed so as not to increase the backpressure on the fan by increasing the flow cross sectional area to account for the splitter and boundary layer buildup.

A cross section of the slotted tip casing is shown in Figure 5. The number of circumferential slots was determined from previous aerodynamic testing[4] as providing the best of increased stall margin and smallest efficiency loss. From the acoustic viewpoint these slots may also be better since, as opposed to axial or oblique slots, the circumferential slots do not present a periodic geometry change relative to the rotor blades.

Outside of the slots the single-degree-of-freedom acoustic treatment can be seen. This treatment is coupled to the slots by holes drilled through the bottoms of the slots. The surface porosity is approximately 11%. This design results in a Helmholtz resonance of about 2500 Hz and a 1/4 wave resonance of 6700 Hz.

Table III. Scale Model and Full-Scale Fan Design Parameters.

Parameter	Scale Model	Full Scale
Diameter, in. (cm)	36.0 (91.44)	68.3 (173.48)
Design Tip Speed, ft/sec (M/sec)	1550 (472.44)	1550 (472.44)
Design Pressure Ratio	1.6	1.6
Weight Flow, lb_m/sec (kg/sec)	187 (84.9)	850 (385.9)
Radius Ratio	.57	.36
Number of Blades	26	26
Blade-to-Vane Spacing, chords	2.0	2.0
Number of Vanes	60	60

IV. TEST PROGRAM AND DATA ANALYSIS

Each configuration was setup on the test facility and run through its operating speed range (50 to 100%) in sufficient steps (10 or 11 points per operating line) to fully define part power characteristics. In addition the untreated, frame treatment, and full nacelle configurations were run with exhaust nozzle areas which were smaller (6%) and larger (16%) than the nominal nozzle.

Noise data were recorded at each microphone for two minutes at each corrected speed point. This procedure was repeated once so that all data are the average of two points unless otherwise stated. The recorded data were processed through a General Radio 1/3-octave band analyzer utilizing a 32-second averaging time. Standard correction factors[5] were applied to bring these data to a standard day of 59° F and 70% relative humidity.

The data represented, of course, the noise signature of the scale model. In order to better assess the PNL results, these data were scaled to full scale by adding a factor of 10 log of the ratio of the full scale to scale model weight flows to all the data and shifting the frequency down by the ratio of the blade passing frequencies of the full scale and scale model. Unless otherwise noted, all the data presented in this report are full scale.

Also of interest are extrapolation of these data to flight. The flight noise calculation was enhanced by adding a predicted core jet and accounting for the relative velocity effect. Core jet noise and relative velocity effects were predicted according to published SAE practices[6].

V. NACELLE TREATMENT

A. Static 200-Foot (60.96 m) Sideline Data

The extent of the nacelle treatment is shown in Figure 2 along with frame treatment and massive aft suppressor cross sections.

Figure 6 shows the PNL at takeoff fan speed (90% corrected). Characteristically, the high speed fan has its peak noise in the front quadrant - at 70 degrees. The addition of frame treatment reduces the front peak by 2.7 PNdB and the rear peak by 2.5 (comparing 120 degrees untreated to 130 degrees treated). Further addition of treatment to the full nacelle reduces the front noise by 8.3 PNdB and the rear noise by 7.7 PNdB relative to the untreated case. In each configuration, however, the fan remains front dominated.

Finally, the addition of the massive aft suppressor shows an insignificant change in the noise level. This signifies that the front radiated noise dominates the PNL's.

Figures 7 and 8 are spectral comparisons at, respectively, 70 and 120 degrees for the takeoff condition. The spectral peak at 500 Hz is controlled by multiple pure tones. At 70 degrees these tones dominate the spectrum; while the 120 degree data show the blade passing frequency (2 KHz) to be at about the same level as the 500 Hz band. Addition of the frame treatment reduced the 500 Hz noise by 8.5 dB at 70 degrees and the rest of the high frequency spectrum by lesser amounts. At 120 degrees both dominating bands (500 and 2000 Hz) were reduced by about 4 dB.

Extending the inlet treatment by 10.5 inches (26.67 cm) had a profound effect on the inlet noise. The MPT's have been eliminated as major contributors to the PNL, although examination of narrowbands does show some MPT content, particularly around 400 Hz. If thicker treatment had been added to the inlet (the existing treatment was 1/2 in. thick) these MPT's probably would have been removed. At 120 degrees, the MPT's have been eliminated indicating that the inlet treatment weakened the MPT's to the extent that they no longer radiate into the aft quadrant. The BPF has been reduced by about 14.5 dB.

The massive aft suppressor increased suppression at frequencies above 3150 Hz. The noise remaining is believed to be solely fan jet noise and flow scrubbing noise from inside the suppressor.

Figures 9-11 show the PNL directivities for, respectively, 84, 72, and 57.5% (approach) fan speeds. Generally, the unsuppressed data move from front dominant to slightly rear dominant at approach. The front noise suppression at approach due to the frame treatment is about 2.7 PNdB (comparing 70 degrees untreated and 60 degrees treated) while the full inlet treatment results in a 7.2 PNdB (70 degrees untreated relative to 40 degrees treated) reduction. The rear noise reduction is slightly greater - 3.8 PNdB for the frame and 9.6 PNdB for the full treatment.

Spectral comparisons at approach for 50, 70, and 120 degrees are shown, in Figures 12, 13, and 14 respectively. The BPF is in the 1250 Hz band. At 70 degrees, the tone-controlled bands show the greatest reduction. At 120 degrees, the suppression for both frame and full treatment extends over all of the high frequency spectrum with the maximum frame suppression being 7.5 dB at 1650 Hz and the maximum full treatment suppression being 16.4 dB at 2 KHz. The persistence of the BPF level at 1250 Hz when the massive aft suppressor is added is not fully understood. However, two possibilities exist; either the noise came from the inlet or there is a flanking path through the vehicle's structure.

Figures 15 and 16 show the progression of front and aft 200-foot (60.96 m) sideline maximum PNL's for each configuration versus corrected fan speed. The untreated front maximum data show a break upward at about 80% speed and a downward turn at 95% speed. The increase at 80% signifies the onset of MPT radiation sufficient to effect the PNL; while the break at 90-95% speed represents the full swallowing of the bow shock wave. When treatment is added, however, the curves begin to smooth out. With full treatment the curve tends to start leveling at 90% speed. The aft maxima are generally smooth with suppression levels being nearly constant over the entire speed range.

Figures 17 through 20 contain maximum PNL information for the frame and full treatment configurations when two other nozzles were employed. One nozzle area was smaller than nominal by 6% and the other was larger than nominal area by 16%. When frame treatment was employed, the large nozzle resulted in slightly higher noise at constant thrust (Figures 17 and 18); while the small and nominal nozzle data were nearly coincident. This same trend was observed when full treatment was used; particularly at the front maximum angle. Figure 21 shows the PNL directivity at approximately takeoff thrust for the large and nominal nozzles. The first thing to be noted is that in order to get the same thrust with the large nozzle, a fan speed increase in excess of 95% speed is required. As a general rule the higher speed tends to drive the front noise up. This explains the increased front noise with the large nozzle. The 60 degree spectral comparison is shown in Figure 22. The noise increase is largely concentrated around the BPF (2 KHz).

B. Flight Noise

In order to better assess the noise reduction obtained with the frame and full treatment, the takeoff and approach results were "flown" on a level flight path at 1000 feet (304.8 m) for takeoff and 370 feet (112.776 m) for approach. Also included was a prediction of the core jet noise based on Engine C cycle data and the method of Reference 6.

Figures 23 and 24 show the PNL and PNLT for takeoff fan speed. The noise reductions for frame and full treatment are similar to the PNL reduction at the 200-foot (60.96 m) sideline (Figure 6). When the tone correction is in force, Figure 24, the full treatment reductions increase; particularly at the aft maximum angles.

At approach fan speed, Figures 25 and 26, the PNL and PNLT reductions are again similar to the PNL reduction at static conditions (Figure 11).

Table IV is a summary of the EPNL values derived from Figures 24 and 26. Nearly 10 EPNdB reduction is obtained at takeoff with full nacelle treatment. The approach reduction, where MPT's are not present at the source, is less - 6.9 EPNdb.

C. Comparison to Full-Scale Fan Data

The scale model fan was a 0.527 linear scale of the outer flowpath of the full-scale Engine C fan (see Section III-B). Engine C was tested by General Electric and the full-scale Fan C was tested as a component by NASA[2]. The data presented in this report has been scaled to the full-scale size (see Section IV-C).

Comparisons of these three sets of data must be interpreted in terms of the installation and site conditions under which each was tested. The engine was run over a gravel field while both the fans were run over asphalt surfaces. Both fan component vehicles were driven by front shafts which required pedestal bearings, while the engine's inlet was relatively clean.

The asphalt to gravel difference has been derived by testing the scale model fan over both surfaces in the frame treated condition. The data obtained were averaged over the speed range and around the microphone arc and finally a smooth line was curve-fitted through the result. The line is shown in Figure 27.

Differences caused by the front shaft drives have not been quantified; however, as would be expected, the differences are concentrated in the front quadrant.

There are also some vehicle differences. The scale model is only the outer panel of the fan while the engine and full-scale fan contain the full-span blade. As described earlier, the scale model has Scottfelt treatment while the full-scale fan and engine use a multiple-degree-of-freedom resonater treatment. The differences in acoustic data attributed to these two characteristics have not been quantitatively established.

Figure 28 contains the PNL for the three vehicles at takeoff fan speed. At the rear angles the agreement is very good. Forward of 60 degrees, the data spread out with the scale model data being the lowest and the full-scale fan data the highest. The lower level of the scale model is probably due to "blocking" of the forward radiated noise by the drive engine housing. The higher level of full-scale fan noise has been generally attributed to higher inlet turbulence levels generated by air flowing over the pedestal bearing.

Table IV. Level Flyover* EPNL, Fan and Predicted Core Jet, Single Engine.

Configuration	Takeoff 1000' (304.8 m) Alt	Approach 370' (112.8 m) Alt
Untreated	105.2	96.7
Frame Treatment	101.2	93.2
Full Nacelle Treatment	95.4	89.8

* Flight Mach No. = 0.25

The 70 and 110 degree spectra are shown in Figures 29 and 30. Considering the highly tone-controlled nature of the spectrum (multiple pure tones) the agreement is quite good. Some of the lower level high frequency noise from the engine is probably attributable to the surface differences (Figure 27). The higher engine noise at low frequencies (below 160 Hz) is due to the engine's core jet. At 110 degrees there is more spread at low frequencies. Some of this may be connected with the surface reflection conditions which have more of an effect on low frequency noise than high frequency noise. The level of the blade passing frequency at 2 KHz is almost the same for all three vehicles. There is no apparent explanation for the lower level of scale model noise at high frequencies.

The approach PNL's, Figure 31, show considerable difference; particularly in the rear quadrant. Spectral comparisons are shown in Figures 32 and 33. At 120 degrees, there is a large spread at frequencies above the second harmonic (2.5 KHz). The difference between the engine and the fans was expected since it is in this region that the engine's turbine noise is detected[2]. At the BPF (1250 Hz) agreement was good. Differences at frequencies below the BPF are not easily explained; however, jet noise and reflection pattern changes probably play a part.

Although differences exist between these vehicles, each by itself provides a reliable method of examining the characteristics of a given fan under varying conditions of acoustic treatment.

D. Aerodynamic Performance

The aerodynamic performance was assumed to remain unchanged for each of the treated configurations. Figure 34 is the performance map for the scale model.

VII. SLOTTED TIP CASING

A. Static 200-Foot (60.96 m) Sideline Data

As described in Section III-B, the Fan C rotor was tested with slots over the rotor with and without a single-degree-of-freedom resonator behind the slots.

Figure 35 shows the takeoff PNL directivity at 200 feet (60.96 m). The front angles show very little variation among the three configurations. At the rear angles, particularly at 120 degrees, there appears to be a hierarchy of slots (untreated), slots (treated), and frame (solid casing) in order of decreasing noise level.

Spectral comparisons at takeoff are shown in Figures 36 and 37. The 120 degree spectra indicate a tendency for the slotted data to be noisier than the frame treatment results at frequencies above the BPF (2 KHz).

Figures 38, 39, and 40 contain the 200-foot (60.96 m) sideline PNL for, respectively, 84%, 72%, and approach (57.5%) fan speed. Generally the slotted data is falling above the frame treatment results in the rear quadrant. The difference between the treated and untreated slots is negligible at the rear angles. However, Figure 40 at 60 degrees shows a noticeable decrease in the slotted (treated) level. Figure 40 also indicates that the slotted results are about 2 PNdB higher than frame treatment at 130 degrees. The spectral comparisons, Figures 41 and 42, show a general increase in high frequency noise at 120 degrees. At 70 degrees, there is a lower BPF with the slotted casing with treatment.

Figures 43 and 44 show, respectively, the progression of front and aft maximum 200-foot (60.96 m) sideline PNL with corrected fan speed. In front at low speeds the slotted casings are quieter than the solid casing levels. At higher speeds (above 73%) the opposite is true. The rear noise shows the slotted data noisier than the solid casing at all speeds with the greatest difference at lower speeds.

B. Flight Noise

Figures 45 through 48 show the noise levels extrapolated to level flight conditions. (A core jet has been added along with relative velocity effects[6].) Generally, the trends are the same as for the ground static data. A notable exception is at approach fan speed, Figure 48, where the PNLT directivity reveals a 4 dB increase in the rear radiated aft maximum noise with the untreated slot and a 3.2 dB decrease with the treated slot at 60 degrees.

Table V summarizes the EPNL results derived from these PNLT histories. The changes at takeoff are small. At approach, however, the untreated slot data show an increase of 1.7 EPNdB. The treated slot data show most of this difference to have disappeared. This is mainly due to a decrease in the front maximum noise when the treatment was added.

Table V. Level Flyover* EPNL, Fan and Predicted Core Jet, Single Engine.

Configuration	Takeoff 1000' (304.8 m) Alt	Approach 370' (112.8 m) Alt
Frame Treatment (Solid Casing)	101.2	93.2
Slotted Casing (Untreated)	101.7	94.9
Slotted Casing (Treated)	100.9	93.6

Flight Mach No. = 0.25

C. Aerodynamic Performance

Along with the acoustic data, nominal nozzle performance data was taken with the slots. Figure 49 shows a comparison of the solid casing and the slotted casing on the performance map. Within the accuracy of the data there is no discernible change. Figure 50 contains the radial distribution of pressure rise, temperature rise, and the resulting efficiency at takeoff fan speed. Again the changes are small, although there are indications that the slotted casing is higher in efficiency.

Finally, Figure 51 shows the average efficiency trends with speed for the solid and slotted casings. The line faired through the solid casing data indicates that the slotted casing data lie largely above the line, particularly at 90% speed.

VII. CONCLUSIONS

1. With full nacelle treatment, the inlet suppression is more effective at takeoff than at approach and the aft duct treatment is more effective at approach than at takeoff.

2. The slots above the rotor increased the aft radiated noise; particularly at low power settings.

3. Including a single-degree-of-freedom acoustic treatment behind the slots reduced front noise levels resulting in a slotted configuration which shows little difference from a solid casing on an EPNL basis.

4. The slotted fan casing appeared to enhance the fan efficiency about one percent at corrected speeds near design.

Appendix A - Illustrations

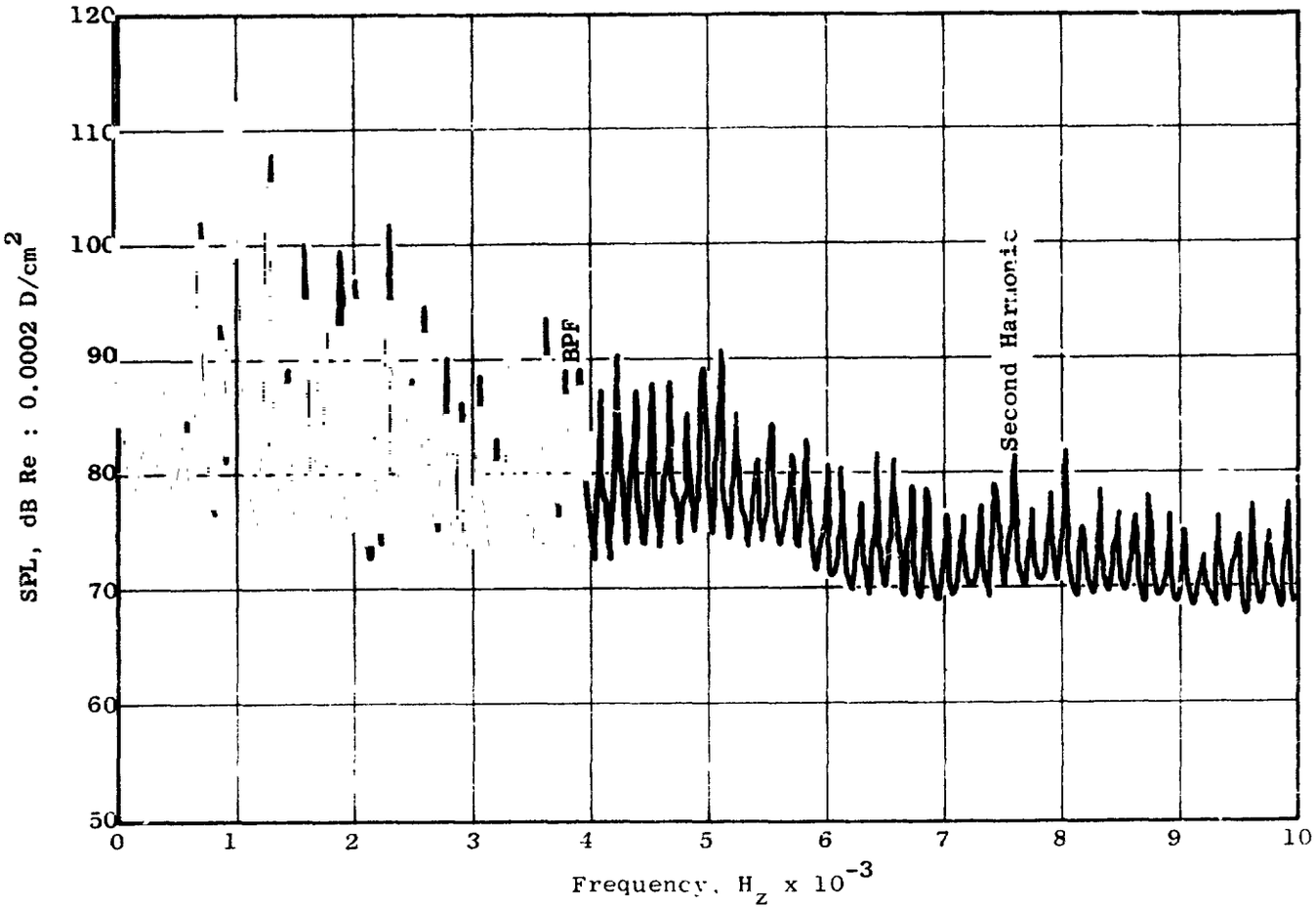

Figure 1. Typical Spectral Characteristics of a High Speed Fan.

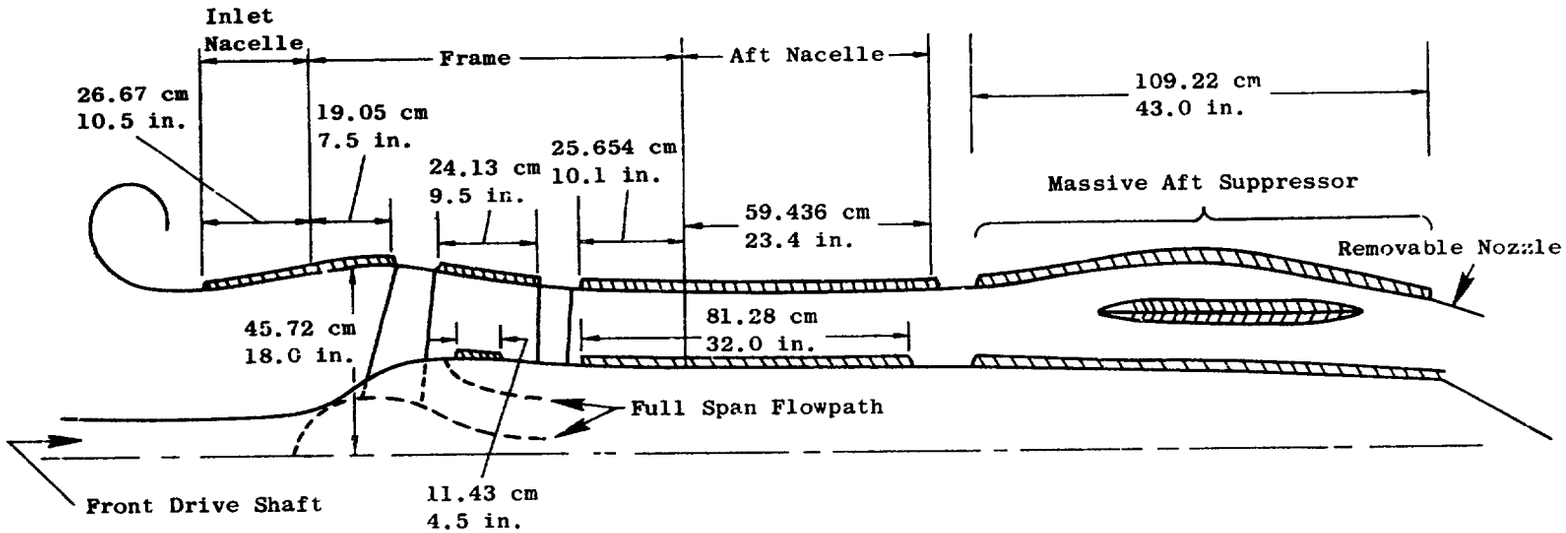

Figure 2. Fan Vehicle Cross Section.

Figure 3. Fan Test Vehicle.

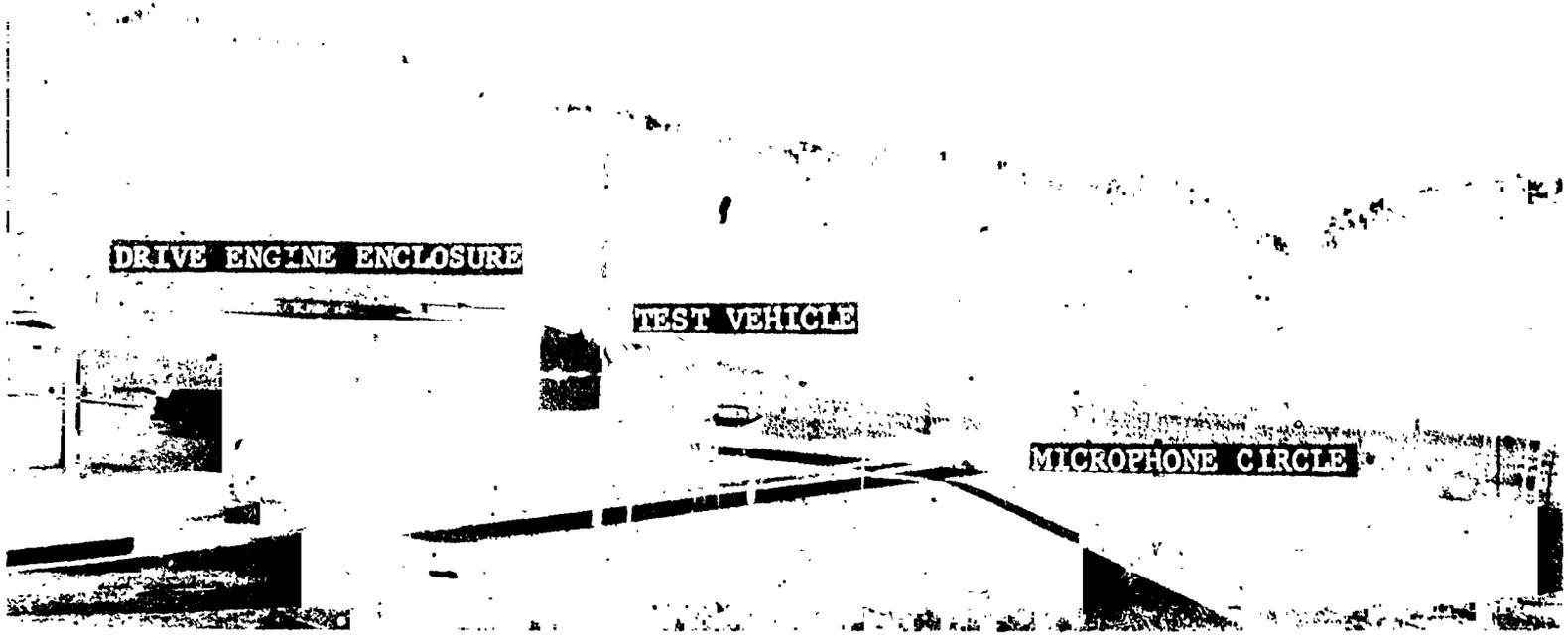

Figure 4. Fan Test Facility.

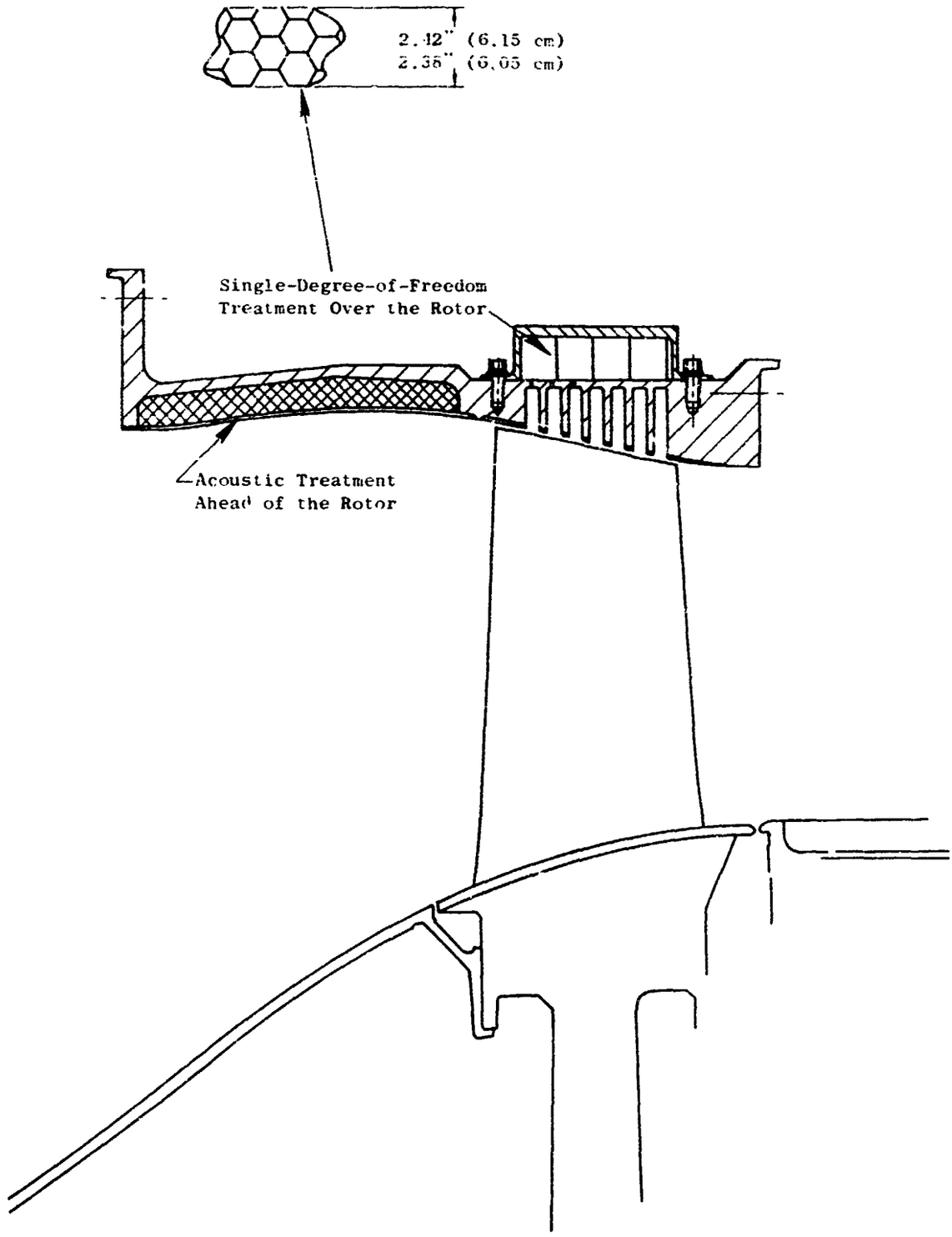

Figure 5. Cross Section of Slotted Tip Casing.

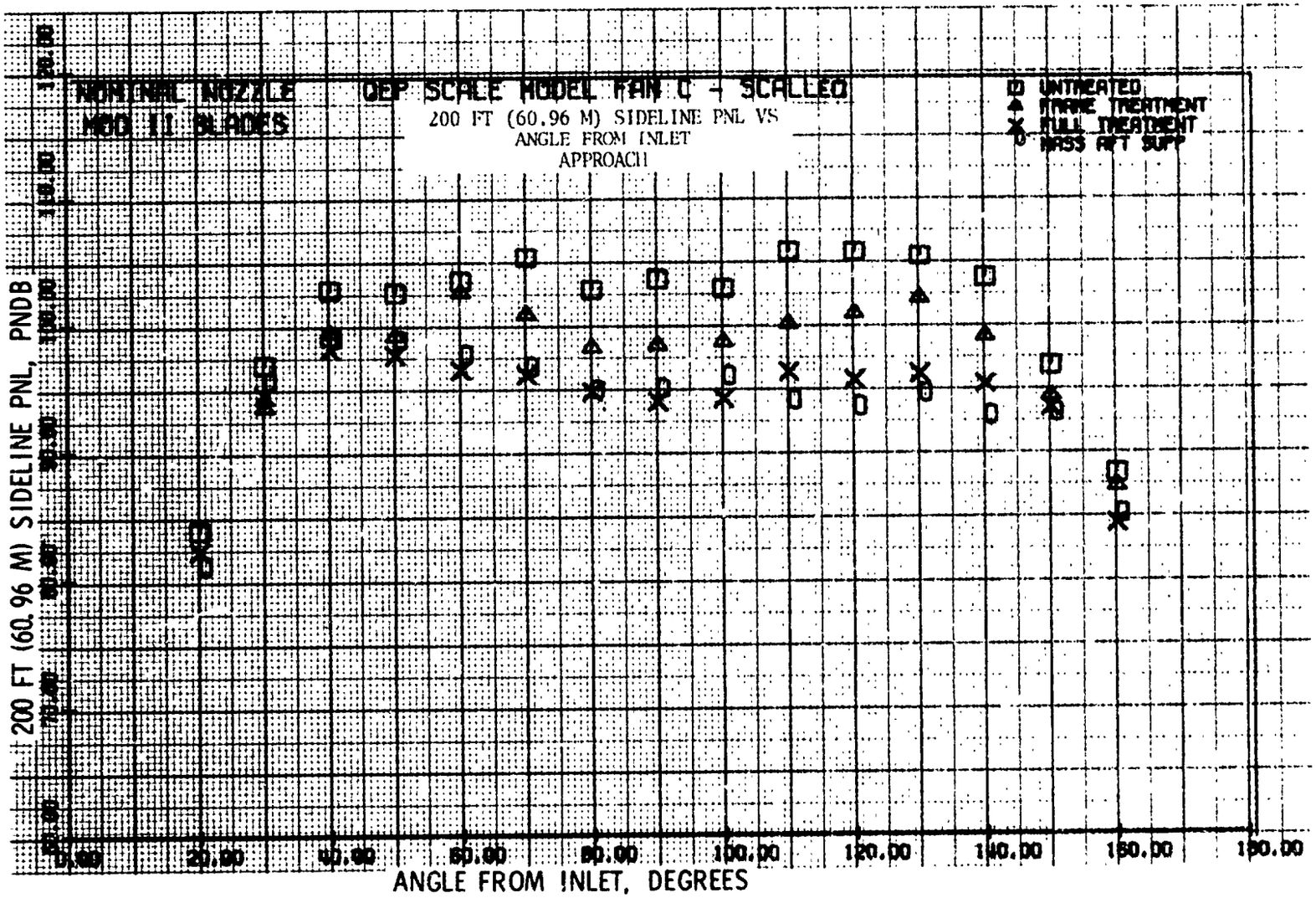

Figure 6. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet, Takeoff.

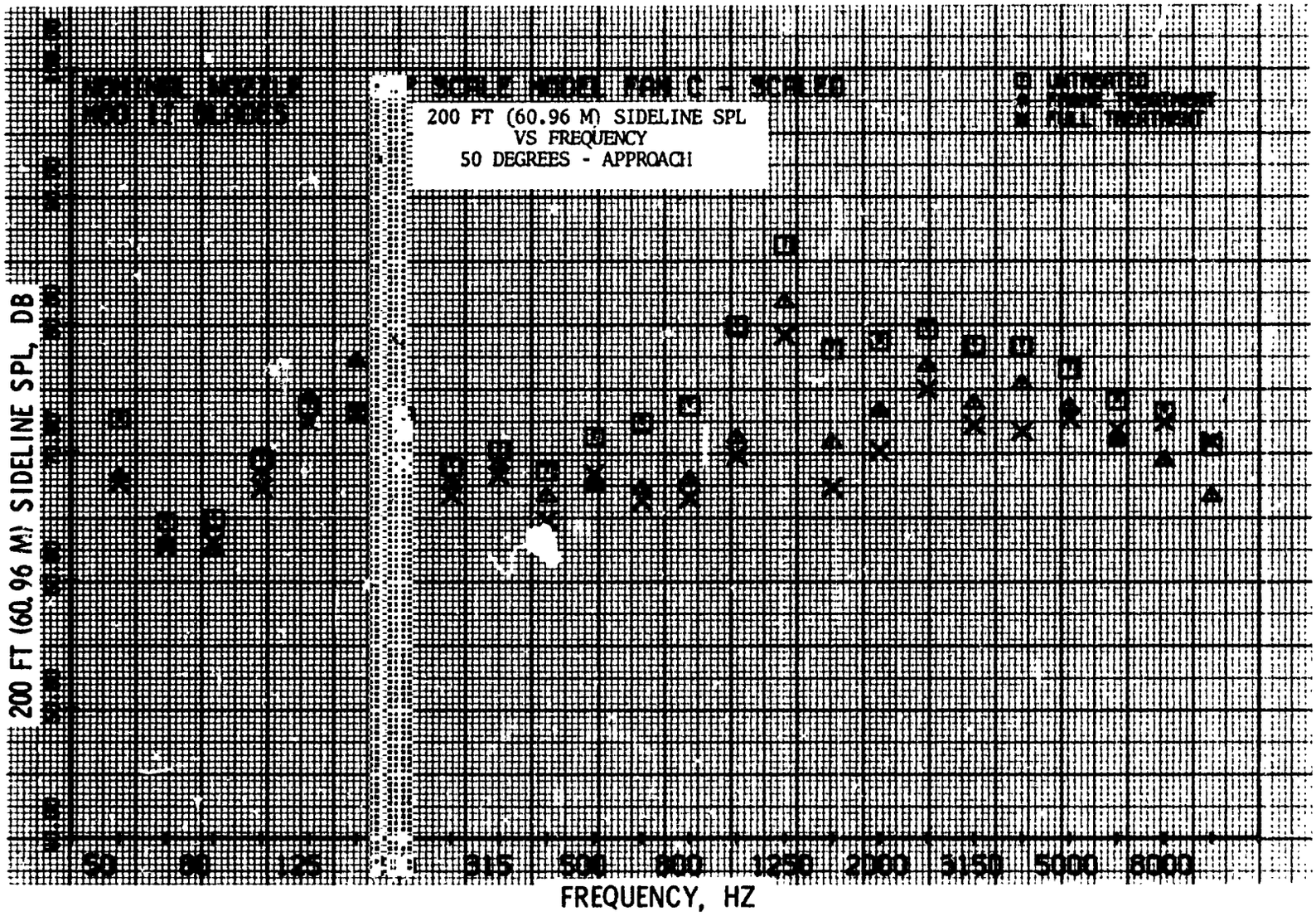

Figure 7. 200-ft (60.96 m) Sideline SPL Vs. Frequency, 70°, Takeoff.

