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THE NOISINESS OF TONES PLUS NOISE

by Karl S. Pearsons, Richard D. Horonjeff, and Dwight E. Bishop

Prepared by
BOLT BERANEK AND NEWMAN INC.
Van Nuys, Calif.
for Langley Research Center

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SUMMARY

A series of judgment tests were conducted to investigate subjective judgments of single, modulated and multiple tones plus noise. The subjects were asked to judge which of two sounds, tones plus noise or noise alone, was noisier (or in some cases louder). Stimuli included both broadband and octave band noises together with single tones at 250, 500, 1000, 2000, 4000 Hz. Amplitude and frequency-modulated tones of 500 and 2000 Hz were also employed. Multiple tone stimuli included 2 and 5 tone complexes with overall frequency spacings of 1/10, 1/3, 1, 4/3 and 2 octaves.

Analysis of the judgment results were made using calculated perceived noise level and pure tone correction procedures suggested both by Little, and by Kryter and Pearsons.

In general, the pure tone corrections were necessary, the exception being situations in which the pure tone is added to an octave band of noise. In one test series; however, the pure tone adjustment appears to overcorrect in all conditions. The effect of the instruction set was marked. The addition of a pure tone to noise had less effect on judgments of loudness and more effect on judgments of noisiness. The average difference was 5 dB. Modulated tones showed little difference from those of unmodulated tones, except at low modulation rates which produced annoying beats. For multiple tones there appeared to be no difference in peoples assessment of harmonic and non-harmonically related tone complexes. Although the noisiness increases somewhat with increase in number of tones, this effect does not require modification of the present pure tone correction methods.

INTRODUCTION

During the development of the calculation procedure for perceived noise level, it was realized that noisiness of discrete tones could not be predicted. This was later confirmed by Little (ref. 1) and Wells and Blazier (ref. 2) who found it necessary to add a correction factor to account for the added effects of the discrete tones. To investigate this discrete tone correction factor, Bolt Beranek and Newman Inc. conducted some tests, the results of which were published by Kryter and Pearsons (ref. 3, 4). These tests utilized pure tones in octave bands of noise at frequencies ranging from 500 to 6,300 Hz. These stimuli were compared with octave bands of noise without tones. Differences in sound pressure level at judged equal noisiness were then determined as a function of tone-to-noise ratio.

There are two ways of including a correction factor for pure tones. One, used by Kryter and Pearsons, is to increase the sound pressure level in the band containing the tone over that actually measured to increase the calculated perceived noise level. The second approach, used by Little, is to simply add a number of decibels to the calculated perceived noise level. In both cases, the increase in the calculated value depends on the frequency of the pure tone and its magnitude relative to the noise. Either method increases the predicted noisiness of those spectra containing pure tones. Later tests by BBN using broadband noises and multiple and modulated pure tones produced results which did not agree with the original tests (ref. 5). These tests indicated that no pure tone correction of any type was necessary.

To resolve these differences and to provide additional information on the effects of multiple and modulated pure tones, BBN agreed to perform the following tasks under Contract No. NAS1-6364.

Task I - Investigate the effect of multiple and modulated tones on perceived noisiness using the rating method of paired-comparison.

Task II - Investigate the effect of non-harmonically related pure tones in the multiple-tone tests.

Task III - Investigate how the spectrum shape of the noise to which the pure tones are added effects judgments of noisiness by systematically varying the background noise spectrum shape and holding the tone-to-noise ratio constant.

The next section describes the series of tests used in these experiments. This is followed by a presentation of the data from the experiments. Next, a discussion of these results is then presented followed finally by a conclusion section.

TEST DESCRIPTION

Test Organization

As noted in the first section, the work statement called for us to investigate the effects on judged noisiness of (a) multiple and modulated tones, (b) non-harmonically related pure tones, and (c) the noise spectrum shape to which the pure tones are added.

To accomplish these tasks, judgment tests were conducted in three series as follows:

Test Series I - Noisiness and loudness judgments of single tones combined with varied broadband noise spectra.

Test Series II - (A) Noisiness judgments of modulated single tones, (B) Noisiness of two-tone complexes as a function of frequency spacing, and (C) Repeat of a portion of Test Series I at a lower level.

Test Series III - Noisiness judgments of multiple tones including both harmonically and non-harmonically related tones.

In Test Series I, two groups of twenty subjects were used. In the succeeding test series, single groups of twenty subjects were employed. The majority of subjects were college students. All subjects were audiometrically screened prior to the tests with the screening level held within 15 dB of the new ISO standard threshold (ref. 6).

Procedure

The judgment tests were all conducted in an anechoic chamber, 8 ft by 10 ft by 7.5 ft high. Two basic test methods were employed during the series of judgment tests; the method of adjustment, and the method of paired-comparison. For Test Series I, II-A, II-C and III, the method of of adjustment was used only in preliminary tests to supplement information of previous tests necessary to obtain levels for the more detailed paired-comparison tests. In Test Series II-B, the method of adjustment was the primary test method.

In the method of adjustment, subjects were asked to adjust the level of comparison sound until they judged that it was just as noisy or disturbing as the standard sound. For this method, a single subject was tested at one time.

For the paired-comparison tests, the primary test method for Test Series I, II-A and III, tapes were prepared for presenting the sound samples to the subjects. In preparing the tapes, each pair of samples included a standard noise and comparison noise. For tests of this type the standard noise or the comparison noise may be presented first. Since the order in which the two noises are presented may influence a subject's judgment, both orders were used. The data was then averaged so that order effects would tend to be cancelled. The test pairs were randomized using a random number table and recorded on magnetic tape. During presentation of the paired-comparison tape, the subjects were asked to choose which of the pair of sound stimuli was the noisier (or the louder) and to indicate that choice by punching the appropriate positions on an IBM port-a-punch card. For the paired-comparison methods, generally four subjects were tested at one time with test sessions limited to approximately 90 minutes. In addition, several rest periods were given to the subjects to prevent possible fatigue. The actual instructions for the different tests are given in Appendix A.

Equipment

The equipment used to present the test stimuli to the subjects is shown in a block diagram in Fig. 1. The electronic switch, the four-second timer, and the trigger amplifier were employed so that no audible tape hiss or verbal anotation on the tape between samples was heard by the test subjects. This was accomplished by putting a pulse on the paired-comparison tape just prior to the sound stimulus. This pulse controlled the four-second timer which, in turn, turned on the electronic switch for the four-second duration of the sound stimulus. The volt meter was used to set the levels of the test stimuli during the test sessions Detailed acoustical analysis of noise samples were later performed in the anechoic chamber with no subjects present.

Further details of the stimulus generating equipment necessary for creating the paired-comparison tape are given in Appendix B.

Test Stimuli

A variety of test stimuli were employed in the three series of tests. The stimuli are briefly described in Tables I through IV which list the basic stimuli for each major test series. One-third octave band noise levels of the stimuli are tabulated in Appendix C. (As noted in the appendix, the levels listed are the maximum levels at which the spectra were presented to the test subjects; the levels listed are the average of those monitored at the various seat positions.)

In Test Series I, the stimuli listed in Table I were used in the paired comparison tests. The standard is always a noise, as the table indicates. The comparison consists either of a) that noise with a pure tone added to the noise, or b) the pure tone alone (no noise). The frequency of the pure tone was 250, 500, 1000, 2000, or 4000 Hz. Figures 2 through 4 show examples of the various stimuli used during these tests. When the tone is added to an octave band of noise at the same center frequency as the tone, see Fig. 2, the standard is the same octave band of noise without the tone. For testing using the tone alone as the comparison, the standard is the octave band of noise whose center frequency is that of the tone. Figure 3 shows a broadband noise similar in shape to a jet aircraft flyover noise (simulating the spectra of a turbojet takeoff at 2000-ft altitude). Figure 4 shows the broadband noise spectra having the spectrum shape corresponding to the 40-noy curve, extending from 100 to 6,000 Hz.

In Test Series II-A, modulated test tones were used as well as unmodulated test tones at 500 and 2000 Hz. (See Table II).

In Test Series II-B, the tests were conducted to determine maximum and minimum noisiness of a two-tone complex as a function of frequency separation. The subjects controlled one component that could be varied in frequency. The other component was fixed throughout the test. (See Table III).

Test Series II-C was a repeat of a portion of Test Series I (single tones) at 10 dB lower levels.

In Test Series III, series of single and multiple tones were tested again in conjunction with the broadband noise standards used in Test Series I and II. Table IV lists the various stimulus conditions.

Test Repeats

Certain pairs of stimuli appeared in more than one test. We can therefore obtain information on variability among the groups. In addition, in Test Series III, one set of comparisons with tones at 2000 and 2500 Hz were repeated for a total of 10 times during the tests. This allows us to assess the variable of a group's judgments over time.

Paired-Comparison Judgment Test Analyses

For Test Series I, II-A and II-C, subjects were asked to choose which of the two sound stimuli was the noisier (or louder). In the Test Series III, subjects were asked to choose not only which of the two sound stimuli was noisier but also to indicate the degree of assurance of their judgment. This was accomplished by using a six-point scale as described in the instructions for Test III in Appendix A. In our analysis, however, results from Test Series I, II-A, and III were treated similarly and we did not use more detailed information initially obtained in Test Series III.

The subjects responses recorded on the IBM cards were entered into a digital computer for sorting and analysis. A computer-generated display of typical results for a Series I test are shown in Fig. 5. The standard in this case was a broadband "jet" noise; the comparison, the same "jet" spectra plus a 4000 Hz tone. The dashed line represents a visual best fit curve for the results obtained when the standard stimulus was presented first. Similarly, the solid line represents the results obtained when the comparison stimulus was presented first. We considered that the two sounds were equally noisy or acceptable (or louder depending upon the test) when 50% of the subjects stated that one sound was noisier (or louder) than the other. The difference in levels between the two curves at the 50% point as shown in Fig. 5 illustrates the effect of the order of presentation. This difference (sometimes referred to as the "time error") shown on the figure as 6dB is typical of all the test sessions. Since we desire the level of equality to be independent of the order of presentation of the stimuli, we averaged the two levels at the 50% point obtained from the two orders of presentation.

For the data shown in Fig. 5, this averaged 50% level is -12 dB below the maximum level of the comparison stimulus. The 50% levels for all other judgment data are tabulated in Appendix D in terms of dB re the maximum level of comparison presented to the subject.

Another method used to determine the 50% point was by plotting the results shown in Fig. 5 on probability paper and using a straightline regression line fitted to the data to obtain the 50% point. As noted in Pearsons (ref. 7) the average difference in techniques is expected to be quite small in comparison with other sources by variability.

DESCRIPTION OF TEST RESULTS

Single Tones

Noisiness Versus Loudness Comparisons

In Test Series I, it will be recalled, the subjects were asked to compare stimuli containing single pure tones alone or these pure tones added to various noise spectra. Twenty subjects (in Group L) were given loudness instructions for the major portion of the test, then acceptability instructions for a minor, secondary test. The remaining twenty subjects (in Group A) were given instructions in the reverse order. Figures 6, 7, and 8 show some of the results from these tests. In these and succeeding figures, values are shown in terms of the comparison level re the standard level. Thus, for judgments of equal noisiness (acceptability) or equal loudness, if the comparison as calculated is less than the standard, it will be plotted as a negative value. If the calculated comparison value is the same as the standard value, it will be plotted as zero in the graphs. The level in Figs. 6 through 8, the basis of comparison, is the perceived noise level calculated from one third octave band spectra (for both comparison and standard stimuli). Figure 6 shows the results for both loudness and noisiness instruction when the comparison is a single pure tone added to a broadband noy and jet noise spectra. The standard is the noise spectra without the tone. Figure 7 shows similar results in which various single tones were compared to a broadband noise. Figure 8 shows the results for the test in which octave bands of noise were used as standards. In this latter test, it should be noted that the standard octave band of noise was selected to have the same center frequency as the discrete tone used as the comparison.

One will note, particularly Figs. 6 and 7, a displacement between the loudness and noisiness judgments indicating that the subjects made a distinction between the two sets of instructions. In Fig. 6 for example, we see when loudness is judged, that equality is reached when the calculated perceived noise level of the comparison is approximately that of the standard. The single exception is the data at 4000 Hz. However, when subjects were asked to judge on a basis of acceptability, the comparison level in PNdB was generally considerably less than the standard level indicating a need for a tone correction. The differences are particularly noted in Figs. 6 and 7 but are less evident in Fig. 8 in which octave bands of noise were used as standards. Even here, however, there is little overlap between loudness and noisiness judgments indicating quite consistent difference in the basis of subject's judgments. The difference between the results of the loudness and noisiness judgments are indicated in Fig. 9. For tones in broadband noise, the difference between loudness and noisiness increases with frequency while the reverse is true for the tones in octave bands of noise. Magnitudes of the median differences range from 2 - 8 dB for the tones in broadband noise and 2 - 5 dB for the tones in octave noise. Detailed analysis of this data indicate that those individual points showing the greatest differences are from the responses of those groups under the second set of instructions. This suggests that experience with both sets of instructions (loudness and noisiness) accentuates any inherent difference between the two sets of instructions.

Consistency Over Tests

The tests whose results are shown in Fig. 8 are comparisons of the noisiness or loudness of pure tones superimposed upon an octave band of noise compared with that octave band of noise alone. However, since the tone-to-octave-band-noise ratio was about 25 dB, the tone will surely dominate and one would expect little differences between the results of the tests employing the tone plus noise and the tone alone. Therefore, the results using the tone alone and tone plus an octave band of noise were analyzed from several different tests and plotted in Fig. 10. The small scatter of the results of the various experiments confirms the idea that the tone is the controlling factor in the tone plus octave band of noise combination. The figure also indicates good agreement in the responses among the various groups and test series. A similar comparison over test series for broadband noise stimuli is shown in Fig. 11. (Again, some of these data was presented in the previous section and is repeated here for comparison of the results of the different test series.) In the A portion of Fig. 11, the results of the two series are quite repeatable with the greatest difference being only 3 dB at 2000 Hz.

In the B portion of Fig. 11, the results of Series I, II-A and II-C indicate fairly good agreement except for the discrepancy in Series I at 500 Hz. However, the results of Test Series III, in which subjects judged multiple pure tones as well as single tones, show a large difference at frequencies above 500 Hz. Possible reasons for this difference will be discussed in the following section.

Let us now re-examine the comparison of pure tones with octave bands of noise as shown in Fig. 10, where quite consistent results were shown for the five series of tests. It was on the basis of tests similar to these that pure tone corrections were developed by Kryter and Pearsons (ref. 4). Figure 12 shows a comparison of the Kryter Pearsons results and those data of Fig. 10 based on similar conditions (tone in octave band of noise).

Because Kryter and Pearsons (ref. 4) originally plotted the comparison minus standard in terms of the overall sound pressure level the same scale is used in Fig. 12. There is quite a large discrepancy at frequencies above 500 Hz. Thus, if one were to use the current data shown in Fig. 12 to obtain pure tone corrections, one would estimate corrections for pure tones at frequencies above 500 Hz which are considerably less than those previously suggested by Kryter and Pearsons. On the other hand, if we use the data obtained with pure tones in broadband noise rather than octave band noise and work backwards to determine how much of a correction would be necessary to add to the band containing the pure tone, we arrive at the data shown in Fig. 13. This data agrees quite closely with the original pure tone corrections suggested by Kryter and Pearsons.

Figure 14 shows the judgment results previously shown in Fig. 11, this time with pure tone corrections. Two sets of corrections have been used, those proposed by Kryter and Pearsons (ref. 4) and those proposed by Little (ref. 1). A table of these corrections is given in Appendix E.

The correction proposed by either methods are somewhat similar in magnitude; however, as was mentioned in the introduction, there is a distinct difference in the method of applying the correction. In the Kryter-Pearsons method, the correction is determined on the basis of the frequency of the pure tone and magnitude of the pure tone above the broadband noise and is applied as an increment in SPL to the band containing the pure tone prior to calculation of the perceived noise level. In the Little method, the correction is also determined upon the basis of frequency and tone-to-noise ratio but is applied after the calculation perceived noise level.

The benefit derived from the pure tone corrections is apparent when Fig. 14 and 11 are contrasted. Figure 14 employs the tone correction, Fig. 11 does not. As indicated in the figure, differences between the two methods are not large for the stimuli tested.

Acceptability Judgments of Modulated Tones

Figures 15 and 16 show the results of the tests with modulated tones. Comparison re standard levels are plotted for several different measures of the overall noise level and perceived noise level with and without tone correction. Separate figures are shown for the test at 500 Hz and at 2000 Hz. The results for an unmodulated tone are plotted in the center of the figure, the results for the amplitude modulated tones to the left and frequency modulated tones to the right. Although there is a tendency for the curve to trend upward as the effective bandwidth of the modulated tone is increased, the range of differences for the various modulation is fairly small. The one exception is the tone which is amplitude modulated at 5 Hz. In that case, listening tests show that there is a distinct subjective impression of beats or large irregularity in the tone in the signal quality that is absent from the other modulated tones.

Table V lists the mean value of comparison re standard for the modulated tones. Several methods of measuring the standard and comparison are listed. The smaller mean values, associated with the calculation employing the tone correction, indicates the validity of this procedure. The standard deviations of all measure, except for dBA, are about the same and indicate that scatter in the calculated value provides little basis for a choice among measures.

Double Tones

This test was conducted to determine the maximum and minimum noisiness of a two-tone complex as a function of frequency separation. The subject controlled the range of the higher of the two frequencies in the two-tone complex according to the instructions given in Appendix A. Figures 17 and 18 shows the results of these tests.

The frequency range for the comparison tone was divided into ten equal percentage bandwidths for analysis purposes. The figures show the number of responses in each of the ten bandwidths versus the ratio of the comparison tone to the standard tone. The results are shown for both the maximum and minimum noisiness judgments. The graphs indicate that the least noisy judgments (right side Fig. 17) were much more consistent than the most noisy judgments (left side Fig. 17). The least noisy judgments seem to cluster nearest the standard frequency. The subject could only adjust the comparison frequency in the range indicated in each panel of Fig. 17. This restriction undoubtly influenced the results. As the frequencies become very close, beats occur which, in general, would increase the noisiness of the pair of sounds as suggested by the results of the tests just described on modulated tones.

The results for the most noisy judgments were not as consistent as the least noisy judgments which would indicate that the greatest noisiness for two-tones over the range tested is practically independent of frequency. There was a tendency, however, to place the frequency of the second tone at the maximum frequency difference between the two tones. This is also indicated for the case when the comparison tone range was extended (Fig. 18). Here, the maximum noisiness also occurred near the maximum difference between the tones. Unfortunately this result might also be caused by the increased noisiness of the comparison tone itself since it was adjusted to a frequency region associated with the maximum sensitivity of the ear.

It was originally hoped that the results of this test would provide specific frequency pairs, however, since no particular frequency ratio stood out as being much noisier than others, it was decided to conduct the judgment tests on multiple tones using a wide range (one-tenth of a octave to two octaves) of frequency differences.