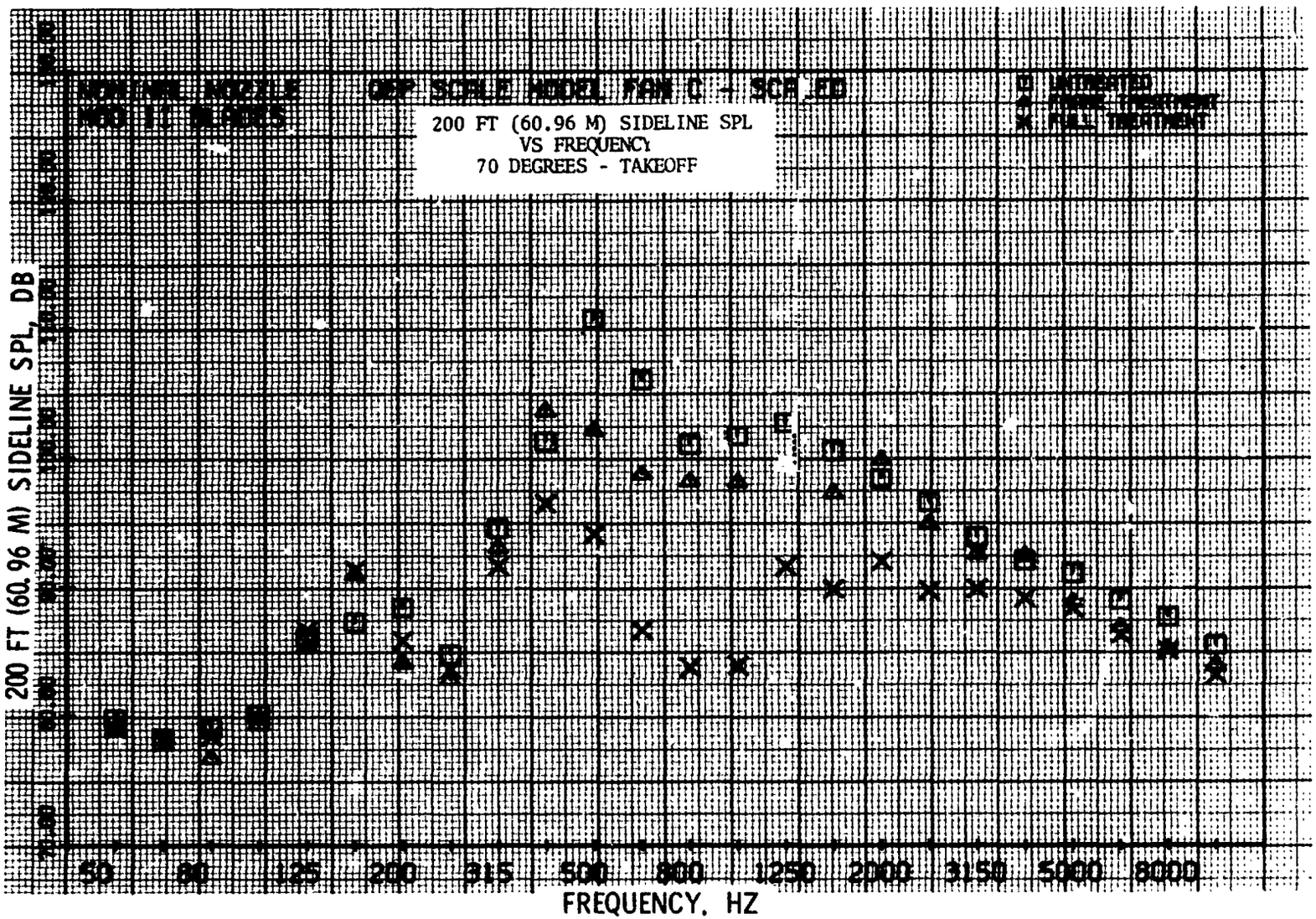

Figure 8. 200-ft (60.96 m) Sideline SPL Vs. Frequency, 120°, Takeoff.

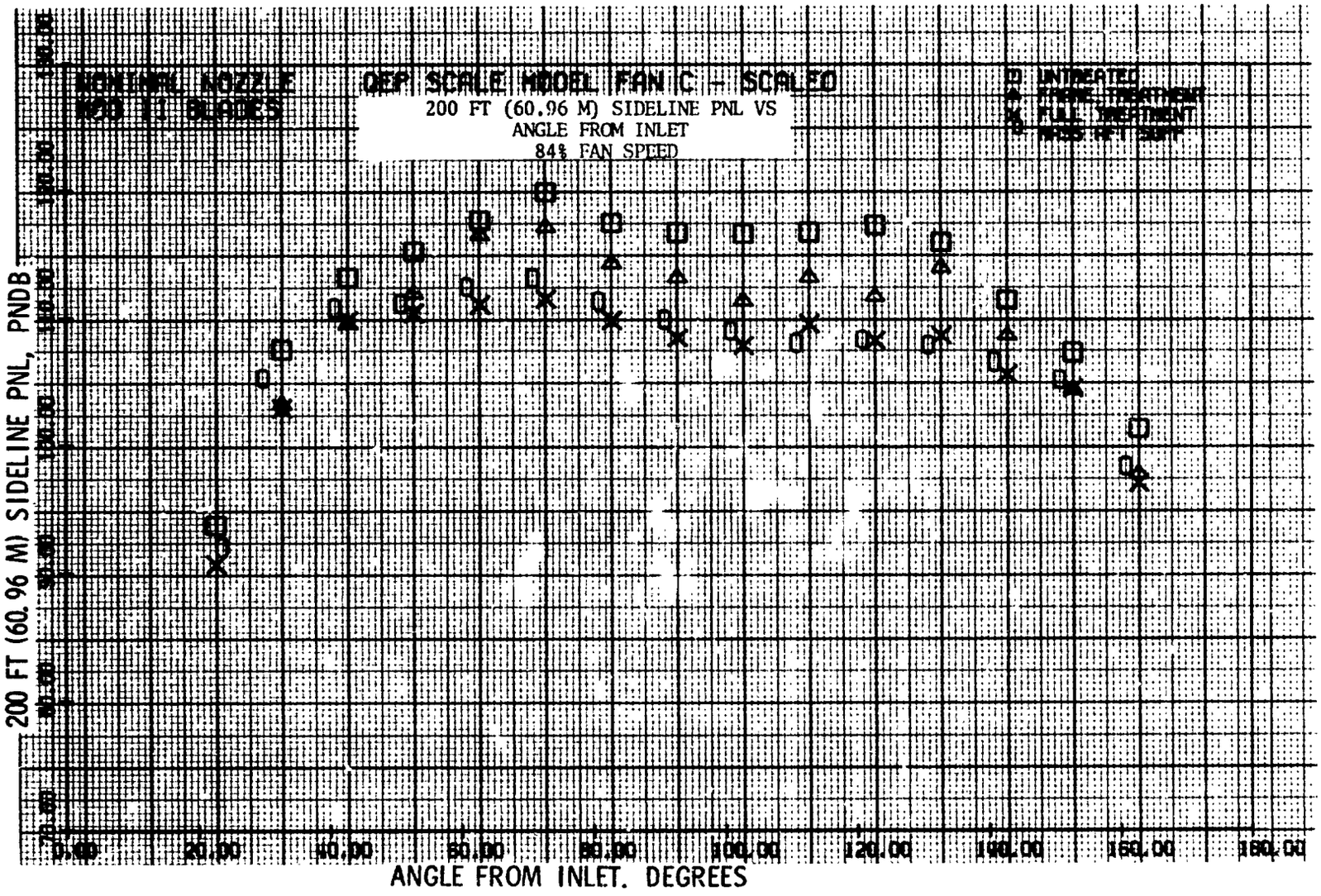

Figure 9. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet, 84% Fan Speed.

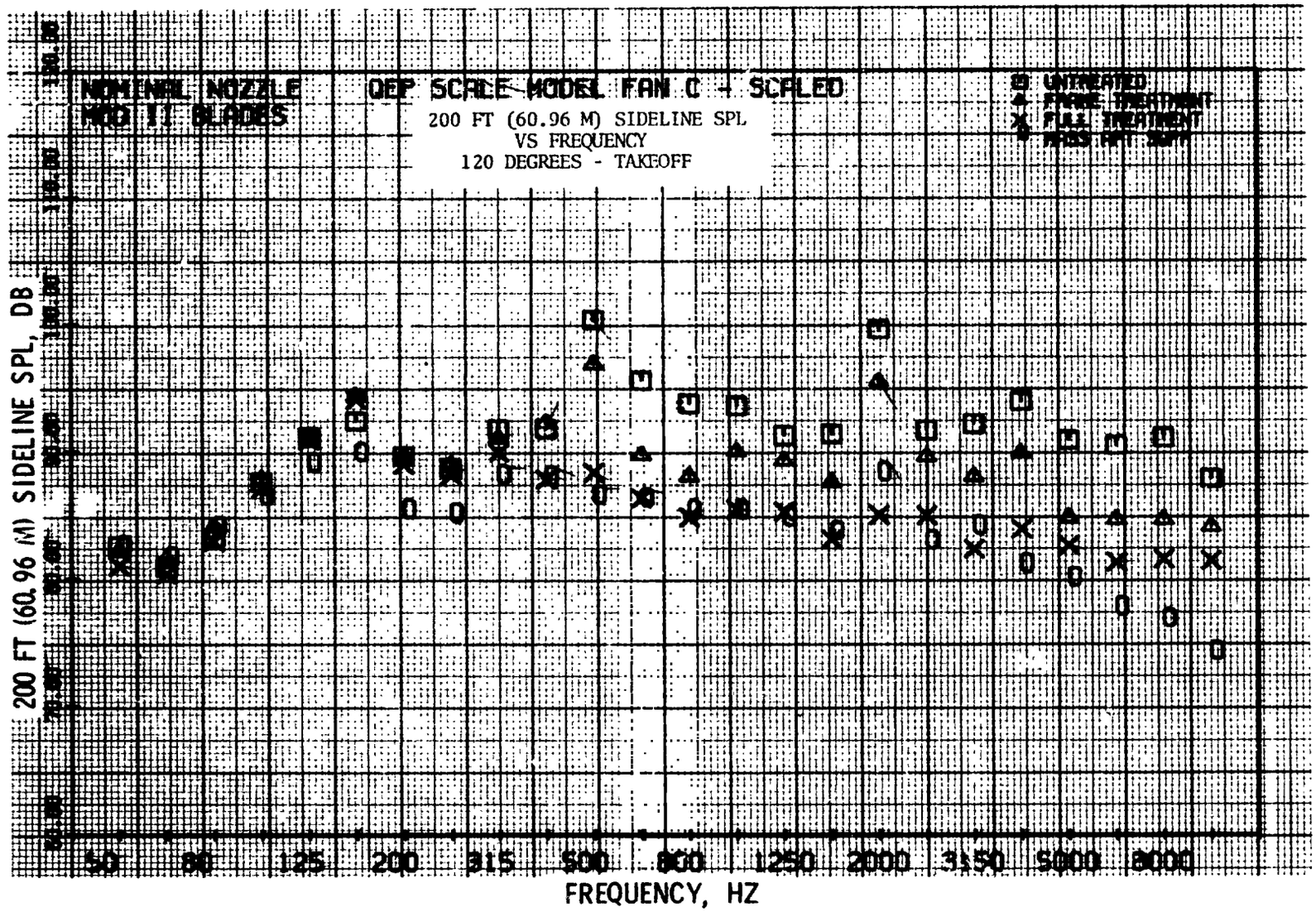

Figure 10. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet, 72% Fan Speed.

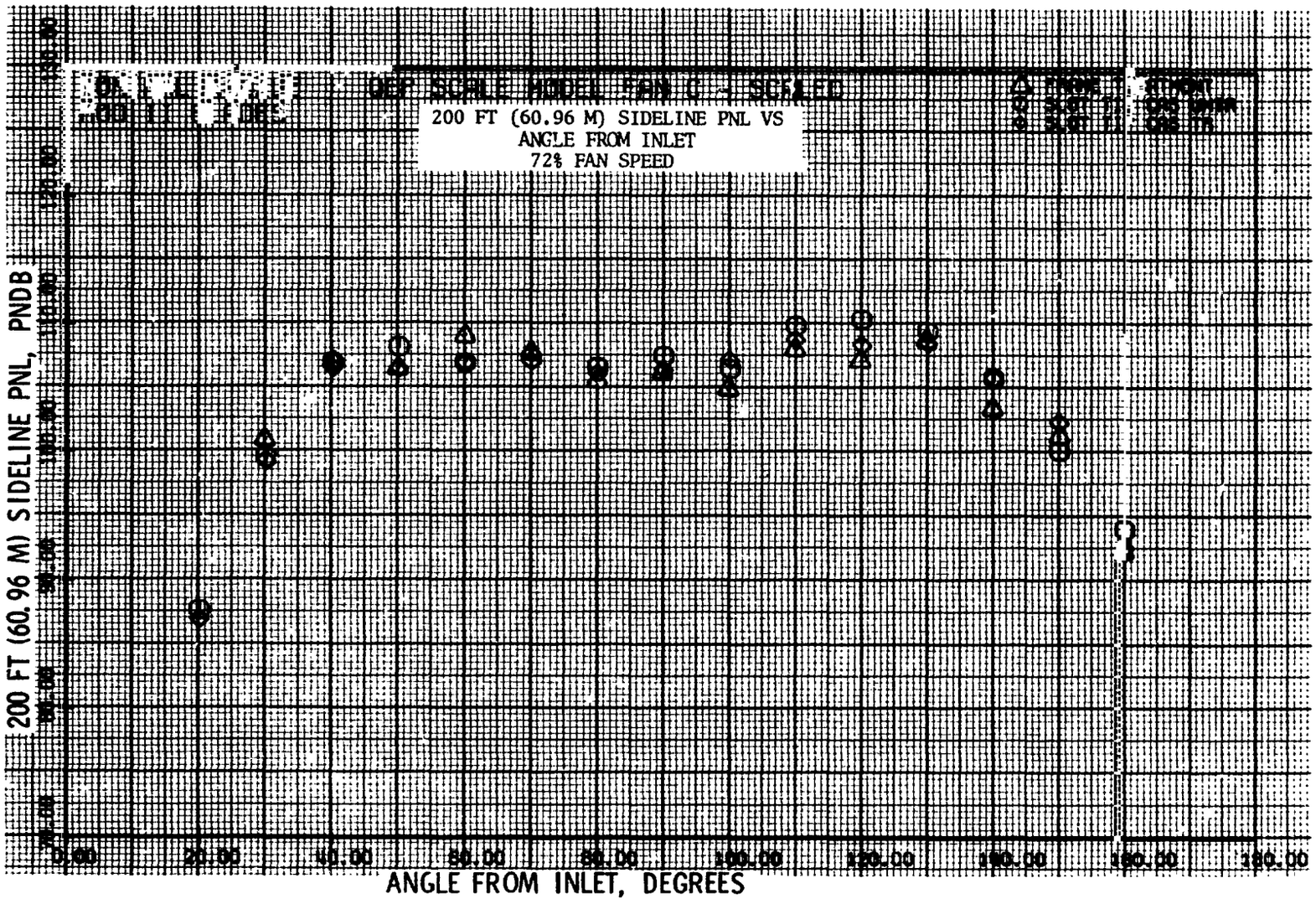

Figure 11. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet, Approach.

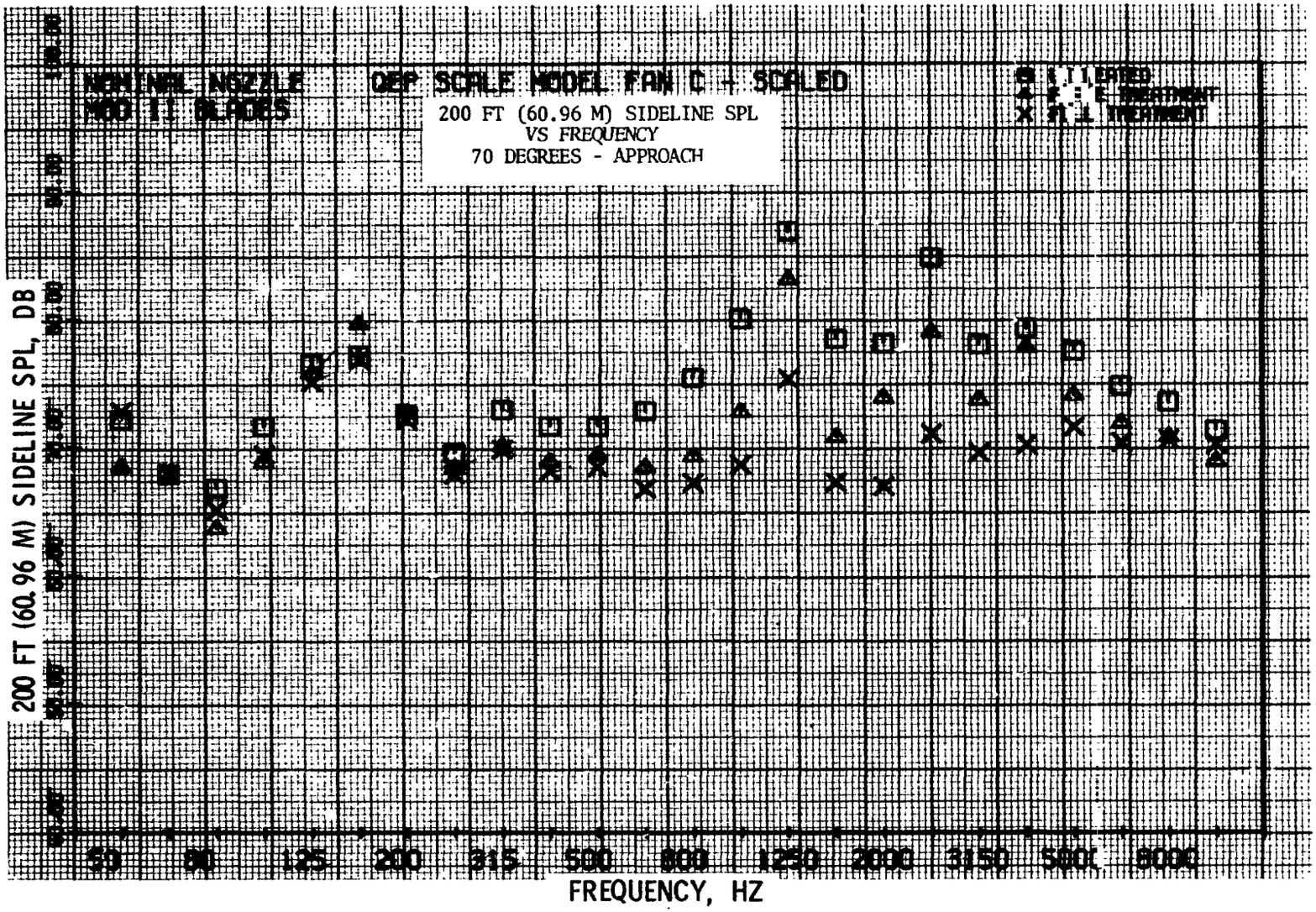

Figure 12. 200-ft (60.96 m) Sideline SPL Vs. Frequency, 50°, Approach.

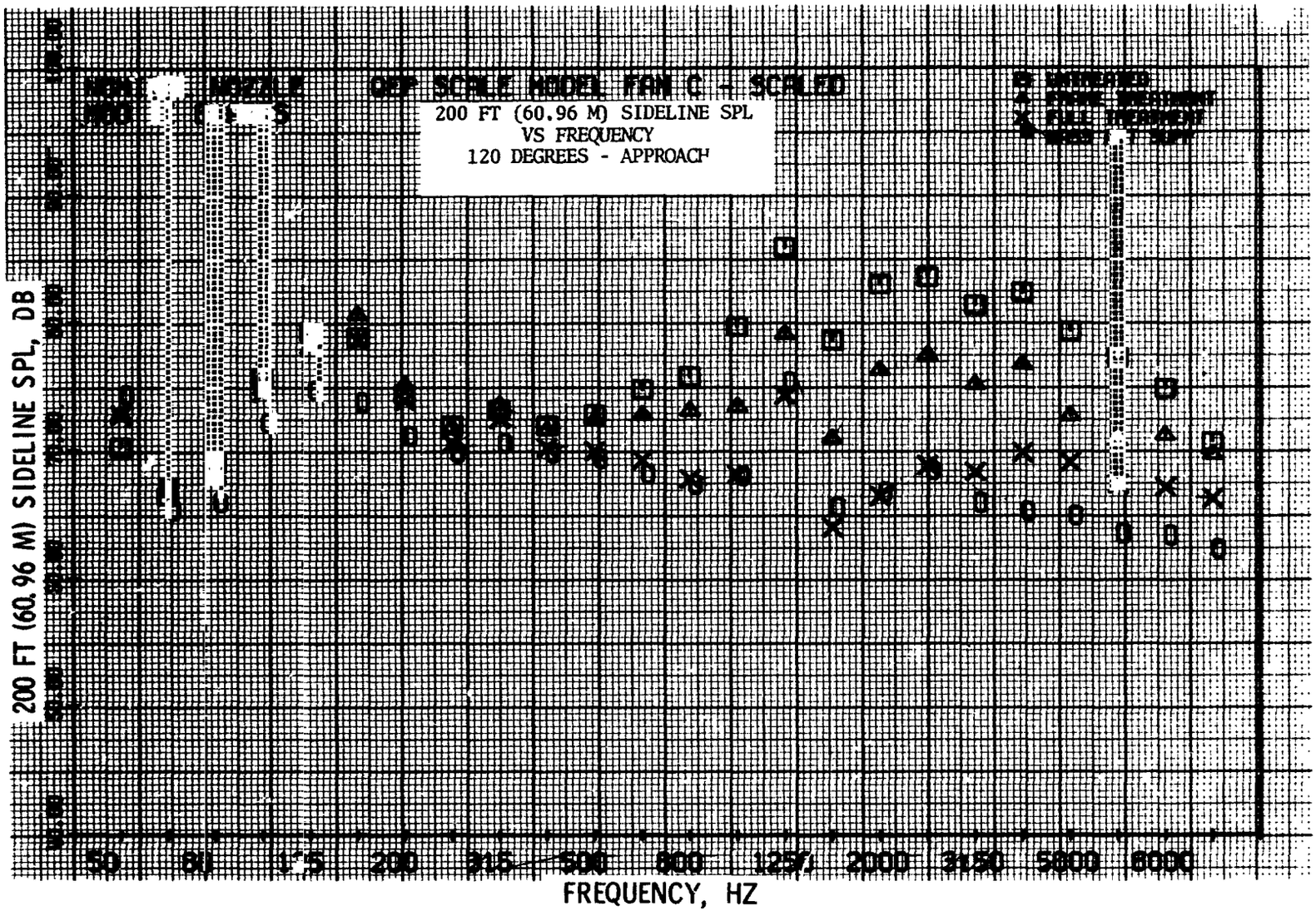

Figure 13. 200-ft (60.96 m) Sideline SPL Vs. Frequency, 70°, Approach.

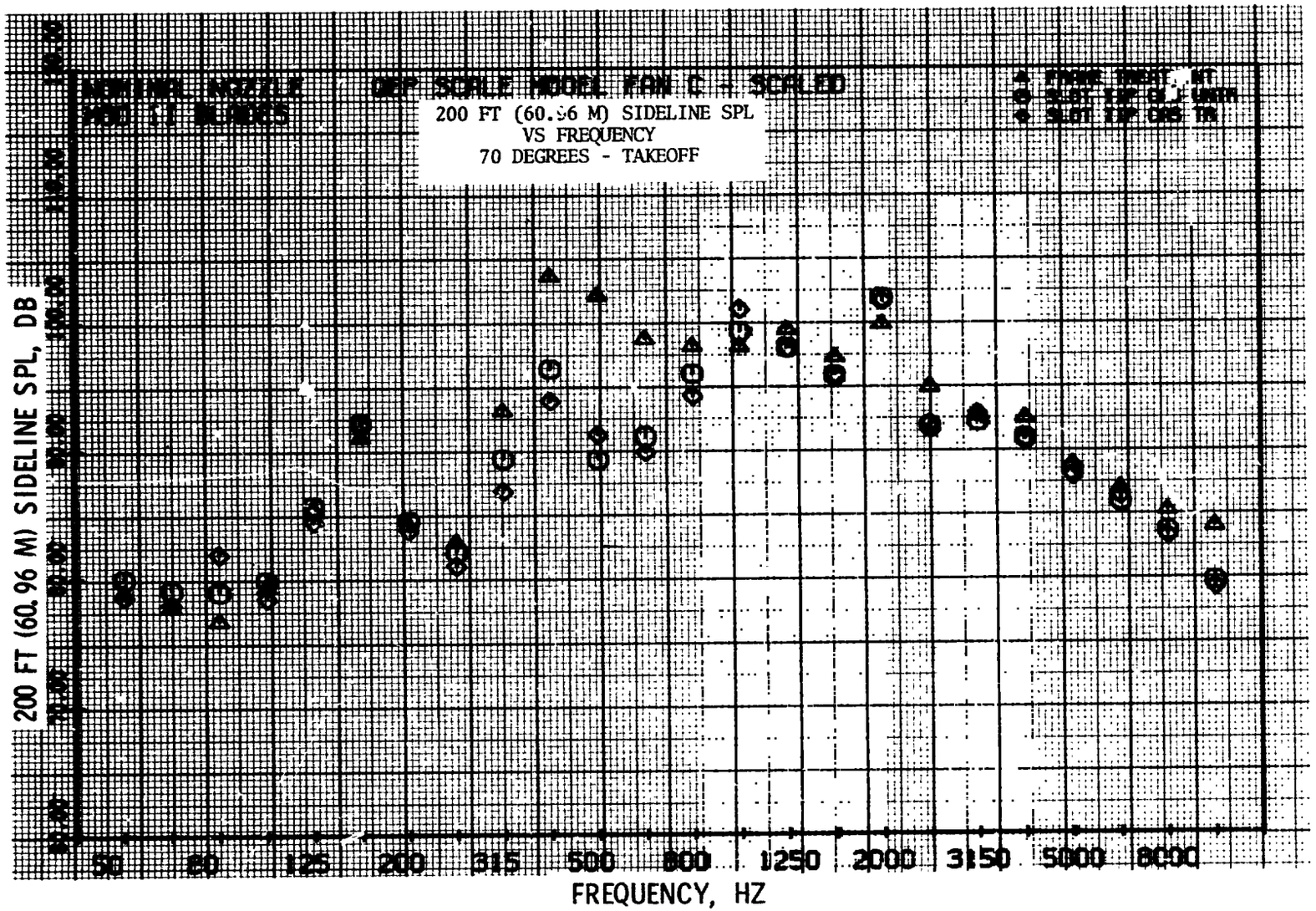

Figure 14. 200-ft (60.96 m) Sideline SPL Vs. Frequency, 120°, Approach.

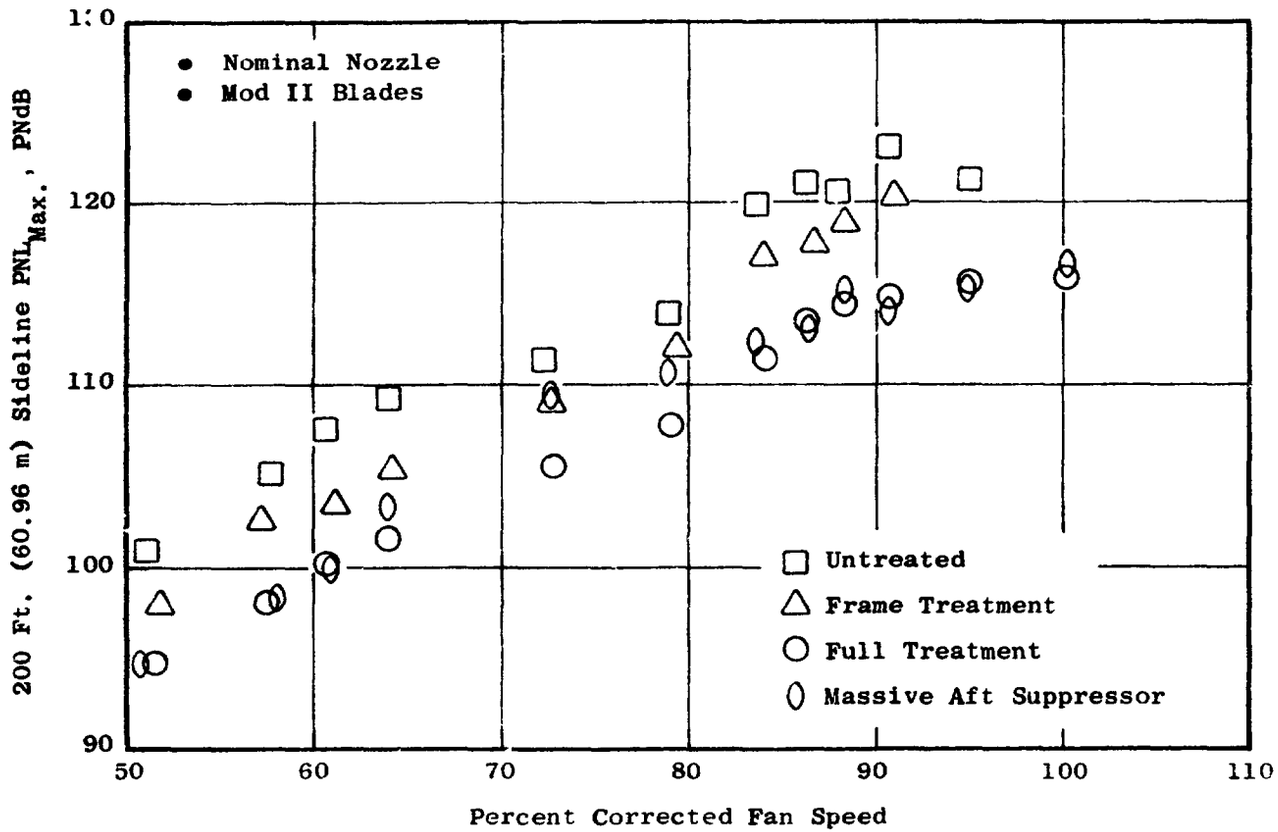

Figure 15. 200-ft (60.96 m) Sideline Front Maximum PNL Vs. Corrected Fan Speed.

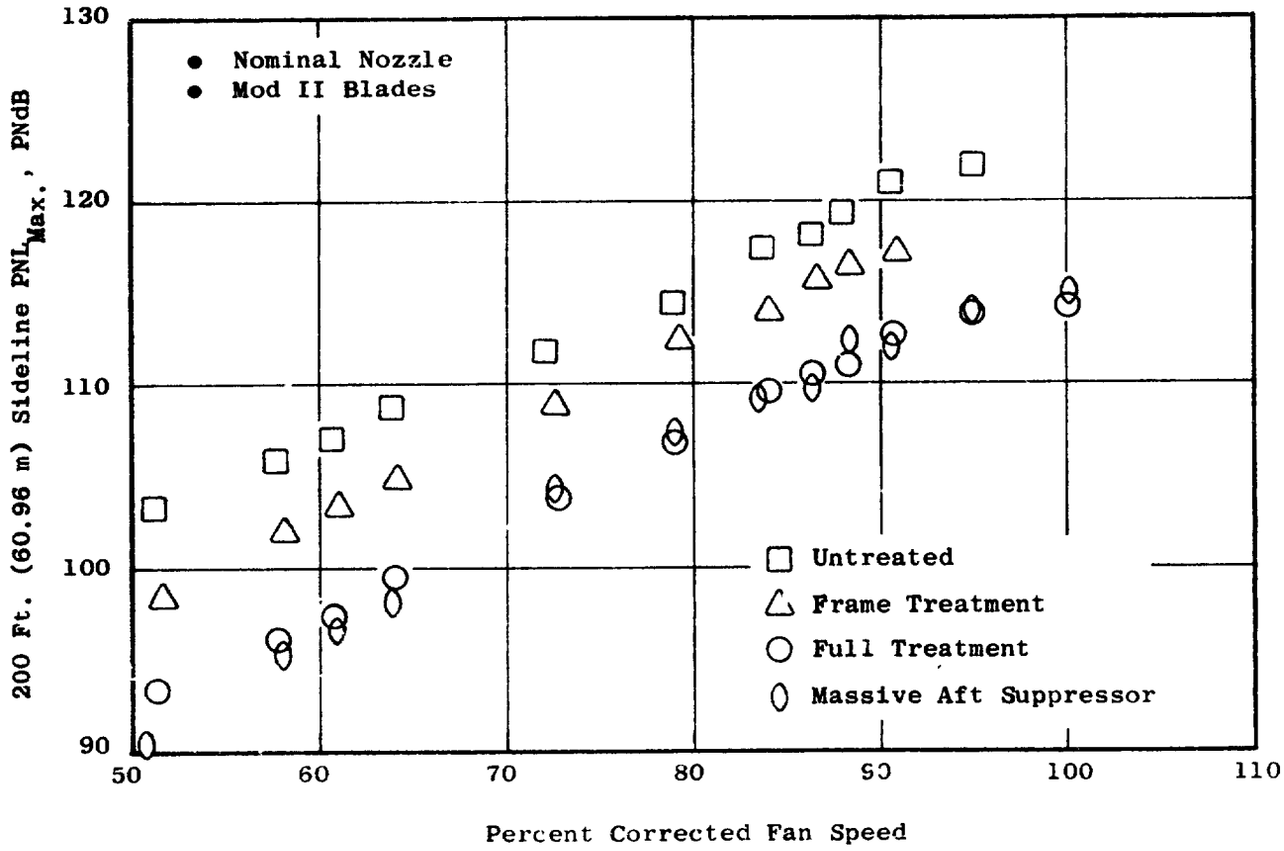

Figure 16. 200-ft (60.96 m) Sideline Aft Maximum PNL Vs. Corrected Fan Speed.

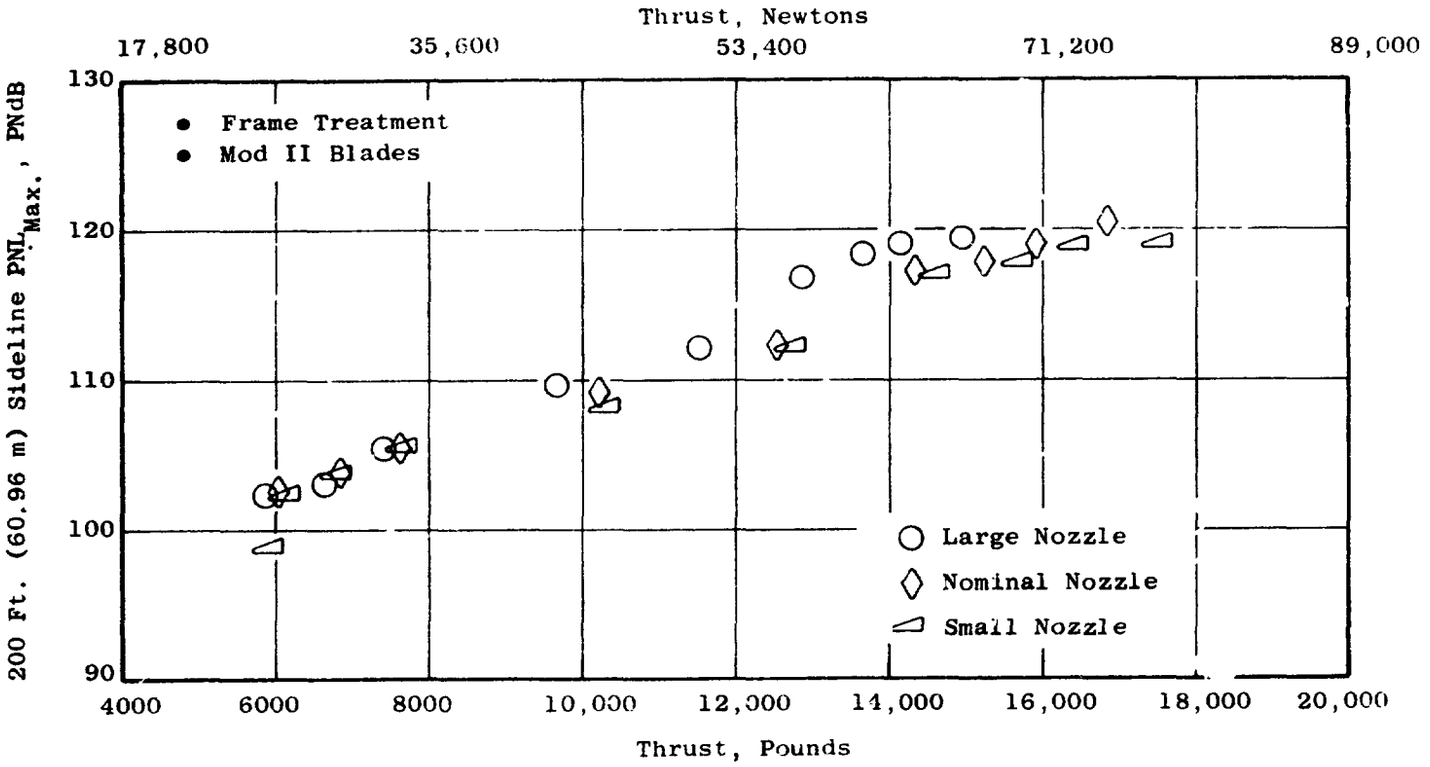

Figure 17. 200-ft (60.96 m) Sideline Front Maximum PNL Vs. Thrust, Frame Treatment Configuration.

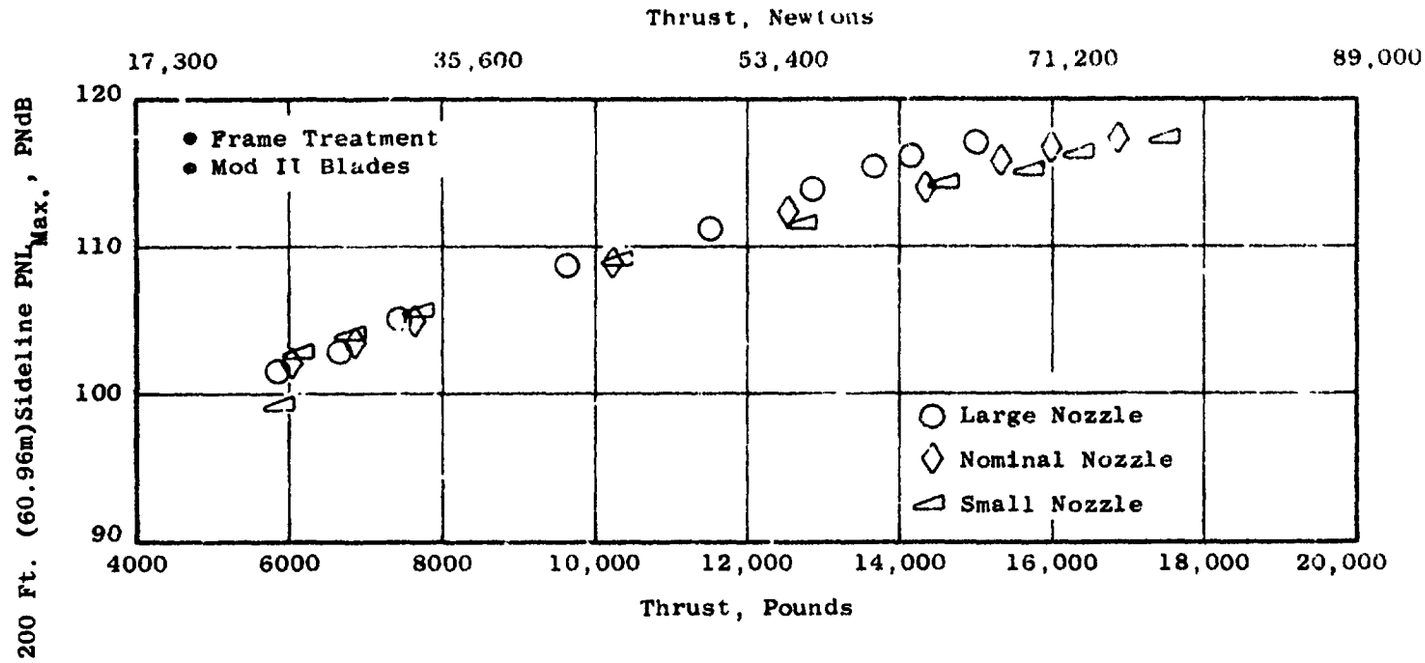

Figure 18. 200-ft (60.96 m) Sideline Aft Maximum PNL Vs. Thrust, Frame Treatment Configuration.

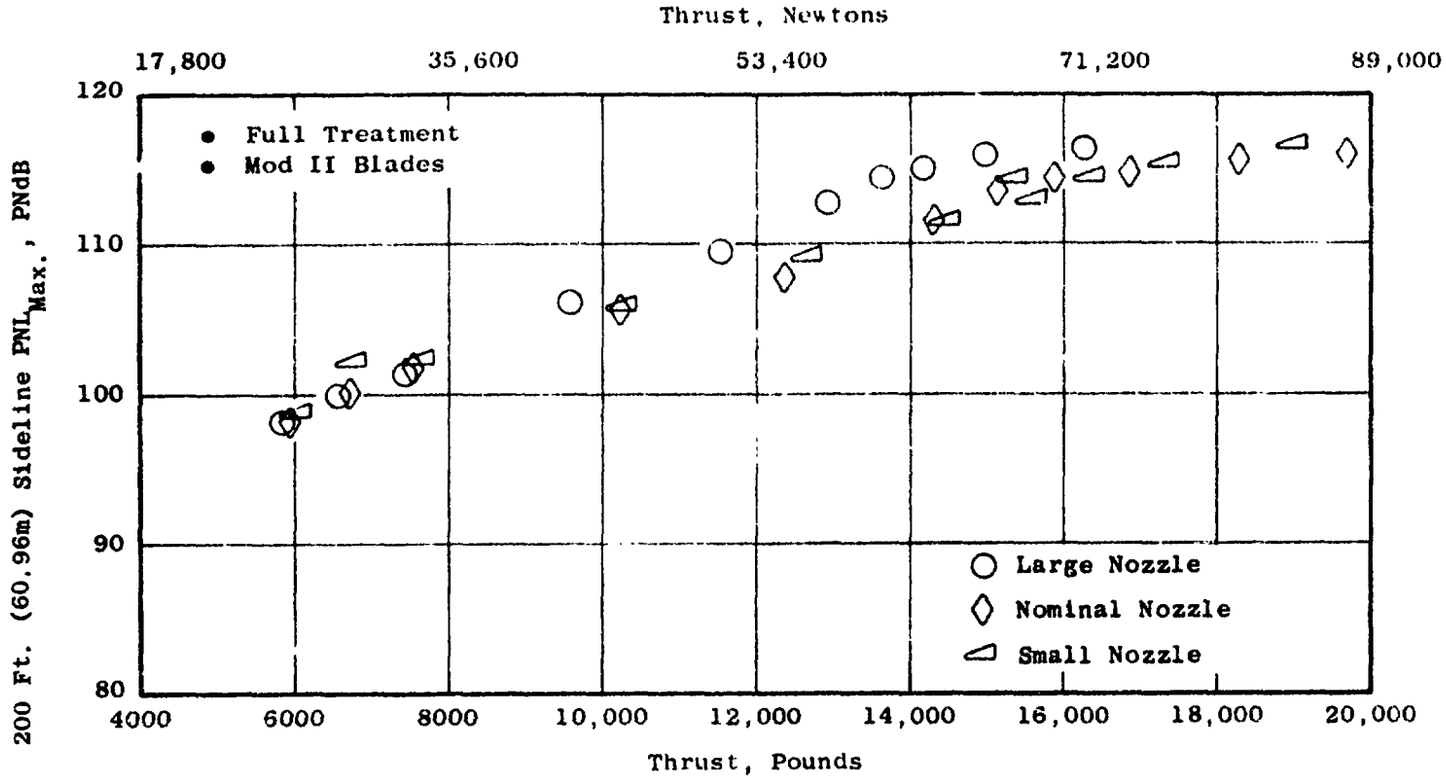

Figure 19. 200-ft (60.96 m) Sideline Front Maximum PNL Vs. Thrust, Full Treatment Configuration.

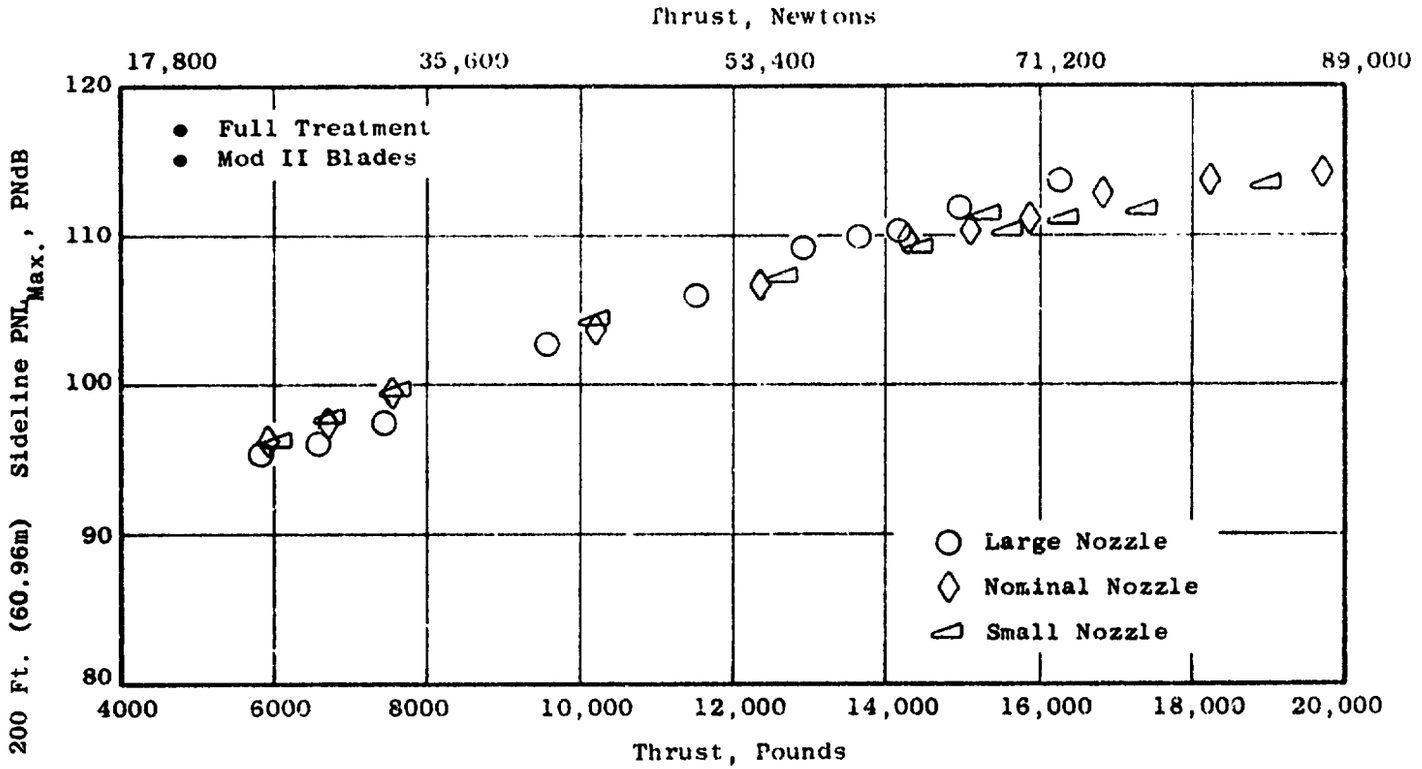

Figure 20. 200-ft (60.96 m) Sideline Aft Maximum PNL Vs. Thrust, Full Treatment Configuration.

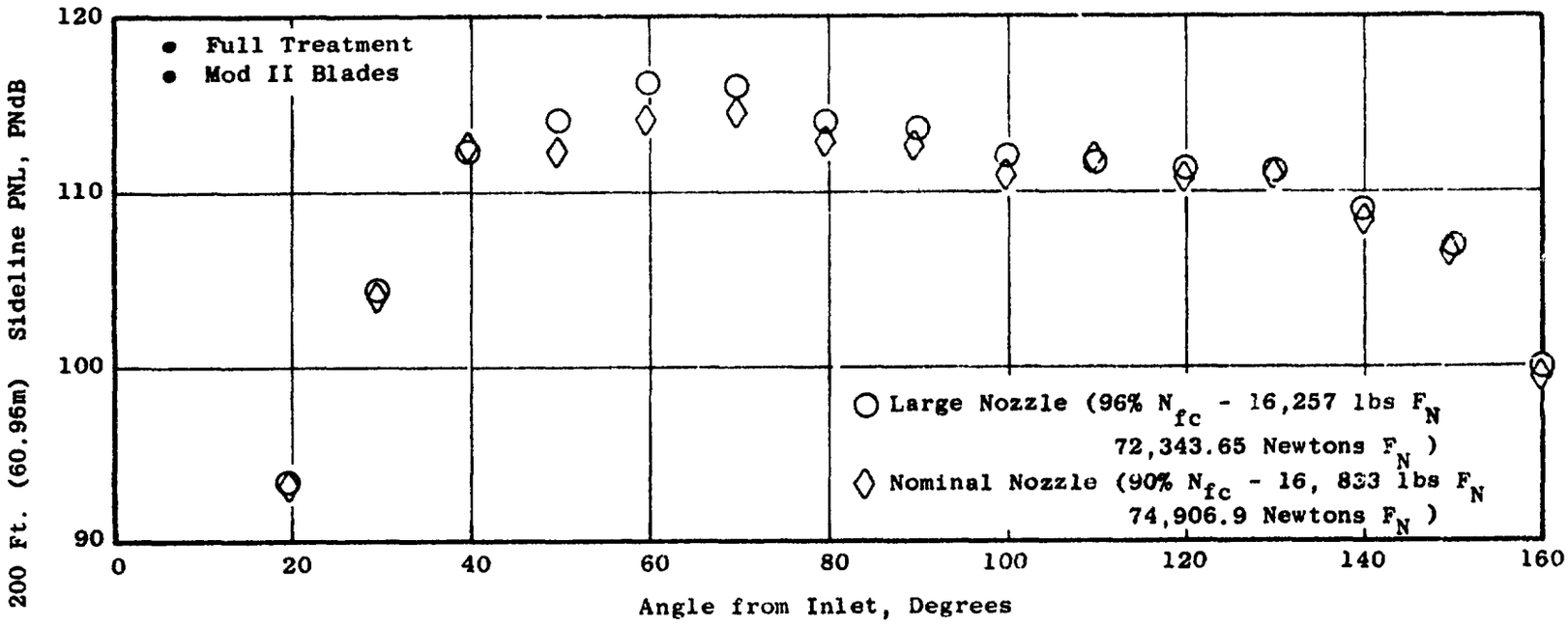

Figure 21. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet, Takeoff.

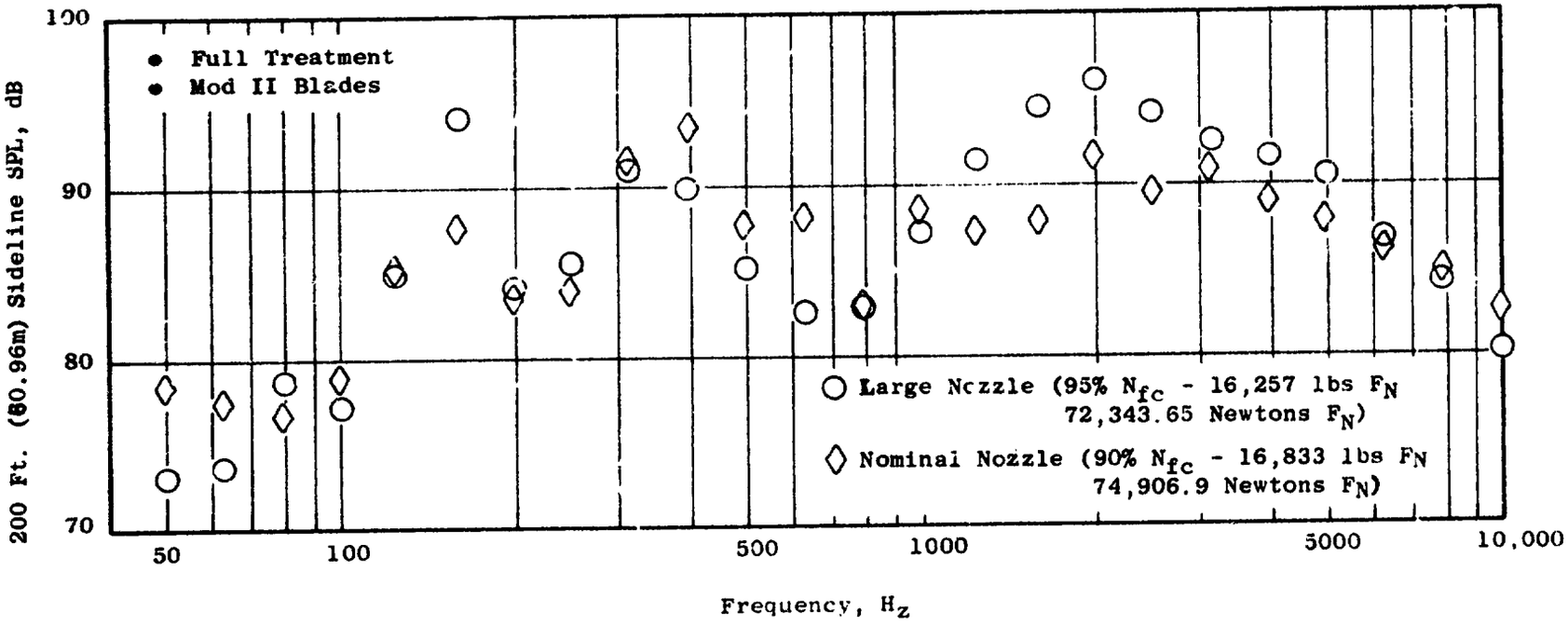

Figure 22. 200-ft (60.96 m) Sideline PNL Vs. Frequency, 60°.

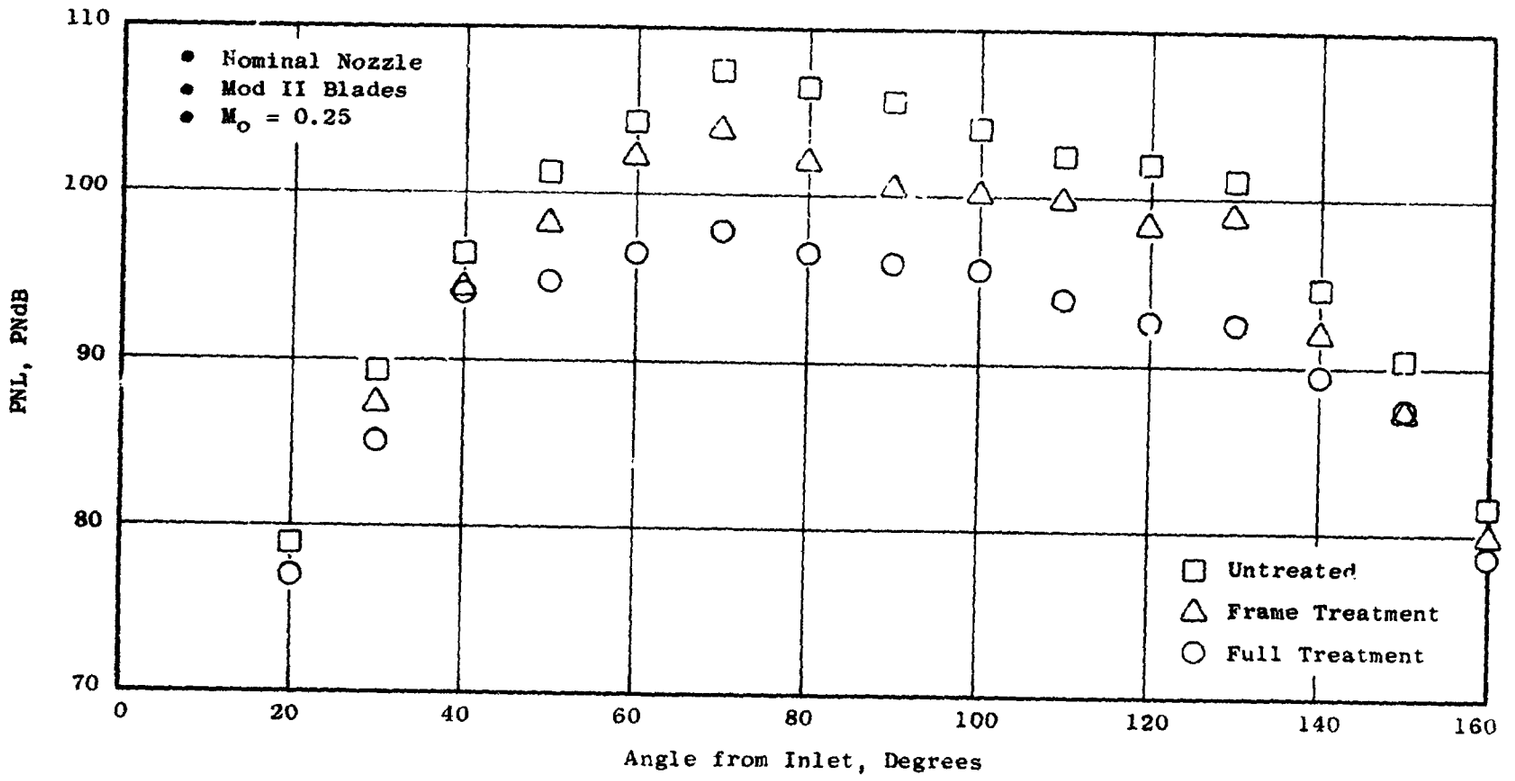

Figure 23. 1000-ft (304.8 m) Level Flyover PNL, Takeoff.

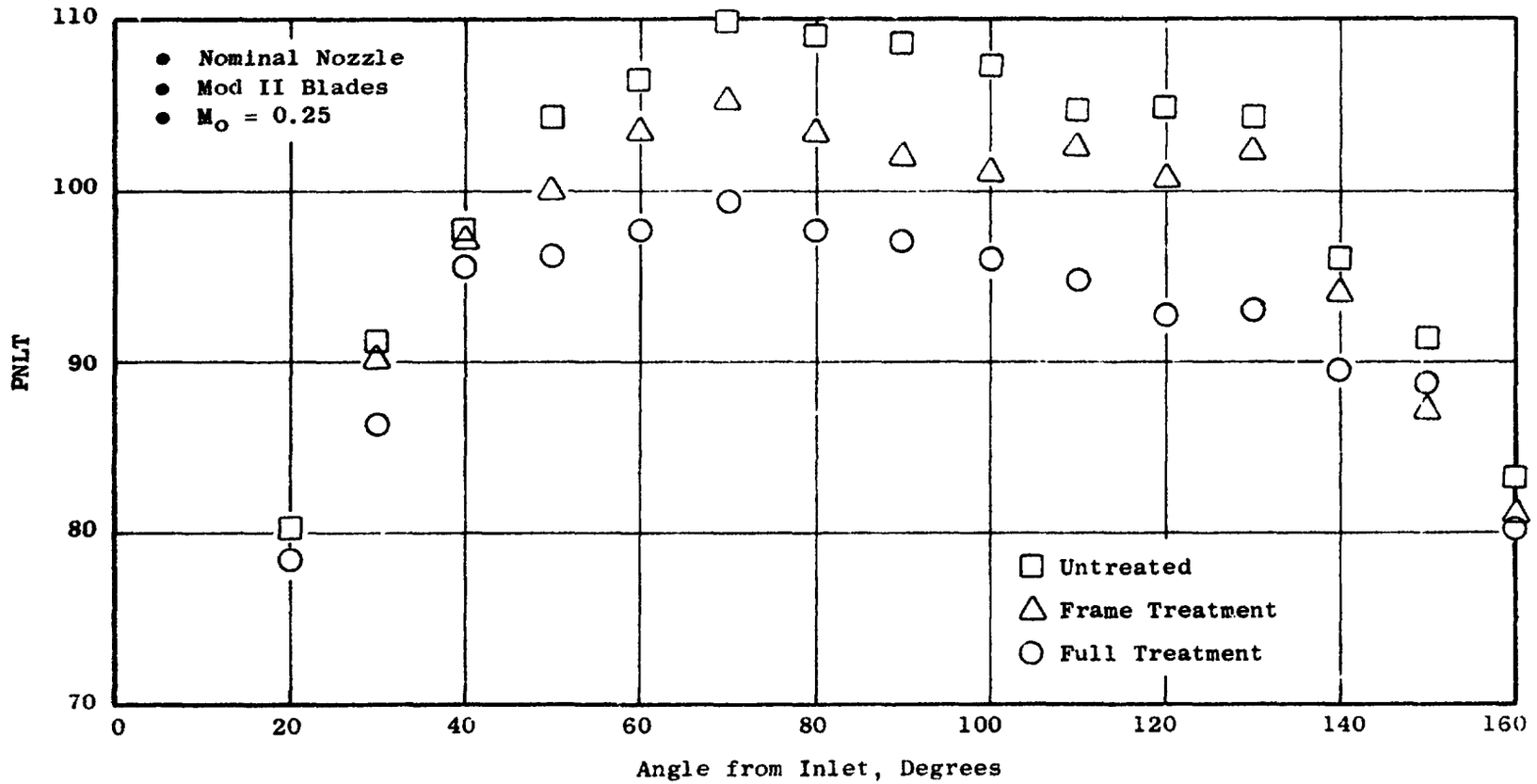

Figure 24. 1000-ft (304.8 m) Level Flyover PNLT, Takeoff.

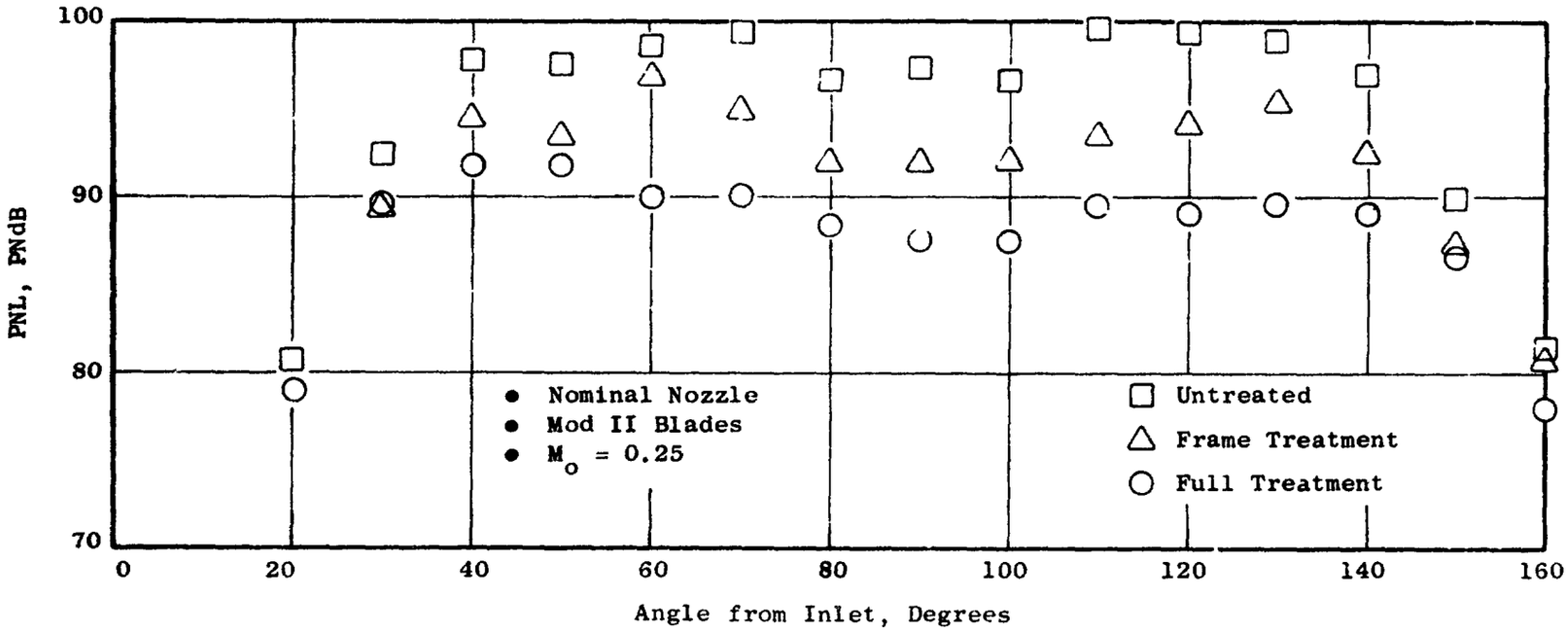

Figure 25. 370-ft (112.8 m) Level Flyover PNL, Approach.

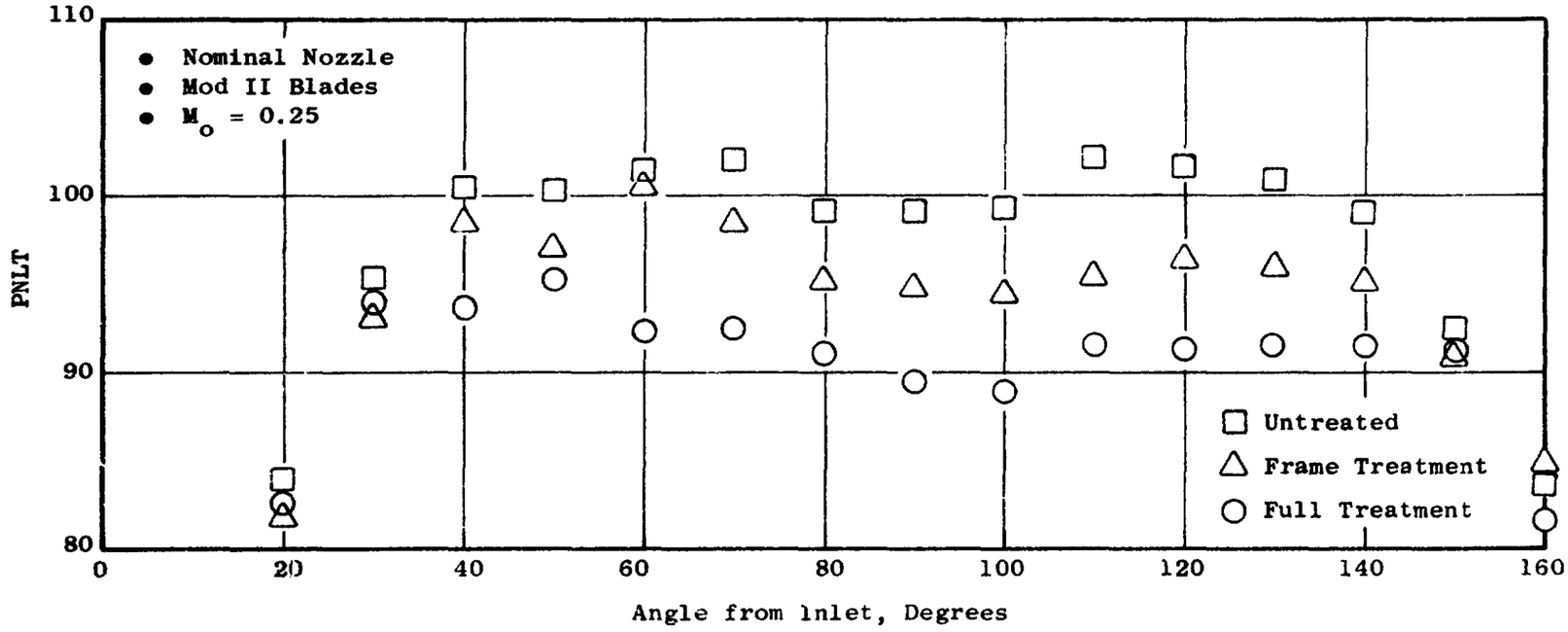

Figure 26. 370-ft (112.8 m) Level Flyover PNLT, Approach.

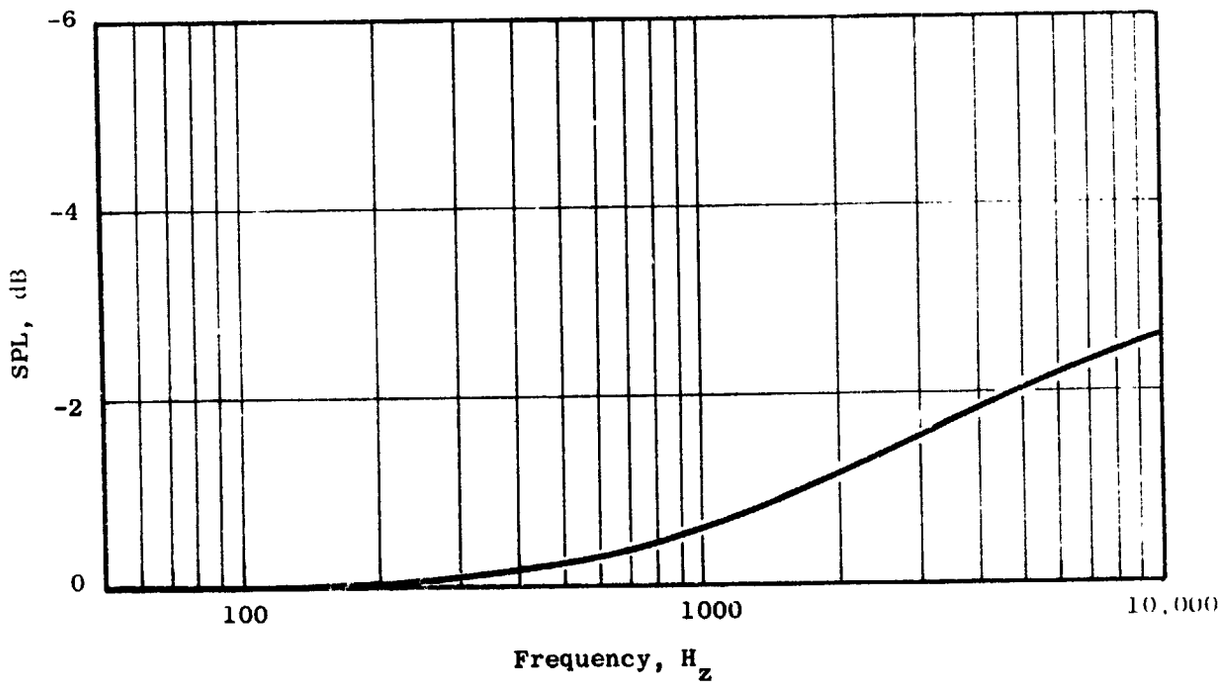

Figure 27. Asphalt to Gravel Surface Spectral Corrections.