Multiple Tones

Figure 19 shows the results of the tests with multiple tones. Comparison re standard levels are plotted for perceived noise level with and without the tone corrections. The results for a single tone are plotted in the center of the figure; the results for the five-tone complexes are plotted to the right and the two-tone complexes are plotted to the left. As indicated by the differences in perceived noise level, multiple tones tend to be somewhat noisier than do single tones, although the differences appear rather small (on the order of 1 - 5 PNdB). Also, the five tones tend to be as noisy or noisier than the two-tone complex by about 1 - 2 PNdB. In looking at the results for the harmonically related tones, those with one and two-octave spacings, there appears to be little difference when compared to the non-harmonically related tones, those with spacings of 1/10, 1/3 and 4/3 octaves.

If we now look at the results obtained using calculated perceived noise levels with two types of pure tone corrections, we find that, in general, the results with the Kryter-Pearsons pure tone corrections agree quite closely with those obtained using the Little tone correction. Both methods tend to overcorrect for the effect of the pure tone. This over-correction appears to be greater for the higher frequencies. This might be expected, however, if we re-examine the results shown in Figs. 11 and 14 which indicate the results of Test III are not in agreement with those of the other test series, particularly at the higher frequencies. We believe that people were judging something closer to loudness rather than noisiness for this series of tests. This will be discussed further in the next section.

Figure 20 shows the effects of adding more tones to the complexes tested. Using the fundamental frequency and separation of 250 Hz, a plot of the results for 1, 2, 5 and 16 tones is indicated. The curves without the tone correction fall as more tones are added, indicating that noisiness increases as the number of tones increases. If we now look at the results obtained using the pure tone corrections, the curves tend to flatten out. The tone adjustments overcorrect the PNL's, a deficiency we again attribute to the instruction set. In any event, the overcorrection for the 16-tone case is not as great in magnitude as the underestimation without any tone correction.

A final point should be considered. The Little correction adjusts for only a single pure tone. This fact suggests that complex tones can be predicted by considering the single most noisy tone. This conclusion is, of course, based on a complex with relatively broad frequency spacing.

DISPERSION OF TEST RESULTS

To provide some idea of the consistency of the group samples of a two-tone sample was repeated ten times in Test Series III. The comparison sound for this test series consisted of 2000 Hz and 2500 Hz tones emersed in a broad-band jet noise. The standard noise was a broadband jet noise without tones. The standard deviation of these ten repeats was 1.3 dB.

Since each subject gave ten judgments, we may compare the even and odd numbered judgments and determine the variability within a single subject over time. The average variance was 4.9 (standard deviation 2.2 based on five judgments.) We can also compare the even numbered subjects with the odd numbered subjects and determine the variability within the group. This split-halves variable based on 10 subjects in each group was 1.9 dB. Thus, the variability within and between subjects is about the same.

DISCUSSION

Most of the results show good agreement with previous data. The tone corrections of Little and Kryter and Pearsons correlate highly and provide considerable improvements for the perceived noise calculation. However, two general areas of difficulty remain.

First there is the problem of instruction. As we showed earlier, there is a clear difference between the results obtained with noisiness and loudness (see Fig. 9). The problem is that it is difficult to determine, other than to examine the final data, which interpretation of the instruction was used by the subject. We believe that all of the data of Test III was heavily influenced by the subjects using a loudness interpretation during the test session. This was quite apparent in Test III, as indicated in Fig. 11-B. It has been suggested that the more complicated task required of the subject in Test Session III is responsible for his mis-interpretation of the instructions. During this session he had to determine not only which of the two sounds was noisier, but state whether he felt it was slightly noisier, somewhat noisier or greatly noisier than the other sound. This portion of the task was, thus, more difficult, and he may have reverted to the somewhat simpler judgment, i.e. that of loudness.

Another related explanation is that when we use the term noisiness, we imply several other adjectives including objectionability and unwantedness, as mentioned in the first part of the instruction. However, in the Test Series III, the word noisier was used a great deal in the later part of the instructions under the assumption that people completely understood the larger equivalence implied by this word.

The repeated use of the term noisiness, without further definition, as it appears in the later part of the instruction and the complication of further instruction may have lead people to re-interpret noisiness as simply loudness. It is interesting to note that in a recent test, where subjects were asked to develop category scales, (ref. 8), for loudness, people used the words noisy and loud almost synonomously. This would indicate that, unless well defined, people will use in general, the two words interchangeably. It is planned that we will re-run these tests (Test III) in the near future to resolve this dilema if possible.*

A second area of difficulty is the inconsistency of the results obtained when the tone is added to a narrow band spectrum. Figure 9 and 12 summarizes this problem. Again we feel that the problem may be how the subjects interpreted the instructions.

Possibly the subjects tend to revert to loudness judgments when asked to judge octave bands of noise which are normally not found ineveryday life. However, this seems highly unlikely since consistent results were obtained using more than one group of subjects. Possibly the difference lies in the method of presentation since the earlier tests used pricipally ear phones while the latter tests used entirely free field presentation in an anechoic chamber. However, the earlier tests did provide some checks using free field techniques and no large differences were noticed at that time. Even though no reason can be found for the lack of agreement, it appears somewhat academic at this point since the corrections do appear to work for the tones in broadband noise which are more representative of those noises which one might encounter under real-life conditions.

CONCLUSIONS

The following conclusions may be drawn as a result of the tests described in this report.

1. Modulated tones show no great difference in judged noisiness compared to unmodulated tones although there is a slight decrease in noisiness with increase in rate of modulation. However, it appears from the test that as the modulation rate becomes quite small, beats occur which do noticeably increase the judged noisiness.

2. For multiple tone complexes plus noise, there appears to be no difference between harmonically related and non-harmonically related pure tones.

3. The noisiness is greater for multiple tones than for single tones and it increases slightly (1-5 dB) with the number of tones. However, present tone

* The results of the re-run of Test III are reported in Appendix F.

correction procedures seem to account for both the single and the multiple tones. The possibility that the subjects may have made their judgments partially on the basis of loudness during the multiple tone tests may have had some influence on these results.*

4. There is a consistent difference ranging from 2 - 8 dB between the results obtained using the loudness instructions and those obtained using the noisiness or acceptability instructions. For example, if a tone in noise is judged equally loud to a noise alone then the tone in noise must be reduced in level to be judged equally noisy. These differences are greater for the pure tone plus broadband noise than for the pure tones plus octave bands of noise.

5. There appears to be no difference in the results using the two different shapes of broadband noise; although, as mentioned above, there is a difference as the bandwidth narrows to an octave band of noise.

6. The pure tone corrections obtained using pure tones in broadband noise agree with previous results; however, those obtained using octave bands of noise do not.

7. The maximum correction necessary for the additional noisiness of a pure tone seems to occur at a tone-to-noise ratio of 25 dB as measured in a one-third octave band. Comparisons between tones at this tone-to-noise ratio and tones without noise present are quite similar.

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* See Appendix F

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TABLE I -- TEST SERIES I STIMULI - SINGLE TONE COMPARISONS

STANDARD	COMPARISON		Total No. of Samples
Noise	Pure Tone Plus Noise		
	Frequency (Hz)	Noise	
Octave Band	250,500,1000, 2000,4000	Octave Band Centered[1] at Tone Frequency	5
Broadband "Jet" Noise	"	Broadband "Jet" Noise[1]	5
Broadband "Noy" Noise	"	"Noy" Noise[1]	5
Broadband "Jet" Noise	"	No Noise	5
Octave Band	"	No Noise	5

1 - Tone to noise ratio was 25 dB as measured in 1/3 octave bands.

TABLE II -- TEST SERIES II - A STIMULI - MODULATED TONE COMPARISONS (Continued)

AMPLITUDE MODULATION

Standard - Comparison Noise[1]	Carrier Frequency Hz	Amplitude Modulation	Modulation Rate, Hz	No. of Discrete Frequency Components[2]	Effective Bandwidth Hz
Jet	500	100%	0	1	1
			5	3	10
			25	3	50
			100	3	200
			300	3	600
Jet	2000	100%	0	1	1
			5	3	10
			25	3	50
			100	3	200
			300	3	600
Octave Band at 2000 Hz	2000	100%	25	3	50

TABLE II -- TEST SERIES II - A STIMULI - MODULATED TONE COMPARISONS (Concluded)

FREQUENCY MODULATION

Standard - Comparison Noise[1]	Carrier Frequency Hz	Frequency Deviation	Modulation Rate, Hz	Modulation Index	No. of Discrete Frequency Components[2]	Effective Bandwidth, Hz[3]
Jet	500	± 2.5% ± 5 ± 16 ± 28	5 25 100 300	5 2 1.6 0.9	6 5 3 3	30 50 200 600
Octave Band at 500 Hz	500	± 5	25	2	5	50
Jet	2000	± 2.5% ± 2.5 ± 8	5 25 100	20 4 3.2	20+ 7 5	120 150 400

1 - Tone to noise ratio of comparison stimuli was 25 dB for unmodulated tone, as measured in 1/3 octave bands.

2 - For 100% modulation, the levels or sideband components are 6 dB less than carrier components.

3 - Approximate values for all components within 15 dB of maximum component.

TABLE III -- TEST SERIES II - B STIMULI - TWO TONE COMPARISONS

Frequency of First Tone	Frequency Range of Second Tone
500 Hz	525 - 950 Hz
1000 Hz	1050 - 1900 Hz
2000 Hz	2100 - 3800 Hz
4000 Hz	4200 - 7600 Hz
1000 Hz	1050 - 3000 Hz

NOTE: Subject adjusted frequency of second tone for maximum and minimum noisiness of the combination keeping level constant.

TABLE IV -- TEST SERIES III STIMULI - MULTIPLE TONE COMPARISONS

Standard - Comparison Noise[1]	Frequency Hz[2]	MAXIMUM SPACING OF TONES IN OCTAVES	
		Two Tones	Five Tones
Jet	250	1/10, 1/3, 1, 4/3, 2	1/10, 1/3, 1, 4/3, 2
	500	"	"
	1000	"	"
	2000	"	"
	4000	"	" , Note 3
	250	16 tones, 250 Hz spacing between tones	
	2500[4]	1/6 (12%)	
	2500[5]	1	

1 - Tone-to-noise ratio of comparison stimuli was 25 dB for all tones measured in 1/3 octave bands except as noted.

2 - Frequency listed is that of the lowest frequency component.

3 - Four tones, with highest frequency component at 11, 310 Hz.

4 - Tone-to-noise ratio of comparison stimuli was 5 dB measured in 1/3 octave bands.

5 - Tone-to-noise ratio of comparison stimuli was 5 dB at 2500 Hz and -5 dB at 5000 Hz measured in 1/3 octave bands.

TABLE V -- RESULTS WITH MODULATED TONE

Entries are Comparison re Standard for Modulated Tone as shown in Figure 15 and 16

Modulated Frequency	Statistic	OASPL	PNL	Tone Corrected PNL		A-Level
				K+P*	Little**	
500 Hz	Mean	-3.3	-4.7	1.7	1.2	-2.4
	Standard Deviation	2.2	2.1	2.1	2.3	2.3
2000 Hz	Mean	-13.1	-7.9	-0.1	-3.1	-15.4
	Standard Deviation	2.6	2.6	3.2	3.1	7.1

* Perceived noise level plus Kryter-Pearsons pure-tone correction.

** Perceived noise level plus Little pure-tone correction.

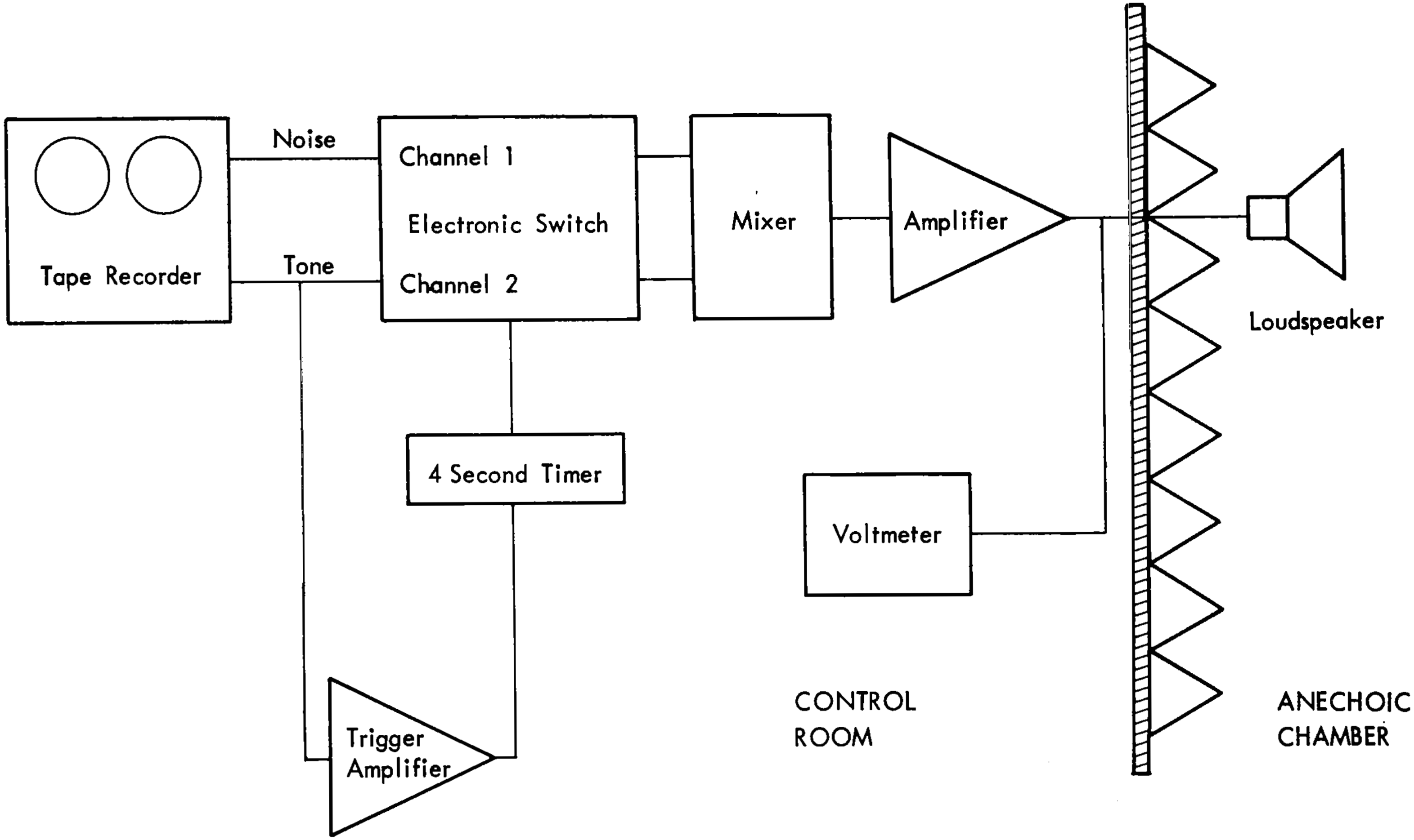


FIGURE 1. BLOCK DIAGRAM OF PLAYBACK SYSTEM FOR JUDGMENT TESTS

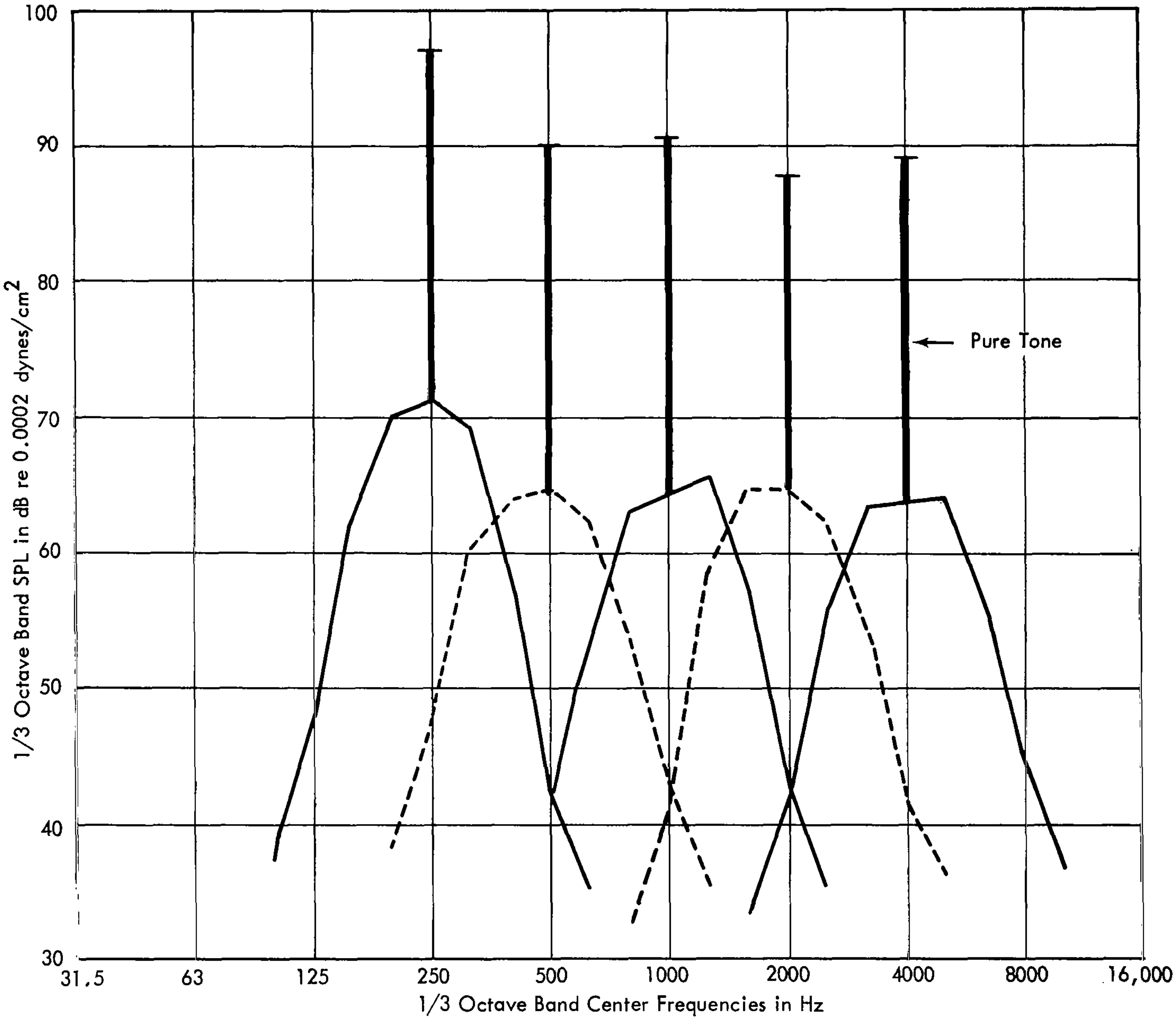


FIGURE 2. AVERAGE LEVEL OF OCTAVE BANDS OF NOISE AND PURE TONE STIMULI FOR JUDGMENT TESTS

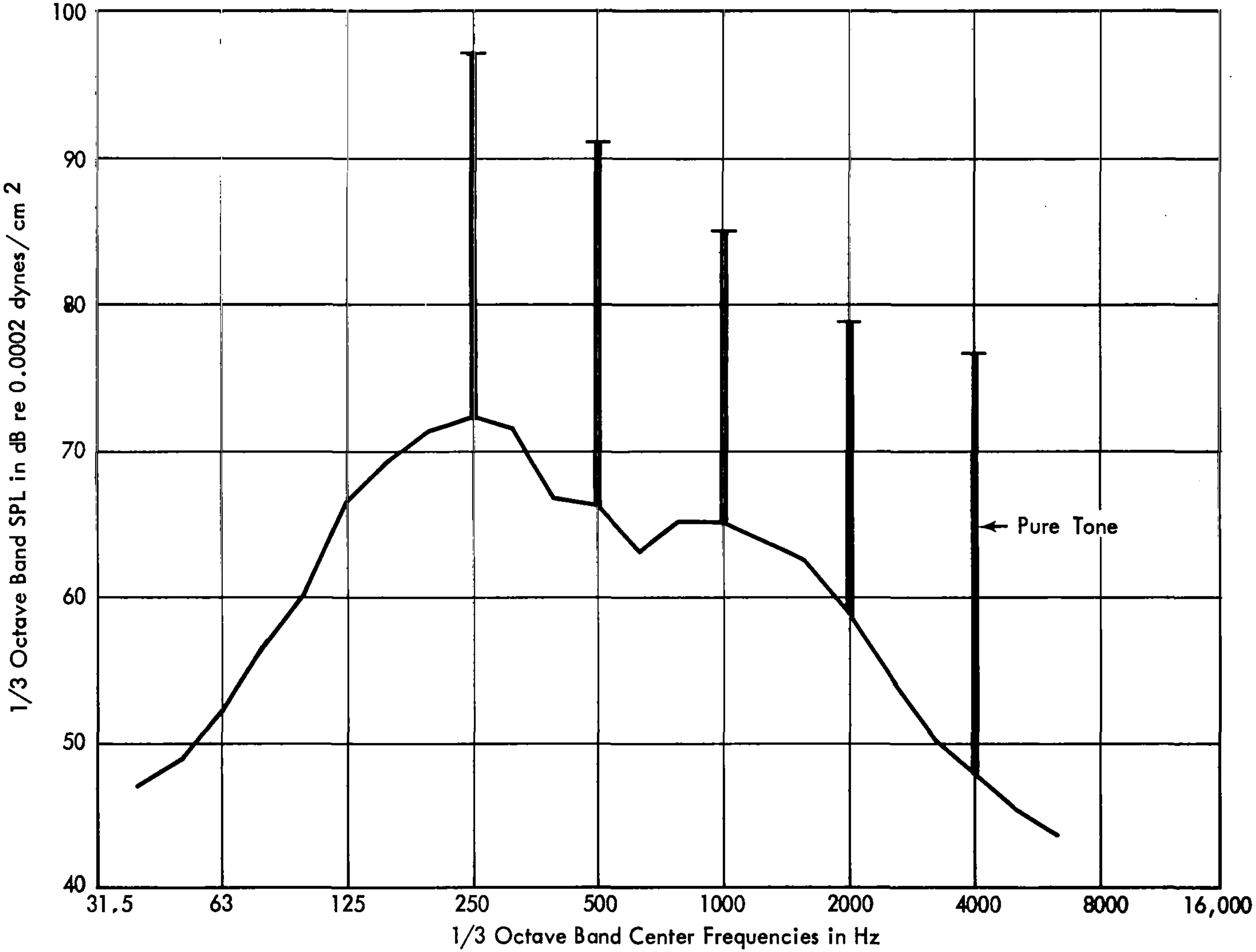


FIGURE 3. AVERAGE LEVEL OF BROADBAND "JET" NOISE AND PURE TONE STIMULI FOR JUDGMENT TESTS

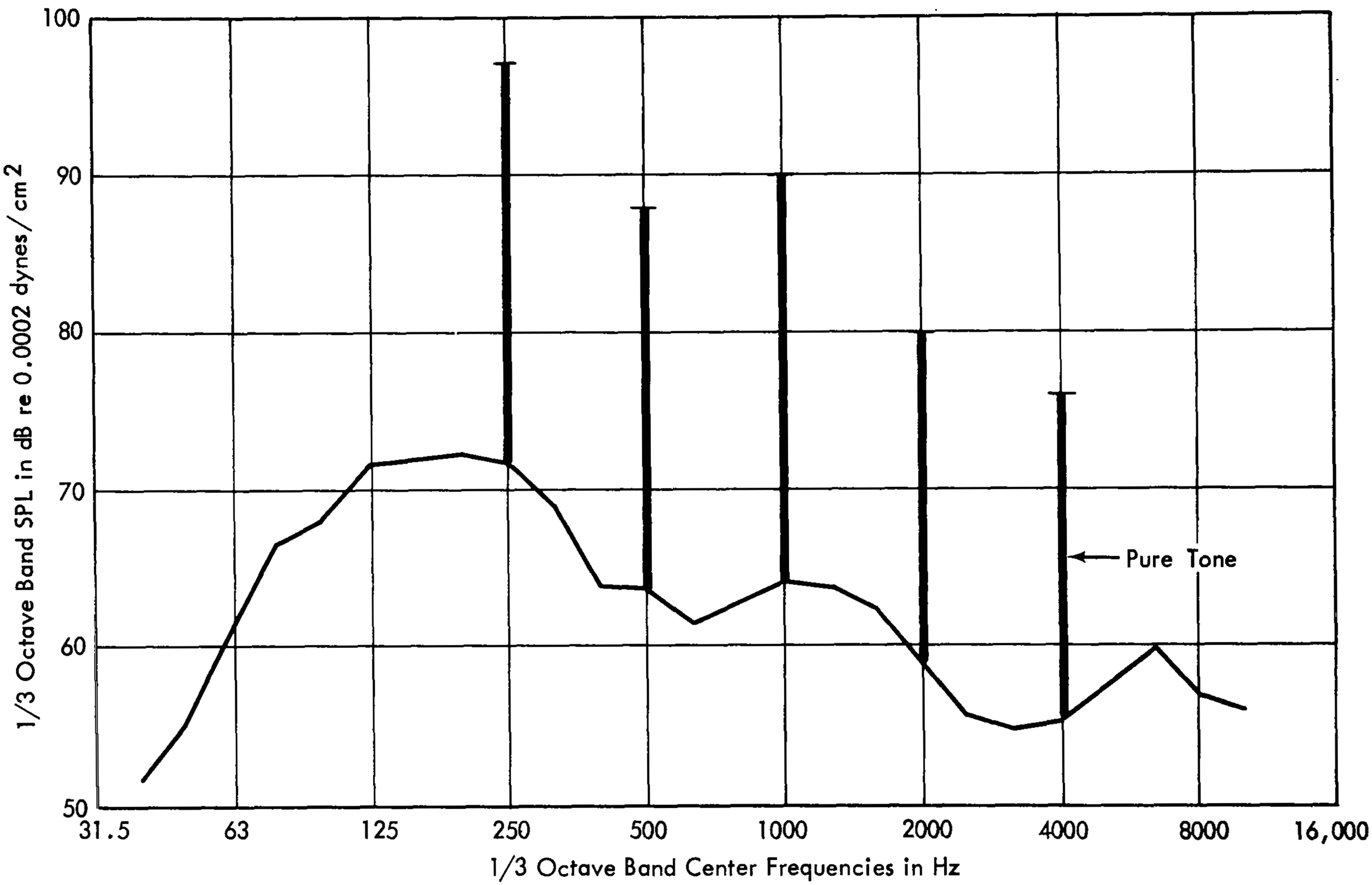


FIGURE 4. AVERAGE LEVEL OF BROADBAND NOY NOISE AND PURE TONE STIMULI FOR JUDGMENT TESTS

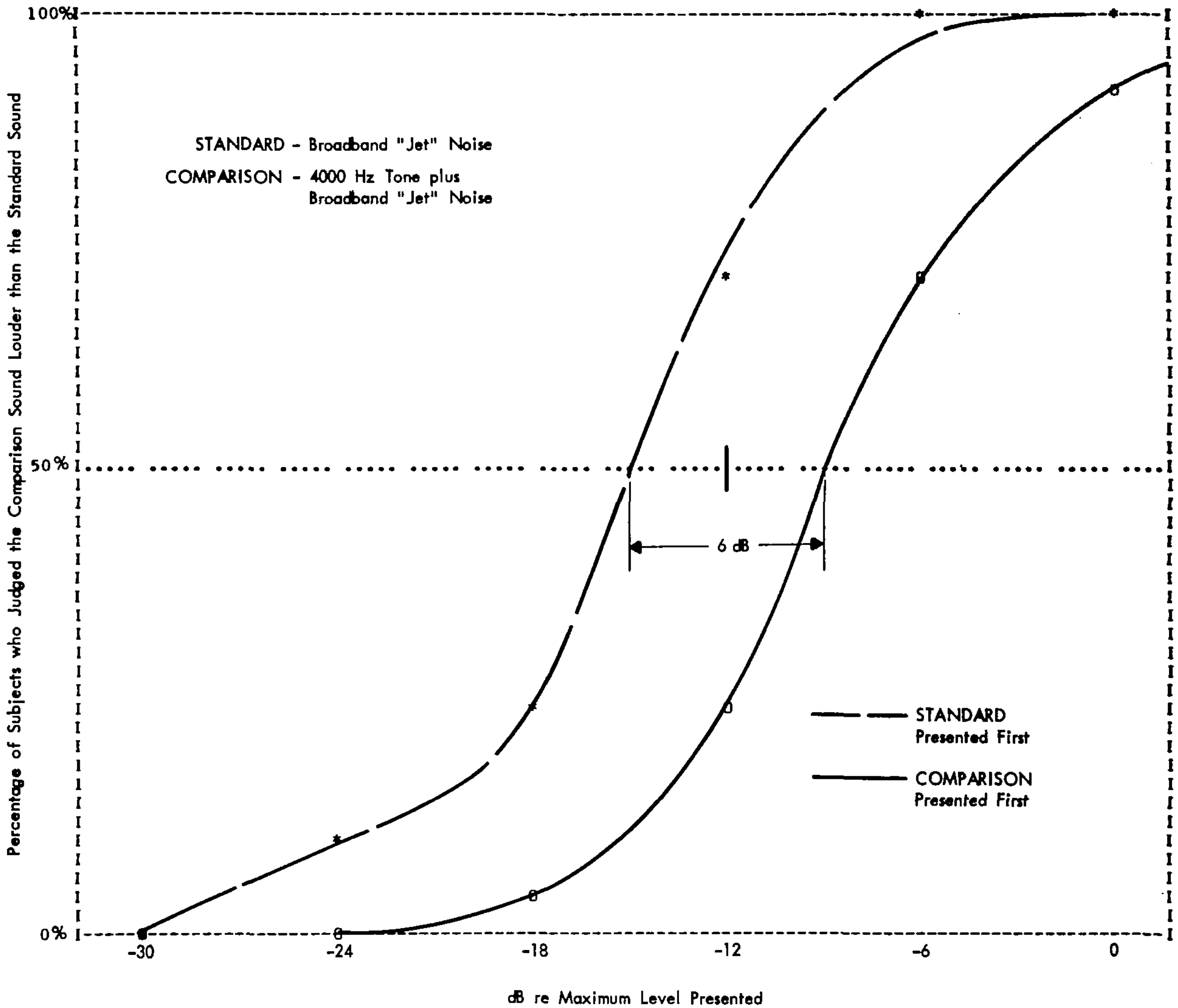


FIGURE 5. COMPUTER - GENERATED DISPLAY OF TYPICAL RESULTS

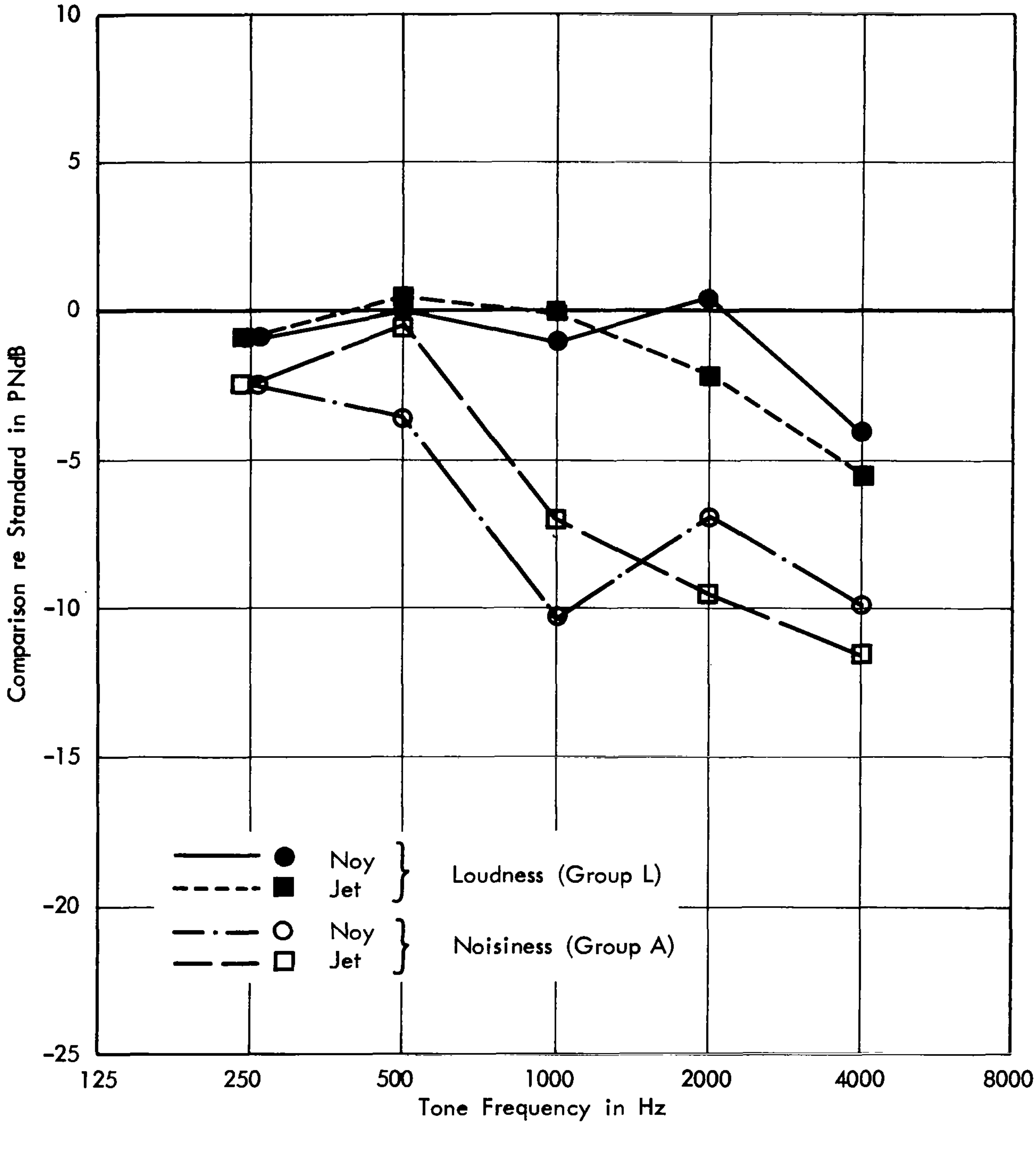


FIGURE 6. JUDGMENTS OF EQUAL LOUDNESS AND NOISINESS - SINGLE TONES IN NOISE (COMPARISONS) JUDGED EQUAL TO BROADBAND NOY AND JET NOISES (STANDARDS)

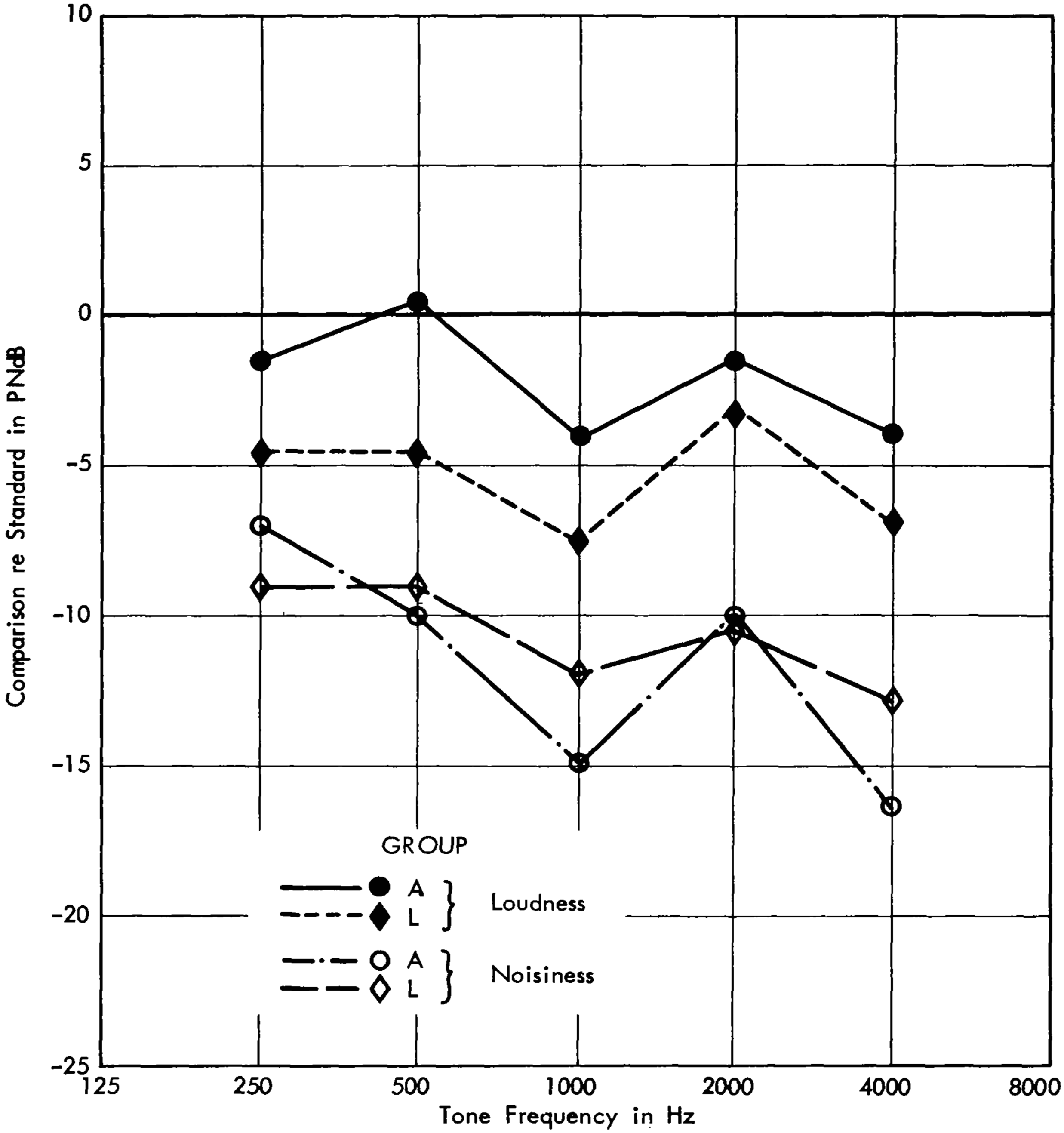


FIGURE 7. JUDGMENTS OF EQUAL LOUDNESS AND NOISINESS - SINGLE TONES (COMPARISONS) JUDGED EQUAL TO BROAD-BAND JET NOISE (STANDARD)