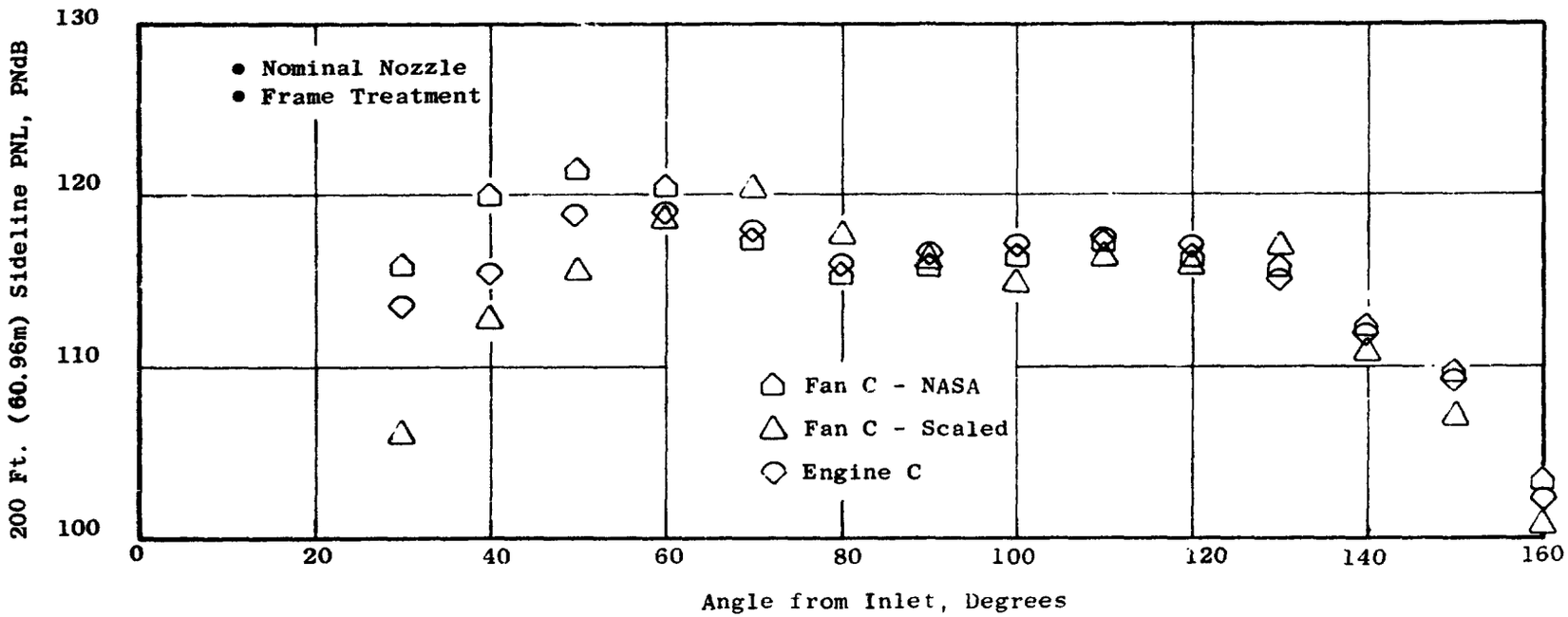

Figure 28. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet for Full-Scale Fan, Scaled Fan, and Engine, Takeoff.

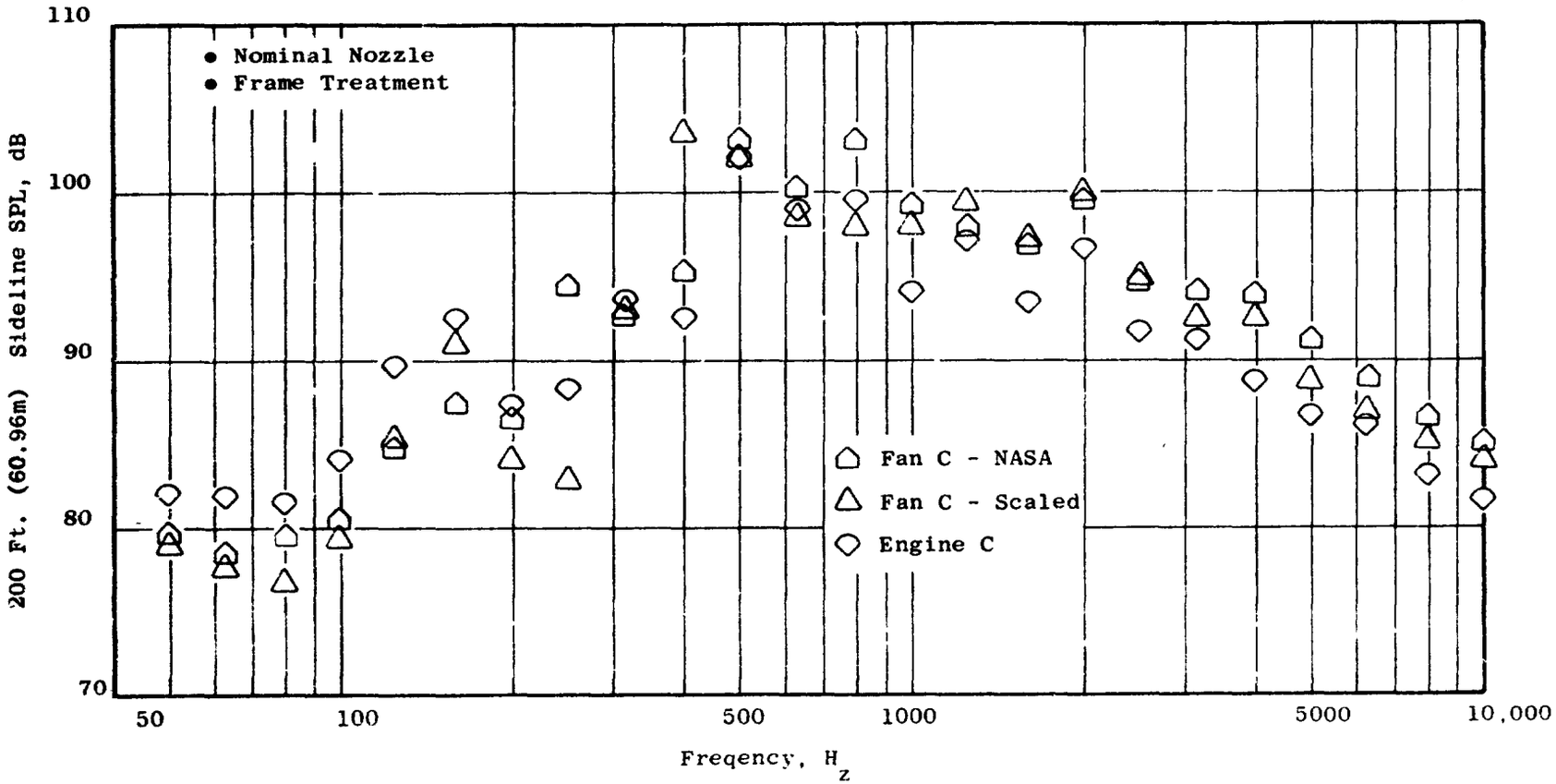

Figure 29. 200-ft (60.96 m) Sideline SPI Vs. Frequency for Full-Scale Fan, Scaled Fan, and Engine, 70°, Takeoff.

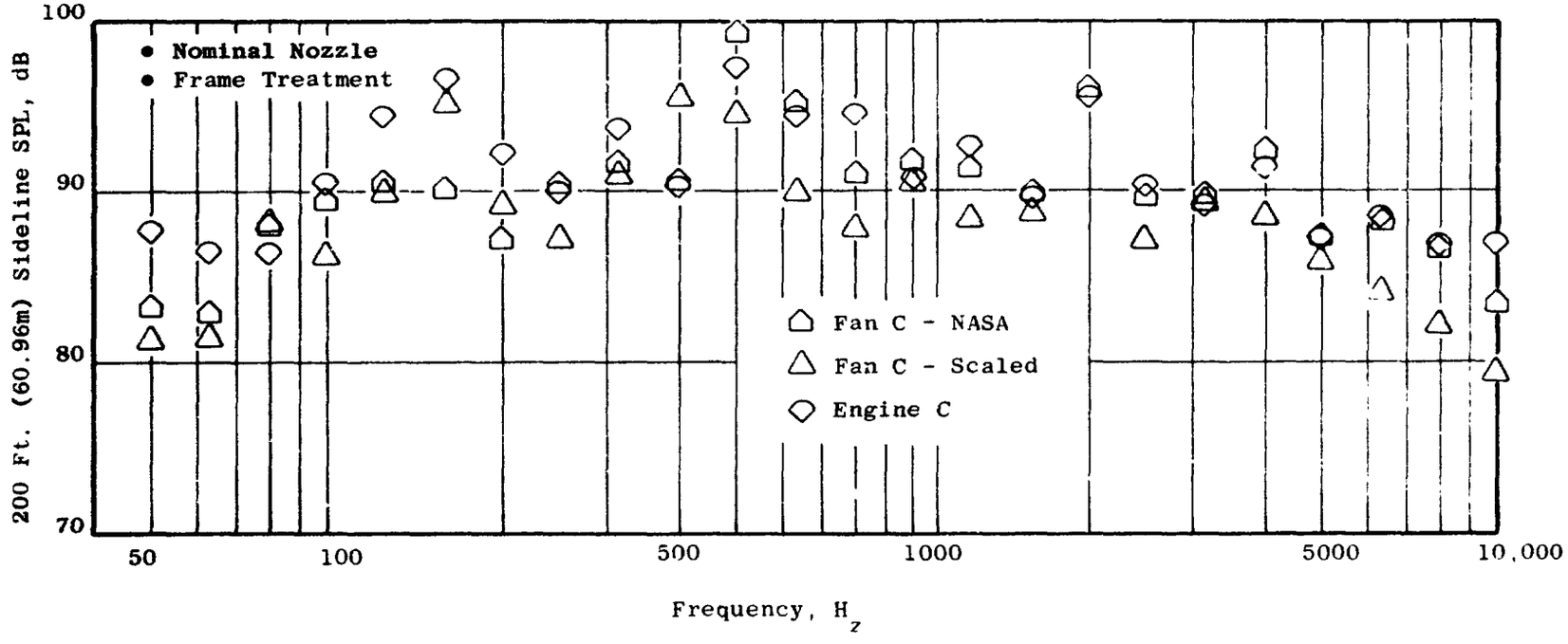

Figure 30 200-ft (60.96 m) Sideline SPL Vs. Frequency for Full-Scale Fan, Scaled Fan, and Engine, 110°, Takeoff.

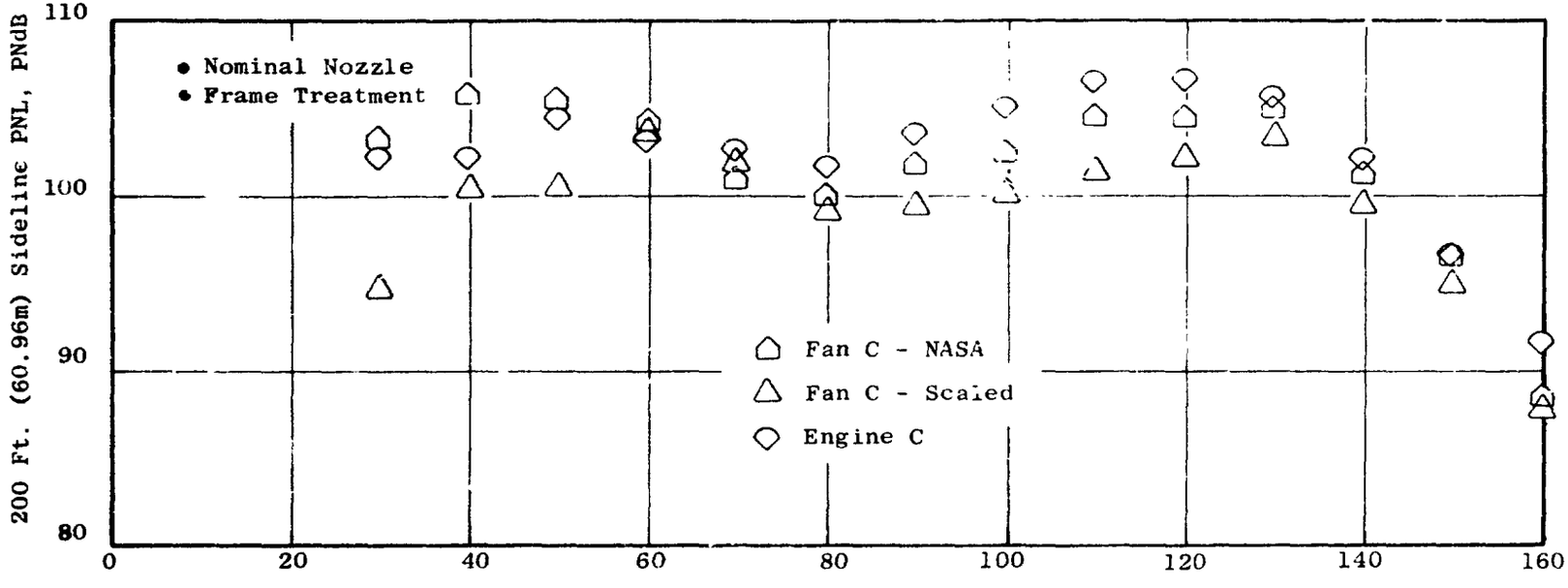

Figure 31. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet for Full-Scale Fan, and Engine, Approach.

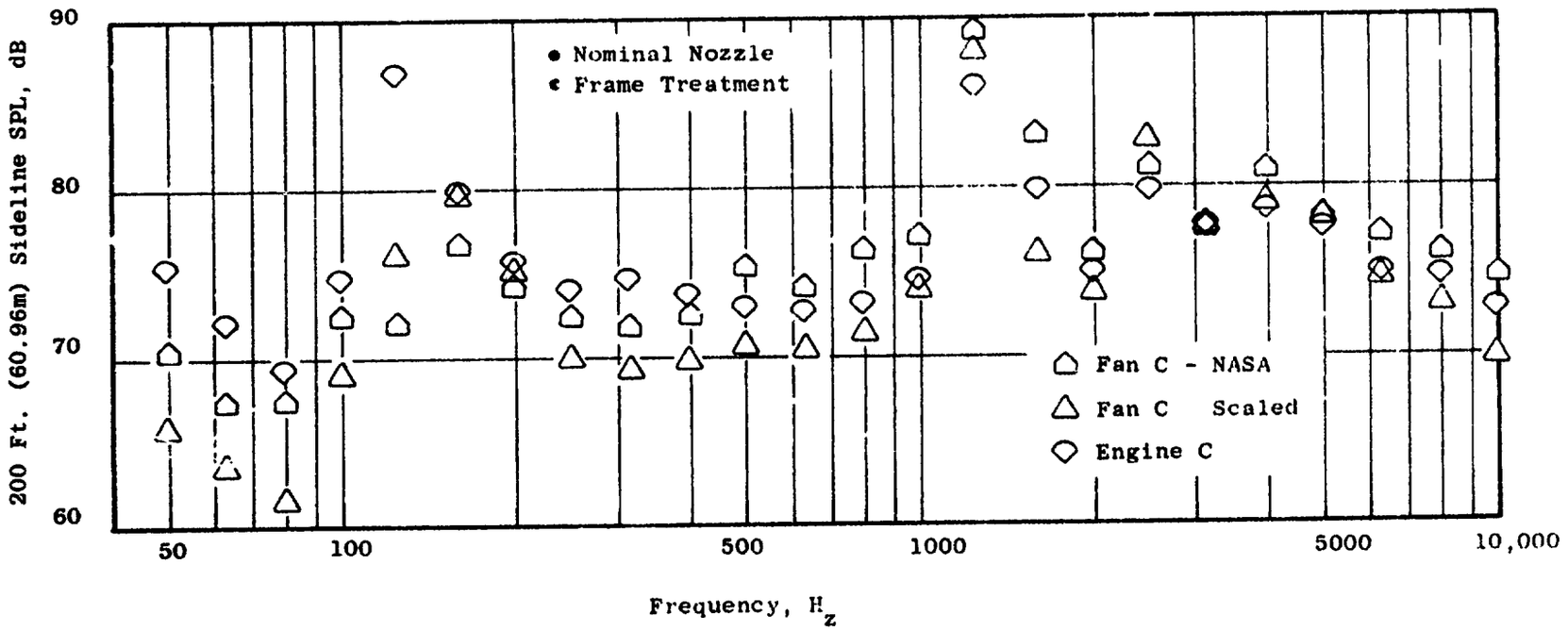

Figure 32. 200-ft (60.96 m) Sideline SPL Vs. Frequency for Full-Scale Fan, Scaled Fan, and Engine, 60°, Approach.

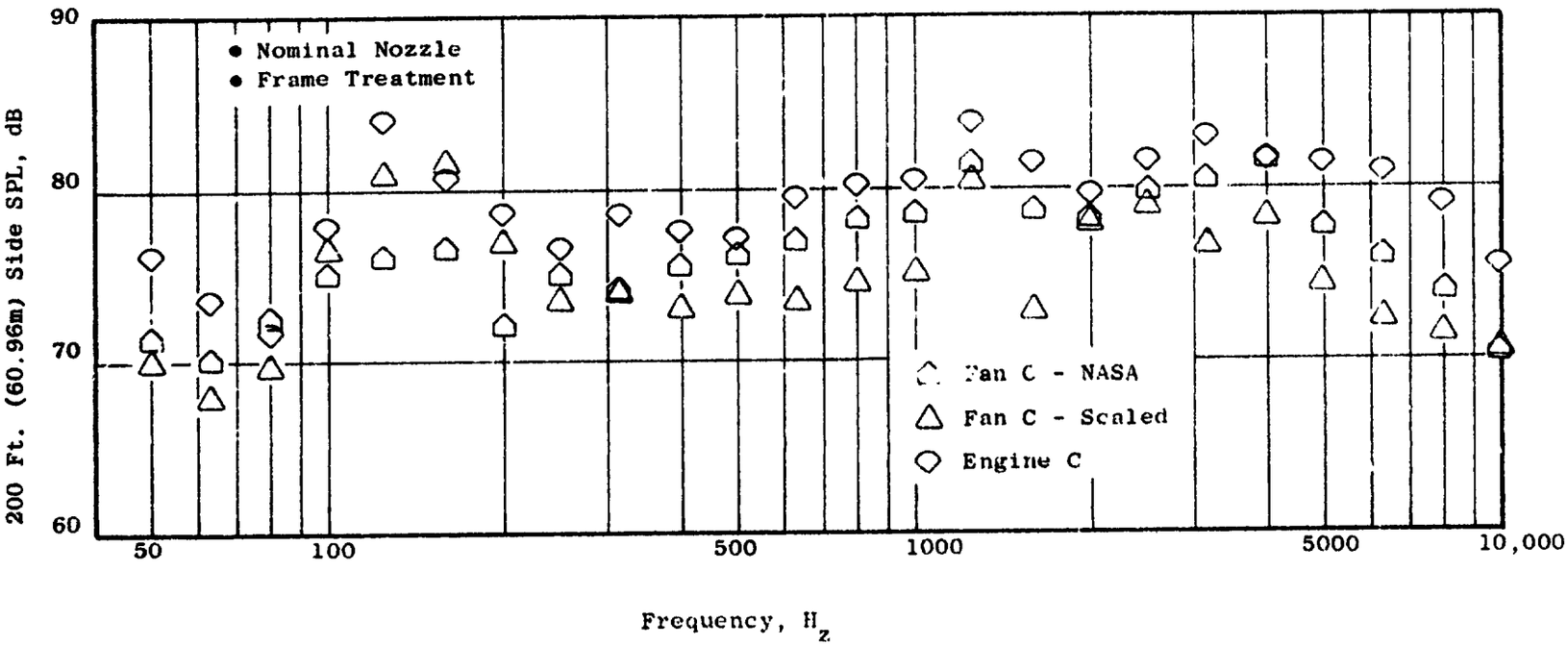

Figure 33. 200-ft (60.96 m) Sideline SPL Vs. Frequency for Full-Scale Fan, Scaled Fan, and Engine, 120°, Approach.

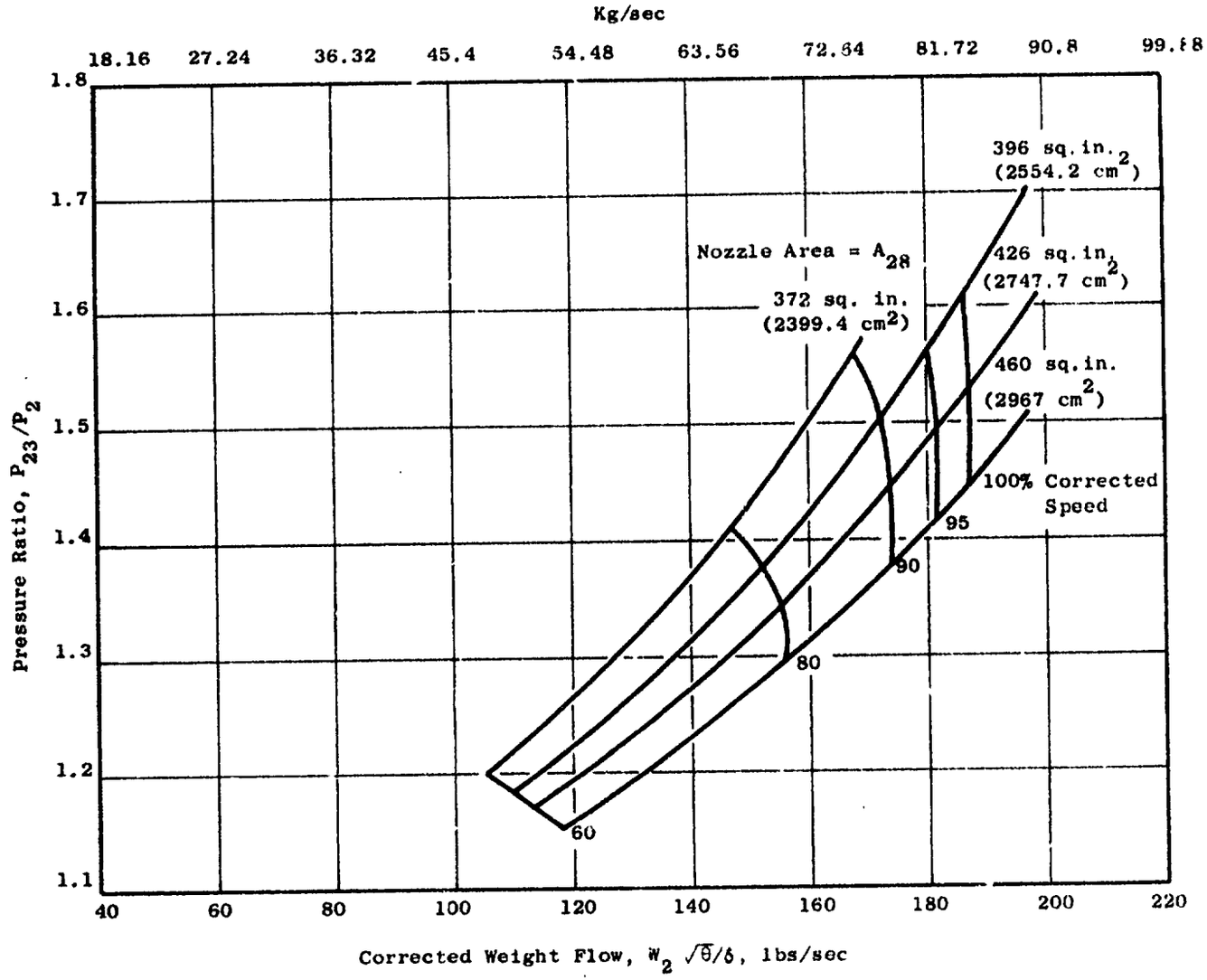

Figure 34. Scale Model Fan C Performance Map.

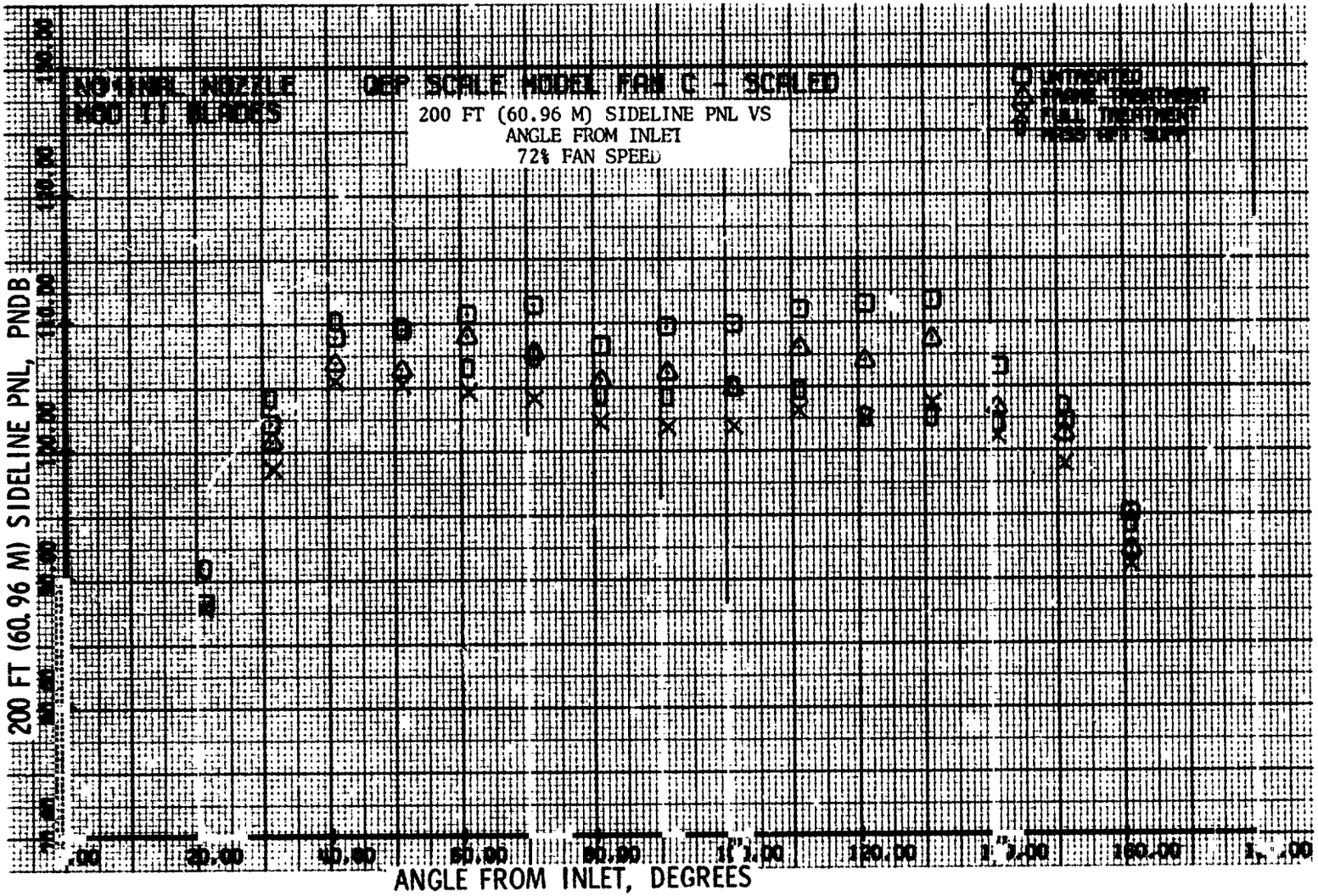

Figure 35. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, Takeoff.

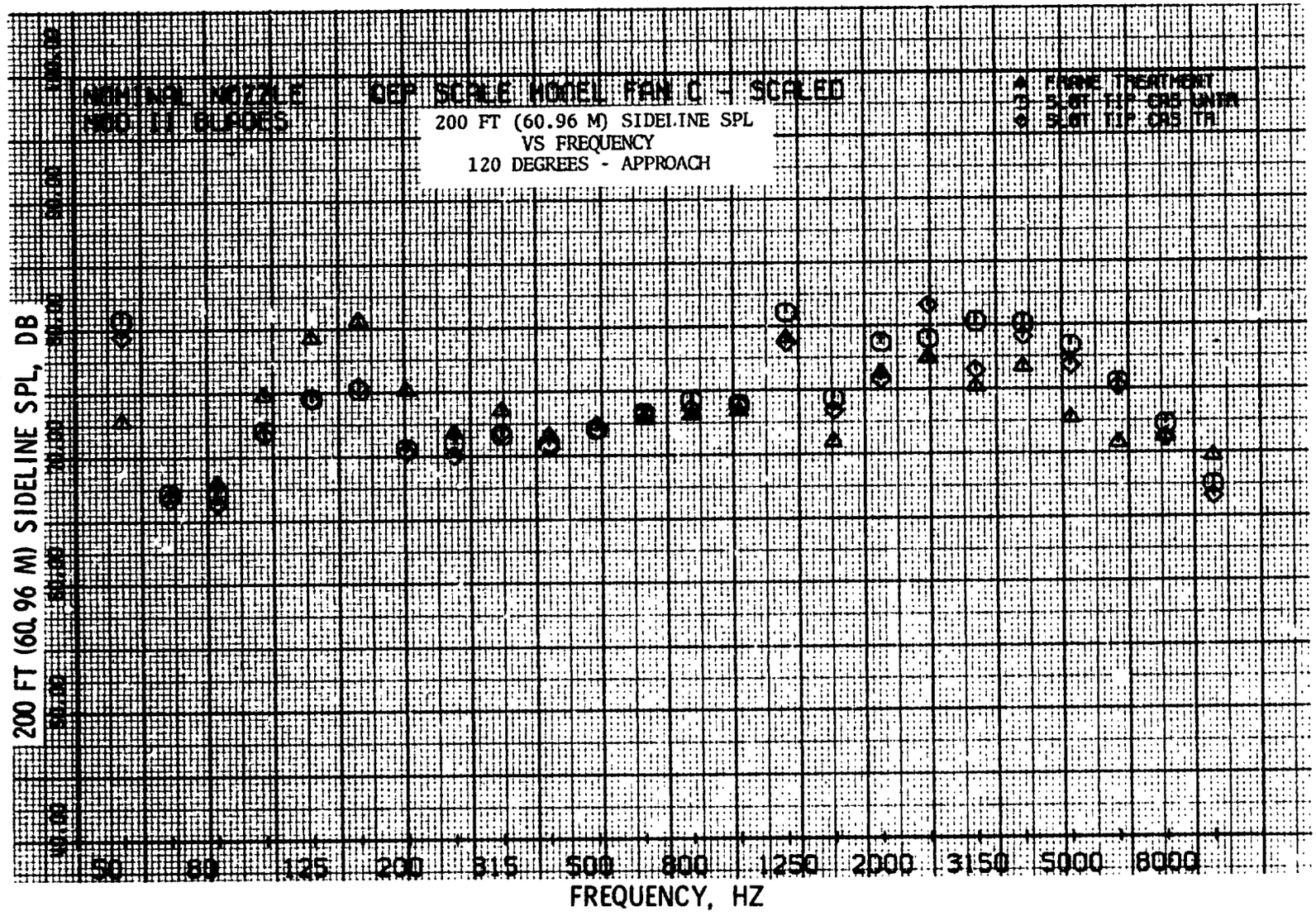

Figure 36. 200-ft (60.96 m) Sideline SPL Vs. Frequency for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, 70°, Takeoff.

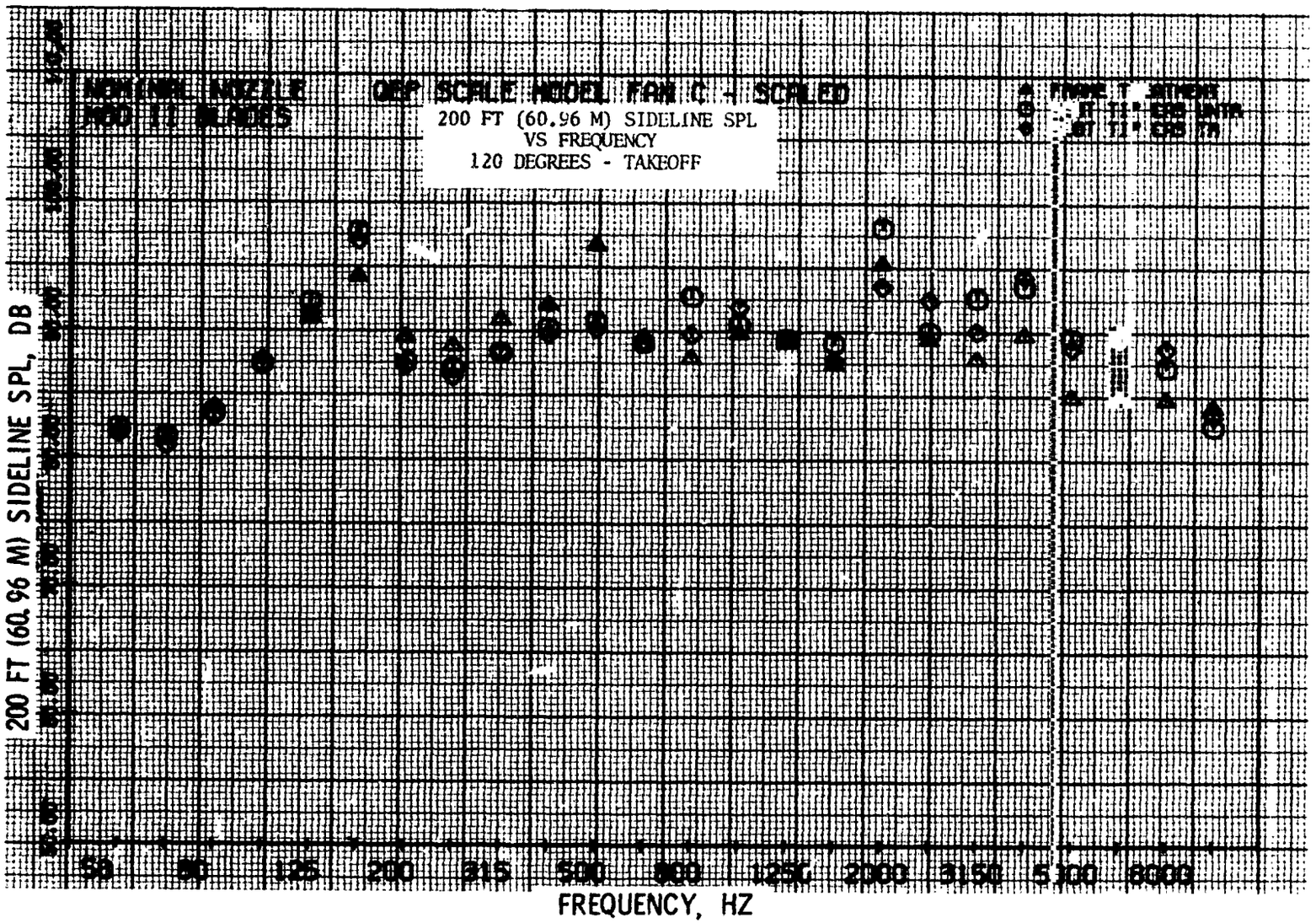

Figure 37. 200-ft (60.96 m) Sideline SPL Vs. Frequency for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, 120°, Takeoff.