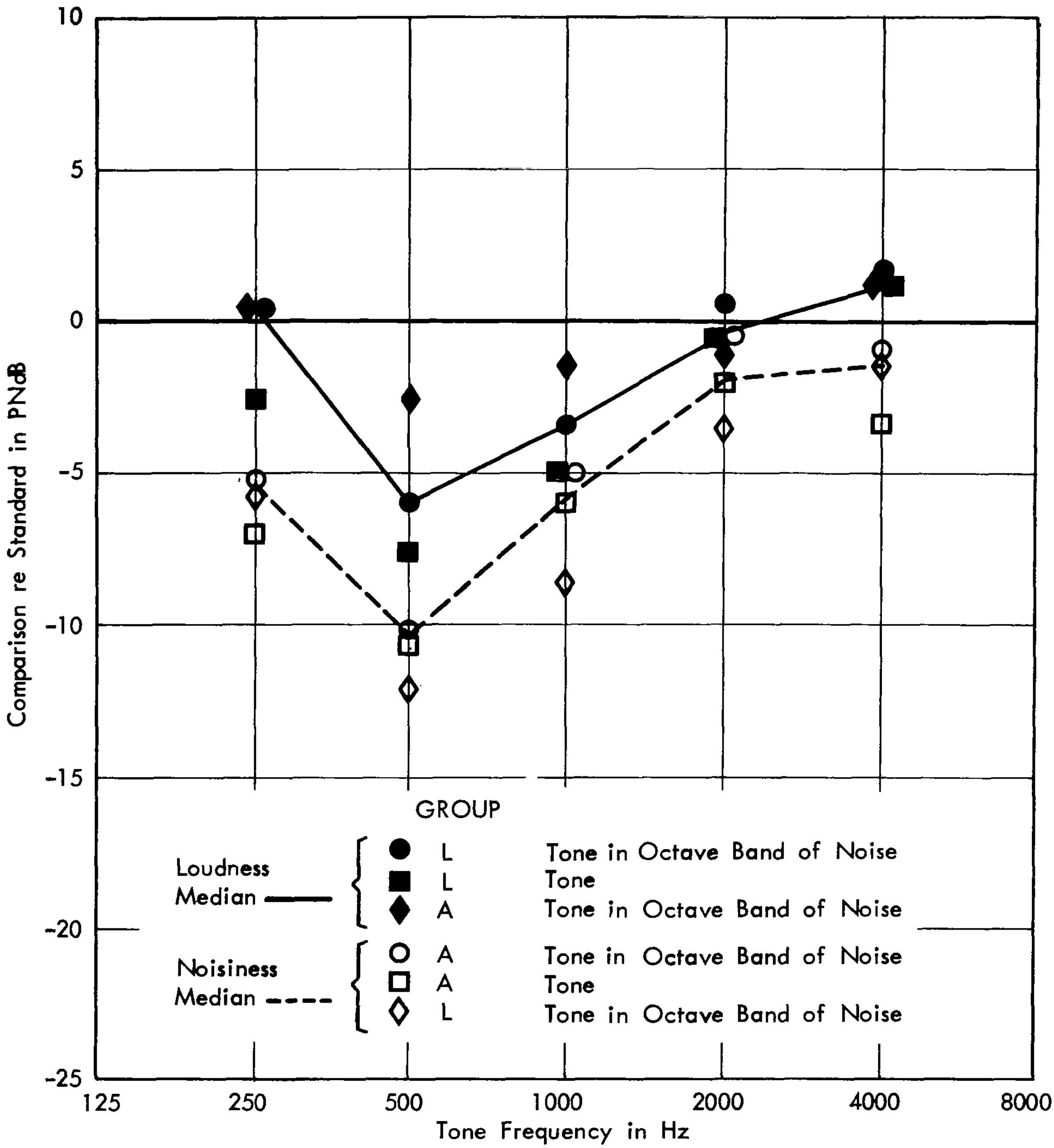


FIGURE 8. JUDGMENTS OF EQUAL LOUDNESS AND NOISINESS - SINGLE TONES (COMPARISONS) JUDGED EQUAL TO OCTAVE BANDS OF NOISE STANDARDS

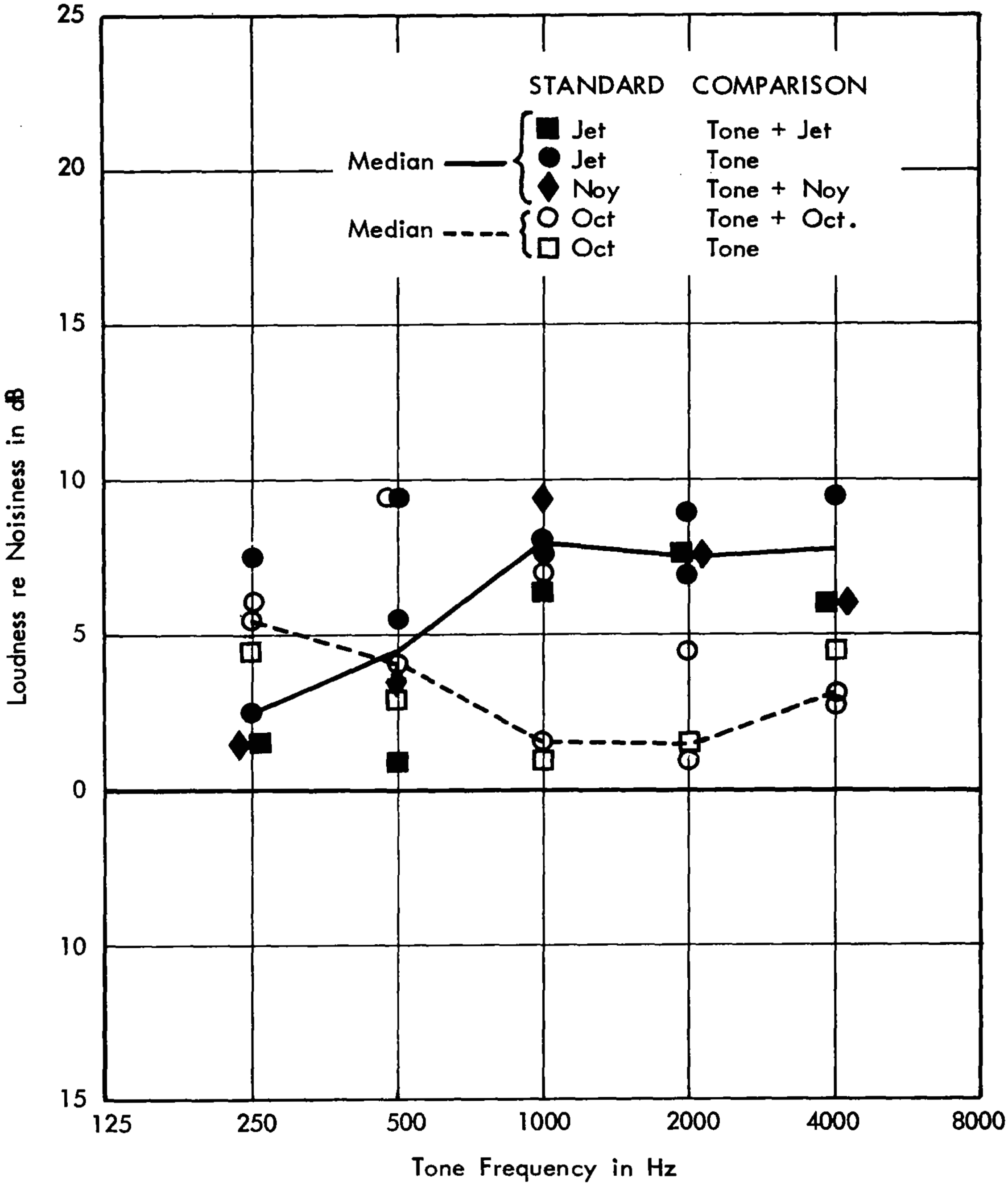


FIGURE 9. DIFFERENCE BETWEEN LOUDNESS AND ACCEPTABILITY JUDGMENTS

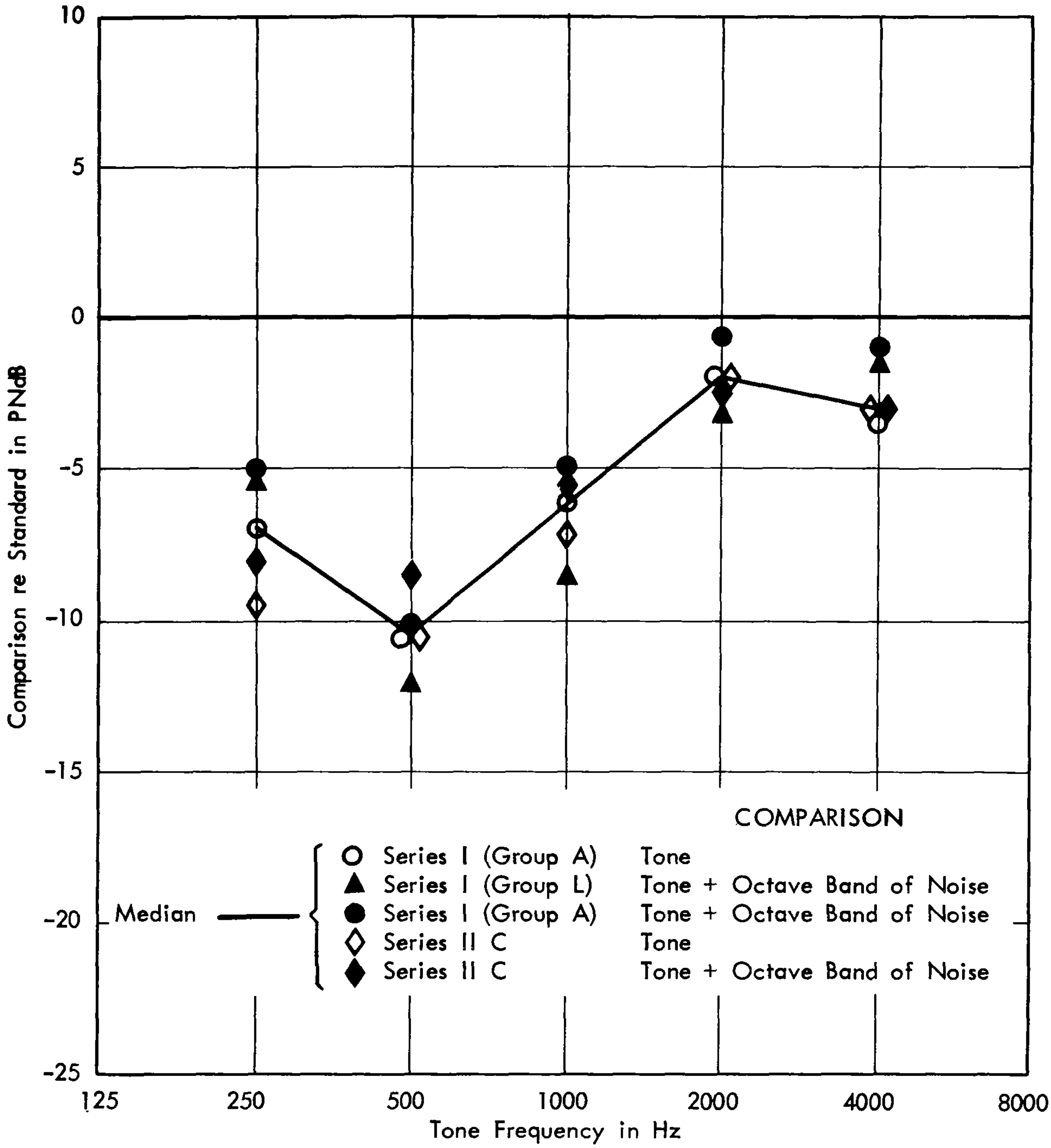
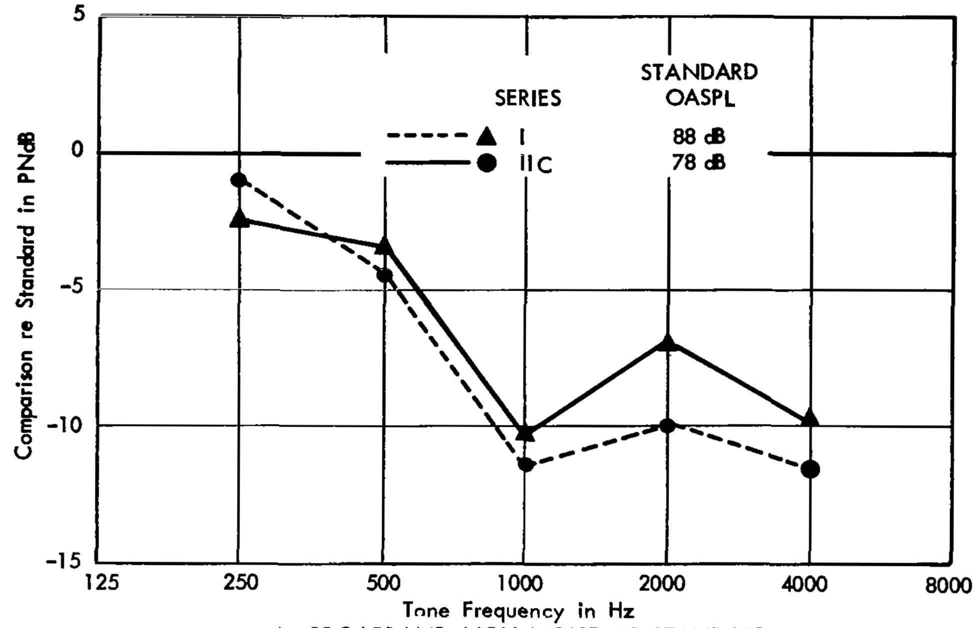
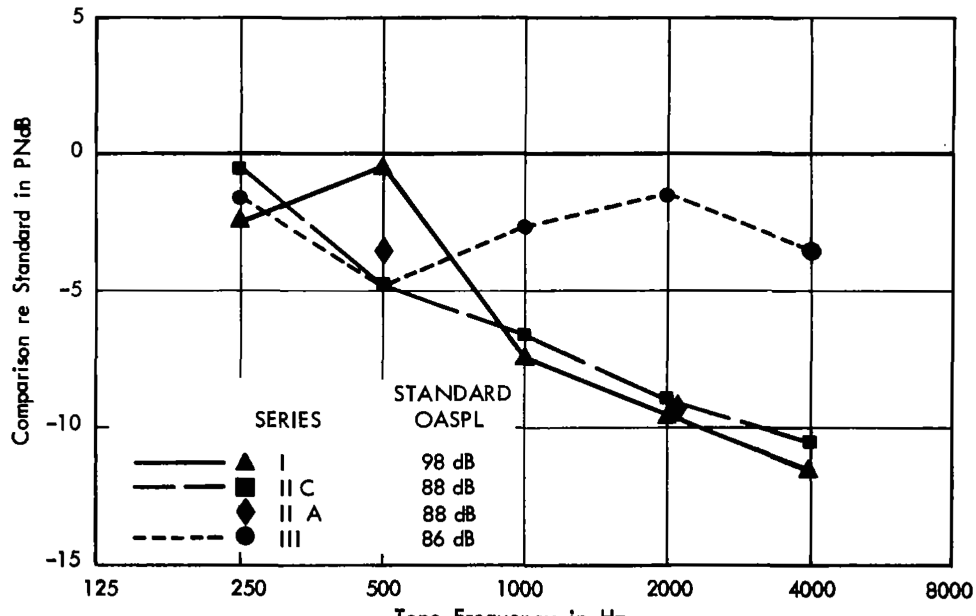


FIGURE 10. JUDGMENTS OF EQUAL NOISINESS FOR DIFFERENT TEST SERIES - SINGLE TONES (COMPARISONS) JUDGED EQUAL TO OCTAVE BANDS OF NOISE (STANDARDS)



A. BROADBAND NOY NOISE AS STANDARD



B. BROADBAND JET NOISE AS STANDARD

FIGURE 11. JUDGMENT OF EQUAL NOISINESS FOR DIFFERENT TEST SERIES - SINGLE TONE PLUS BROADBAND NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND NOISE (STANDARD)

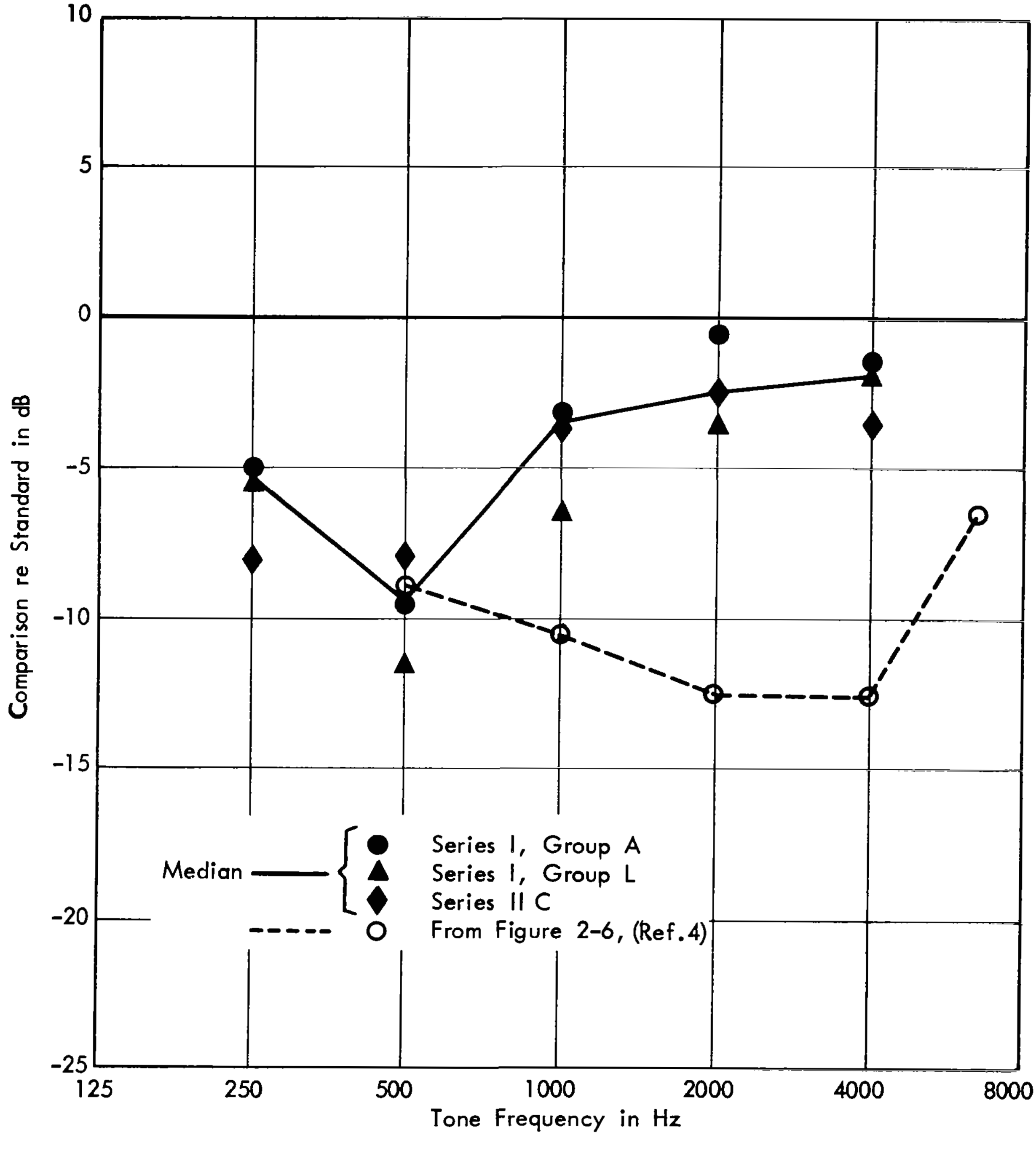


FIGURE 12. JUDGMENTS OF EQUAL NOISINESS - SINGLE TONES IN OCTAVE BANDS OF NOISE (COMPARISONS) JUDGED EQUAL TO OCTAVE BANDS OF NOISE (STANDARDS)

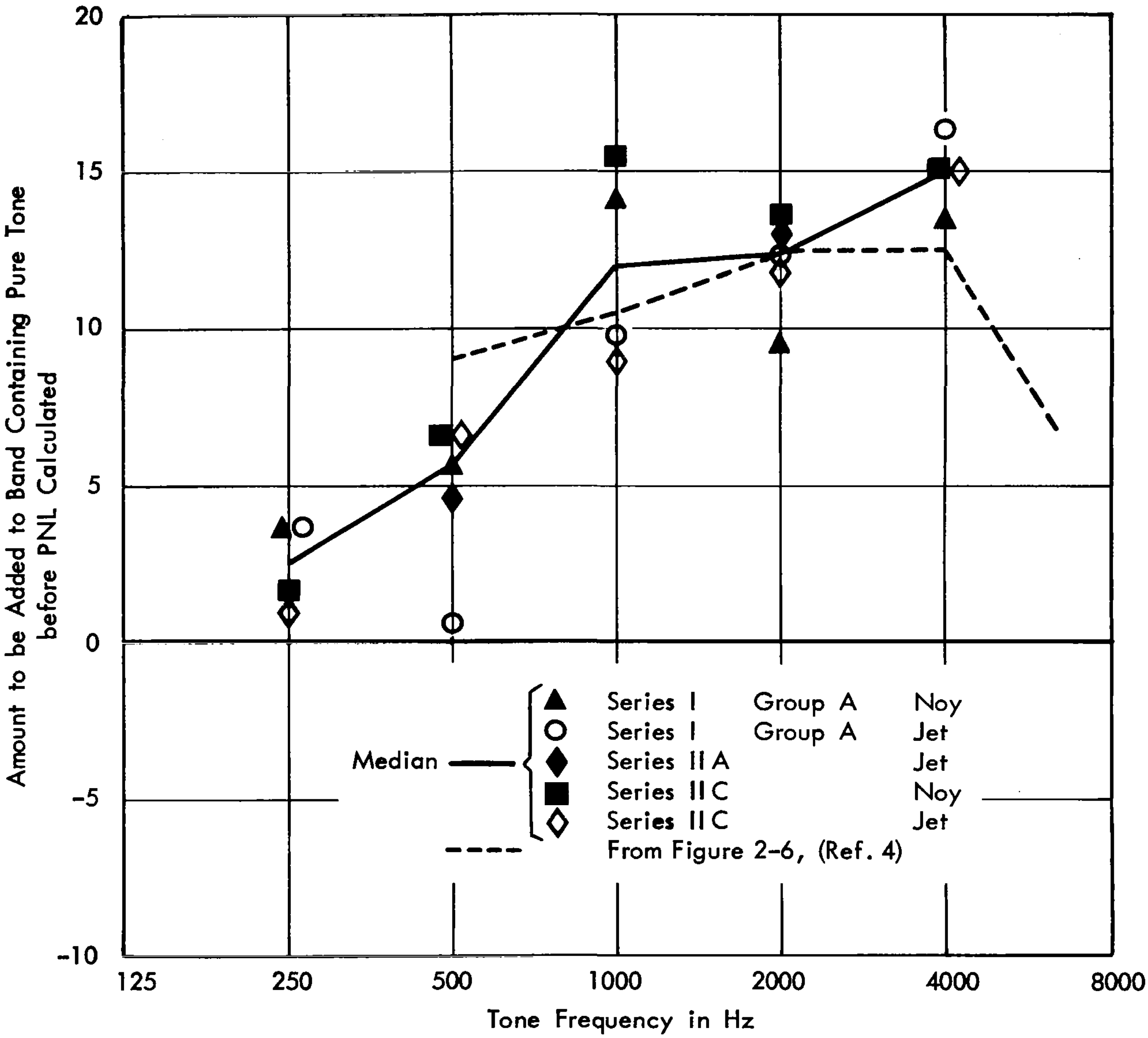
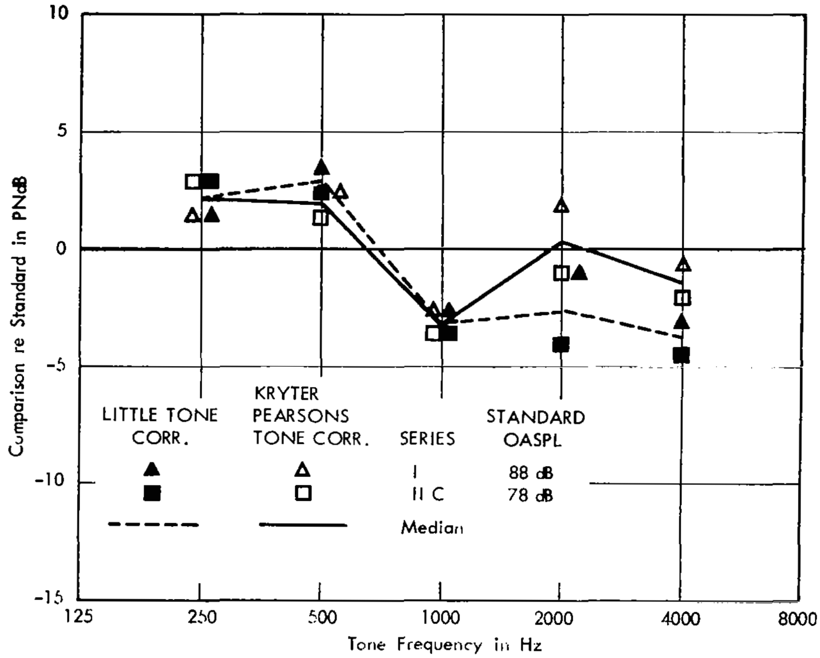
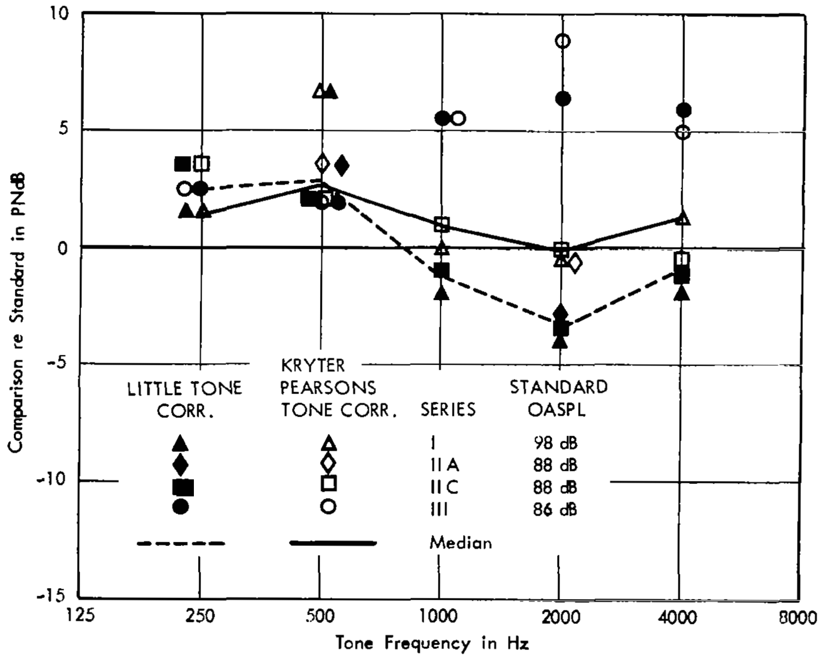


FIGURE 13. CORRECTION NECESSARY FOR EQUAL PNL WHEN PAIR OF SOUNDS (STANDARD AND COMPARISON) ARE JUDGED EQUALLY NOISY



A. BROADBAND NOY NOISE AS STANDARD



B. BROADBAND JET NOISE AS STANDARD

FIGURE 14. JUDGMENTS OF EQUAL NOISINESS FOR DIFFERENT TEST SERIES CORRECTED FOR PURE TONE CONTENT - SINGLE TONE PLUS BROADBAND NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND NOISE (STANDARD)

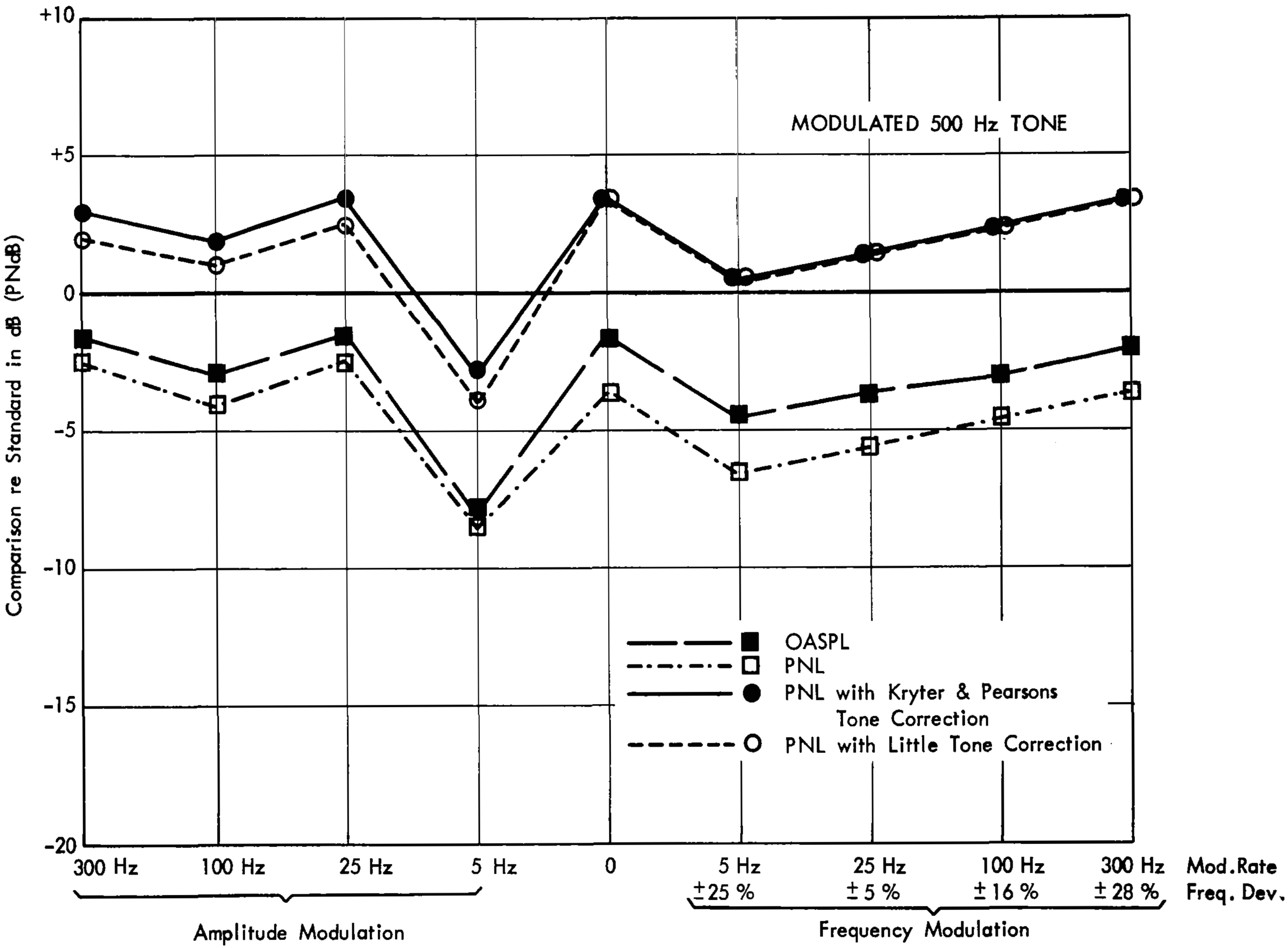


FIGURE 15. JUDGMENTS OF EQUAL NOISINESS - MODULATED 500 Hz TONE IN NOISE COMPARISON) JUDGED EQUAL TO BROADBAND JET NOISE (STANDARD)

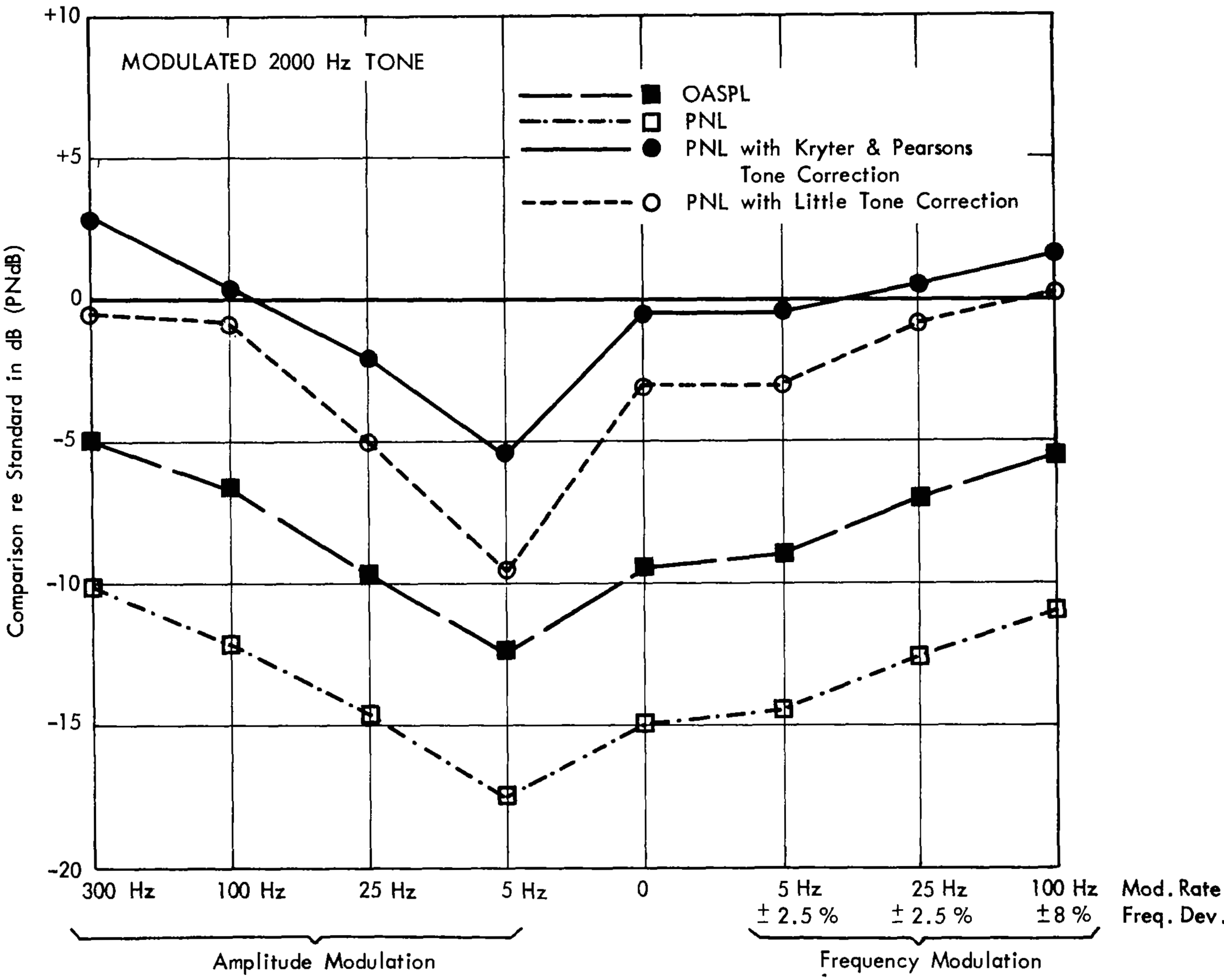


FIGURE 16. JUDGMENTS OF EQUAL NOISINESS - MODULATED 2000 Hz TONE IN NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND JET NOISE (STANDARD)