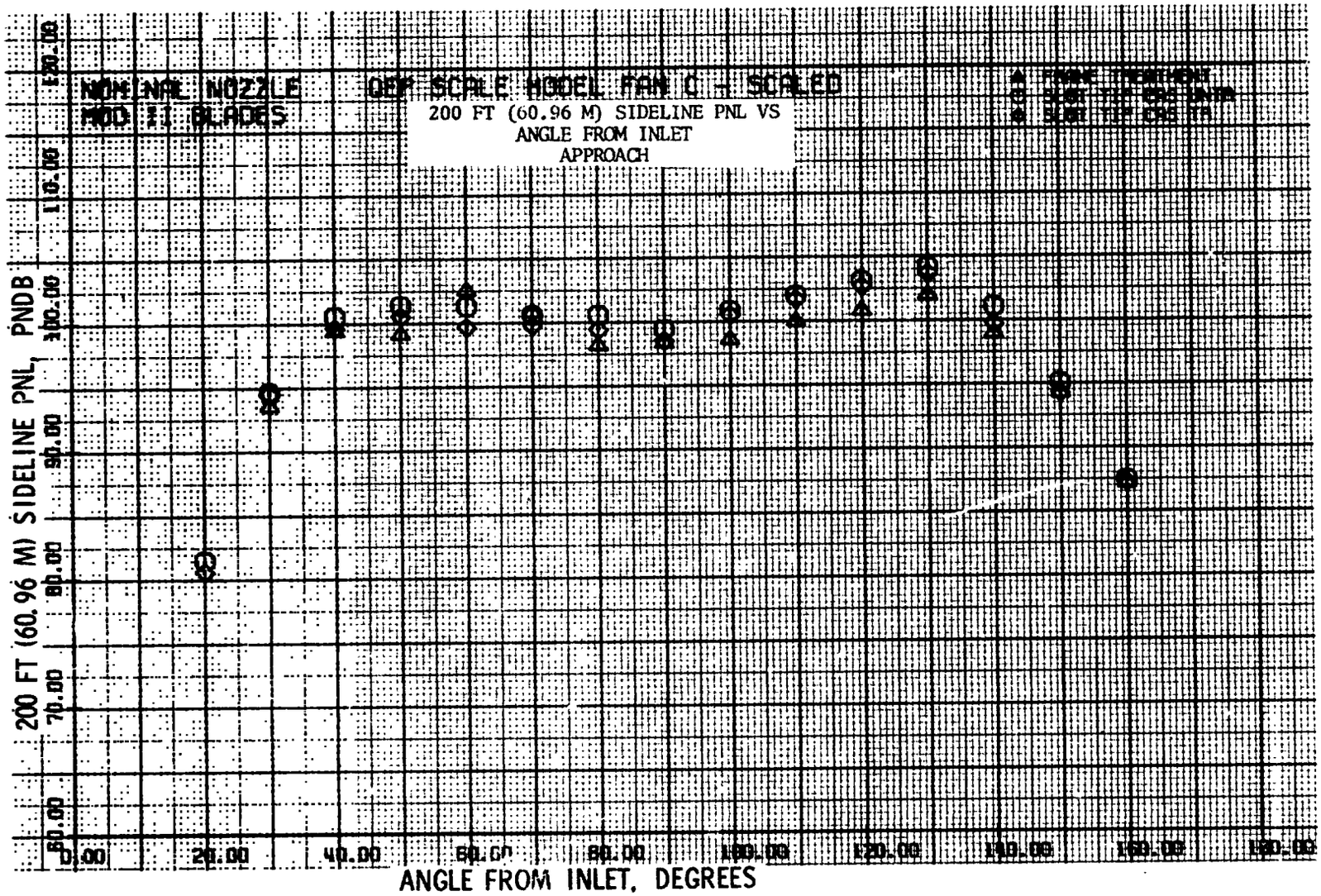

Figure 38. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, 84% Fan Speed.

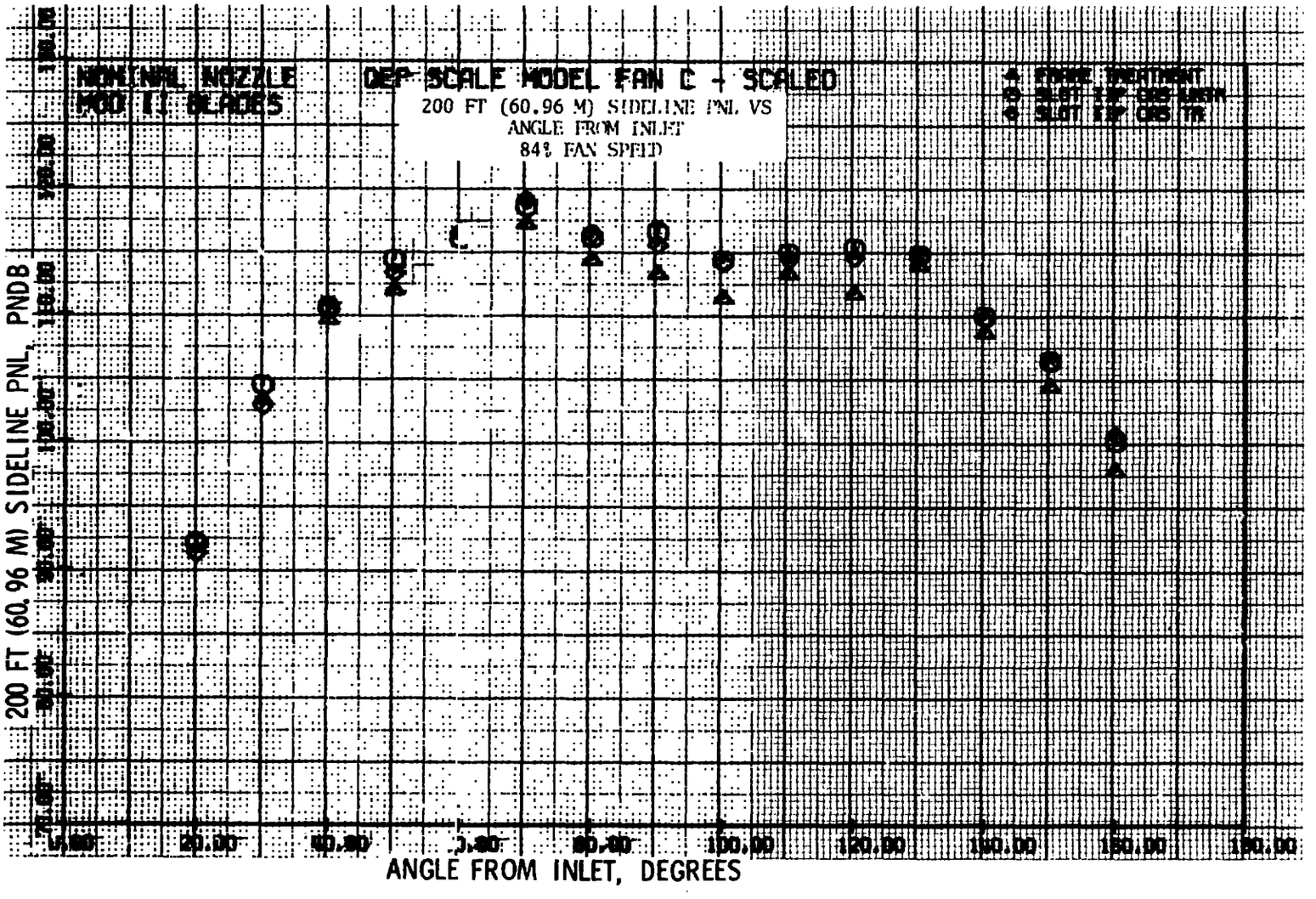

Figure 39. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, 72% Fan Speed.

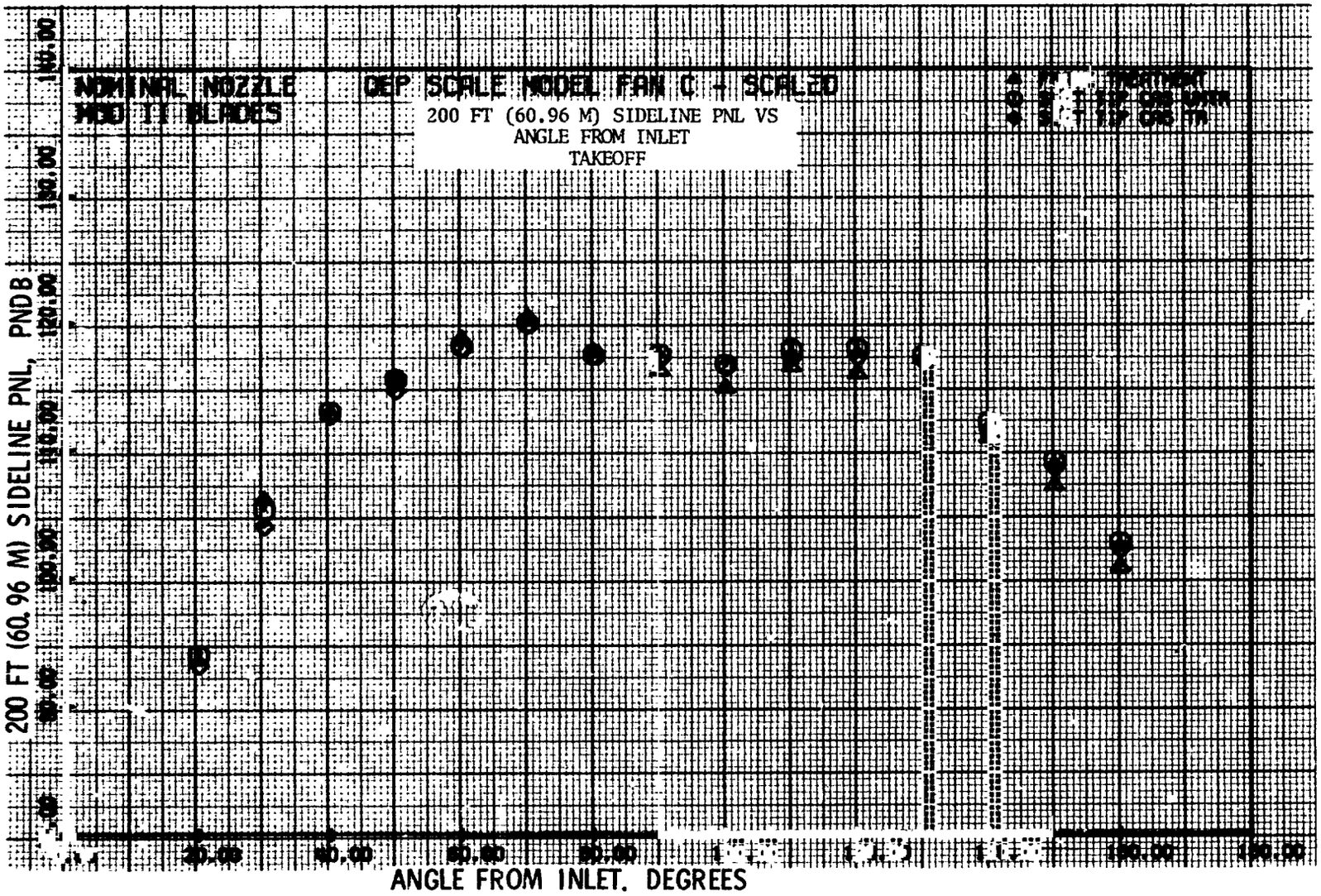

Figure 40. 200-ft (60.96 m) Sideline PNL Vs. Angle from Inlet for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, Approach.

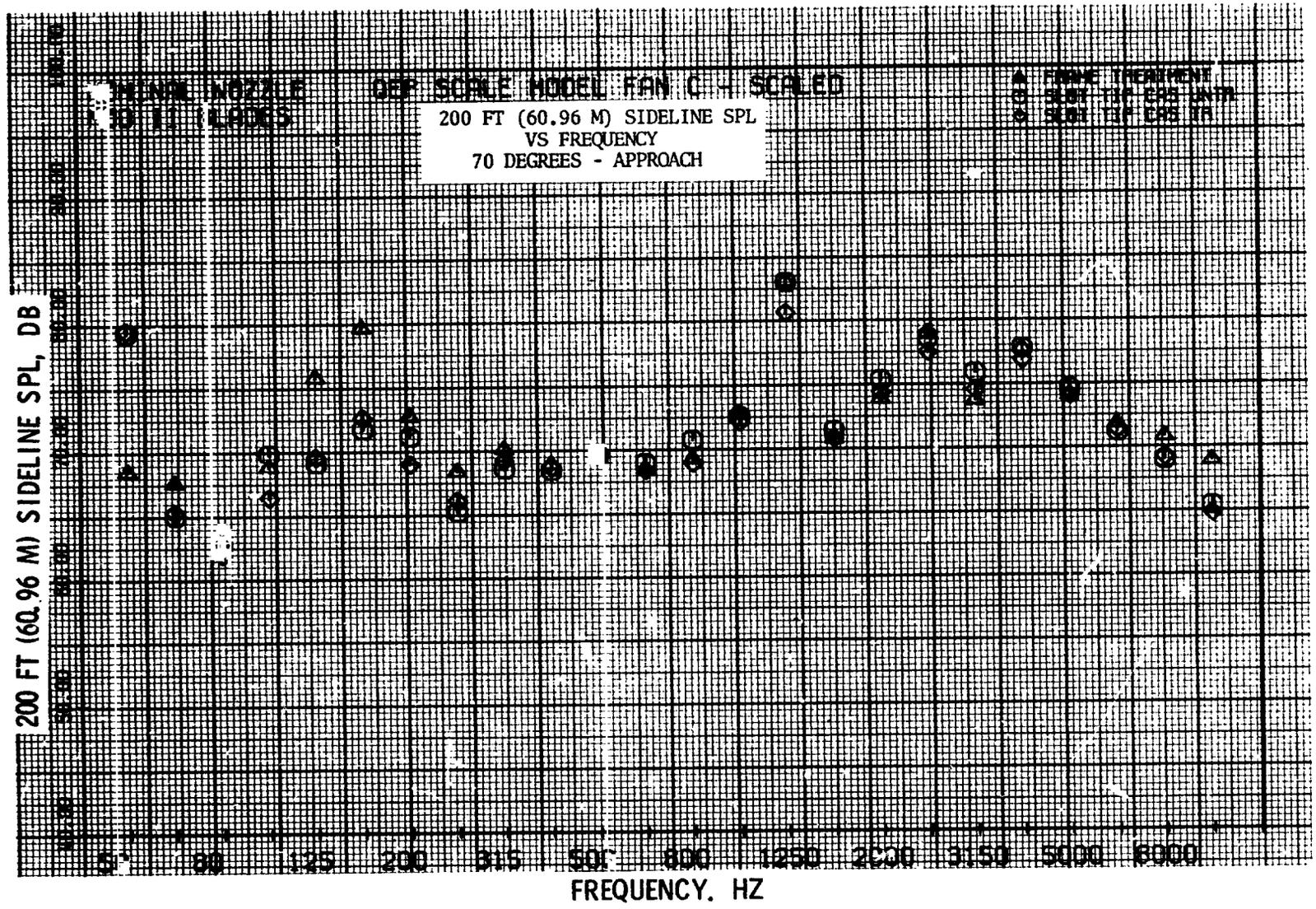

Figure 41. 200-ft (60.96 m) Sideline SPL Vs. Frequency for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, 70°, Approach.

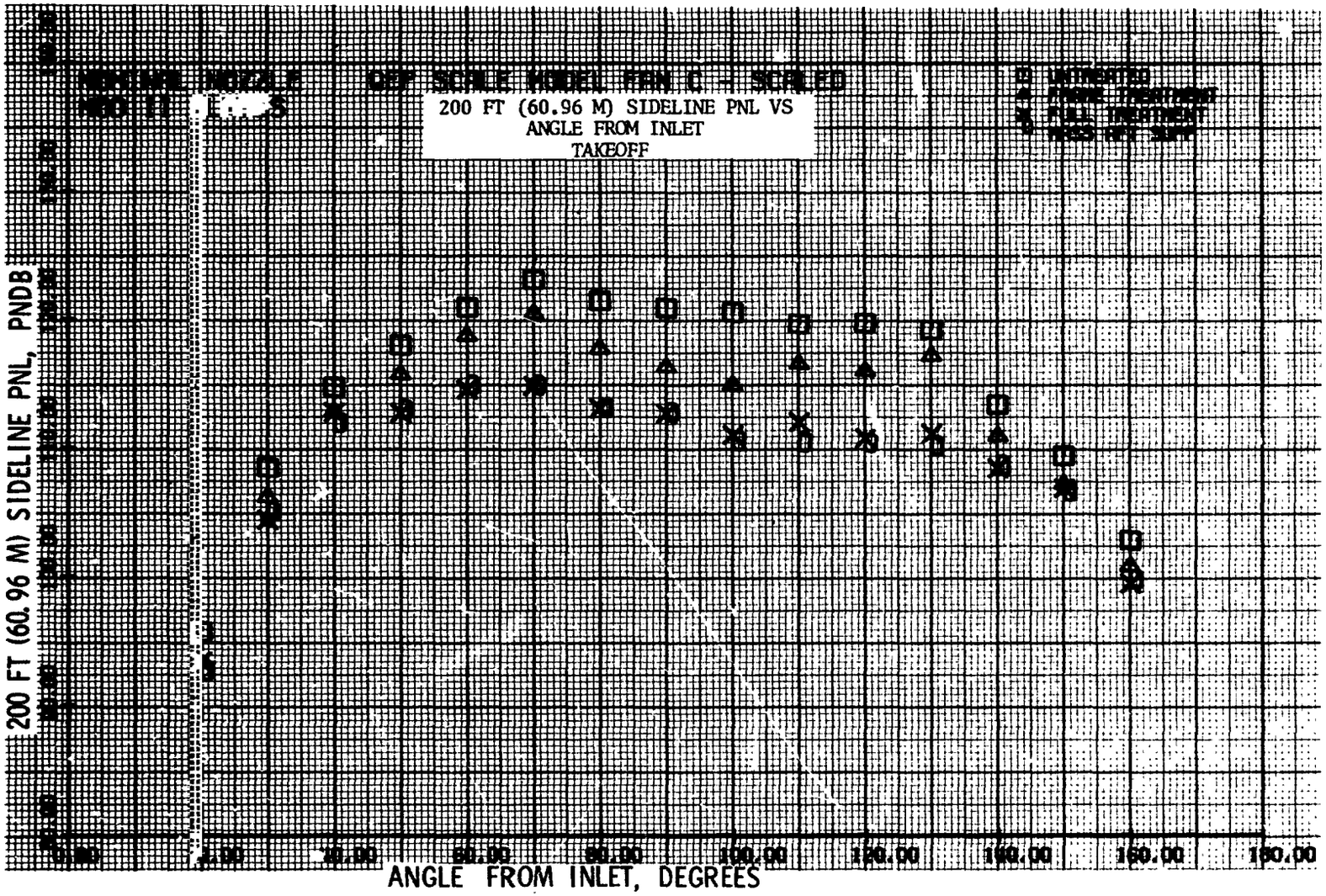

Figure 42. 200-ft (60.96 m) Sideline SPL Vs. Frequency for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, 120°, Approach.

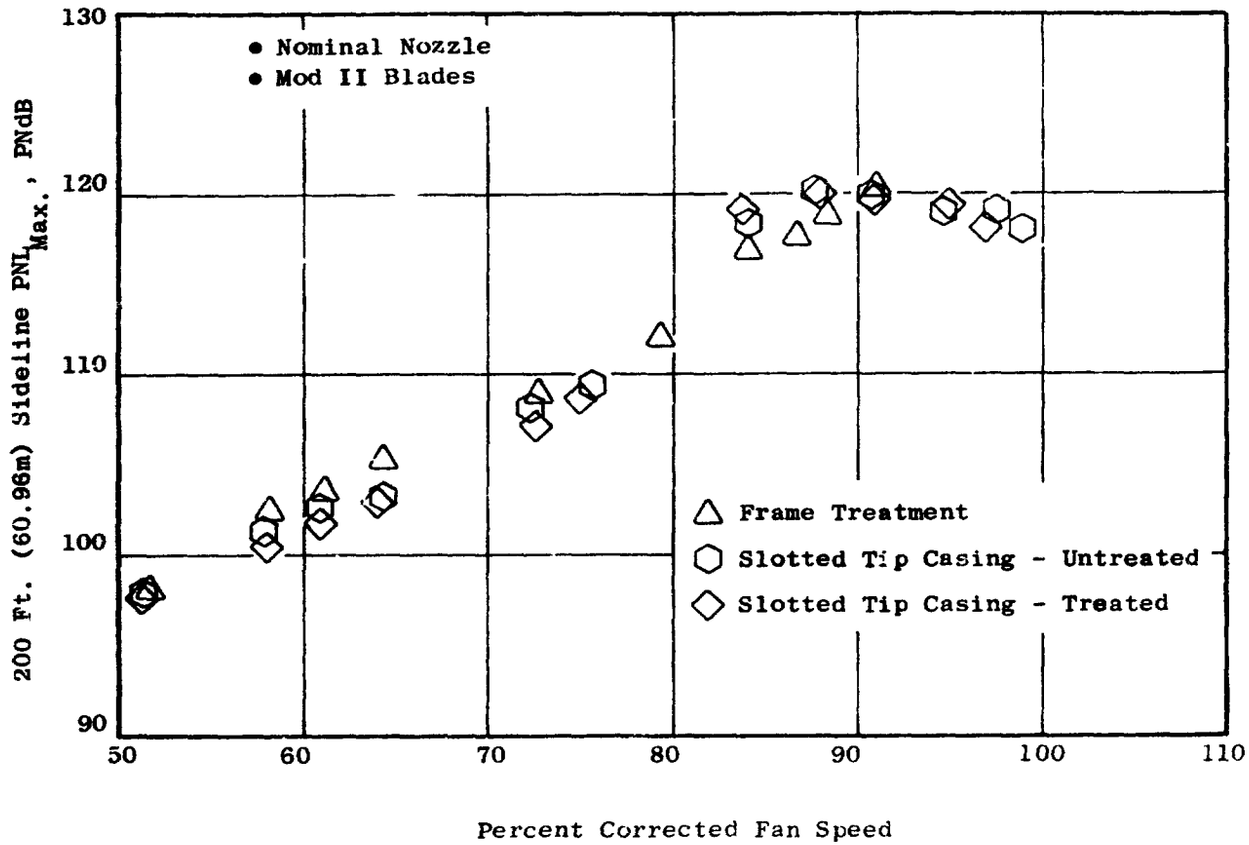

Figure 43. 200-ft (60.96 m) Sideline Front Maximum PNL Vs. Corrected Fan Speed for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations.

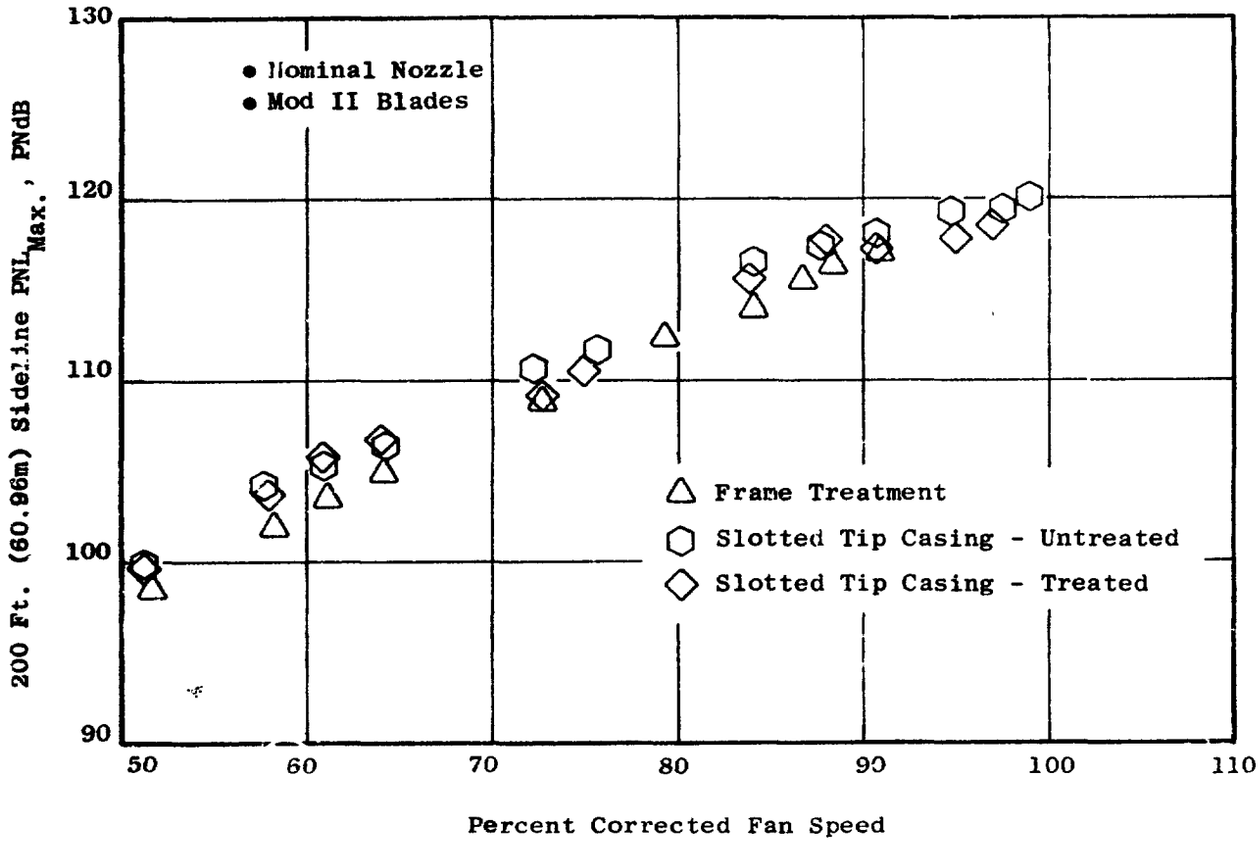

Figure 44. 200-ft (60.96 m) Sideline Aft Maximum PNL Vs. Corrected Fan Speed for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations.

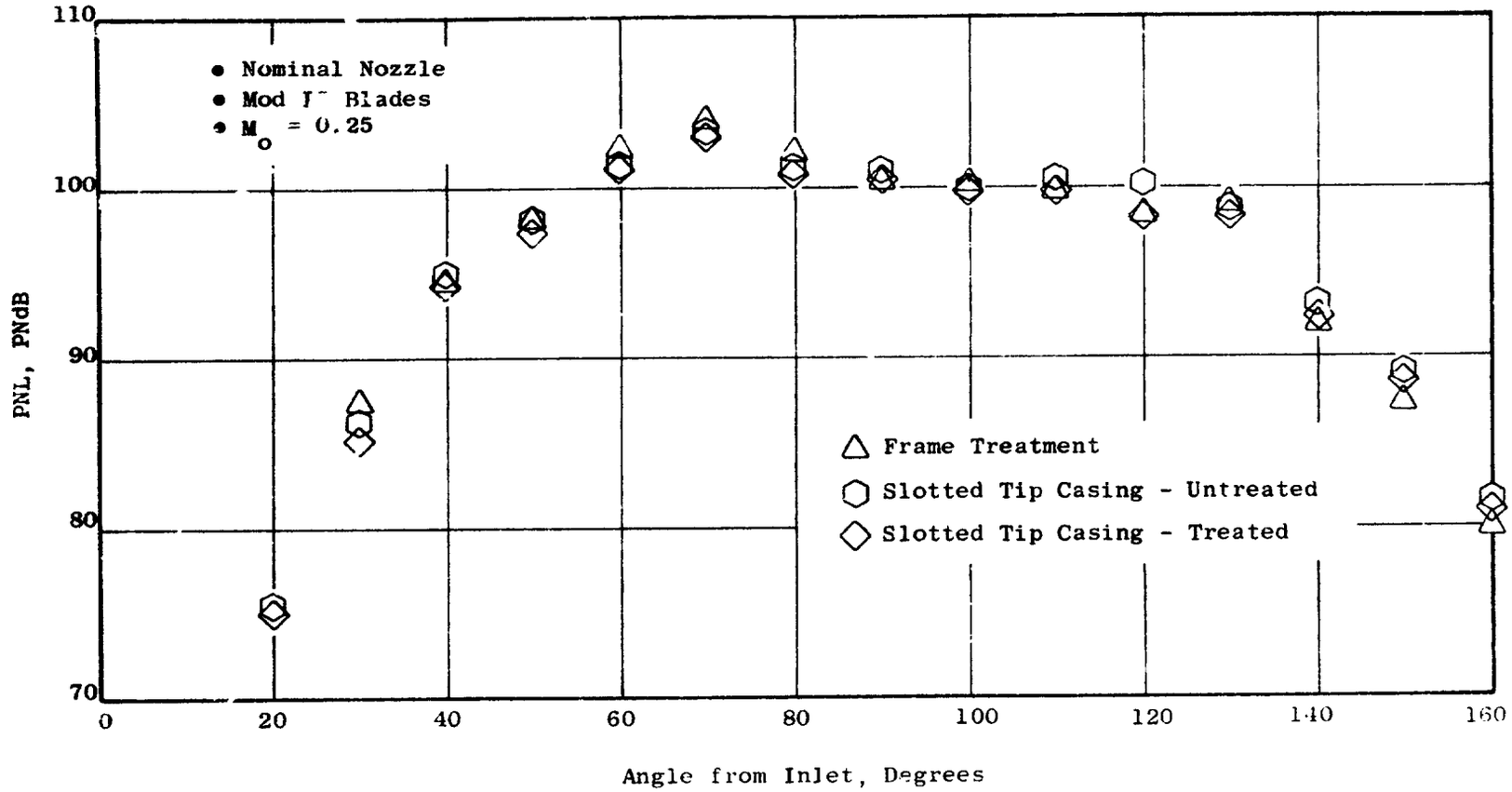

Figure 45. 1000-ft (304.8 m) Level Flyover PNL for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, Takeoff.

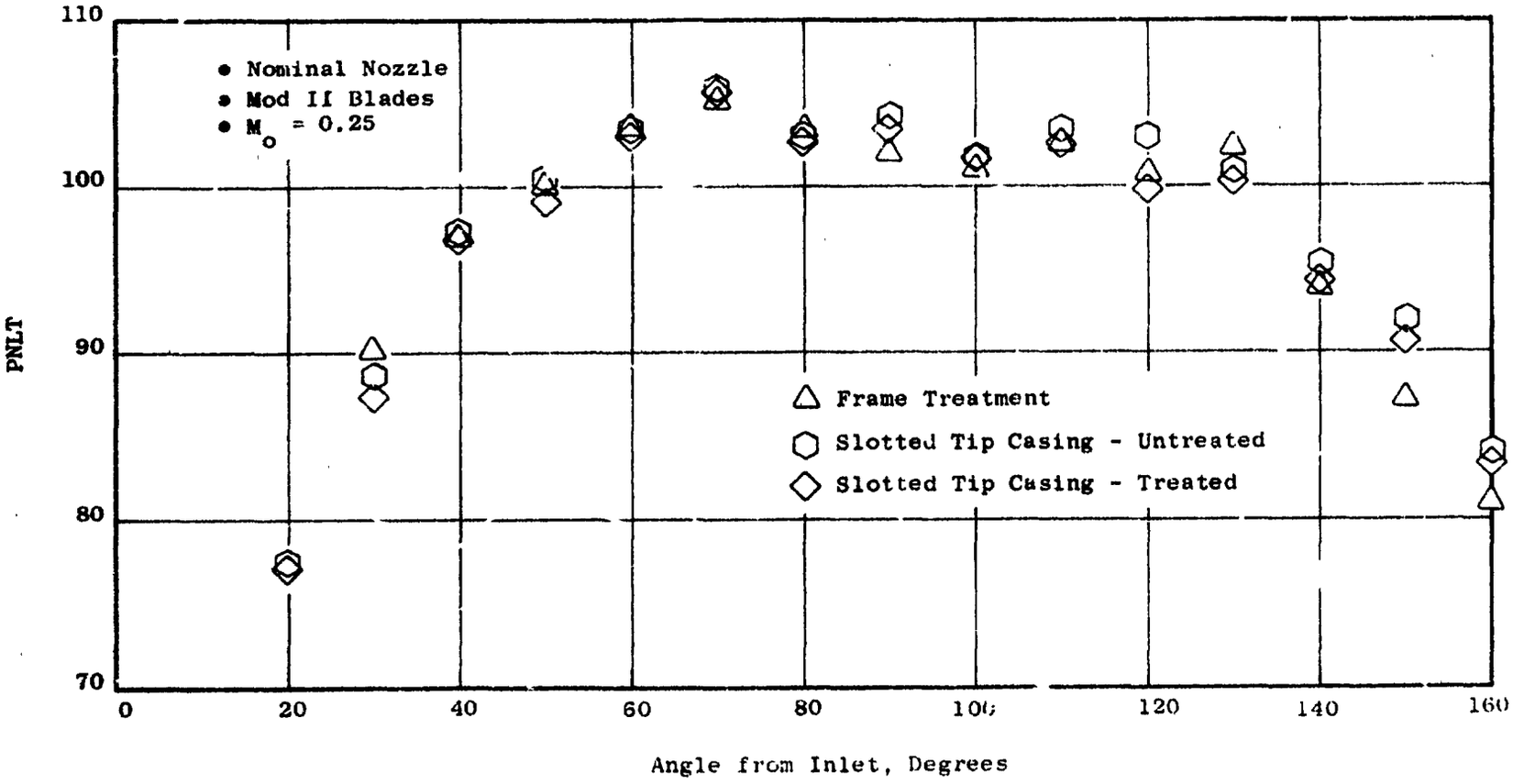

Figure 46. 1000-ft (304.8 m) Level Flyover PNLT for Frame Treatment and Treated and Untreated Slotted Tip Casing Configuratio . Takeoff.

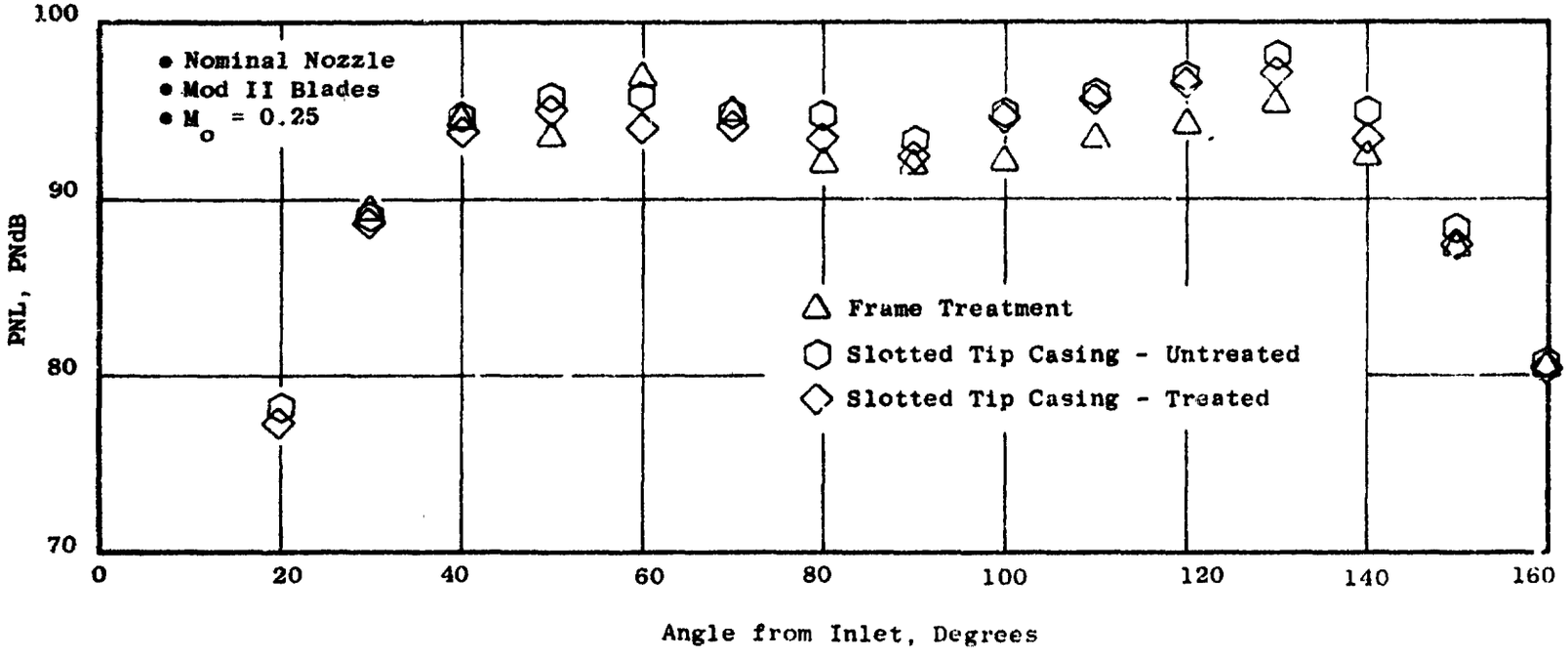

Figure 47. 370-ft (112.8 m) Level Flyover PNL for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, Approach.