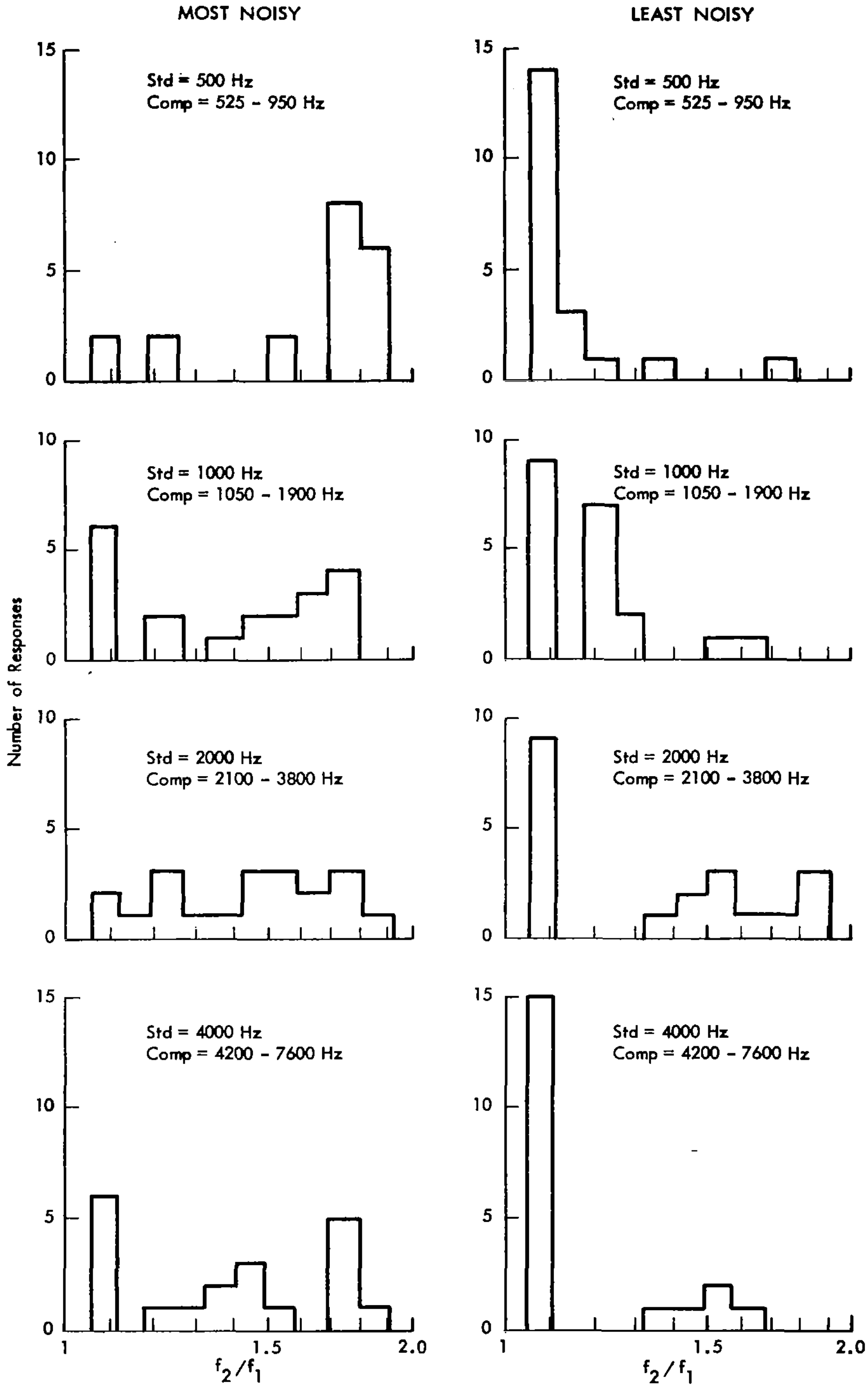


FIGURE 17. FREQUENCY OF COMPARISON TONE FOR RELATIVE NOISINESS OF A TWO-TONE COMPLEX WITH LESS THAN ONE OCTAVE SEPARATION BETWEEN TONES

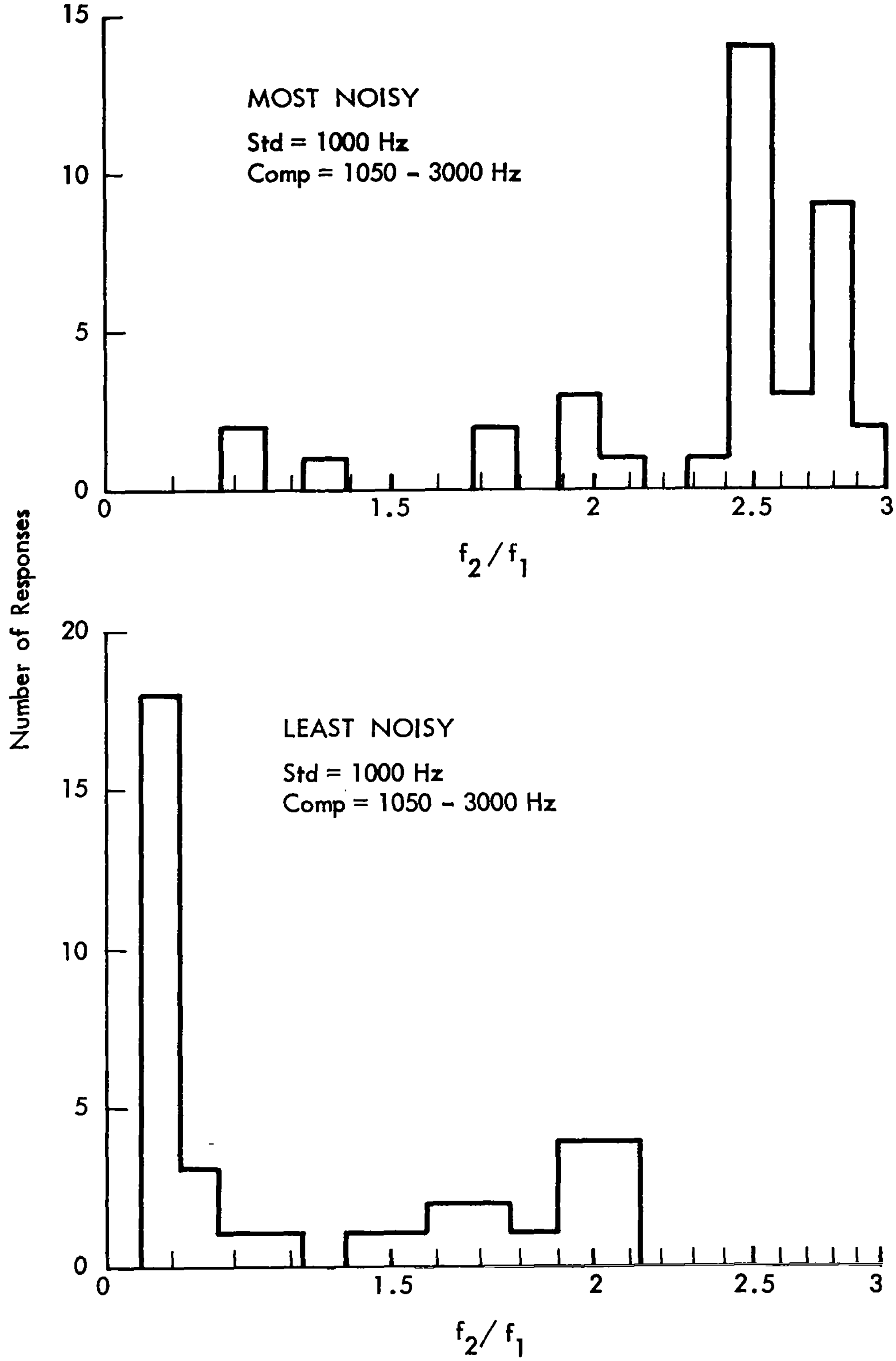


FIGURE 18. FREQUENCY OF COMPARISON TONE FOR RELATIVE NOISINESS OF TWO-TONE COMPLEX WITH GREATER THAN ONE OCTAVE SEPARATION

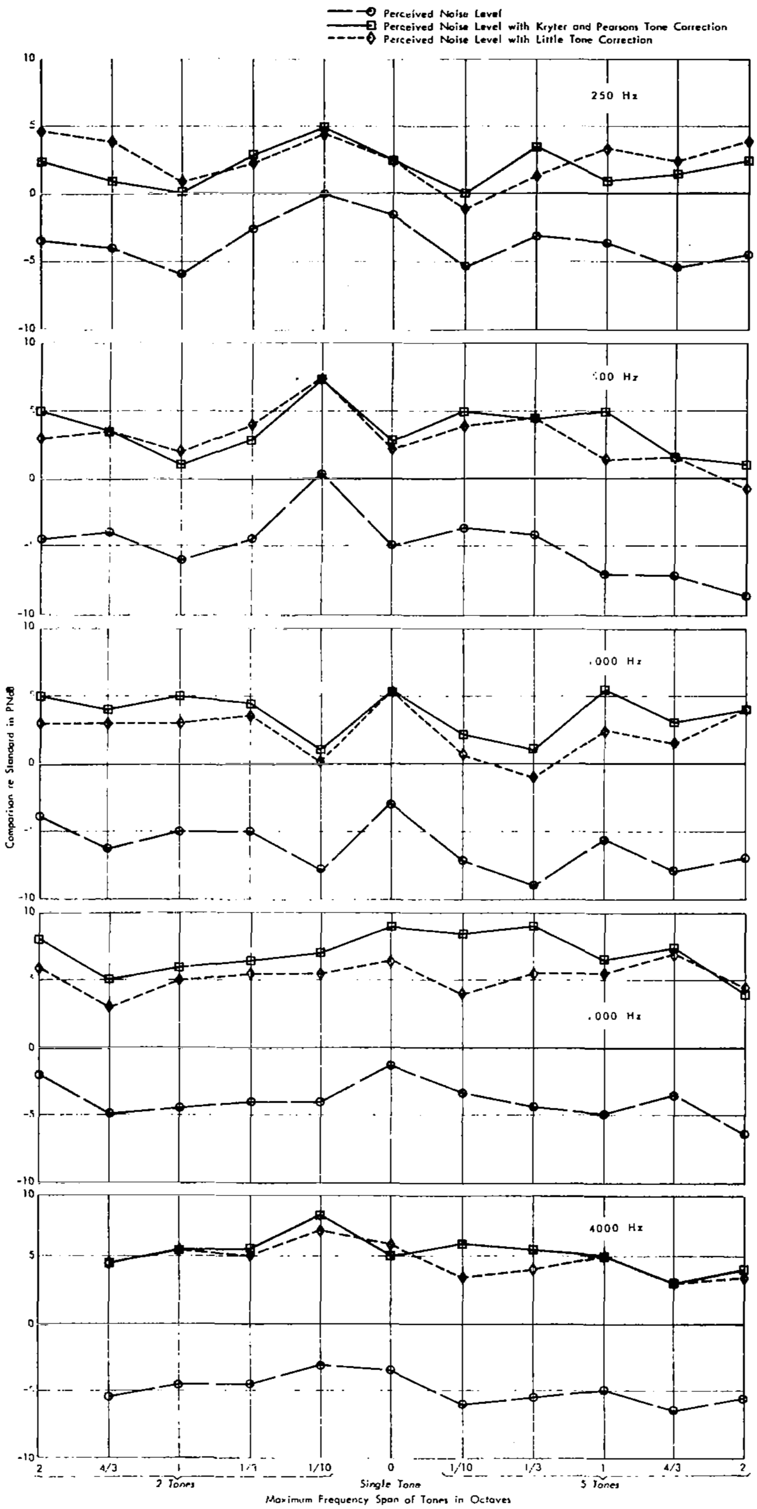


FIGURE 19 JUDGMENTS OF EQUAL NOISINESS - SINGLE AND MULTIPLE TONES IN NOISE BROADBAND JET NOISE (COMPARISONS) JUDGED EQUAL TO BROADBAND JET NOISE (STANDARD)

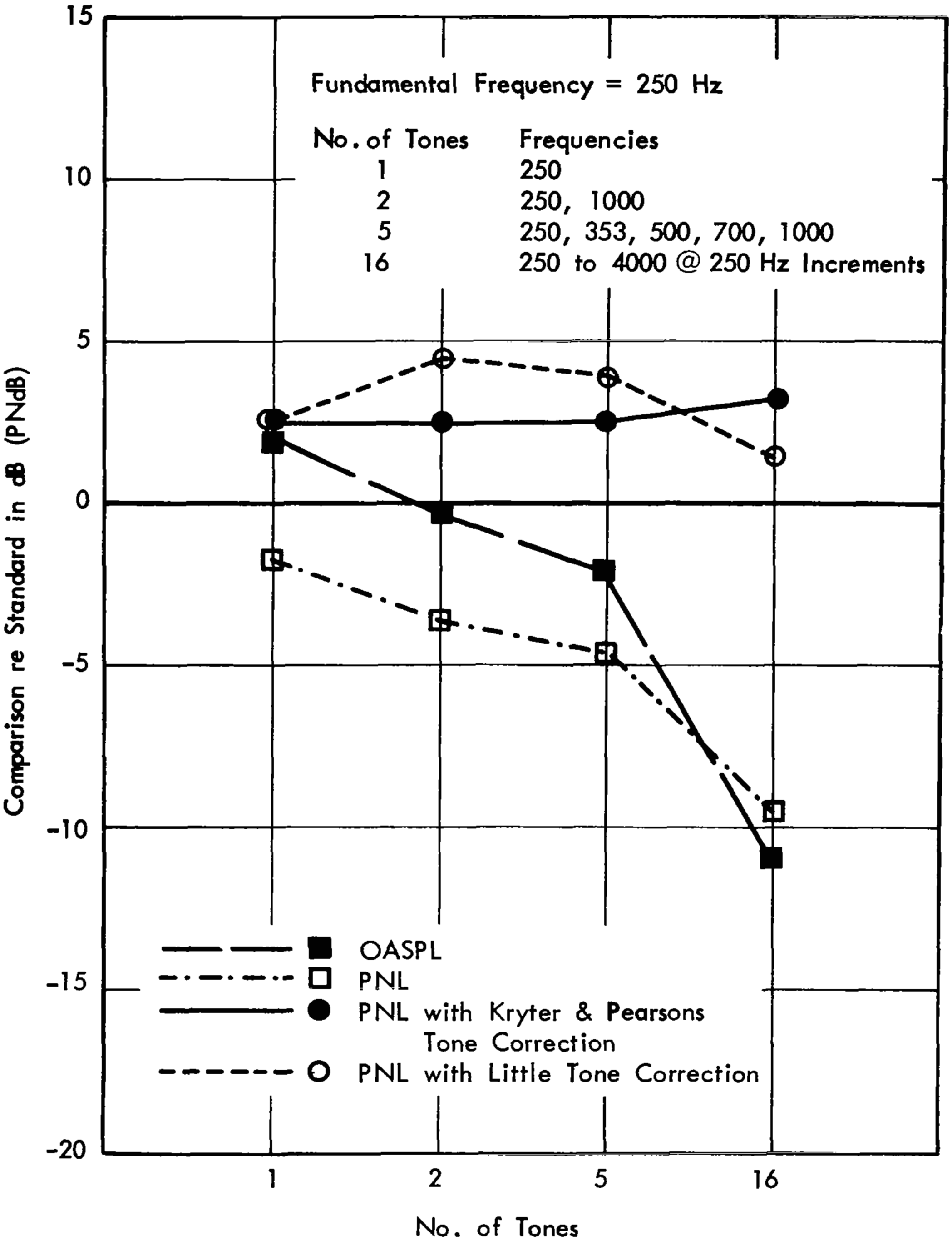


FIGURE 20. JUDGMENTS OF EQUAL NOISINESS - MULTIPLE TONES WITH 250 Hz FUNDAMENTAL IN NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND JET NOISE

APPENDIX A

INSTRUCTIONS FOR TESTS

APPENDIX A

[INSTRUCTIONS FOR TEST I]

JUDGMENTS OF LOUDNESS

The purpose of these tests is to determine the relative loudness of different sounds. The tests are part of a program of research designed to obtain information that will be of aid in planning military and civilian airports and for noise control purposes in general.

On the following recording you will hear a sound followed immediately by a second sound. Your job is to punch a hole in Column 1 or 2 corresponding to the sound (the first or second) which you feel is louder. In other words, pick the sound of greater volume or intensity. Please make a judgment for each pair of sounds, even though you feel you may be guessing.

You may think that neither of the two sounds is particularly loud or that both are very loud. We only want you to judge which of the two sounds is louder.

Please record your answers according to how the sounds affect you -- there are no right or wrong answers, and it is important that we find out how people differ, if they do, in their judgments of these sounds. It does not matter whether your answers agree or disagree with others taking the test as long as you make the best judgment you can for each pair of sounds.

In summary, select the sound (the first or the second) which you feel is louder. Please write on the back of your answer card your name, seat number and the date. Remember to use the same seat location each time you take the test.

[INSTRUCTIONS FOR TESTS I AND II]

JUDGMENTS OF ACCEPTABILITY

The purpose of these tests is to determine the relative acceptability of different sounds. The tests are part of a program of research designed to obtain information that will be of aid in the planning of military and civilian airports and for noise control purposes in general.

On the following recording you will hear a sound followed immediately by a second sound. Your job is to punch a hole in Column 1 or Column 2 corresponding to the sound (the first or the second) which you feel would be more objectionable or disturbing if heard regularly in your home. In other words, pick the sound you would least like to have in your home, even though you might not want either of them. Please make a judgment for each pair of sounds, even though you feel you may be guessing.

Please record your answers according to how the sounds affect you -- there are no right or wrong answers, and it is important that we find out how people differ, if they do, in their judgments of these sounds. It does not matter whether your answers agree or disagree with others taking the test as long as you make the best judgment you can for each pair of sounds.

In summary, select the sound (the first or the second) which, if heard in your home, you feel would be more objectionable or disturbing.

Please write on the back of your answer card your name, seat number and the date. Remember to use the same seat location each time you take the test.

[INSTRUCTIONS FOR TONE ADJUSTMENT TEST]

JUDGMENTS FOR ACCEPTABILITY FOR TONES

The purpose of these tests is to determine the relative acceptability of different sounds. The tests are part of a program of research designed to obtain information that will be of aid in the planning of military and civilian airports and for noise control purposes in general.

During the test, you will hear various types of sounds. With the knob by your left hand you can control the quality [frequency of one] of these sounds.

Task I. Your job is to set the knob by your left hand until the sound you hear is most objectionable or disturbing if heard regularly in your home. In other words, adjust the control until you produce the sound you would least like to have in your home. After you have completed the task, please signal by pressing the button on the signal cable and wait for the instructions to proceed to Task II. Please do not change the knob setting after you have made your decision.

Task II. After you have been told to proceed with Task II, adjust the knob by your left hand until the sound is least objectionable or disturbing if heard regularly in your home. In other words, adjust the control until you produce the sound you would most like to have in your home. After you have completed this task, please signal and wait for further instruction. Please do not change the knob setting after you have made your decision.

NOTE - Tasks I and II of these instructions were reversed in sequence for half of the subjects to reduce possible order effects produced by having to judge the most (or least) noisy case first.

[INSTRUCTIONS FOR TEST III]

JUDGMENTS OF ACCEPTABILITY

The purpose of these tests is to determine the relative acceptability of different sounds. The tests are part of a program of research designed to obtain information that will be of aid in the planning of military and civilian airports and for noise control purposes in general.

On the following recording you will hear a sound followed immediately by a second sound. Your job is to determine which of the two sounds (the first one or the second) was the noisier, more objectional or disturbing if heard regularly in your home. In other words, pick the sound you would least like to have in your home, even though you might not want either of them.

The series of "+'s" on the top of the answer card are used to provide indicators of how much noisier or more objectionable the particular sound was. For example, if you felt the Number One sound was much noisier, you should punch a hole in the first column with three "+'s"; if you feel the Number One sound was somewhat noisier or more objectionable, you should punch the number two column with the two "+'s"; if you felt the Number One sound was only slightly noisier or more objectionable, then you should punch the third column with the one "+" in it. Similarly, if you felt the Number Two sound was slightly noisier, you should punch number four column with one "+"; if you felt Number Two was somewhat noisier, you should punch number five column with two "+'s"; and if you felt Number Two was much noisier, you should punch the number six column with three "+'s"; but be sure and punch only one hole for each sound. Please make a judgment for each pair of sounds, even though you feel you may be guessing.