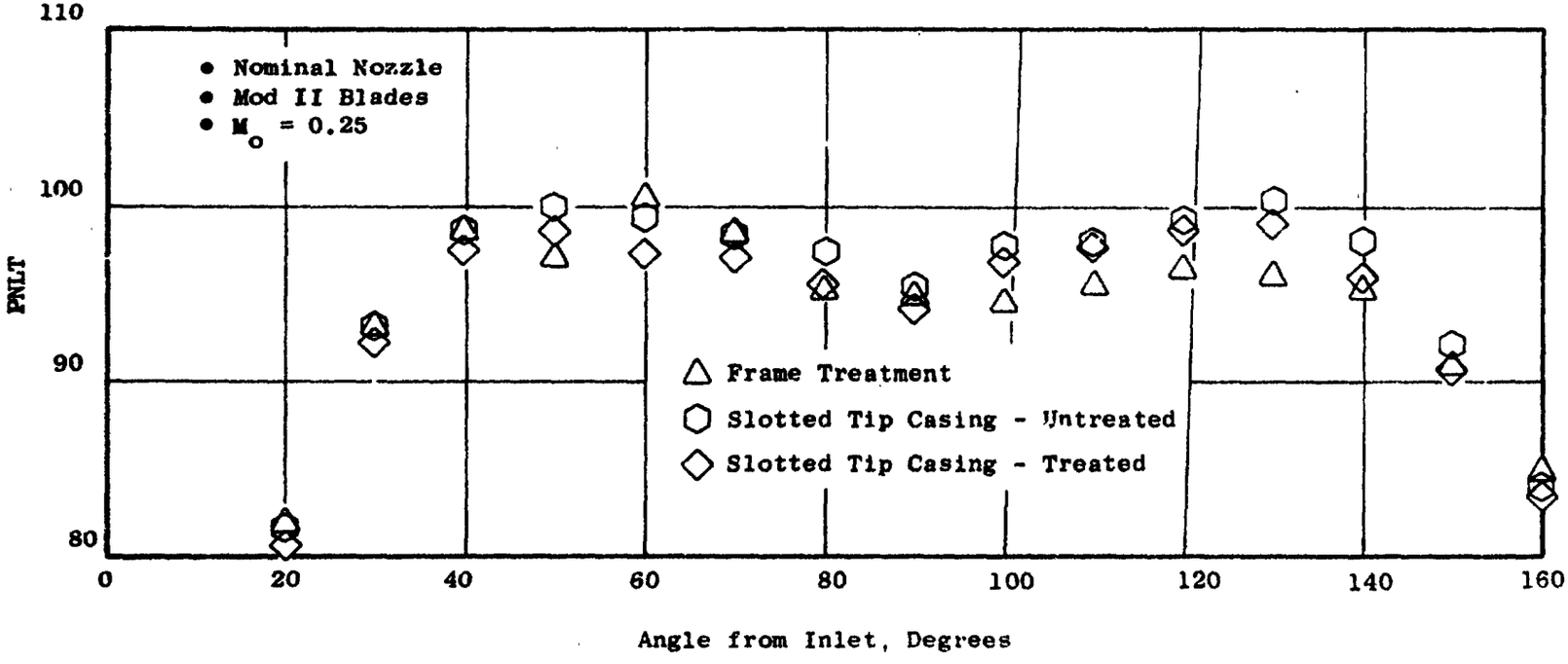

Figure 48. 370-ft (112.8 m) Level Flyover PNLT for Frame Treatment and Treated and Untreated Slotted Tip Casing Configurations, Approach.

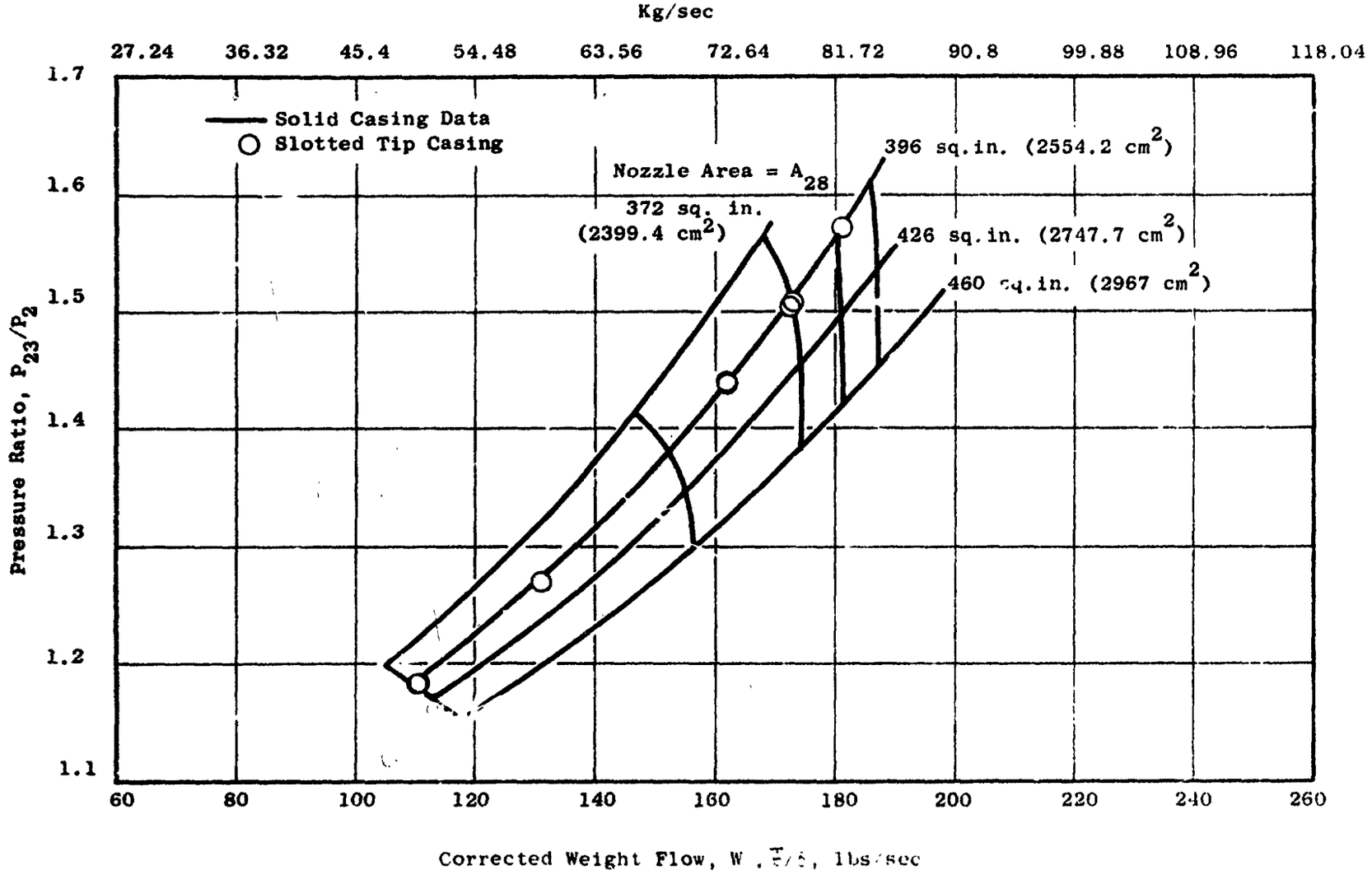

Figure 49. Performance Map Showing Comparison of Solid Casing and Slotted Casing Data.

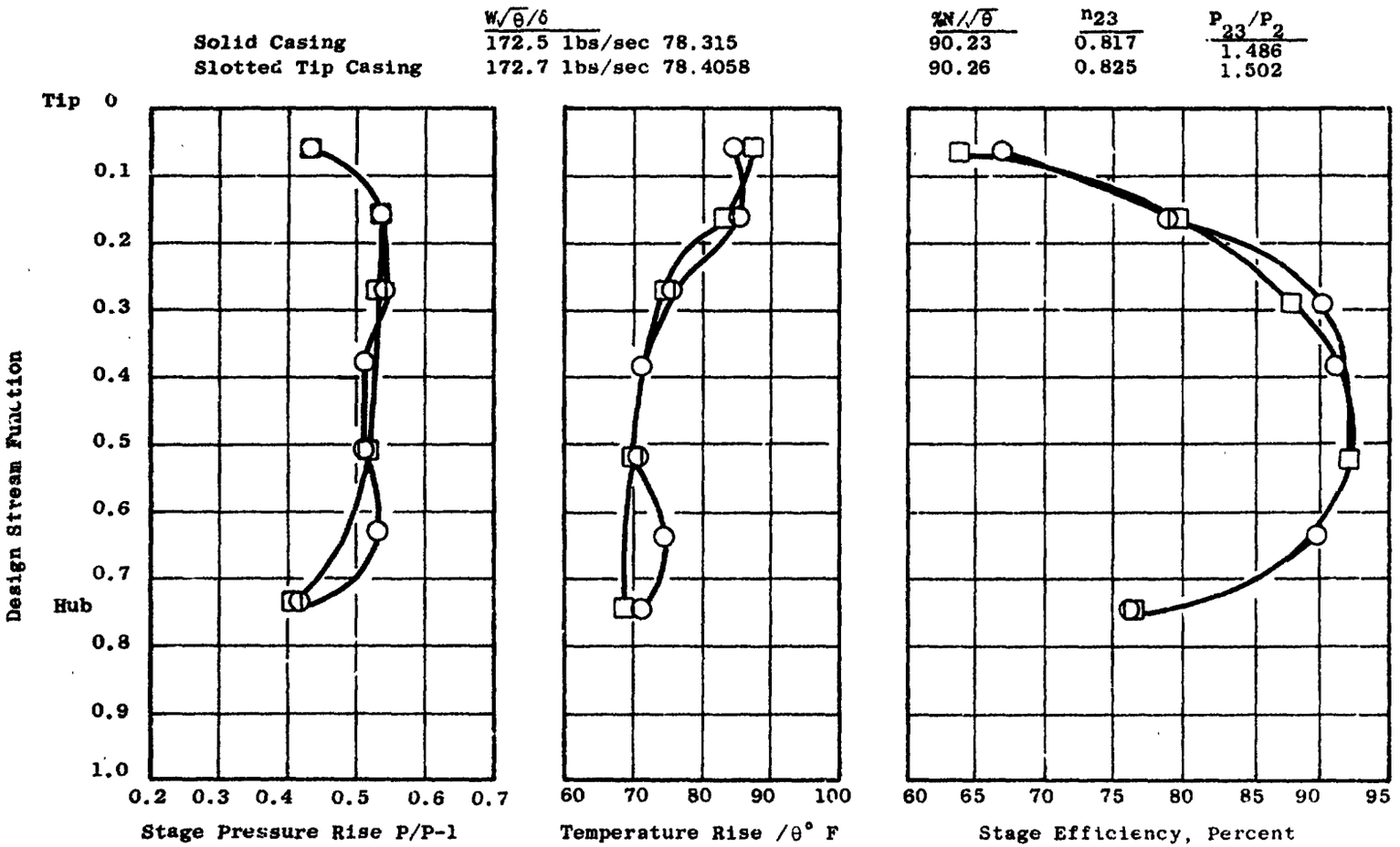

Figure 50. Radial Distribution of Pressure Rise, Temperature Rise, and Resulting Efficiency at Takeoff Fan Speed.

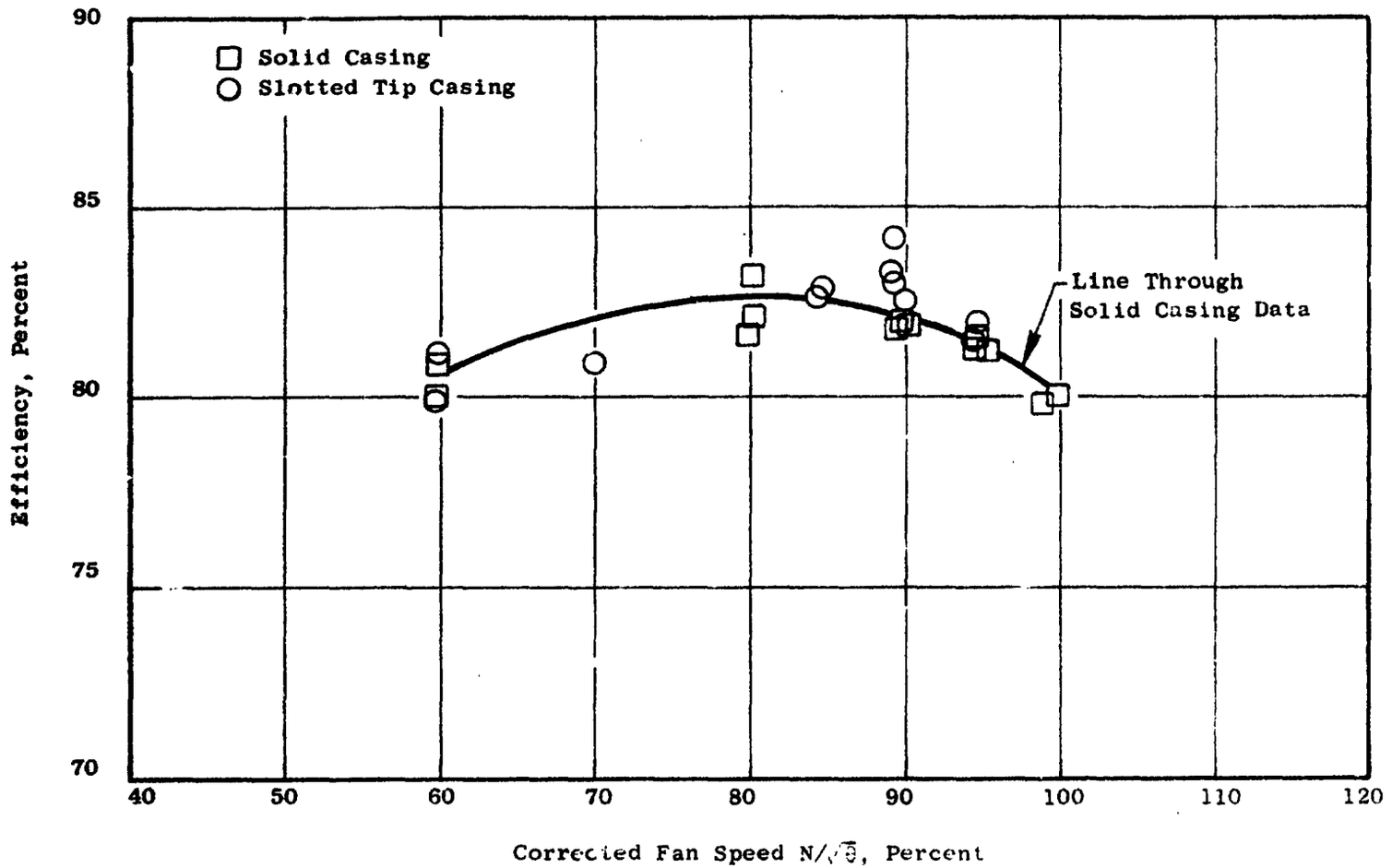

Figure 51. Efficiency Vs. Corrected Fan Speed for Solid and Slotted Casings.

APPENDIX B
One-Third Octave Data

The one-third octave data have been corrected to standard day (59° F, 70% R.H.). These data are on a 100-foot (30.48 m) arc for the scale model size and a 200-foot (60.96 m) sideline for the full-scale fan. A takeoff and approach set of data are included for the untreated frame treatment, full treatment, slotted (untreated), and slotted (treated) configurations.

UNTREATED
NOMINAL NOZZLE
TAKEOFF
200' (60.96 m) SIDELINE

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. 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
50	79.3	78.1	77.1	77.8	77.0	79.1	79.9	80.4	81.4	83.4	84.1	85.1	87.2	93.3	97.7			135.9
63	75.4	76.2	76.1	77.8	77.8	78.7	79.6	80.6	81.3	83.0	83.5	84.9	87.4	92.8	96.8			135.4
80	75.9	77.1	80.0	80.4	79.0	79.4	80.7	81.1	81.6	83.8	84.4	86.0	88.6	93.0	95.8			135.5
100	78.5	79.1	79.5	79.9	80.1	80.7	81.5	81.1	81.9	83.4	84.2	86.3	88.1	91.4	92.0			134.3
125	76.6	77.9	80.6	78.3	79.2	79.0	79.2	80.3	81.6	83.7	82.8	84.9	86.2	89.5	91.0			133.1
160	76.5	79.5	82.7	80.4	78.2	80.2	81.6	82.0	85.3	88.0	85.3	88.8	90.1	94.3	95.2			136.9
200	77.2	78.8	81.2	80.8	80.9	81.3	82.7	84.4	85.3	87.9	89.5	92.0	94.1	96.8	96.7			139.2
250	83.0	85.6	87.3	87.6	87.9	87.1	88.2	89.2	89.9	91.6	93.0	94.6	96.8	97.8	96.8			141.9
315	86.4	89.7	89.5	89.1	91.9	88.3	89.5	90.0	91.2	92.9	94.3	95.1	96.7	96.2	95.2			142.4
400	83.6	85.9	87.2	86.4	88.0	89.3	88.5	88.8	91.2	91.6	91.5	91.4	92.3	93.3	91.4			140.1
500	81.1	82.9	86.3	85.0	85.0	85.8	85.4	86.4	88.7	89.3	90.7	92.6	92.2	93.2	91.5			139.0
630	84.6	89.4	92.4	92.2	95.0	96.1	95.2	95.5	95.7	93.5	94.0	94.4	93.5	93.2	92.2			144.3
800	90.0	95.2	98.5	96.7	101.6	103.1	102.2	101.1	99.3	96.8	94.2	96.0	95.1	92.9	89.7			149.4
1000	93.9	94.9	99.7	108.4	109.8	112.1	110.2	109.1	104.1	101.3	103.1	96.5	95.7	99.2	90.9			157.1
1250	86.0	92.0	99.9	102.9	105.3	107.6	103.3	99.5	96.1	96.2	97.7	98.2	93.1	92.3	93.0			151.6
1600	87.5	89.9	97.5	100.0	103.7	102.4	100.9	99.6	94.9	94.5	95.9	94.5	97.0	93.5	93.4			149.2
2000	89.1	92.5	99.9	101.2	104.7	103.0	100.8	97.4	94.9	93.7	95.3	96.8	94.1	94.6	94.0			149.8
2500	87.9	94.1	98.8	95.7	98.9	103.7	98.8	96.9	94.2	95.4	93.9	93.9	93.7	92.5	90.3			147.9
3150	84.4	93.0	98.6	96.9	98.2	98.0	94.7	96.1	93.7	92.8	93.7	95.2	92.3	92.6	90.9			146.2
4000	85.1	96.8	98.5	100.3	101.7	98.7	99.3	97.6	102.4	100.4	102.0	102.9	96.7	94.8	94.4			150.9
5000	83.2	90.2	96.2	93.6	93.2	98.1	94.3	95.3	92.2	95.2	94.2	93.8	92.1	91.3	87.9			145.4
6300	81.3	91.6	96.9	95.1	95.1	94.3	92.4	93.0	92.2	94.1	94.8	95.6	90.7	89.4	87.9			145.0
8000	79.3	90.3	94.4	92.6	93.1	93.2	92.4	94.2	92.6	96.3	96.3	96.5	93.3	91.1	87.3			145.9
10000	78.3	88.5	92.1	90.8	92.1	91.8	89.4	89.9	89.3	91.5	92.8	92.8	89.3	87.1	84.2			143.6
12500	74.8	85.7	89.6	88.2	90.9	89.4	87.7	88.9	88.1	90.8	91.7	92.1	89.0	86.1	82.9			143.4
16000	73.1	83.5	88.2	86.3	90.8	87.5	86.2	87.1	86.9	89.7	91.7	92.6	88.9	85.4	81.8			144.7
20000	71.0	79.9	85.4	83.1	88.7	84.5	83.9	83.2	83.6	86.2	87.9	89.5	86.8	83.0	79.7			144.3
OVERALL MEASURED	101.3	104.1	110.2	113.5	115.5	117.0	114.9	113.0	110.9	110.0	110.9	110.6	109.2	109.8	109.4			
OVERALL CALCULATED	99.5	104.4	108.7	111.8	113.9	115.3	113.0	111.8	109.2	108.4	109.3	109.1	107.4	107.8	107.3			161.7
PNDB	111.0	118.3	121.5	122.6	124.3	125.1	122.7	121.8	122.7	122.0	123.0	123.5	120.2	119.5	118.6			

UNTREATED
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	68.4	72.6	75.2	77.1	78.4	79.7	80.9	80.7	81.3	82.4	82.9	83.5	83.8	84.8	81.8
63	66.3	71.2	76.2	75.4	77.5	78.0	78.6	79.8	81.0	82.7	81.0	82.1	81.8	82.8	80.7
80	66.0	72.6	76.2	77.5	76.4	79.2	80.9	81.5	84.7	86.9	83.5	85.9	85.6	87.4	84.7
100	66.5	71.9	76.6	77.9	79.1	80.2	82.1	83.8	84.6	86.8	87.7	89.0	89.6	89.9	86.0
125	72.1	76.5	82.6	84.6	86.0	86.0	87.9	88.6	89.1	90.4	91.1	91.6	92.1	90.7	85.9
160	75.3	82.5	84.8	86.0	90.0	87.1	88.7	89.3	90.4	91.7	92.3	92.0	91.9	89.0	84.1
200	72.3	78.6	84.4	83.2	86.0	88.1	87.7	88.1	90.4	90.4	89.5	88.2	87.5	86.0	80.1
250	69.6	75.4	81.4	81.8	82.9	84.6	84.6	85.7	87.9	88.1	88.7	89.4	88.0	85.7	80.0
315	72.9	81.8	87.4	88.9	92.9	94.8	94.4	94.7	94.8	92.2	91.9	91.1	88.5	85.6	80.4
400	78.1	88.1	93.5	93.5	99.7	101.7	101.3	100.3	98.4	95.4	92.1	92.7	90.0	85.2	77.8
500	81.8	87.1	94.5	105.0	107.6	110.7	109.3	108.3	103.1	99.9	101.0	93.0	90.5	91.4	78.7
630	75.5	84.0	90.6	99.4	103.0	106.2	102.3	98.7	95.1	94.8	95.5	94.7	87.8	84.3	80.6
800	74.8	81.2	92.1	96.4	101.4	100.9	99.9	98.7	93.8	93.0	93.6	91.0	91.6	85.4	80.7
1000	76.1	84.2	94.4	97.6	102.4	101.5	99.7	96.5	93.9	92.1	92.9	93.2	88.6	86.3	81.0
1250	74.6	85.6	91.2	92.0	96.5	102.2	97.7	95.5	93.1	93.8	91.5	90.3	88.1	84.0	77.0
1600	72.1	84.3	92.9	93.2	95.8	100.0	95.6	95.2	92.6	91.7	91.3	91.5	86.4	83.9	77.3
2000	71.1	88.0	92.8	96.6	99.4	97.8	98.3	96.7	101.4	98.9	99.6	99.1	90.9	85.9	80.4
2500	68.8	81.2	90.3	89.8	90.7	96.5	93.2	94.4	91.1	93.7	91.7	89.9	86.2	82.3	73.5
3150	66.4	82.4	88.9	91.3	92.7	93.3	91.4	92.2	91.2	92.6	92.3	91.7	84.7	80.1	73.0
4000	63.7	80.7	88.3	88.8	90.7	91.8	91.5	93.5	91.8	94.9	94.0	92.7	87.2	81.5	71.7
5000	62.7	79.2	86.4	87.4	90.3	90.9	89.1	89.8	89.0	90.7	90.9	89.4	83.6	77.8	68.6
6300	58.2	76.1	83.9	85.0	89.4	89.0	87.8	89.2	88.2	90.3	90.2	88.9	83.4	76.5	66.3
8000	55.0	73.5	82.6	83.9	89.9	87.7	87.1	88.1	87.8	90.0	90.8	89.9	83.3	75.4	63.6
10000	50.7	69.2	79.9	80.8	88.5	85.6	85.7	85.3	85.4	87.3	87.7	87.2	81.3	72.3	59.4
OVERALL CALCULATED	87.1	96.3	104.2	108.3	111.7	114.0	112.1	111.0	108.3	107.0	107.1	105.5	102.0	99.7	94.3
PNDB	95.8	108.2	114.5	117.7	120.8	122.8	121.3	120.7	120.3	119.5	119.5	118.7	113.2	109.1	102.6

FRAME TREATMENT
NOMINAL NOZZLE
TAKEOFF
200' (60.96 m) SIDELINE

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM, 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
50	70.0	69.3	68.3	68.9	67.2	68.1	68.3	68.7	69.7	70.2	70.6	71.4	72.0	76.0	76.9			120.6
63	65.5	65.9	65.9	69.2	67.2	66.6	68.1	70.3	68.6	69.4	70.0	70.7	72.1	75.0	77.2			119.8
80	67.9	69.4	69.6	69.4	70.9	68.2	69.0	68.5	70.0	70.3	70.9	73.2	73.2	74.7	75.7			120.7
100	74.8	76.4	76.9	75.5	78.1	73.1	72.0	70.7	73.7	72.9	72.1	78.4	77.6	77.7	77.6			125.2
125	64.0	65.1	65.1	65.2	66.8	66.8	65.9	67.2	66.8	67.4	68.0	68.8	69.3	70.8	71.1			117.2
160	64.5	66.5	65.2	66.4	64.6	65.9	67.8	68.3	67.9	69.3	70.2	71.4	71.4	73.3	74.6			118.9
200	67.8	69.4	69.1	71.9	71.0	72.0	72.4	74.4	74.6	76.5	76.9	77.6	76.9	77.4	77.1			124.5
250	70.7	72.6	74.3	76.6	77.1	77.6	78.7	79.7	80.2	80.8	80.8	81.0	80.4	79.9	78.3			126.9
315	71.8	74.0	74.6	76.0	79.1	78.5	77.6	79.0	79.1	80.5	80.8	80.9	80.3	79.2	77.1			126.8
400	69.8	74.4	75.7	76.2	74.3	73.6	75.4	74.4	74.6	75.9	76.8	77.1	75.1	75.1	74.0			125.2
500	70.6	74.2	73.1	71.8	70.0	70.0	70.6	69.9	70.6	72.3	74.2	74.1	74.2	74.1	73.3			122.3
630	71.6	75.7	75.0	73.2	72.0	73.8	72.6	74.4	73.9	74.8	75.2	75.1	75.6	75.2	74.8			124.4
800	68.8	73.1	72.4	71.5	72.8	72.7	71.9	72.7	72.4	72.8	73.8	74.1	74.3	75.0	73.7			123.1
1000	70.3	73.3	73.2	74.8	72.6	72.8	71.7	72.4	72.3	73.5	74.8	75.9	75.4	73.9	72.5			123.9
1250	68.8	71.4	73.1	75.6	73.5	74.2	72.5	73.4	72.5	75.5	77.0	76.6	77.1	75.2	73.1			125.0
1600	71.2	76.6	77.9	76.8	76.4	77.2	74.3	75.0	74.6	76.6	78.1	78.2	78.5	76.9	76.1			127.0
2000	75.8	83.3	85.0	83.5	81.7	81.7	78.3	77.7	79.2	81.2	81.8	82.5	81.8	80.4	79.3			131.9
2500	84.0	89.9	92.8	89.1	89.2	88.1	84.9	83.5	87.8	89.6	88.0	88.9	87.6	87.6	84.3			136.9
3150	72.2	79.3	84.8	81.7	80.6	80.2	75.9	78.6	78.3	80.2	80.8	83.8	82.0	79.7	77.2			131.2
4000	70.1	81.0	81.2	82.1	81.9	80.0	79.7	78.3	81.6	81.8	85.2	86.1	83.6	79.5	76.9			132.9
5000	74.0	82.1	86.7	82.7	83.0	86.5	81.2	82.3	80.2	85.9	85.9	85.4	87.8	83.6	79.1			135.4
6300	69.9	80.7	82.4	82.1	81.2	80.0	77.0	78.3	78.8	80.9	83.7	85.9	84.2	78.6	76.1			132.9
8000	68.6	81.5	84.2	81.9	82.3	81.4	78.3	79.2	78.8	81.7	84.7	84.6	85.6	80.3	75.6			134.1
10000	68.0	80.7	81.5	80.0	79.3	78.8	74.6	75.5	75.8	78.3	80.9	81.5	82.2	76.7	72.8			131.9
12500	64.8	78.0	79.0	77.0	76.2	75.5	72.1	73.1	72.4	75.9	78.4	79.1	79.8	74.8	70.7			130.5
16000	63.1	76.6	77.9	75.6	74.9	73.4	69.8	69.9	69.5	72.4	75.5	77.8	76.0	73.0	69.0			130.5
20000	60.9	73.3	74.8	72.4	71.1	70.3	66.5	65.8	65.6	68.4	70.7	72.9	73.8	69.4	66.1			129.3
OVERALL MEASURED	89.0	95.1	97.3	95.0	95.0	94.9	92.3	92.5	93.8	95.7	96.1	96.7	96.4	94.8	92.9			
OVERALL CALCULATED	87.3	93.8	96.2	93.9	93.7	93.4	90.6	90.9	92.2	94.2	94.8	95.6	95.3	93.1	91.1			144.8
PNDB	102.0	108.4	110.8	108.3	108.1	107.6	104.8	104.5	106.8	108.7	108.6	109.2	108.8	107.5	104.9			

FRAME TREATMENT
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	64.7	69.8	72.6	72.7	76.4	72.2	71.4	70.2	73.2	71.9	70.4	75.6	73.3	71.1	67.5	
63	53.7	58.4	60.7	62.4	65.0	65.8	65.3	66.7	66.2	66.4	66.2	66.0	64.9	64.1	60.8	
80	53.9	59.7	60.7	63.5	62.8	64.9	67.2	67.8	67.3	68.2	68.4	68.5	66.9	66.5	64.1	
100	57.1	62.5	64.6	68.9	69.1	70.9	71.8	73.8	73.9	75.3	75.1	74.7	72.3	70.5	66.4	
125	59.8	65.6	69.6	73.5	75.2	76.5	78.0	79.1	79.5	79.6	78.9	78.0	75.7	72.8	67.4	
160	60.7	66.8	69.9	73.0	77.1	77.3	76.8	78.4	78.4	79.3	78.9	77.8	75.6	72.0	66.0	
200	58.5	67.1	70.9	73.1	72.3	72.4	74.6	73.7	73.8	74.7	74.8	73.9	70.3	67.8	62.7	
250	59.1	66.8	68.2	68.6	67.9	68.7	69.8	69.2	69.8	71.1	72.2	70.9	69.3	66.7	61.8	
315	59.8	68.2	70.0	69.9	69.9	72.3	71.7	73.6	73.0	73.5	73.1	71.8	70.7	67.7	63.1	
400	56.9	65.4	67.3	68.2	70.6	71.4	71.0	71.9	71.5	71.3	71.7	70.2	69.2	67.3	61.7	
500	58.1	65.9	70.0	71.3	70.4	71.4	70.8	71.6	71.3	72.1	72.6	72.5	70.2	66.1	60.3	
630	56.4	63.9	69.8	72.1	71.3	72.7	71.6	72.5	71.5	74.0	74.7	73.1	71.8	67.2	60.7	
800	58.5	68.4	72.5	73.2	74.1	75.7	73.3	74.1	73.6	75.2	75.8	74.6	73.1	68.7	63.4	
1000	62.8	75.0	79.5	79.8	79.4	80.2	77.2	76.8	78.1	79.6	79.5	78.9	76.3	72.1	66.3	
1250	70.6	81.5	87.2	85.4	86.8	86.6	83.8	82.2	86.8	88.1	85.6	85.2	82.0	79.2	71.0	
1600	58.5	70.6	78.2	78.0	78.2	78.6	74.8	77.8	77.2	78.6	78.4	80.0	76.4	71.1	63.5	
2000	54.1	72.2	75.5	78.4	79.5	78.5	78.7	77.5	80.6	80.3	82.8	82.4	77.9	70.7	62.9	
2500	59.5	73.1	80.8	78.9	80.5	84.9	80.1	81.4	79.1	84.3	83.5	81.5	81.9	74.5	64.7	
3150	55.0	71.4	76.4	78.2	78.7	78.4	76.0	77.5	77.8	79.4	81.2	82.1	78.2	69.3	61.2	
4000	52.9	71.9	78.1	78.1	79.9	80.0	77.4	78.5	77.9	80.3	82.4	80.9	79.4	70.7	60.0	
5000	52.4	71.5	75.8	76.6	77.5	77.9	74.2	75.3	75.5	77.4	79.1	78.1	76.5	67.5	57.2	
6300	48.2	68.4	73.3	73.8	74.7	75.0	72.2	73.4	72.5	75.4	76.9	76.0	74.2	65.2	54.1	
8000	45.0	66.6	72.3	72.9	73.6	73.6	70.7	72.6	70.4	72.7	74.6	75.0	72.4	63.0	50.8	
10000	39.7	62.6	69.3	70.1	70.8	71.4	68.3	67.9	67.4	69.4	70.4	70.6	68.3	58.7	45.8	
OVERALL CALCULATED	74.3	85.2	90.6	90.2	91.4	92.0	89.6	90.0	91.2	92.8	92.5	92.0	89.6	84.6	77.9	
PNDB	84.0	96.4	102.3	102.1	103.3	105.2	102.1	103.0	102.4	105.4	105.4	104.9	103.1	96.4	87.9	

FULL TREATMENT
NOMINAL NOZZLE
TAP OFF
200' (60.96 m) SIDELINE

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. DAY) - ANGLES FROM INLET IN DEGREES (AND RADIANS)