Please record your answers according to how the sounds affect you -- there are no right or wrong answers, and it is important that we find out how people differ, if they do, in their judgments of these sounds. It does not matter whether you answers agree or disagree with others taking the test as long as you make the best judgment you can for each pair of sounds.

In summary, rate the sound (the first or the second) which, if heard in your home, you feel would be more objectionable or disturbing.

Please write on the back of your answer card your name, seat number and the date. **Remember to use the same seat location each time you take the test.

APPENDIX B

STIMULUS GENERATING EQUIPMENT

APPENDIX B

STIMULUS GENERATING EQUIPMENT

General

Before the test sessions commenced, the stimuli to be presented to the test subjects were recorded on magnetic tape. The tones and the noise spectra were generated independently and recorded on separate channels of a 1/4 in. tape recorder. The duration and rise time of the stimuli were controlled by a two-channel electronic switch in conjunction with an external four-second timer. The external timer had two functions; it controlled the "on" time of the electronic switch and also controlled a pulse generator which placed a high intensity pulse on Channel 2 of the magnetic tape before each stimulus. On playback, this pulse controlled an electronic gate which "opened" while a stimulus was being presented and "closed" between stimuli. In this way, no audible tape hiss or verbal annotation on the tape between samples was heard by the test subjects.

TEST I (Single Tones)

To produce the stimuli for Test I, five fixed tones and three noise spectra were required. A block diagram of the stimulus generating equipment is shown in Fig. B-1. To produce the three noise spectra, broadband noise generated by a random noise source was shaped by three parallel filters. The octave band of noise was obtained by using a sound level meter octave band filter set. The broadband noise whose spectrum shape approximates the 40 noy contour ("noy") was produced using a special BBN designed filter. Another special BBN designed filter was used to produce the noise whose spectrum shape approximates that of a four-engine turbojet aircraft ("jet") at a distance of two thousand feet from the observer. The outputs of these three filters could be selected independently and the level controlled by an attenuator, adjustable in steps of 0.1 dB.

The discrete tones were generated by a BBN designed oscillator which simultaneously produced five fixed frequencies. The fixed frequencies could be selected independently and the level adjusted by means of a 0.1 dB attenuator. The tones and the noise were fed to the separate channels of the electronic switch.

TEST II (Modulated Tones)

To produce the stimuli for Test II, amplitude and frequency modulated tones and two noise spectra were required. A block diagram of the stimulus generating equipment is shown in Fig. B-2. To produce the two noise spectra, broadband noise generated by random noise source was shaped by two parallel filters. The octave band of noise was produced using a sound level meter and octave band filter set. The broadband noise whose spectrum is similar to a four-engine turbojet aircraft ("jet") at a distance of two thousand feet from the observer was generated by a special BBN designed filter. The two spectra could be selected independently and the level was controlled by an attenuator adjustable in steps of 0.1 dB.

To generate the modulated tones, two oscillators were required. A beat frequency oscillator (with provision for voltage control of frequency) was employed to produce the carrier signal and a second oscillator was used to supply the modulating signal. The amplitude of the modulating signal was controlled by a 0.1 dB step attenuator. Generation of a frequency modulated signal (switches in FM position in Fig. B-2) was accomplished in the following manner. The modulating signal was connected to the voltage frequency control input of the carrier oscillator. Hence, the amplitude of the modulation signal controlled the extent of frequency variation (or percent modulation) of the carrier, and the frequency of the modulation signal controlled the rate at which the carrier was modulated. Thus, the output of the voltage controlled oscillator was the desired FM signal. The amplitude modulated signal (switches in AM position) was generated by feeding the modulating signal and the carrier signal* into a special BBN designed amplitude

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* With zero input, the oscillator generates the frequency which is set on the instrument.

modulator was the desired AM signal. The level of the resulting AM or FM signal was controllable by an attenuator adjustable in steps of 0.1 dB. The tone signal and noise signal were fed to separate channels of the electronic switch.

TEST III

To prepare the stimuli for Test III it was necessary to generate a single broadband "jet" noise and a variety of discrete frequency tones. A block diagram of the stimulus generating equipment is shown in Fig. B-3. For this test it was necessary to generate the tones singly or in complexes of two, four, five or sixteen tones. Single tones were produced by a fixed frequency oscillator, generating tones at the preferred octave band center frequencies from 250 to 4000 Hz. Non-harmonically related, two-tone complexes were generated by mixing the outputs of the fixed frequency oscillator and the sine wave output of a sine and square wave oscillator.

Generation of harmonically related two-tone complexes required phase locking the two tones to prevent beating. This was accomplished by taking the square wave output of sine and square wave oscillator and passing the square wave signal through a BBN designed frequency divider. At the outputs of the frequency divider yield two square waves whose frequencies are 1/2 and 1/4 that of the input frequency. These two waves were then mixed and passed through a 1/3 octave band filter in order to filter out all unwanted harmonics of the square wave. The output of the 1/3 octave band filter is a sine-wave whose frequency is an exact one octave or two octaves lower than the frequency of the sine and square wave oscillator. The divided signal was mixed with the sine-wave output of the sine and square wave oscillator to generate the harmonic two-tone complex. All tone complexes involving more than two tones were pre-recorded for playback on a tape cartridge player. All frequencies were checked using a frequency counter. The tones and the "jet" noise were fed into separate channels of the two channel electronic switch.

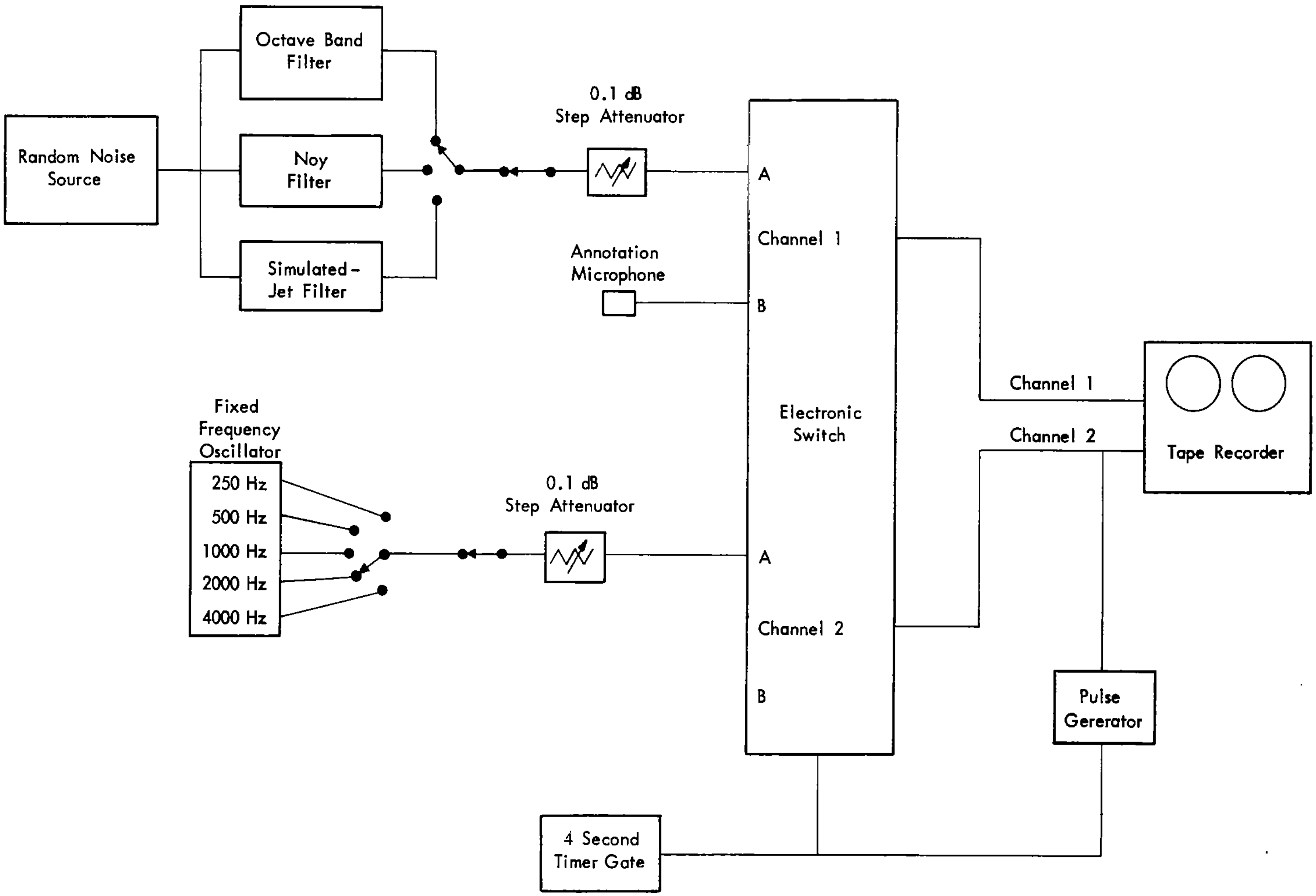


FIGURE B-1. BLOCK DIAGRAM OF STIMULUS GENERATING EQUIPMENT FOR TEST I
(Single Tones)

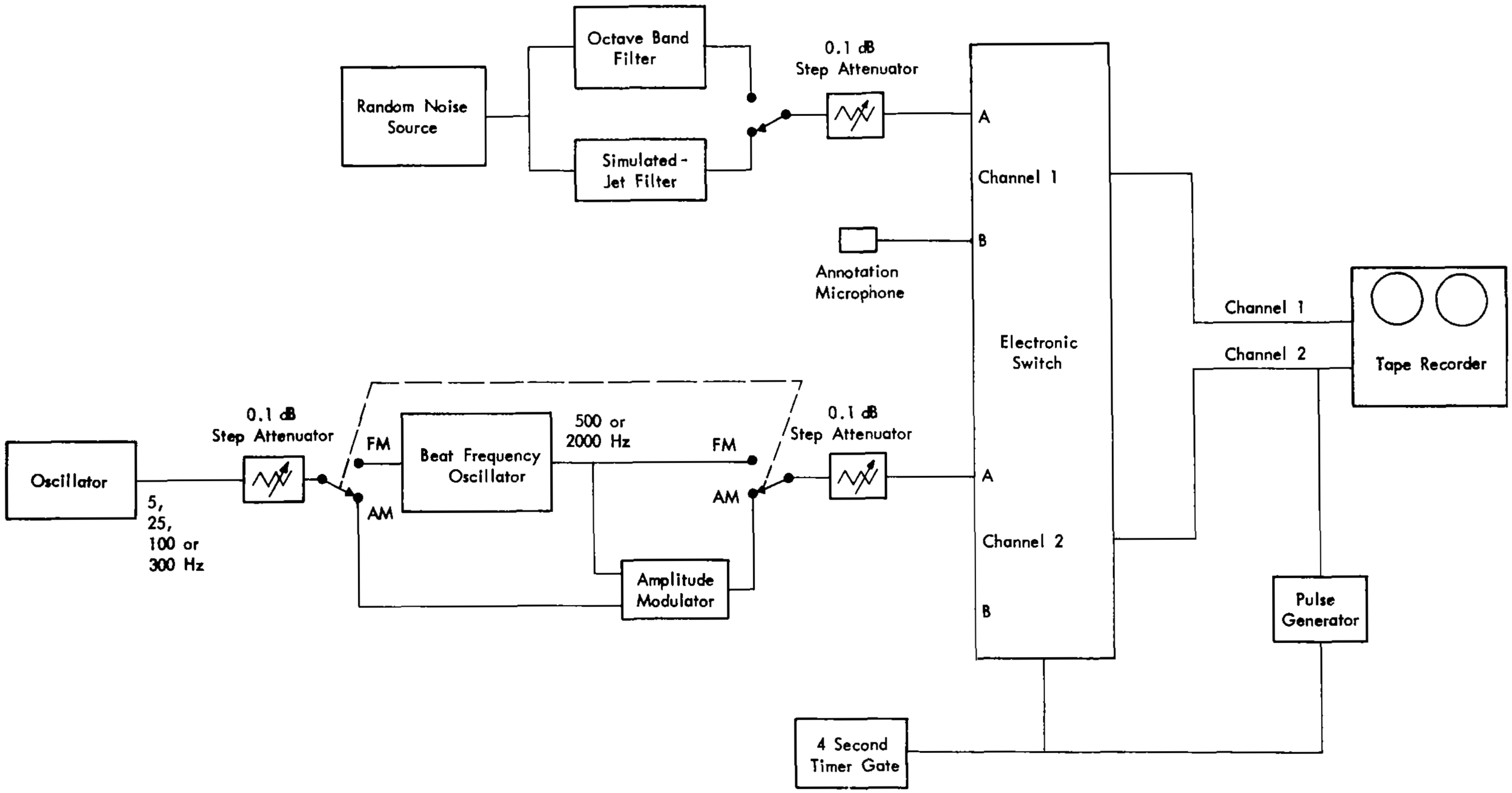


FIGURE B-2. BLOCK DIAGRAM OF STIMULUS GENERATING EQUIPMENT FOR TEST II
(Modulated Tones)

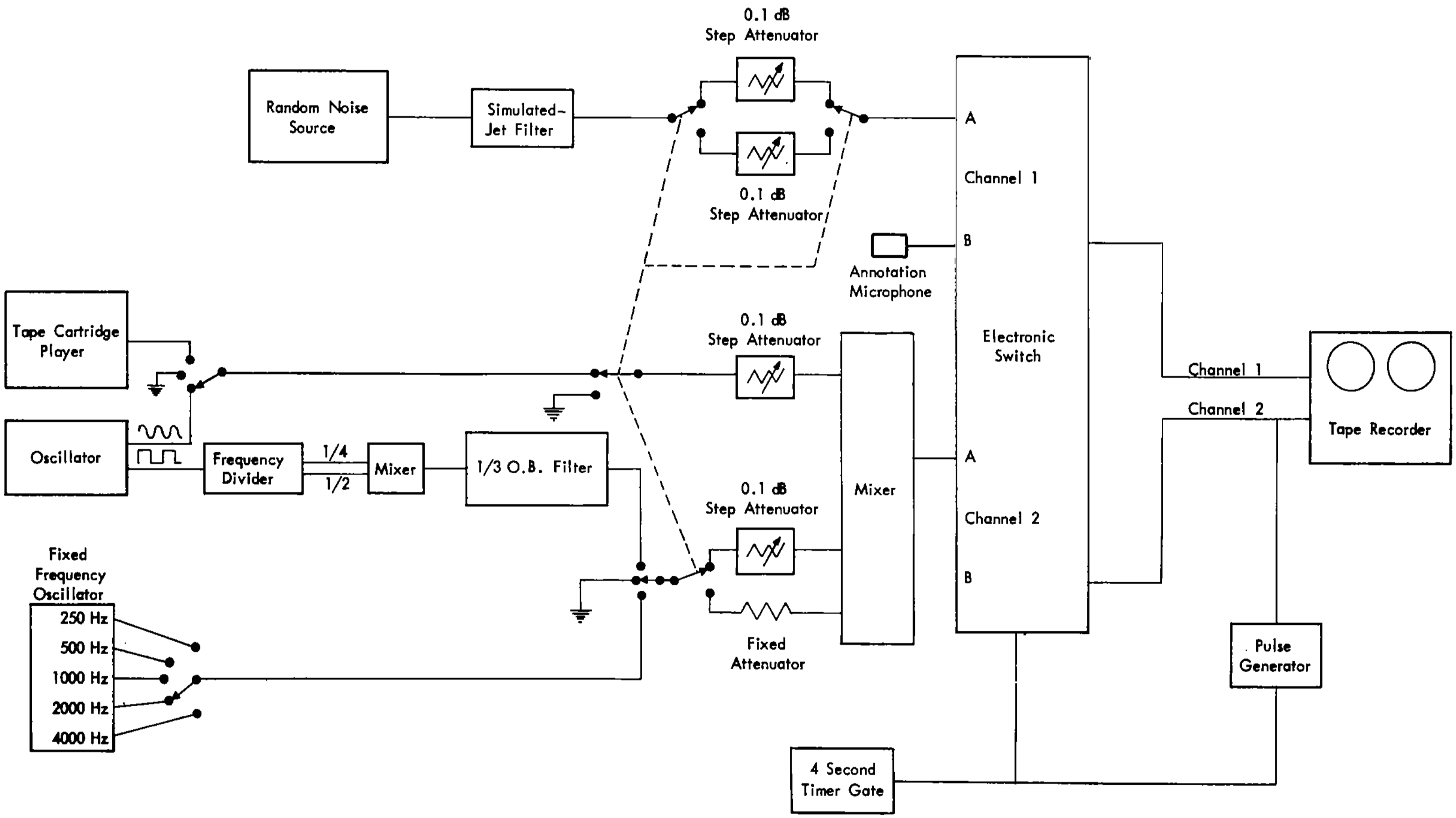


FIGURE B-3. BLOCK DIAGRAM OF STIMULUS GENERATING EQUIPMENT FOR TEST III
(Multiple Tones)

APPENDIX C

MAXIMUM LEVELS PRESENTED DURING JUDGMENT TESTS

TABLE C-1

MAXIMUM LEVELS OF STIMULI FOR TEST 1 (SINGLE TONES)