FREQ.	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
50	76.8	74.3	77.8	69.4	79.3	79.9	80.8	80.9	82.2	84.1	84.3	88.3	92.7	96.7				135.5
63	74.9	75.4	78.0	72.1	78.3	79.6	80.8	81.3	82.7	84.4	84.3	88.4	92.8	96.6				135.5
80	75.5	76.8	78.7	73.7	79.2	80.2	81.0	82.1	83.0	84.9	85.5	88.6	92.1	94.4				134.9
100	76.3	75.4	79.1	75.5	80.2	80.3	80.5	81.1	82.2	83.6	84.6	87.7	90.4	90.8				133.5
125	77.4	77.1	78.3	76.2	78.8	78.9	80.3	80.3	82.6	83.2	84.2	86.2	88.6	90.3				132.7
160	82.4	80.5	81.1	76.2	77.6	80.7	87.1	83.8	89.1	85.8	88.4	89.9	93.3	94.2				136.9
200	77.4	78.5	80.7	79.6	80.5	82.5	84.2	85.4	87.4	89.4	91.6	94.3	96.7	95.1				139.0
250	83.3	85.7	87.2	86.7	86.9	87.6	88.8	89.3	91.2	92.8	94.4	96.2	97.1	95.4				141.4
315	87.4	90.7	93.0	90.9	92.9	90.5	93.8	91.1	96.5	96.2	98.9	98.8	97.0	95.8				144.8
400	84.6	84.3	84.7	86.1	85.3	86.4	87.5	89.1	90.8	91.7	91.6	92.0	92.2	90.4				139.1
500	83.6	83.7	84.1	86.3	84.1	85.8	85.8	87.2	88.6	90.7	92.5	92.8	92.5	90.0				138.7
630	89.4	91.6	91.0	96.1	94.0	92.5	92.4	92.8	92.1	93.0	92.7	92.7	92.6	89.8				143.0
800	97.3	100.7	93.6	102.3	104.6	100.8	100.0	101.4	96.5	94.2	94.3	92.2	93.6	88.6				149.9
1000	86.1	93.3	100.2	100.4	103.3	100.5	98.9	96.4	95.8	98.6	94.1	91.3	91.4	89.8				148.8
1250	84.1	92.5	98.0	99.3	100.7	94.7	95.2	94.0	90.9	91.6	92.5	91.8	89.0	92.7				145.9
1600	83.4	91.8	95.5	96.5	100.7	94.8	92.6	88.5	89.7	89.8	91.9	92.2	90.0	89.4				144.7
2000	87.4	95.8	96.0	100.7	98.2	98.1	91.6	91.7	91.7	91.7	93.5	93.4	91.3	89.0				146.8
2500	88.1	94.5	94.3	102.9	101.5	96.5	92.8	91.1	90.1	91.0	90.9	90.7	93.6	80.3				147.0
3150	90.4	94.0	96.2	101.1	97.7	94.9	91.9	90.0	90.5	89.8	92.3	88.1	91.9	86.7				145.5
4000	94.8	96.9	99.9	97.7	102.4	98.1	95.0	92.7	98.5	97.9	103.3	94.4	90.8	91.9				149.5
5000	90.3	96.3	93.8	96.7	95.4	93.4	89.4	90.1	88.7	91.7	91.8	88.7	90.1	89.2				144.0
6300	91.1	93.1	94.5	95.8	94.7	91.2	90.5	86.9	91.2	90.0	93.0	88.5	89.7	85.4				143.7
8000	89.5	93.2	92.0	93.5	94.3	89.9	88.6	88.7	90.1	92.1	93.1	88.9	87.8	85.5				143.5
10000	87.1	90.6	89.8	92.3	90.0	86.8	84.3	84.3	86.8	86.5	89.1	85.4	85.7	82.1				141.2
12500	84.3	87.7	86.7	87.7	87.8	83.8	84.0	82.7	84.9	86.2	88.2	83.4	82.0	79.5				139.8
16000	80.9	85.5	84.0	85.8	85.3	81.4	81.7	80.4	82.1	85.7	84.7	81.3	80.1	77.0				139.5
20000	78.1	84.0	81.9	82.7	81.2	78.3	79.5	77.3	78.4	84.7	80.9	78.9	77.2	75.5				139.8
OVERALL MEASURED	104.4	108.0	108.3	110.9	113.8	109.1	107.4	107.2	107.4	107.9	109.2	107.8	108.0	107.4				
OVERALL CALCULATED	102.5	106.6	107.5	110.5	111.3	107.8	104.2	105.6	105.7	106.1	107.9	106.0	106.5	106.1				158.3
PNDB	113.7	119.3	121.2	123.5	123.9	120.4	118.2	116.7	119.9	119.6	122.8	118.1	117.8	116.5				

FULL TREATMENT
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	69.7	71.1	76.4	73.8	79.2	79.7	80.1	80.6	81.2	81.9	81.8	83.4	83.8	80.7
63	70.7	72.7	75.5	74.5	77.8	78.3	79.8	79.7	81.6	81.5	81.3	81.8	81.9	80.0
80	75.6	76.0	78.2	74.4	76.5	80.1	86.6	83.2	78.1	84.0	85.5	85.4	86.5	83.7
100	78.5	73.9	77.7	77.7	79.4	81.8	83.6	84.7	86.3	87.5	88.6	89.8	89.8	84.4
125	76.3	81.0	84.1	84.8	85.7	86.9	88.2	88.6	90.0	90.9	91.4	91.5	90.0	84.5
160	80.3	85.9	89.9	89.0	91.7	89.8	93.1	90.3	75.3	94.2	95.8	94.0	89.8	84.7
200	77.2	79.4	81.6	84.1	84.1	82.6	86.8	88.3	89.6	89.7	88.5	87.2	84.9	79.1
250	76.2	78.8	80.9	84.2	82.8	35.0	85.2	86.4	87.3	88.6	89.2	87.9	85.0	78.5
315	81.8	86.6	87.7	94.0	92.6	91.7	91.7	91.9	90.7	90.9	89.4	87.7	85.0	78.1
400	89.6	95.6	90.2	100.2	103.2	99.9	99.2	100.5	95.1	92.0	90.9	87.1	85.9	76.6
500	78.3	88.1	96.8	98.2	101.1	99.6	98.1	95.4	94.4	96.4	90.7	86.1	83.5	77.6
630	76.1	87.2	94.5	97.0	99.3	93.7	94.3	93.0	89.5	89.4	89.0	84.5	81.0	80.2
800	75.2	86.4	92.0	94.2	99.2	93.8	91.7	87.5	88.2	87.5	88.4	86.8	81.9	76.6
1000	79.1	89.6	92.3	98.3	96.7	97.1	90.7	90.7	90.2	89.3	89.8	87.9	83.0	76.0
1250	79.6	88.9	90.6	100.5	99.8	95.4	91.9	90.0	88.5	88.6	87.2	85.1	85.1	75.0
1600	81.7	88.3	92.4	98.7	97.8	93.9	91.0	89.0	88.9	87.4	86.6	82.9	82.9	73.8
2000	85.2	91.2	96.2	96.2	100.9	97.1	94.1	91.7	97.0	95.9	99.6	88.6	82.0	77.9
2500	81.3	90.4	89.9	94.2	93.9	92.3	88.4	89.1	87.1	89.2	88.0	82.8	81.0	74.8
3150	81.8	87.1	90.6	93.3	93.2	90.2	89.7	85.9	9.6	87.6	89.2	82.5	80.4	70.5
4000	79.7	87.2	88.1	91.2	92.8	89.1	87.9	87.8	88.7	89.7	89.3	82.8	78.2	69.9
5000	77.8	84.9	86.4	90.4	89.1	86.4	86.2	84.0	85.9	84.7	85.7	79.7	76.4	66.5
6300	74.7	82.2	83.3	86.1	87.3	83.9	84.3	82.8	84.4	84.6	85.0	77.8	72.4	62.8
8000	70.9	80.1	81.3	84.8	85.5	82.3	82.8	81.3	82.3	84.7	82.0	75.7	70.1	58.9
10000	67.4	78.5	79.6	82.5	84.2	80.1	81.5	79.1	79.5	84.5	78.6	73.4	68.5	59.2
OVERALL CALCULATED	94.3	101.1	104.8	108.2	110.8	108.8	108.4	104.7	104.2	103.9	104.4	100.7	98.3	83.8
PNDB	105.8	112.9	116.0	118.6	120.8	117.7	115.9	114.6	116.5	115.9	117.5	110.6	107.0	100.5

SLCTTED TIP CASING - JNTREATED
NOMINAL NOZZLE
TAKEOFF
200' (60.96 m) SIDELINE

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. DAY) - ANGLES FROM INLET IN DEGREES (AND RADIANS)

FREQ.	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
50	70.4	68.7	70.2	61.2	68.9	69.5	69.7	70.2	70.6	71.4	71.4	73.5	75.9	79.0				121.1
63	69.6	66.7	71.5	65.7	67.0	69.2	70.9	68.5	69.3	71.0	70.9	73.5	74.7	76.9				120.4
80	65.1	64.8	67.0	61.8	66.4	67.3	68.6	69.1	69.6	70.5	70.8	72.4	73.6	74.8				119.2
100	71.6	71.9	70.3	67.1	69.2	70.2	70.9	77.4	74.5	74.3	75.7	76.2	73.3	72.6				123.7
125	64.6	65.0	65.3	64.4	68.6	65.9	67.3	67.2	68.1	68.8	68.8	69.3	70.6	70.8				117.6
160	64.9	64.6	64.9	62.4	64.5	67.4	67.5	67.6	69.2	69.5	70.7	71.0	73.0	74.0				118.5
200	67.3	67.3	71.0	69.8	70.2	71.7	73.6	74.3	75.6	76.5	76.9	77.1	77.0	77.1				124.1
250	71.5	74.4	77.2	77.0	77.2	78.9	79.5	80.4	80.9	80.9	81.2	80.5	79.6	78.2				129.2
315	73.7	74.6	80.2	81.0	81.7	80.1	80.0	81.8	82.5	82.6	83.8	82.9	80.5	78.5				131.3
400	72.5	76.0	73.6	75.3	73.5	76.7	74.5	77.0	76.5	77.5	77.3	77.7	75.8	74.0				126.0
500	71.4	71.0	70.8	76.9	69.5	69.6	69.8	71.0	72.1	73.4	74.3	73.6	74.4	72.0				121.9
630	72.5	73.9	72.3	73.7	72.4	72.9	73.3	74.2	74.6	75.4	75.4	75.9	75.0	74.2				124.1
800	72.8	73.2	76.4	72.5	70.5	70.8	71.7	71.9	72.4	73.9	74.8	73.7	73.9	73.6				122.8
1000	70.5	70.5	70.9	71.9	70.7	70.8	71.0	72.1	73.2	74.6	75.1	73.6	72.2	71.1				122.6
1250	70.5	71.8	70.5	72.1	70.1	69.7	69.7	70.8	72.1	74.9	75.2	74.8	73.1	71.4				122.6
1600	70.6	72.6	71.2	72.4	70.6	69.2	70.2	71.0	72.7	75.4	76.8	75.9	73.9	71.8				123.4
2000	74.8	76.6	74.6	75.2	74.2	71.3	72.0	73.0	74.7	75.6	78.7	77.5	75.8	73.6				125.6
2500	87.5	90.3	85.8	87.2	84.7	81.2	81.0	79.2	81.4	81.2	82.0	84.9	86.2	85.4				135.3
3150	75.8	77.9	74.4	74.8	72.3	69.7	70.9	70.5	73.8	73.3	79.2	75.7	75.9	72.3				125.3
4000	75.7	76.7	76.8	74.7	75.2	72.2	73.0	73.5	76.7	78.4	80.7	79.6	73.3	73.7				127.4
5000	88.1	83.6	80.8	84.4	80.4	75.4	72.9	76.1	76.3	79.8	92.4	81.3	80.5	79.5				131.4
6300	77.9	78.6	77.4	78.6	75.0	71.7	73.9	72.7	76.9	77.4	82.5	81.2	77.4	72.7				129.1
8000	78.2	80.7	79.4	80.1	79.0	73.8	74.2	74.4	76.8	78.9	81.0	80.7	76.7	73.6				130.4
10000	77.5	78.6	76.5	78.2	74.6	69.3	71.0	70.3	73.6	74.2	78.0	76.8	74.7	70.2				128.2
12500	75.3	76.0	73.7	73.6	72.1	65.7	68.0	67.3	70.0	71.9	75.0	73.5	70.6	67.5				126.3
16000	72.8	74.6	71.6	71.8	70.5	63.8	66.2	64.3	66.4	70.9	71.1	69.8	68.5	64.5				1.6.2
20000	68.5	71.5	68.3	67.9	68.0	60.4	63.9	60.7	62.7	69.4	66.3	65.7	63.5	60.8				125.4
OVERALL MEASURED	93.0	95.4	92.6	94.1	92.1	90.8	90.5	91.0	92.1	93.0	94.8	94.5	93.5	92.5				
OVERALL CALCULATED	90.8	93.1	90.4	91.8	89.9	87.9	88.4	88.9	89.9	90.9	92.5	92.2	91.3	90.4				141.6
PNDB	105.4	107.7	104.4	105.9	103.9	101.3	101.5	101.1	102.9	103.9	105.3	105.0	105.6	104.4				

SLOTTED TIP CASING -- UNTREATED
NOMINAL NOZZLE
APPROACH
2. 30.96 m) SIDELINE

	FULL SIZE SOUND PRESSURE LE						SCALED FROM MODEL DA				(59 DEG. F, 70 PERCENT REL. HUM. DAY)			
50	65.1	67.2	67.5	65.4	68.2	69.	75.5	76.8	73.5	7	72.9	71.9	66.7	62.5
63	57.	60.6	62.5	62.6	67.6	66.3	66.8	66.6	67.1	67.0	66.0	64.9	63.9	60.5
80	58.1	60.1	62.0	60.6	63.5	60.	67.0	67.0	68.1	67.7	67.8	66.5	66.2	63.
100	60.4	6 . 8	68.0	67.9	69.1	71.0	73.1	73.6	74.5	74	73.9	72.6	70.1	66.4
125	64.8	69.8	74.2	75.1	76.1	78.2	79.0	79.7	79.8	79.1	78.1	75.8	72.6	67.3
160	66.6	71.9	77.1	79.1	80.5	79.3	80.2	81.1	81.3	80.6	80.7	78.1	73.3	67.4
200	65.2	71.2	70.5	73.8	72.3	75.9	73.9	76.2	75.2	75.5	74.	72.9	68.4	62.2
250	63.9	66.1	67.6	68.5	68.2	68.7	69.1	70.1	70.8	71.	7 .1	68.7	66.9	60.5
315	64.9	68.0	69.0	71.6	70.1	72.0	72.5	73.4	73.2	73.3	72	70.9	67.4	62.4
400	64.3	68.1	67.1	70.4	69.1	69.9	70.9	71.0	71.0	71.7	71.	.6	66.2	61.7
500	62.7	65.3	67.4	69.7	69.3	69.8	70.2	71.1	71.8	72.4	71.6	68.5	64.4	58.9
630	62.6	66.5	67.0	69.9	68.7	68.7	68.8	69.8	70.7	72.7	71.7	69.5	65.1	58.9
800	62.4	67.2	67.7	70.1	69.3	68.2	69.3	70.0	71.2	73.1	73.2	70.5	65.8	59.0
1000	66.5	71.1	71.0	72.8	72.7	70.5	71.1	71.9	73.2	73.3	75.0	72.0	67.3	60.6
1250	79.0	84.7	81.3	84.8	83.1	80.1	80.1	78.2	79.8	78.8	78.	79.3	77.7	72.1
1600	67.2	72.2	70.7	72.4	70.8	68.6	70.0	69.4	72.2	70.9	73.4	70.0	67.2	58.6
2000	66.9	71.0	73.1	72.3	73.7	71.2	72.1	72.5	75.1	76.0	77.0	73.8	.5	59.7
2500	7 .	77.7	76.9	81.9	78.8	74.8	72.0	75.0	74.8	77.3	78.6	75.4	71.5	65.1
3150	69.6	72.6	73.5	76.2	73.4	70.7	73.1	71.6	75.4	75.0	78.7	75.2	68.1	57.8
4000	66.6	74.6	75.5	77.7	77.5	72.9	73.5	73.5	75.4	76.5	77.2	74.5	67.2	58.0
5000	78.2	72.9	73.1	76.4	73.9	69.0	70.6	70.0	72.7	72.3	74.6	71.1	65.4	54.6
6300	65.6	70.3	70.5	72.1	71.6	65.5	68.5	67.4	69.6	70.4	71.8	67.8	61.0	50.9
8000	62.8	67.1	68.8	70.9	70.8	64 .	67.3	65.2	66.6	70.9	68.3	64.2	58.5	46.4
10000	57.8	66.0	66.0	67.7	69.1	. .2	64.0	62.5	3.8	69.2	64.9	60.2	52.8	40.4
OVERALL CALCULATED	82.1	87.5	86.7	89.5	88.5	86.9	87.5	87.9	86.5	88.6	89.0	86.7	82.9	77.2
PNDB	93.5	99.0	98.9	102.4	100.6	97.6	98.1	98.4	99.7	100.5	101.7	98.6	93.8	86.8

SLOTTED TIP CASING - TREATED
NOMINAL NOZZLE
TAKEOFF
200' (60.96 m) SIDELINE

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. 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
50	78.2	77.1	74.2	77.2	78.0	78.2	79.7	80.6	81.2	83.3	82.6	84.1	86.6	92.9	96.9			135.3
63	73.5	74.2	76.0	77.7	78.3	77.5	79.0	80.1	81.0	82.9	82.4	84.5	87.1	92.5	96.2			134.9
80	73.8	75.6	76.9	79.1	79.4	78.9	80.0	80.6	81.6	83.6	83.2	85.3	87.8	91.6	93.9			134.3
100	80.6	77.6	76.2	79.1	80.0	79.8	80.5	80.7	81.3	83.3	82.8	84.6	86.5	89.8	90.2			133.1
125	76.5	78.4	79.7	77.9	79.4	78.9	78.9	79.4	80.6	84.1	82.2	84.7	86.1	89.4	90.8			132.9
160	77.6	80.9	83.0	77.3	78.6	79.0	79.7	80.7	83.0	87.8	84.8	88.3	90.3	94.2	94.4			136.4
200	75.9	78.0	79.4	80.3	80.6	80.8	82.9	84.4	85.8	88.3	88.9	91.9	94.1	96.7	95.2			138.9
250	82.0	84.0	86.2	87.6	86.9	87.6	87.7	89.5	89.9	93.6	92.8	95.3	96.7	97.6	95.9			142.0
315	85.4	87.1	89.5	90.9	89.2	92.3	88.7	93.0	91.6	99.0	96.3	99.9	98.8	97.9	96.8			145.1
400	85.1	85.8	86.0	86.0	85.4	87.0	86.9	87.5	89.9	92.3	91.2	91.0	91.7	92.3	90.9			139.3
500	83.2	85.6	86.4	86.4	85.8	84.8	85.2	86.1	87.5	90.5	90.3	92.4	92.4	92.9	90.7			138.9
630	89.7	92.7	94.0	93.4	93.3	93.1	92.9	93.0	93.1	94.0	92.0	92.7	92.3	93.6	91.0			143.1
800	89.7	91.1	94.6	92.3	95.4	97.9	95.6	94.5	96.6	90.0	89.0	91.9	91.8	95.1	90.5			144.4
1000	81.9	84.6	87.0	89.6	90.0	95.8	91.8	92.1	91.6	89.6	90.4	90.7	90.1	89.0	87.3			141.2
1250	81.3	82.3	85.4	90.7	90.2	88.5	85.1	86.6	86.1	88.0	88.6	89.3	90.5	87.8	88.8			138.4
1600	80.3	86.2	90.0	86.5	84.9	85.3	83.0	84.0	84.9	87.3	87.2	87.9	88.2	89.2	88.2			136.9
2000	80.4	84.7	89.3	83.7	90.0	85.5	85.9	82.9	85.3	87.9	87.5	88.5	88.6	88.6	86.1			137.5
2500	86.5	87.0	91.0	87.8	89.1	94.1	89.4	89.3	84.5	86.7	87.3	90.2	89.5	91.5	86.2			140.1
3150	82.3	87.1	93.0	89.3	91.1	89.0	87.3	86.5	84.1	85.5	84.7	87.2	87.3	87.7	85.5			138.8
4000	82.1	89.8	97.5	94.5	94.6	92.7	90.4	86.2	86.3	88.4	87.6	90.1	89.1	92.2	89.6			142.6
5000	82.2	89.6	94.9	91.4	90.9	90.5	85.0	87.3	83.9	86.6	86.1	86.8	86.0	87.1	85.1			139.9
6300	80.6	87.4	92.4	92.2	92.2	92.1	88.8	87.2	83.0	85.6	84.6	86.1	86.7	86.2	83.5			140.4
8000	78.3	89.1	92.9	90.6	90.8	91.1	87.3	85.8	83.9	85.8	86.3	86.7	86.0	87.3	83.5			140.4
10000	76.3	87.2	91.5	89.7	89.5	89.3	87.2	84.3	81.3	84.5	84.6	85.7	85.2	85.5	82.1			139.9
12500	75.8	86.2	90.2	87.3	87.2	87.0	84.5	82.6	80.3	82.4	82.8	84.5	83.9	83.8	80.7			139.3
16000	75.0	84.4	88.9	86.1	85.6	84.8	82.4	81.1	81.4	82.3	82.3	84.8	83.0	82.1	79.1			140.0
20000	72.9	81.4	86.2	83.2	82.6	82.2	80.3	78.8	80.8	81.4	81.5	83.4	81.9	80.1	76.3			140.5
OVERALL MEASURED	97.5	100.6	105.1	103.6	103.8	104.9	102.2	102.6	102.8	104.6	103.5	105.9	106.1	107.4	106.8			
OVERALL CALCULATED	97.0	100.7	104.8	103.1	103.5	104.5	102.1	102.1	102.2	104.0	102.9	105.0	105.2	106.5	105.9			154.4
PNDB	109.0	113.2	118.6	116.5	116.8	116.5	114.0	113.3	112.1	114.1	113.5	115.5	115.3	117.1	115.1			

SLOTTED TIP CASING - TREATED
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	70.5	71.0	71.9	76.4	78.3	78.8	79.9	80.2	80.7	82.3	81.1	81.8	82.2	83.2	80.0
63	66.2	71.6	75.3	75.0	77.7	77.8	78.3	78.9	80.0	83.1	80.4	81.9	81.7	82.7	80.5
80	67.0	74.1	78.5	74.4	76.8	78.0	79.0	80.2	82.3	86.5	83.0	85.4	85.8	87.4	83.9
100	65.2	71.0	74.8	77.3	78.8	79.7	82.2	83.9	85.1	87.2	87.1	88.9	89.6	89.8	84.5
125	71.1	77.0	81.6	84.6	85.0	86.5	87.0	88.9	89.2	92.4	90.9	92.3	92.1	90.6	85.0
160	74.3	79.9	84.7	87.8	87.2	91.1	87.9	92.4	90.9	97.8	94.4	96.8	94.0	90.7	85.7
200	73.8	78.5	81.2	82.8	83.5	85.7	86.1	86.9	89.1	91.1	89.2	87.9	86.8	85.0	79.5
250	71.7	78.2	81.5	83.2	83.7	83.5	84.4	85.4	86.7	89.2	88.3	89.2	87.4	85.4	79.1
315	77.9	85.1	89.0	90.1	91.2	91.8	92.0	92.3	92.3	92.7	89.9	89.4	87.3	86.0	79.3
400	77.7	83.4	89.6	88.9	93.2	96.6	94.6	93.7	95.7	88.7	87.7	88.5	88.7	87.4	78.5
500	68.8	76.9	81.8	86.2	87.8	94.4	90.9	91.3	90.7	88.2	88.2	87.3	85.0	81.2	75.2
630	68.9	74.3	80.1	87.3	87.9	87.0	84.1	85.7	85.1	86.6	86.3	85.8	85.3	79.8	76.3
800	67.6	73.0	84.6	83.0	82.6	83.9	82.0	83.1	83.9	85.8	84.9	84.4	82.8	81.0	75.5
1000	67.4	76.4	83.8	80.1	87.6	84.0	84.8	82.0	84.3	86.4	85.2	84.8	83.1	80.3	73.1
1250	73.2	78.5	85.4	84.1	86.7	92.6	88.4	88.4	83.5	85.1	84.9	86.5	83.9	83.1	72.9
1600	70.7	78.4	87.3	85.5	88.7	90.4	86.2	86.2	83.8	84.0	82.7	84.3	81.7	80.7	71.8
2000	68.2	81.0	91.7	90.8	92.2	91.2	89.3	87.3	85.3	86.9	85.2	86.4	83.4	83.4	75.6
2500	67.7	80.5	89.0	87.6	88.4	88.9	86.9	86.3	82.8	85.0	83.6	82.9	80.1	78.0	70.7
3150	65.7	78.1	86.4	88.3	89.8	90.6	87.8	86.4	82.0	84.1	82.2	84.3	80.7	76.9	68.6
4000	62.7	79.5	86.8	86.8	88.4	89.7	86.4	85.1	83.0	84.4	83.9	82.8	79.9	77.7	67.8
5000	62.7	78.0	85.8	86.3	87.6	88.4	86.9	84.2	81.0	83.6	82.7	82.3	79.5	76.2	66.5
6300	59.2	76.6	84.5	84.3	85.7	86.5	84.7	82.9	80.4	81.9	81.3	81.3	78.2	74.2	64.0
8000	56.9	74.4	83.4	83.3	84.6	85.0	83.3	82.2	82.3	82.6	81.4	82.0	77.4	72.1	61.0
10000	52.6	70.7	80.7	80.9	82.4	83.2	82.1	80.8	82.6	82.5	81.2	81.1	76.3	69.4	56.0
OVERALL CALCULATED	84.8	92.4	99.3	99.6	101.3	103.3	101.2	101.3	101.3	102.7	100.7	101.7	100.0	98.5	93.0
PNDB	93.2	104.3	112.2	112.2	113.8	115.0	112.6	112.0	110.8	111.6	110.5	110.9	108.3	106.7	99.3

FULL TREATMENT
NOMINAL NOZZLE
APPROACH
100' (30.48 m) ARC
(SCALE MODEL DATA)

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. 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
50	72.9	71.1	69.6	70.0	69.0	67.4	67.9	68.8	69.0	71.0	72.1	71.0	71.8	75.6	78.1			120.8
63	69.2	66.3	68.4	71.7	70.4	66.5	68.3	71.7	68.4	69.3	70.9	69.9	71.6	73.9	76.2			120.1
80	67.8	66.7	68.9	67.0	63.9	67.5	68.1	68.8	70.6	71.4	71.8	73.1	71.3	73.7	73.9			120.0
100	72.9	72.6	74.4	70.4	75.6	73.8	69.1	71.5	75.5	75.2	71.5	78.1	72.8	75.6	73.9			124.0
125	67.3	64.7	68.3	65.5	67.9	65.9	67.6	68.7	67.3	68.5	69.0	68.4	69.0	70.4	70.5			118.0
160	67.2	64.8	67.7	65.9	65.9	66.2	68.6	69.1	68.7	70.4	70.4	70.9	71.4	73.5	74.0			119.2
200	68.7	67.2	69.5	70.2	70.4	70.6	72.6	74.0	74.9	76.8	76.4	76.3	77.0	76.9	76.0			124.1
250	71.1	72.6	74.4	75.0	76.5	76.4	78.4	79.0	80.1	81.2	80.2	80.4	79.8	79.3	77.1			128.5
315	73.1	73.8	75.2	76.[illegible]	[illegible]	78.2	77.7	79.0	79.3	81.4	80.6	80.6	80.0	78.9	76.0			128.8
400	72.3	74.0	74.4	72.3	73.3	73.4	72.9	73.8	75.0	76.5	75.9	76.0	74.7	75.2	72.6			124.4
500	70.4	71.9	72.5	69.9	70.2	69.2	69.7	69.5	70.8	72.6	72.6	73.5	73.0	73.3	72.3			121.5
630	71.6	72.5	73.1	71.5	71.0	71.2	72.4	73.4	73.8	74.9	74.6	74.5	74.3	74.8	73.7			125.4
800	68.9	69.9	70.3	68.0	69.8	69.6	70.1	70.3	70.8	72.3	72.3	72.9	72.6	73.2	72.8			121.2
1000	69.9	70.6	73.[illegible]	71.8	70.3	69.9	69.2	70.1	69.8	71.8	72.2	73.1	72.2	70.9	70.8			121.4
1250	68.2	69.0	71.5	69.8	68.1	68.3	67.3	68.4	68.0	70.5	71.5	72.1	72.1	70.4	70.3			120.1
1600	69.3	71.7	72.3	70.0	69.3	68.8	66.9	66.8	68.0	69.9	70.1	71.0	72.2	72.3	70.8			120.3
2000	71.0	76.5	76.5	73.4	71.1	70.2	68.5	67.1	68.7	70.5	70.5	70.8	71.7	76.1	72.5			122.5
2500	81.1	87.6	81.9	82.8	77.6	76.9	76.6	74.1	72.0	75.9	76.7	76.2	79.1	87.5	82.0			131.1
3150	68.0	71.9	75.7	71.0	69.0	68.8	65.4	66.3	64.7	66.8	66.4	68.7	69.8	71.2	68.0			120.1
4000	66.6	74.5	75.1	73.9	70.7	68.4	67.8	66.4	66.6	69.3	68.8	72.2	71.7	75.0	71.3			122.1
5000	70.8	81.8	81.0	78.9	71.3	72.6	69.2	67.4	68.3	70.2	71.3	74.0	75.9	77.2	73.8			126.3
6300	68.5	75.8	78.3	76.0	72.7	71.1	68.3	67.6	66.4	70.4	70.7	74.8	77.1	74.1	70.0			124.7
8000	66.9	78.2	79.9	75.5	73.8	71.6	68.1	67.2	67.6	71.7	72.2	73.9	75.4	75.1	70.4			125.8
10000	67.8	78.5	80.1	76.1	74.4	72.4	70.0	67.9	66.1	70.1	70.9	73.4	74.4	74.0	69.6			126.6
12500	65.9	78.5	79.6	75.0	72.9	70.8	67.1	65.6	65.3	67.5	69.0	71.2	72.9	72.9	68.3			126.7
16000	65.5	78.1	80.0	75.2	72.6	70.4	66.6	65.7	69.0	67.6	68.1	70.9	72.8	72.8	68.4			128.8
20000	64.4	75.6	78.2	73.1	70.9	69.1	[illegible].9	64.4	69.5	66.8	66.5	70.1	71.1	70.5	66.6			129.7
OVERALL MEASURED	85.5	89.8	90.0	87.7	87.2	86.5	86.3	86.2	87.1	88.8	88.5	88.8	89.2	90.3	88.2			
OVERALL CALCULATED	85.7	91.3	90.7	88.7	87.1	86.2	85.7	86.0	86.7	88.3	88.1	88.8	89.0	91.3	88.5			139.5
PNDB	99.8	105.5	103.2	102.9	99.3	98.5	97.8	96.7	96.1	98.9	99.3	99.9	101.3	105.7	101.7			

FULL TREATMENT
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE
(SCALE MODEL - SCALED DATA)

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	62.8	66.1	70.1	67.6	73.9	72.8	68.5	71.0	74.9	74.2	72.8	75.4	68.5	69.0	63.7	
63	57.0	58.0	63.9	62.7	66.2	67.9	67.0	68.3	66.7	67.5	67.2	65.5	64.6	63.7	60.2	
80	56.7	57.9	63.2	63.0	64.1	65.2	67.9	68.6	68.1	69.4	68.6	68.0	66.9	66.6	63.5	
100	58.0	60.2	65.0	67.3	68.6	69.5	71.9	73.5	74.2	75.7	74.6	73.3	72.4	69.9	65.3	
125	60.2	65.5	69.8	72.5	74.6	75.2	77.6	78.4	79.3	80.1	78.3	77.3	75.1	72.2	66.2	
160	62.0	66.6	70.4	73.0	77.4	77.0	77.0	78.3	78.5	80.2	78.7	77.5	75.2	71.7	64.9	
200	60.9	66.6	69.6	69.1	71.3	72.2	72.1	73.1	74.2	75.3	73.9	72.8	69.8	67.9	61.3	
250	58.9	64.5	67.6	66.7	68.2	67.9	68.9	68.8	70.0	71.3	70.5	70.3	68.1	65.9	60.8	
315	59.9	64.9	68.1	68.2	68.9	69.9	71.5	72.7	73.0	73.6	72.5	71.2	69.3	67.3	62.0	
400	57.0	62.2	65.2	64.7	67.6	68.2	69.2	69.5	69.9	70.9	70.2	69.5	67.5	65.5	60.8	
500	57.7	62.7	68.3	68.3	68.1	68.5	68.3	69.3	68.8	70.4	70.0	69.7	67.0	63.0	58.6	
630	55.7	61.0	66.2	66.3	65.8	66.8	66.3	67.5	67.0	69.0	69.3	68.6	66.9	62.4	57.9	
800	56.6	63.5	66.9	66.5	67.0	67.3	65.9	65.9	67.0	68.4	67.8	67.4	66.9	64.2	58.1	
1000	58.0	68.2	71.0	69.8	68.8	68.6	67.4	66.2	67.6	69.0	68.1	67.2	66.2	67.8	59.5	
1250	67.8	79.2	76.3	79.1	75.2	75.3	75.5	73.2	70.9	74.4	74.3	72.5	73.5	79.0	68.7	
1600	54.3	63.2	70.0	67.3	66.6	67.2	67.3	65.4	63.6	65.2	64.0	65.0	64.1	62.6	54.3	
2000	52.6	65.7	69.4	70.1	68.3	66.9	66.8	65.6	65.6	67.8	66.4	66.4	65.9	66.2	57.3	
2500	56.4	72.7	75.1	75.0	68.9	71.1	68.1	66.5	67.2	68.6	68.8	70.1	70.0	68.2	59.4	
3150	53.5	66.6	72.3	72.2	70.3	69.5	67.3	66.8	65.4	68.9	68.3	70.9	71.1	64.8	55.0	
4000	51.3	68.6	73.8	71.7	71.4	70.2	67.2	66.5	66.7	70.3	69.8	70.0	69.3	65.5	54.7	
5000	52.2	69.3	74.4	72.7	72.6	71.5	69.7	67.3	65.7	69.2	69.0	70.0	68.7	64.8	54.0	
6300	49.2	68.8	73.9	71.8	71.4	70.4	67.2	65.9	65.4	67.3	67.4	68.0	67.2	63.3	51.7	
8000	47.3	68.1	74.4	72.4	71.7	70.6	67.5	66.8	69.9	67.8	67.2	68.1	67.2	62.8	50.2	
10000	44.1	64.9	72.7	70.8	70.6	70.2	67.7	66.4	71.3	67.9	66.2	67.7	65.6	59.8	46.3	
OVERALL CALCULATED	72.8	82.6	85.1	85.1	85.0	84.9	84.7	85.1	85.8	86.9	85.8	85.4	83.6	82.9	75.4	
PNDB	82.2	94.4	97.9	97.5	96.3	95.9	94.6	93.8	94.0	96.1	95.5	95.9	95.1	93.3	84.2	

SLOTTED TIP CASING - UNTREATED
NOMINAL NOZZLE
TAKEOFF
100' (30.48 m) ARC
(SCALE MODEL DATA)

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. 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
50	80.0	78.5	75.9	77.5	78.0	80.1	79.3	80.9	81.4	82.9	83.7	85.7	88.6	92.9	97.9			136.2
63	75.2	75.9	76.9	77.7	79.2	79.3	79.5	81.8	81.9	83.9	84.2	86.8	89.0	93.8	97.8			136.6
80	74.8	76.2	76.7	78.7	79.8	79.7	80.1	81.4	82.2	83.7	84.5	86.7	89.6	93.5	96.4			136.2
100	74.9	77.5	75.8	79.0	80.1	81.1	80.6	82.0	81.8	83.8	84.1	85.8	88.0	91.9	92.0			134.6
125	76.2	76.8	77.3	78.9	80.2	80.2	79.9	81.1	81.1	82.1	83.4	85.1	87.0	89.0	91.1			133.3
160	76.9	78.6	77.0	79.7	77.9	79.2	83.6	83.7	81.5	84.0	85.8	88.7	90.0	93.0	95.0			136.3
200	77.2	77.6	77.9	80.0	80.3	81.0	81.5	84.1	85.6	86.9	89.1	92.1	94.1	97.0	96.1			139.2
250	82.9	82.6	83.8	86.0	86.2	87.0	86.8	87.9	90.0	92.0	94.2	95.9	96.2	98.1	95.8			142.1
315	87.1	85.9	88.0	89.8	92.2	93.0	93.6	90.2	93.9	99.1	99.1	102.0	99.9	99.0	97.1			146.6
400	82.9	85.8	84.0	83.7	86.0	85.9	85.4	86.8	86.8	89.0	89.0	90.0	91.7	93.0	90.8			138.3
500	81.9	83.7	81.9	82.4	83.0	83.1	83.3	83.9	85.6	87.8	88.9	90.7	91.6	91.6	89.9			137.3
630	83.4	88.2	87.4	86.2	90.1	90.2	88.0	88.2	90.2	90.5	90.2	92.1	92.1	92.3	90.0			140.1
800	85.9	89.7	93.0	88.7	95.2	96.3	95.7	95.0	94.0	93.3	92.3	92.9	91.8	91.0	90.8			144.3
1000	82.2	87.1	90.2	89.0	89.4	90.1	94.9	89.1	89.2	90.5	92.2	92.1	91.3	90.0	88.0			141.2
1250	82.9	85.9	89.3	89.8	91.0	93.1	92.6	91.0	90.0	91.0	91.3	92.1	90.8	88.8	88.1			141.3
1600	85.1	87.9	95.3	94.8	97.0	98.5	96.7	97.1	94.9	94.2	93.1	93.0	91.9	91.0	90.1			145.7
2000	85.5	88.8	94.4	98.2	98.2	101.5	95.0	96.1	93.8	91.4	92.1	93.2	92.1	90.2	90.9			146.5
2500	83.1	87.7	94.2	95.8	99.3	100.3	92.8	92.1	91.7	92.2	91.2	92.0	91.0	89.7	87.7			145.5
3150	81.1	86.8	91.4	92.2	97.1	95.4	92.0	90.2	87.8	91.1	91.5	93.1	88.2	87.9	88.9			143.1
4000	88.0	94.6	99.1	100.1	102.2	104.0	98.6	99.8	96.6	99.2	100.9	98.9	96.8	97.6	95.7			150.9
5000	81.2	88.0	92.2	92.9	93.2	93.4	92.8	90.2	91.9	90.3	92.2	93.1	89.3	89.0	86.9			141.0
6300	79.2	88.3	93.3	94.4	93.6	94.3	91.2	91.5	90.3	94.4	94.4	93.4	90.1	88.4	87.0			144.1
8000	80.1	89.0	93.5	92.0	93.5	92.5	93.1	92.4	92.9	95.3	96.2	99.4	92.2	90.0	86.9			146.4
10000	77.2	86.8	90.4	90.2	89.4	89.1	89.0	88.4	88.9	90.2	91.3	91.3	88.2	86.1	83.8			142.3
12500	73.9	84.5	87.2	86.7	86.9	85.9	86.4	85.8	88.7	91.3	91.3	90.8	90.9	82.8	81.8			142.5
16000	70.0	80.7	83.9	85.6	83.8	83.8	82.3	81.9	85.4	87.0	88.1	87.7	86.9	79.5	77.8			141.0
20000	64.6	76.1	78.3	79.2	79.7	78.8	77.2	76.6	80.3	81.6	82.8	83.3	84.5	74.2	73.4			139.0
OVERALL MEASURED	87.2	100.0	105.1	106.1	107.9	109.2	105.5	104.9	104.8	106.0	107.2	108.2	106.8	106.9	107.0			
OVERALL CALCULATED	96.5	100.9	105.1	105.9	107.8	109.1	105.9	105.6	104.7	106.4	107.1	108.1	106.6	107.1	107.0			117.6
PNDB	110.8	113.5	1.9.5	120.4	122.3	123.6	119.8	120.1	118.4	120.3	121.4	121.1	119.3	119.6	118.4			

SLOTTED TIP CASING - UNTREATED
NOMINAL NOZZLE
TAKEOFF
200' (60.96 m) SIDELINE
(SCALE MODEL - SCALED DATA)

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	64.7	70.9	71.8	76.2	78.4	80.1	80.0	81.6	81.2	82.8	82.4	83.0	83.6	85.3	81.9		
63	65.8	70.1	72.9	76.1	78.5	79.2	79.3	80.6	80.4	81.1	81.6	82.2	82.6	82.3	80.8		
80	66.3	71.8	72.5	76.8	76.1	78.1	83.0	83.2	80.9	82.9	84.0	85.8	85.5	86.2	84.5		
100	66.9	70.7	73.3	77.0	78.4	79.9	80.8	83.5	84.9	85.8	87.2	89.1	89.5	90.1	85.4		
125	72.1	75.6	79.2	83.0	84.3	85.8	86.0	87.3	89.2	90.8	92.3	92.9	91.5	91.0	85.0		
160	76.0	78.7	83.3	86.7	90.3	91.8	92.8	89.6	93.2	97.9	97.1	98.9	95.2	91.8	86.0		
200	71.8	78.5	79.2	80.5	84.0	84.7	84.6	86.1	86.0	87.7	87.0	86.9	86.8	85.7	79.5		
250	70.4	76.2	77.0	79.2	81.0	81.4	82.4	83.2	84.8	86.6	86.9	87.5	86.7	84.2	78.4		
315	71.2	80.6	82.4	82.9	88.0	88.8	87.1	87.4	89.3	89.1	88.1	88.8	87.1	84.7	78.3		
400	72.0	82.0	87.9	85.4	93.1	94.9	94.8	94.2	93.1	92.0	90.1	89.6	86.7	83.3	78.9		
500	70.0	79.3	85.0	85.6	87.2	88.7	93.9	88.3	88.2	89.1	90.0	88.7	86.1	82.2	75.8		
630	70.3	77.9	84.0	86.3	88.7	91.6	91.6	90.2	89.0	89.6	89.1	88.6	85.5	80.8	75.6		
800	72.6	79.7	89.8	91.3	94.7	97.1	95.7	96.2	93.8	92.7	90.8	89.5	86.5	82.8	77.4		
1000	72.3	80.5	88.9	94.6	95.8	100.6	94.0	95.2	92.8	89.9	89.7	89.6	86.6	81.8	77.9		
1250	69.8	79.2	88.6	92.1	96.9	98.7	91.7	91.2	90.6	90.6	88.8	88.3	85.4	81.2	74.4		
1600	67.4	78.2	86.3	89.9	94.8	96.6	90.9	89.2	88.4	89.6	89.1	89.3	83.1	79.3	75.3		
2000	74.0	85.8	93.3	96.3	99.8	102.5	97.5	98.9	95.6	97.7	98.5	95.1	91.0	88.8	81.7		
2500	66.8	78.9	86.3	89.1	90.7	92.2	91.7	89.3	90.9	88.7	89.7	89.2	83.4	80.0	72.5		
3150	64.3	7?	87.3	90.5	91.1	92.8	90.2	90.5	88.3	92.8	91.9	86.5	84.1	79.1	72.1		
4000	64.5	7?	87.4	88.1	91.1	91.1	92.2	91.7	92.0	93.9	93.9	95.6	86.1	80.4	71.2		
5000	61.9	77.5	84.7	86.8	87.5	88.3	88.7	88.2	88.6	89.3	89.4	87.9	82.5	76.8	68.2		
6300	57.2	74.9	81.5	83.5	85.4	85.4	86.5	86.1	88.8	90.8	89.7	87.6	85.3	73.2	65.2		
8000	51.8	70.7	78.4	80.8	82.9	84.0	83.2	83.0	86.3	87.2	87.1	84.9	81.4	69.5	59.7		
10000	44.3	65.4	72.8	76.9	79.5	79.8	79.0	78.6	82.1	82.7	82.4	81.0	79.0	63.5	53.1		
OVERALL CALCULATED		83.7	92.5	99.5	102.3	105.5	107.8	104.9	104.8	103.8	105.1	104.9	104.6	101.3	99.0	93.8	
PNDB	94.1	103.4	112.5	115.1	118.2	120.2	117.3	117.6	116.3	117.7	117.9	117.5	112.3	108.8	102.3		

SLOTTED TIP CASING - UNTREATED
NOMINAL NOZZLE
APPROACH
100' (30.48 m) ARC
(SCALE MODEL DATA)

NOISE SOUND PRESSURE LEVELS (50 DB, P, 70 PERCENT REL. HUM. 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)	( )	OVL
50	70.9	70.8	70.6	71.4	67.9	68.4	69.8	70.0	69.7	70.9	72.0	72.8	74.4	76.7	79.7		121.9
63	67.9	66.0	67.8	67.6	64.9	64.9	67.9	69.2	69.6	70.1	71.8	73.3	75.9	75.9	78.7		121.2
80	64.7	64.5	67.5	68.4	68.7	69.3	70.8	71.8	71.2	70.7	72.8	74.5	74.3	74.7	76.2		121.5
100	71.0	78.7	77.5	77.5	81.1	80.9	81.9	80.2	83.6	78.8	82.9	85.0	82.6	82.1	80.6		128.0
125	63.4	64.0	69.2	68.7	67.1	66.2	64.4	67.2	66.9	67.4	68.2	69.3	70.1	70.4	71.8		117.6
160	62.0	63.0	64.6	65.4	64.8	63.8	65.1	66.8	65.5	68.1	69.1	70.9	71.8	72.8	74.7		118.2
200	69.1	67.0	71.8	76.9	74.1	70.9	70.9	72.2	71.6	73.8	73.9	76.2	76.7	77.0	77.9		124.1
250	68.9	66.9	70.7	71.6	70.9	69.9	72.0	73.2	74.8	76.1	76.9	78.3	78.8	78.0	77.7		125.0
315	68.7	69.8	73.8	73.7	73.1	72.9	73.1	73.9	76.9	78.2	78.1	80.2	80.8	78.2	77.9		126.5
400	67.8	71.9	73.8	72.7	72.8	73.5	73.8	74.9	73.5	75.8	74.9	75.1	73.5	73.8	72.7		123.6
500	68.9	69.6	70.8	69.3	69.7	68.5	69.0	69.7	68.6	70.7	71.8	72.8	73.7	72.7	71.6		120.6
630	69.2	71.9	73.1	71.7	71.0	69.8	71.1	72.0	71.7	75.0	74.0	74.3	75.0	74.0	73.4		122.1
800	68.1	69.8	70.8	69.6	69.7	69.9	70.1	71.1	71.7	72.9	73.2	73.9	73.8	73.1	71.8		122.0
1000	67.1	70.0	71.2	71.0	71.3	71.1	71.1	72.4	72.0	73.3	74.3	76.5	75.8	73.1	71.8		123.2
1250	67.9	70.0	72.0	71.5	72.4	70.9	71.0	72.0	72.9	74.1	76.2	78.1	76.8	73.1	72.8		124.1
1600	68.8	70.8	72.9	71.7	71.2	71.7	70.2	72.1	72.8	73.9	77.0	79.4	78.0	73.2	72.8		125.6
2000	69.3	73.2	75.9	75.7	73.1	74.1	70.3	72.2	72.8	75.0	76.4	78.3	80.0	75.3	74.0		125.7
2500	70.9	85.9	80.7	87.8	84.9	84.6	80.0	79.2	81.9	81.8	82.9	86.2	87.7	86.9	83.8		137.6
3150	67.3	73.9	78.3	75.7	74.3	72.8	72.3	72.4	73.0	76.0	77.1	81.3	78.6	75.2	73.8		126.8
4000	68.9	77.0	80.8	79.6	74.7	74.9	73.0	75.0	74.7	78.9	81.0	82.0	81.6	79.0	76.4		131.5
5000	74.3	83.3	86.8	84.1	83.4	80.3	81.2	77.2	80.1	79.4	81.8	86.5	84.2	82.2	79.9		132.8
6300	68.9	78.4	81.5	81.5	77.5	77.3	75.5	76.5	75.9	80.6	82.7	84.6	84.1	78.6	75.9		131.8
8000	69.3	79.4	83.1	83.2	80.5	79.3	79.2	76.5	77.8	79.5	82.6	85.6	84.0	79.3	75.8		134.4
10000	68.1	78.3	82.3	80.2	78.2	78.1	78.1	74.1	74.8	77.1	80.3	81.6	81.2	77.4	74.7		132.8
12500	68.1	76.7	79.9	78.9	74.1	71.6	71.1	70.1	72.4	73.8	76.9	78.1	75.6	73.8	72.5		129.3
16000	60.8	72.7	76.9	73.5	72.1	68.8	68.2	66.2	68.5	76.8	73.1	75.2	72.8	70.0	67.8		128.1
20000	56.7	69.3	71.6	68.5	67.5	64.3	62.8	60.8	64.5	65.5	67.6	69.6	67.6	64.8	63.4		123.7
OVERALL MEASURED	86.2	90.9	93.8	91.8	90.1	89.9	89.2	89.3	89.6	90.8	92.1	94.1	93.6	91.8	91.7		
OVERALL CALCULATED	85.7	90.7	93.5	91.8	90.1	89.8	88.9	89.4	89.8	90.4	92.3	94.8	94.2	92.3	90.6		143.9
PNDB	98.2	104.7	107.4	106.8	104.4	103.9	101.9	101.1	102.7	103.7	105.1	106.0	106.1	104.4	104.2		

SLOTTED TIP CASING - UNTREATED
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE
(SCALE MODEL - SCALED DATA)

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (90 DEG. F, 70 PERCENT REL. HUM. DAY)

50	65.7	72.1	73.2	74.7	79.4	79.6	81.3	84.7	83.6	77.8	81.2	82.2	78.3	79.9	78.8		
63	53.8	57.3	60.8	62.9	65.4	65.2	65.8	66.7	66.4	64.5	66.5	65.7	63.7	61.8			
80	51.5	54.8	60.1	62.5	63.0	62.8	64.4	66.3	64.9	67.8	67.3	68.0	67.1	66.0	64.1		
100	58.4	60.8	66.4	73.9	72.2	69.6	70.2	71.6	70.9	72.7	72.8	73.2	72.2	70.1	67.2		
125	56.8	58.9	66.8	68.6	69.8	68.7	71.2	72.6	74.1	74.9	75.8	75.3	74.2	70.9	66.8		
160	57.8	62.6	68.2	78.7	71.2	71.7	72.4	73.3	76.1	77.8	78.2	77.1	75.3	71.1	64.8		
200	56.5	61.6	69.8	69.5	70.8	72.3	73.0	72.2	72.7	74.8	69.9	72.0	68.7	66.2	61.4		
250	53.4	62.1	65.8	68.1	67.7	65.2	68.1	67.8	67.8	69.4	69.8	69.6	68.8	65.3	60.1		
315	57.5	64.3	68.1	68.4	68.9	68.4	70.2	71.3	70.8	73.6	72.8	71.1	70.8	66.4	61.9		
400	58.2	62.1	64.9	66.3	67.4	68.5	69.2	70.4	70.7	71.5	71.8	70.6	68.7	65.4	59.8		
500	54.7	62.1	66.8	67.6	69.1	69.7	70.1	71.6	71.1	71.9	72.1	73.1	70.6	65.2	59.6		
630	55.4	62.8	66.7	68.1	69.9	66.5	70.8	71.2	71.9	72.6	73.9	74.6	71.9	65.1	60.3		
800	55.2	62.7	67.5	68.1	68.9	70.2	69.2	71.2	71.7	72.4	74.7	75.8	72.6	65.8	60.1		
1000	56.3	64.9	70.4	70.8	70.7	72.5	6.2	71.8	71.8	73.9	74.1	74.7	74.5	67.0	61.8		
1250	65.5	77.5	83.1	84.1	82.5	83.1	78.9	78.2	80.8	80.3	80.5	82.5	82.1	78.4	78.8		
1600	53.0	62.3	72.6	72.0	71.9	71.3	71.2	71.5	71.9	74.4	74.7	77.6	72.3	66.9	60.1		
2000	54.8	60.1	74.3	79.8	72.3	75.4	72.0	74.2	73.7	77.3	78.6	78.3	75.9	70.2	62.4		
2500	57.8	74.0	80.1	80.2	80.9	78.7	80.1	78.2	79.8	77.8	79.8	82.7	78.3	73.1	65.9		
3150	53.0	69.2	75.5	77.4	75.1	75.8	74.5	75.7	74.9	79.1	80.2	80.7	78.1	69.3	61.8		
4000	53.7	69.6	77.0	79.3	78.1	77.9	76.4	78.8	77.8	78.1	80.2	81.7	77.9	69.7	60.1		
5000	50.9	69.0	76.6	76.8	76.4	74.3	74.7	74.8	74.9	73.2	78.8	78.2	75.5	68.1	59.1		
6300	46.9	67.1	74.2	73.7	72.5	71.1	71.2	70.4	72.7	73.3	75.4	74.9	70.8	64.2	55.8		
8000	42.7	62.7	71.4	70.7	71.1	69.8	69.1	67.2	69.4	71.1	72.2	72.4	67.3	60.0	49.7		
10000	36.3	58.6	66.1	66.2	67.3	65.4	64.6	62.8	64.3	66.5	67.4	67.3	62.1	54.1	43.1		
OVERALL CALCULATED	70.9	82.1	87.9	88.9	88.5	88.4	88.0	88.6	88.9	89.0	90.0	91.2	88.6	83.8	77.8		
PNDB	81.3	94.6	100.8	101.8	101.5	100.5	100.8	99.4	100.9	102.0	103.8	104.2	101.8	95.1	87.8		

SLOTTED TIP CASING - TREATED
NOMINAL NOZZLE
TAKEOFF
100' (30.48 m) ARC
(SCALE MODEL DATA)

MEASURED SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. 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
50	80.6	78.5	76.6	78.7	77.5	78.8	79.7	80.6	81.8	82.9	83.8	85.9	88.9	92.8	97.7			136.1
63	75.8	75.6	77.7	77.1	78.8	77.8	79.0	80.7	82.8	83.8	84.1	86.0	88.9	94.0	98.0			136.7
80	75.8	76.6	77.7	78.9	79.4	79.3	80.8	81.6	82.7	84.8	84.7	87.9	89.7	93.8	96.8			136.6
100	75.9	77.5	76.9	78.8	79.5	79.8	81.0	81.5	81.8	83.7	83.8	85.7	87.9	92.2	92.7			134.7
125	74.9	76.7	78.1	78.0	79.7	79.8	79.6	79.9	80.8	81.9	83.3	86.2	86.3	89.2	91.8			133.3
160	75.0	78.5	78.8	77.1	83.8	82.5	81.7	82.8	83.9	84.7	85.2	90.9	91.0	93.0	95.7			137.1
200	76.1	77.8	78.7	79.5	78.9	79.4	82.1	83.5	85.9	87.9	89.1	92.2	94.2	98.1	96.8			139.7
250	81.8	82.7	85.0	86.3	85.9	85.6	85.9	87.7	90.1	92.2	93.4	96.2	97.0	98.2	96.9			142.3
315	88.1	86.6	88.5	90.3	93.1	93.8	92.2	89.9	96.8	99.8	99.3	101.9	101.0	100.3	99.1			147.3
400	82.7	84.6	84.9	83.9	85.4	85.6	85.0	89.5	86.9	88.1	89.4	90.9	92.1	92.0	91.7			136.2
500	81.0	83.5	82.8	83.0	83.7	83.5	83.7	83.6	84.7	86.9	88.2	92.1	91.8	91.9	90.9			137.6
630	82.8	86.2	87.0	87.5	91.6	89.0	89.5	89.9	98.8	98.2	98.6	93.2	93.2	92.3	91.1			140.5
800	82.8	89.0	92.9	91.3	95.9	97.8	97.2	95.9	94.8	93.2	92.1	93.3	93.3	91.3	90.9			144.8
1000	82.1	85.9	98.4	88.6	89.3	91.3	95.3	91.0	90.1	89.5	92.8	91.5	91.2	89.6	88.4			141.5
1250	82.8	84.9	89.2	90.1	91.1	90.1	91.4	89.8	88.9	89.0	91.4	92.3	90.2	88.4	87.9			140.5
1600	85.9	85.0	95.8	92.2	93.9	95.9	97.1	94.8	93.9	93.0	92.2	94.1	91.3	90.4	89.1			144.5
2000	84.1	87.2	97.4	99.5	100.8	102.3	97.3	99.0	95.1	93.2	92.7	92.2	91.2	90.6	91.3			147.3
2500	81.0	84.8	96.1	96.0	98.8	98.7	93.0	90.9	92.3	91.1	92.4	92.9	90.9	90.3	87.8			145.2
3150	82.1	86.1	93.4	94.5	98.3	96.0	93.2	89.9	86.2	90.2	91.3	93.5	88.5	87.3	86.9			142.9
4000	88.9	93.1	100.8	100.8	100.8	102.7	98.2	98.9	96.8	98.6	98.3	97.1	94.9	96.0	94.8			149.9
5000	81.3	88.3	93.4	94.6	95.4	94.1	92.2	91.3	92.1	90.4	93.7	95.2	88.5	89.6	87.0			145.2
6300	79.2	88.4	9 .2	92.7	94.2	94.1	91.6	91.1	89.4	93.4	92.5	92.6	90.5	88.5	86.3			143.9
8000	79.0	88.3	94.2	94.5	93.1	92.3	93.2	90.2	92.3	94.2	97.4	98.4	89.5	90.3	88.3			144.0
10000	75.8	86.1	91.3	90.4	90.3	88.9	89.4	86.7	87.8	89.1	91.3	91.1	87.1	86.1	84.1			142.2
12500	73.0	83.5	88.0	86.2	87.9	86.7	86.7	84.4	86.6	88.1	91.0	89.9	83.7	82.8	81.6			141.4
16000	70.7	80.3	83.7	82.8	84.6	82.5	83.5	81.2	84.6	87.6	89.1	88.7	81.7	79.8	78.4			141.1
20000	66.8	75.2	79.8	78.4	79.9	77.9	78.4	76.1	80.9	82.1	83.2	83.3	78.1	75.2	75.2			138.7
OVERALL MEASURED	95.8	99.8	106.8	106.1	107.7	107.8	104.1	104.6	105.0	106.8	106.8	107.8	106.1	107.9	107.9			
OVERALL CALCULATED	96.0	99.9	106.8	106.3	107.8	108.5	106.3	104.9	105.1	106.2	106.6	108.0	106.6	107.3	107.5			152.9
PNDB	107.8	114.3	120.6	120.6	121.8	122.8	119.9	119.4	118.7	119.9	119.4	120.5	118.5	119.0	118.1			

SLOTTED TIP CASING - TREATED
NOMINAL NOZZLE
TAKEOFF
200 (60.96 m) SIDELINE
(SCALE MODEL - SCALED DATA)

FULL SIZE BOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	68.8	70.9	72.8	75.0	77.8	78.6	80.4	81.8	81.2	82.7	82.1	82.4	83.5	85.4	82.6	
63	69.0	70.8	73.7	75.1	78.0	78.0	78.6	79.4	80.2	80.9	81.6	83.4	81.9	82.5	80.9	
80	69.5	71.7	74.1	74.2	82.0	81.4	81.1	82.2	83.2	83.6	83.4	86.0	86.9	86.2	85.2	
100	69.4	70.8	74.2	76.9	77.1	78.5	81.4	83.0	85.2	86.8	87.2	89.2	89.6	91.2	86.1	
125	70.9	73.6	80.4	83.2	84.0	84.5	85.2	87.1	89.3	91.0	91.6	93.1	92.4	91.1	86.0	
160	72.0	75.4	84.1	87.2	91.2	92.4	91.4	89.3	96.0	98.7	97.4	98.8	96.2	93.1	88.0	
200	71.8	77.3	80.1	80.7	83.8	84.4	83.2	84.9	86.1	86.9	87.4	87.8	87.3	84.7	80.4	
250	69.5	76.0	77.9	79.8	81.7	82.2	82.8	82.9	83.9	85.6	86.2	86.8	86.9	84.5	79.4	
315	70.5	78.6	82.0	84.2	88.9	87.7	88.6	88.2	89.1	88.9	88.5	89.9	88.2	84.7	79.3	
400	70.5	81.3	87.8	87.9	93.7	95.7	96.3	95.1	93.9	91.9	90.0	89.9	88.2	83.6	78.9	
500	69.9	78.1	85.2	85.2	87.1	85	94.6	90.1	89.1	88.1	90.4	88.1	86.0	81.7	76.2	
630	70.4	76.9	83.9	86.6	88.8	88.7	90.4	88.9	87.9	87.6	89.2	88.8	84.9	80.4	75.4	
800	73.1	76.9	89.8	88.6	91.4	94.4	94.1	93.9	92.8	91.5	89.9	90.6	85.9	82.3	76.4	
1000	71.0	78.9	91.9	95.7	97.6	100.7	96.2	94.1	94.8	93.7	90.3	88.6	85.7	82.3	78.3	
1250	67.7	76.4	96.5	92.4	96.4	97.2	91.9	90.0	91.7	89.6	90.0	89.2	85.3	81.8	74.5	
1600	68.1	77.5	88.2	90.8	95.8	95.0	92.2	89.0	89.5	88.6	88.9	89.7	83.1	79.5	73.2	
2000	72.9	84.3	94.3	96.2	98.4	101.2	97.2	96.8	95.8	97.3	94.8	93.4	89.2	87.1	80.8	
2500	68.9	79.2	87.5	90.8	92.9	92.5	91.2	89.5	91.8	88.9	93.2	91.3	82.6	80.5	72.8	
3150	64.2	79.1	89.2	88.8	91.6	92.4	90.4	89.3	89.4	91.8	90.8	88.7	84.5	79.2	71.4	
4000	63.4	78.7	88.8	90.6	90.7	90.9	92.4	89.5	91.1	92.8	95.8	94.6	83.4	80.7	72.7	
5000	60.8	76.8	89.6	87.0	88.4	88.1	89.1	86.6	87.9	88.2	89.4	87.7	81.4	76.8	69.8	
6300	56.3	73.9	82.3	83.0	86.4	84.2	86.8	84.7	86.7	87.6	89.4	86.7	78.8	73.2	64.9	
8000	52.6	70.3	78.1	80.1	83.6	82.8	84.4	82.3	85.9	87.8	88.1	89.9	76.2	69.8	60.3	
10000	45.7	64.5	73.8	76.1	79.7	78.9	80.2	78.1	82.7	83.2	83.0	81.0	72.6	64.5	54.9	
OVERALL CALCULATED		83.6	91.5	100.6	102.8	105.5	107.1	105.3	104.8	104.2	104.8	104.4	104.6	101.4	99.3	94.6
PNDB		93.6	104.3	113.4	115.8	117.8	119.4	117.4	116.9	116.4	117.2	117.6	117.1	111.1	108.3	102.1

SLOTTED TIP CASING - TREATED
NOMINAL NOZZLE
APPROACH
100' (30.48 m) ARC
(SCALE MODEL DATA)

MODEL SOUND PRESSURE LEVELS (59 DEG. F, 70 PERCENT REL. HUM. 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
50	72.8	72.5	70.9	70.9	68.9	69.8	70.1	70.8	72.7	71.8	71.1	73.8	74.8	77.1	79.1			122.6
63	67.9	65.8	67.9	65.9	73.0	67.7	67.8	69.8	76.8	72.1	71.3	72.9	74.9	76.2	79.0			122.6
80	63.8	65.3	65.7	66.8	68.8	69.5	69.7	71.4	72.6	71.9	71.8	74.7	74.0	76.0	77.8			121.8
100	68.8	75.8	77.6	75.9	81.6	81.9	82.1	83.8	82.9	79.9	82.0	86.9	82.8	83.2	80.7			132.1
125	62.9	64.1	66.8	65.1	66.8	66.9	66.1	68.1	68.1	68.1	69.2	70.2	69.4	70.5	71.0			117.9
160	63.0	63.5	63.9	63.1	63.4	63.8	64.8	65.8	66.9	68.1	68.2	69.9	70.9	72.2	74.7			117.8
200	65.1	63.6	69.0	72.3	71.7	67.7	69.0	70.7	71.8	73.9	73.3	75.2	76.1	76.2	77.8			122.8
250	66.1	66.6	69.9	70.3	69.8	69.8	71.3	73.8	75.2	76.0	76.1	78.3	77.9	78.3	77.9			124.8
315	67.2	71.0	73.1	73.4	72.7	72.0	73.0	76.7	75.1	78.0	77.3	81.0	80.2	78.1	78.9			26.7
400	67.8	70.9	71.7	69.3	69.9	70.0	71.2	71.9	70.8	71.9	72.0	73.2	72.9	73.0	71.7			121.6
500	67.0	69.9	70.7	68.2	68.9	66.9	67.8	68.5	68.9	69.8	71.9	72.8	72.8	72.2	71.6			120.4
630	69.1	72.0	73.3	71.3	72.3	71.2	70.5	72.2	72.1	74.2	73.6	74.5	74.2	73.4	73.1			123.0
800	67.2	70.0	69.9	68.4	69.8	70.1	71.0	70.8	70.9	72.0	73.1	73.0	73.0	72.1	73.1			121.7
1000	67.2	69.2	70.4	70.3	72.3	71.0	71.5	71.2	72.4	73.4	74.3	76.2	74.2	72.6	72.3			123.0
1250	67.2	68.8	70.9	71.1	70.8	69.8	70.1	70.8	71.9	74.0	75.1	76.5	75.0	73.1	71.8			123.1
1600	67.1	69.1	71.2	70.4	70.2	70.8	70.4	71.8	72.0	74.1	76.2	77.1	75.3	73.5	72.9			123.6
2000	67.2	71.0	74.1	72.6	71.0	73.3	70.2	71.0	73.1	74.2	75.6	76.5	76.2	73.6	73.1			124.2
2500	77.9	84.7	87.0	86.2	83.0	83.7	77.0	76.9	79.8	81.1	81.0	83.9	84.9	84.0	82.0			133.8
3150	66.1	74.0	76.2	74.3	73.3	72.0	71.2	71.9	73.1	74.4	76.3	80.2	77.5	73.4	71.4			125.8
4000	67.9	75.0	78.0	76.0	74.1	75.9	72.0	74.0	75.0	78.9	78.3	81.2	79.1	76.2	76.0			128.0
5000	72.1	83.2	84.1	83.3	80.2	79.0	77.5	75.9	79.3	79.2	83.3	86.2	82.2	81.3	80.0			132.8
6300	68.5	77.4	80.4	77.4	76.2	75.5	74.7	75.1	75.3	80.3	78.4	82.5	82.6	76.7	75.2			130.0
8000	68.4	79.0	82.1	81.5	79.1	77.3	77.5	74.9	77.3	80.1	81.3	84.5	81.5	78.5	77.1			132.2
10000	65.3	78.2	80.9	78.5	76.9	74.9	74.4	74.2	75.0	78.4	78.2	80.1	79.3	76.5	74.3			130.5
12500	62.9	76.8	78.7	75.2	73.7	71.9	70.9	68.8	72.7	74.8	76.2	77.9	74.8	74.0	71.9			128.9
16000	61.5	73.4	76.5	72.0	71.7	68.5	67.7	65.3	69.7	71.7	72.0	74.0	71.6	70.0	67.5			127.7
20000	59.3	69.2	71.1	67.3	67.1	63.9	62.4	59.6	66.0	65.3	66.3	68.2	66.2	63.4	62.2			125.1
OVERALL MEASURED	85.8	90.1	91.9	91.1	89.6	88.9	88.7	89.6	89.7	90.4	91.1	94.0	92.7	91.9	90.3			
OVERALL CALCULATED	83.1	90.0	92.1	90.9	89.5	89.2	87.7	88.5	89.4	90.4	91.2	94.2	92.5	91.3	90.7			141.9
PNDB	97.2	103.7	105.9	104.9	102.9	103.0	99.7	99.9	101.7	103.3	104.5	107.2	105.9	104.5	103.3			

SLOTTED TIP CASING - TREATED
NOMINAL NOZZLE
APPROACH
200' (60.96 m) SIDELINE
(SCALE MODEL - SCALED DATA)

FULL SIZE SOUND PRESSURE LEVELS SCALED FROM MODEL DATA (59 DEG. F, 70 PERCENT REL. HUM. DAY)

50	58.7	69.2	72.5	73.1	79.9	80.9	81.5	83.4	82.4	78.9	80.3	84.1	78.5	76.6	70.6	
63	52.8	57.4	60.4	62.2	65.1	65.9	65.4	67.6	67.5	67.0	67.5	67.3	65.0	63.8	60.7	
80	52.4	56.7	59.4	60.2	62.0	62.7	64.1	65.2	66.2	67.0	66.4	67.0	66.4	65.4	64.2	
100	54.4	56.7	64.4	69.3	69.9	66.6	68.3	70.1	71.1	72.8	71.4	72.3	71.6	69.3	67.1	
125	55.2	59.5	65.2	67.3	67.9	68.7	70.6	73.2	74.5	74.8	74.2	75.2	73.3	71.3	67.0	
160	59.1	63.8	68.4	70.3	70.8	70.8	72.4	76.1	74.4	76.8	75.4	77.9	75.5	70.9	67.8	
200	58.5	63.6	66.9	68.1	67.9	68.7	70.4	71.2	70.0	70.6	70.0	70.0	68.1	65.7	60.4	
250	55.5	62.4	65.8	65.0	66.8	65.6	67.0	67.8	68.1	68.5	69.9	69.6	67.9	64.7	60.1	
315	57.3	64.4	68.3	68.0	70.2	69.9	69.6	71.5	71.2	72.8	71.5	71.2	69.2	65.8	61.3	
400	55.3	62.3	64.8	65.0	67.7	68.7	70.1	70.0	70.0	70.7	71.0	69.7	67.9	64.4	61.2	
500	55.0	61.4	65.2	66.9	70.1	69.6	70.6	70.4	71.4	72.4	72.1	72.8	69.0	64.7	60.1	
630	54.8	60.8	65.6	67.6	68.6	68.4	69.1	69.9	70.9	72.5	72.9	72.8	69.7	65.1	59.4	
800	54.3	60.9	65.8	66.9	67.9	69.4	69.4	70.9	70.9	72.6	73.9	73.5	69.9	65.3	60.2	
1000	54.2	62.7	68.6	69.0	68.7	71.7	69.2	70.1	72.0	73.7	73.2	72.9	70.7	65.3	60.1	
1250	64.9	76.2	81.4	82.5	80.6	82.1	75.9	76.0	78.7	79.5	78.6	80.2	78.3	75.5	68.7	
1600	52.4	65.3	70.5	70.6	70.9	70.5	70.2	71.0	72.0	72.9	73.9	76.5	71.9	64.7	57.7	
2000	53.9	66.2	72.3	72.3	71.7	72.4	70.9	73.1	74.0	77.3	75.9	77.5	73.4	67.4	62.0	
2500	57.7	74.1	78.1	79.5	77.8	77.4	76.4	75.0	78.2	77.6	80.8	82.4	76.3	72.2	65.6	
3150	53.8	68.2	74.4	73.6	73.8	73.9	73.7	74.3	74.3	78.8	76.0	78.6	76.4	67.4	60.3	
4000	52.7	69.4	76.0	77.7	76.7	75.9	76.6	74.2	76.5	78.7	78.9	80.6	75.4	68.9	61.4	
5000	49.7	68.9	75.3	75.1	75.1	74.1	74.1	74.0	74.7	77.5	76.3	76.7	73.6	67.2	58.7	
6300	46.3	67.2	73.1	72.0	72.2	71.4	71.0	69.1	72.8	74.3	74.7	74.7	69.1	64.4	55.3	
8000	43.4	63.4	70.9	69.2	70.8	68.7	68.6	66.4	70.6	71.9	71.1	71.2	66.1	60.0	49.4	
10000	39.1	58.5	65.6	65.0	66.8	65.0	64.2	61.9	67.8	66.4	66.1	65.9	63.7	52.7	41.9	
OVERALL, CALCULATED	69.7	81.3	86.4	87.2	87.2	87.7	86.8	87.7	88.2	88.9	88.9	90.7	87.0	82.9	77.6	
PNDB	80.0	94.3	99.2	100.0	99.5	99.4	99.1	98.4	100.3	101.9	102.2	103.4	99.4	94.1	87.6	

APPENDIX C
Nomenclature

BPF	- blade passing frequency
EPNL	- effective perceived noise level
F	- degrees Fahrenheit
F_N	- corrected thrust, pounds
Hz	- frequency, cycles per second
MPT	- multiple pure tones
N_{fc}	- corrected fan speed
P_{23}/P_2	- fan pressure ratio
PNdB	- PNL in decibels
PNL	- perceived noise level
PNLT	- tone corrected PNL
R.H.	- relative humidity
SL	- sideline
SPL	- sound pressure level
TR	- treated
UNTR	- untreated
W_2	- fan weight flow
δ	- the ratio of inlet pressure to standard pressure, 14.7 pounds per square inch (10.13 Newtons/cm^2)
η_{23}	- adiabatic efficiency
θ	- temperature ratio

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