Stimulus			Sound Pressure Level in dB re 0.0002 dyn/sq. cm. One-Third Octave Band Center Frequency, Hz																								
Standard or Comparison	Noise Type	F(Hz)	OA	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10,000
Std.	Oct.(250)*		98.0				60.5	71.0	85.5	93.0	94.0	92.0	81.0	64.5	58.0												
Comp.	Oct.(250)	250	111.0				52.5	63.0	77.5	90.0	111.0	89.0	73.0	56.5	50.0												
Std.	Oct.(500)		94.0							63.0	72.5	55.0	68.5	89.5	87.0	78.0	67.5	60.5									
Comp.	Oct.(500)	500	105.0							53.0	62.5	75.0	84.0	105.0	82.5	68.0	57.5	50.5									
Std.	Oct.(1000)		95.5											67.0	79.0	89.0	90.0	91.5	83.5	68.5	61.0						
Comp.	Oct.(1000)	1000	106.0																72.5	57.5	50.0						
Std.	Oct.(2000)		96.5													59.0	68.5	85.0	91.5	91.5	90.0	81.0	68.0	63.0			
Comp.	Oct.(2000)	2000	104.0													47.0	56.5	73.0	84.0	104.0	82.5	69.0	56.0	51.0			
Std.	Oct.(4000)		95.5																60.5	68.5	81.5	90.5	90.5	90.5	83.0	70.5	64.5
Comp.	Oct.(4000)	4000	104.0																48.5	56.5	69.5	84.0	104.0	84.0	71.0	58.5	52.5
Std.	Jet**		98.0	68.5	71.0	75.5	79.0	85.5	88.0	90.0	91.0	90.0	85.5	85.0	82.5	84.0	84.0	83.0	81.0	77.5	73.0	69.5	66.5	64.5	62.5		
Comp.	Jet	250	111.0	64.0	67.0	71.5	75.0	81.5	84.0	90.0	111.0	90.0	81.5	81.0	78.5	80.0	80.0	79.0	77.0	73.5	69.0	65.5	62.5	60.5	58.5		
Comp.	Jet	500	106.0	63.0	66.0	70.5	74.0	80.5	83.0	85.0	86.0	85.0	86.5	106.0	83.5	79.0	79.0	78.0	76.0	72.5	68.0	64.5	61.5	59.5	57.5		
Comp.	Jet	1000	100.5	58.0	61.0	65.5	69.0	75.5	78.0	80.0	81.0	80.0	75.5	75.0	72.5	80.0	100.0	79.0	71.0	67.5	63.0	59.5	56.5	54.5	52.5		
Comp.	Jet	2000	95.5	60.0	63.0	67.5	71.0	77.5	80.0	82.0	83.0	82.0	77.5	77.0	74.5	76.0	76.0	75.0	77.5	94.0	69.5	61.5	58.5	56.5	54.5		
Comp.	Jet	4000	99.0	68.0	71.0	75.5	79.0	85.5	88.0	90.0	91.0	90.0	95.5	95.0	82.5	84.0	84.0	83.0	81.0	77.5	73.0	75.0	92.0	70.0	62.5		
Std.	Noy***		88.0	63.0	69.0	74.0	76.0	79.0	79.5	80.0	79.5	76.5	71.5	71.0	69.0	70.5	71.5	71.5	70.0	66.5	63.0	62.5	63.0	65.0	67.5	64.5	63.5
Comp.	Noy	250	111.0	70.0	76.0	81.0	83.0	86.0	86.5	91.5	111.0	88.0	78.5	78.0	76.0	77.5	78.5	78.5	77.0	73.5	70.0	69.5	70.0	72.0	74.5	71.5	70.5
Comp.	Noy	500	102.5	68.0	74.0	79.0	81.0	84.0	84.5	85.0	84.5	81.5	82.5	102.0	80.0	75.5	76.5	76.5	75.0	71.5	68.0	67.5	68.0	70.0	72.5	69.5	68.5
Comp.	Noy	1000	103.5	68.0	74.0	79.0	81.0	84.0	84.5	85.0	84.5	81.5	76.5	76.0	74.0	82.0	103.0	76.0	75.0	71.5	68.0	67.5	68.0	70.0	72.5	69.5	68.5
Comp.	Noy	2000	96.5	66.0	72.0	77.0	79.0	82.0	82.5	83.0	82.5	79.5	74.5	74.0	72.0	73.5	74.5	74.5	78.5	95.0	71.5	65.5	66.0	68.0	70.5	67.5	66.5
Comp.	Noy	4000	93.5	65.0	71.0	76.0	78.0	81.0	81.5	82.0	81.5	78.5	73.5	73.0	71.0	72.5	73.5	73.5	72.0	68.5	65.0	70.5	91.0	73.0	69.5	66.5	65.5

* Octave band of noise centered at (250) Hz.

** Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

*** Broadband noise with spectrum similar to 40 noy contour.

TABLE C-2

MAXIMUM LEVELS OF STIMULI FOR TEST 2 (MODULATED TONES)

Stimulus: Std. or Comp.	Noise Type	Fund. Freq. (Hz)	Modul. Rate (Hz)	% Modul.	Type Modul.	Sound Pressure Level in dB re 0.0002 dyn/sq. cm. One-Third Octave Band Center Frequency, Hz.: OA	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
Std.	Jet*					87.0	55.0	59.0	65.0	72.0	75.0	76.0	78.5	79.0	75.0	75.5	76.5	74.0	75.5	73.5	71.5	71.0	67.5	63.5	62.0	59.5	56.0	54.0	53.5
Comp.	Jet	500				98.5	49.5	54.5	60.5	67.0	71.0	70.5	74.0	73.5	73.0	78.0	76.5	74.0	75.5	68.5	66.5	66.5	62.5	58.5	56.5	54.0	51.0	48.5	46.5
Comp.	Jet	500	5	100	AM	91.5	51.5	55.0	54.0	67.0	70.0	71.0	74.5	74.0	73.5	74.5	90.5	76.0	71.0	69.0	67.0	66.0	62.5	58.5	57.0	54.0	51.0	48.5	46.5
Comp.	Jet	500	25	100	AM	94.5	50.5	54.5	60.0	67.5	70.5	71.5	73.5	74.0	74.0	76.0	94.0	78.0	71.5	68.5	67.0	65.5	62.5	58.5	56.5	54.0	51.0	48.0	46.0
Comp.	Jet	500	100	100	AM	94.0	49.5	55.0	61.5	69.0	71.0	72.0	74.5	74.5	74.0	73.5	92.5	85.5	71.5	69.0	66.5	65.5	62.5	58.5	56.5	54.0	51.0	48.5	46.5
Comp.	Jet	500		100	AM	94.5	50.5	56.0	60.5	67.5	71.5	72.0	87.0	77.5	75.5	74.0	92.5	75.5	86.5	71.0	68.0	66.0	63.0	59.0	57.0	53.5	51.0	49.5	47.0
Comp.	Jet	2000				84.5	44.5	51.5	57.0	65.0	67.5	67.5	69.5	71.0	70.0	67.5	69.0	66.5	67.5	66.0	64.0	65.0	83.0	61.5	54.5	51.5	48.0	47.0	
Comp.	Jet	2000	5	100	AM	81.0	44.5	51.5	57.0	65.0	67.5	67.5	69.5	71.0	70.0	67.5	69.0	66.5	67.5	66.0	64.0	65.0	83.0	61.0	54.5	51.5	48.0	47.0	
Comp.	Jet	2000	25	100	AM	82.5	50.5	51.0	58.0	65.0	66.0	68.0	71.0	71.5	71.0	67.5	68.5	67.5	67.5	65.5	64.0	65.5	79.5	62.0	54.5	51.5	48.0	47.0	
Comp.	Jet	2000	100	100	AM	83.0	47.5	51.0	57.0	64.0	68.0	68.5	70.5	70.5	70.5	68.0	68.5	67.0	68.5	66.5	64.0	67.5	80.0	64.0	54.5	51.5	48.0	46.0	
Comp.	Jet	2000	300	100	AM	82.6	45.0	51.0	57.0	64.5	67.0	68.5	70.0	71.0	71.5	68.5	69.0	66.5	67.0	65.0	63.5	74.0	78.0	72.0	55.0	51.0	48.0	47.0	
Comp.	Jet	500	5	± 2.5	FM	98.5	50.0	54.0	61.0	66.5	70.5	71.5	73.0	74.5	73.5	78.0	98.5	80.5	70.5	68.5	66.5	66.5	62.0	58.5	57.0	54.0	51.0	48.5	47.0
Comp.	Jet	500	25	± 5	FM	98.5	49.0	54.0	59.5	66.5	70.5	70.5	73.5	74.0	73.5	79.0	98.0	82.0	71.0	69.0	66.5	66.0	62.5	58.5	57.0	54.0	51.5	49.0	47.5
Comp.	Jet	500	100	± 16	FM	98.0	49.0	54.5	61.0	66.5	69.5	70.5	73.5	74.0	78.0	87.0	97.0	88.5	73.5	68.5	67.0	66.0	63.0	58.5	56.5	54.0	51.0	49.0	47.0
Comp.	Jet	500	300	± 28	FM	98.5	49.0	53.0	60.0	68.0	70.0	72.0	86.5	74.5	73.0	78.0	97.5	79.5	84.5	71.5	67.0	66.0	63.0	58.5	56.5	54.0	51.0	49.0	47.5
Comp.	Jet	2000	5	± 2.5	FM	86.0	50.5	54.0	59.5	67.0	69.5	71.0	74.0	74.5	73.0	70.5	72.0	69.5	70.5	68.0	66.5	68.0	83.5	64.5	57.0	55.0	51.0	50.0	48.0
Comp.	Jet	2000	25	± 2.5	FM	86.0	50.0	53.5	59.5	67.0	70.0	71.5	73.0	74.0	73.0	70.5	71.5	69.0	70.5	68.0	66.5	68.5	84.0	64.5	57.0	55.0	51.0	49.5	47.0
Comp.	Jet	2000	100	± 8	FM	86.5	49.0	54.5	60.0	68.0	69.0	70.5	73.0	73.5	72.5	70.0	70.5	69.5	70.5	68.5	66.5	73.5	84.5	68.5	57.0	54.5	51.0	49.5	47.0
Std.	Oct(500)**					85.5					41.0	44.0	51.5	61.0	75.0	79.5	80.5	80.0	72.0	59.5	51.5	53.5							
Comp.	Oct(500)	500	25	± 5	FM	97.5					31.0	34.0	41.5	51.0	65.0	77.0	97.5	79.0	62.0	49.5	41.5	43.5							
Std.	Oct(2000)					81.5														56.5	67.0	77.0	77.0	74.5	66.5	55.5			
Comp.	Oct(2000)	2000	25	100	AM	81.5														44.5	55.0	65.0	81.0	62.5	54.5	43.5			

* Broadband noise with spectrum similar to turbojet flyover at 2000 ft.
** Octave band of noise centered at (500) Hz.

TABLE C-3

MAXIMUM LEVELS OF STIMULI FOR TEST 3 (MULTIPLE TONES)

Stimulus: Standard or Comparison	Stimulus: Noise Type	Stimulus: F(Hz)	Sound Pressure Level in dB re 0.0002 dyn/sq. cm. One-Third Octave Band Center Frequency, Hz: OA	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10,000	12,500
Std.	Jet [1]		85.5	52.0	55.5	62.5	70.5	75.0	74.5	76.5	78.0	77.0	74.5	75.0	73.5	73.5	71.5	70.5	69.0	65.5	62.0	59.5	56.5	54.0	51.5	48.5		
Std.	Jet	1000	80.5	37.0	40.5	44.5	53.0	56.0	57.5	59.5	61.0	59.5	58.0	57.5	55.5	61.0	80.0	61.0	52.0	49.0	44.5	42.0						
Comp.	Jet	250	102.5	50.5	55.0	62.0	69.5	72.5	73.0	82.5	102.5	85.5	75.0	75.0	71.5	72.5	71.0	69.0	67.5	65.0	61.0	58.5	55.5	53.0	50.5	47.5		
Comp.	Jet	500	99.5	50.5	53.5	61.0	68.0	72.5	72.5	74.0	75.5	75.0	80.0	99.5	79.5	72.0	70.0	68.0	67.0	64.0	60.0	57.5	54.5	52.5	50.5	48.0		
Comp.	Jet	1000	96.0	50.5	57.0	60.5	67.0	71.5	72.5	72.0	76.0	74.5	73.0	73.0	70.5	76.0	95.5	75.0	67.0	65.5	59.5	57.5	54.0	52.5	49.5	46.5		
Comp.	Jet	2000	90.0	49.0	54.8	60.0	67.5	70.5	72.0	73.0	74.5	73.5	71.5	72.5	70.0	70.5	69.0	67.0	70.5	89.5	70.0	58.0	57.0	51.5	50.5	48.0		
Comp.	Jet	4000	88.0	53.0	56.0	63.5	70.5	74.5	75.0	76.5	78.0	77.0	75.5	75.5	73.5	74.0	72.5	70.5	69.5	66.5	62.5	64.0	83.5	65.0	52.5	50.0	42.0	
Comp.[2]	Jet	8000	90.5	54.5	60.5	66.5	74.5	79.5	78.5	81.5	82.5	81.5	79.5	80.0	78.0	79.0	76.0	75.0	73.5	70.0	66.5	64.0	61.0	59.0	61.0	80.0	63.5	45.5
Comp.	Jet	250,268	103.0	49.5	55.5	59.0	65.5	70.0	71.0	80.5	102.5	91.5	72.5	72.5	69.0	70.0	68.0	66.0	64.5	61.5	58.0	56.0	52.5	50.0	48.0			
Comp.	Jet	250,315	101.0	48.5	60.0	58.0	64.5	69.5	69.5	79.0	98.5	97.0	79.5	70.5	68.5	69.5	67.0	65.0	64.0	61.0	57.0	54.5	51.5	48.5	47.0			
Comp.	Jet	250,500	104.0	52.0	56.0	61.5	69.0	72.0	74.0	83.0	102.0	84.5	80.5	99.0	79.0	73.5	71.0	69.5	67.5	64.5	61.0	58.0	56.0	53.0	50.5	49.0		
Comp.	Jet	250,630	103.5	52.0	56.0	60.5	68.5	72.0	72.5	83.0	102.0	85.5	76.0	78.5	97.0	78.5	72.5	70.5	68.0	65.0	61.0	58.5	55.5	53.0	51.0	48.0		
Comp.	Jet	250,1000	103.5	51.0	55.0	61.5	69.0	74.5	73.0	83.0	102.0	84.5	74.0	74.5	72.0	78.5	97.0	77.5	68.5	68.0	62.0	58.5	56.0	53.0	51.5	48.0		
Comp.	Jet	500,536	99.5	51.0	53.0	59.5	65.0	70.0	71.5	71.5	73.5	72.5	78.0	99.5	84.5	70.5	68.0	65.5	64.5	61.5	57.5	55.5	52.0	50.0	47.5			
Comp.	Jet	500,630	99.0	50.0	53.0	58.0	67.0	69.5	70.5	72.0	73.5	73.5	78.0	97.5	94.0	75.0	68.5	67.0	65.0	62.0	58.0	55.5	52.5	51.0	48.0			
Comp.	Jet	500,1000	100.5	52.0	53.5	60.5	67.5	72.5	72.0	74.0	75.5	75.0	80.0	98.5	78.5	76.5	96.0	76.0	71.5	67.0	58.0	54.5	53.0	53.0	50.5	47.5		
Comp.	Jet	500,1250	100.5	53.0	53.5	60.0	67.5	71.5	72.5	74.0	75.5	74.5	80.0	99.5	79.5	73.0	77.5	94.5	75.0	67.0	64.5	59.0	55.5	52.5	50.5	47.5	42.0	
Comp.	Jet	500,2000	99.5	53.0	53.5	61.0	68.0	71.5	73.0	74.0	75.5	74.5	79.5	99.0	78.5	71.5	70.0	68.0	72.0	90.5	72.0	60.0	59.0	53.0	50.5	47.5		
Comp.	Jet	1000,1070	96.0	52.5	59.5	59.5	65.5	69.0	69.5	71.0	72.0	71.5	70.0	70.0	68.0	73.5	95.5	82.0	64.5	67.5	58.0	55.0	51.5	50.0	47.5	42.0		
Comp.	Jet	1000,1250	93.5	47.5	55.0	55.0	63.0	67.5	68.0	69.0	71.5	70.0	68.5	68.5	66.5	71.5	91.0	90.0	69.0	62.5	60.5	54.0	50.0	48.5	46.0			
Comp.	Jet	1000,2000	96.0	51.5	48.0	60.0	66.5	70.5	71.5	72.5	74.5	74.0	72.0	72.0	69.5	75.5	95.0	75.5	71.0	89.0	70.0	66.0	56.5	53.5	50.0	47.5	39.0	
Comp.	Jet	1000,2500	95.5	51.5	54.0	60.0	66.5	72.0	72.0	74.0	75.5	74.5	72.5	73.0	70.5	75.5	95.0	75.5	66.5	68.0	85.5	66.0	57.5	53.0	50.0	47.0		
Comp.	Jet	1000,4000	95.5	50.0	53.5	61.0	67.5	71.0	72.0	74.0	75.5	74.0	72.0	72.0	70.5	75.5	95.0	75.5	66.5	66.5	59.5	61.5	80.0	62.5	50.5	47.5		
Comp.	Jet	2000,2140	90.5	48.0	54.0	58.0	65.0	69.5	68.0	72.0	72.0	72.5	71.0	70.5	68.5	69.0	66.5	65.0	69.0	90.0	76.5	57.5	57.5	50.5	49.5	47.0		
Comp.	Jet	2000,2500	90.5	48.5	52.5	58.5	66.5	69.5	71.5	72.5	74.0	73.5	71.0	71.5	69.5	69.5	68.0	66.5	69.5	88.5	84.5	64.5	57.0	53.5	50.0	48.0	43.0	
Comp.	Jet	2000,4000	91.0	51.5	53.0	59.0	67.0	70.0	71.0	74.0	74.0	74.5	72.0	72.5	70.5	70.5	69.0	67.0	71.0	89.5	70.0	61.5	80.5	62.5	53.5	48.0	43.0	
Comp.	Jet	2000,5000	90.5	49.5	54.0	60.5	67.5	70.5	71.5	73.0	74.0	74.5	73.0	72.0	69.5	71.0	68.5	67.0	70.5	89.5	70.0	58.0	60.5	77.5	57.5	50.5	44.0	
Comp.	Jet	2000,8000	90.5	50.0	53.5	61.0	68.0	72.0	70.5	74.0	75.0	74.5	72.0	72.0	70.0	70.5	69.0	67.0	70.5	89.5	70.0	58.0	57.0	51.5	54.0	72.5	56.5	
Comp.	Jet	4000,4280	87.0	52.5	53.5	60.5	68.0	72.5	72.0	75.0	76.0	74.5	73.0	73.0	71.5	72.0	70.0	68.5	67.0	64.0	60.0	62.0	84.0	71.5	52.0	49.0		
Comp.	Jet	4000,5000	86.5	53.0	55.0	62.5	69.0	72.0	72.5	74.0	76.0	75.5	73.0	74.0	71.5	72.5	70.5	69.0	67.5	64.5	60.5	62.5	81.5	79.0	58.5	50.0	44.0	
Comp.	Jet	4000,8000	88.5	54.5	58.0	63.5	70.0	75.5	75.5	76.5	78.0	77.0	75.5	76.0	73.5	74.0	72.0	71.0	69.5	66.5	63.0	64.0	83.5	65.0	57.0	75.5	59.0	44.0
Comp.	Jet	4000,10000	88.0	53.5	56.5	64.5	70.0	74.5	75.0	76.5	78.0	78.0	75.0	75.5	73.5	74.0	72.0	71.0	69.0	66.5	63.0	64.0	83.5	64.5	52.0	52.5	65.0	50.5
Comp.	Jet	250,255,259, 264,268	102.5	57.5	51.5	54.5	61.5	66.5	68.0	77.5	102.0	93.5	70.5	72.5	66.0	69.0	64.0	62.0	60.5	58.5	54.5	52.0	49.5	47.5	47.0			
Comp.	Jet	250,265,281, 297,315	102.0	59.5	53.0	55.5	61.5	66.0	67.5	75.0	98.0	99.5	79.5	69.0	69.0	69.0	65.5	62.0	60.5	57.5	54.0	51.5	48.5	47.0	46.0			
Comp.	Jet	250,297,315 420,500	105.0	61.5	57.0	59.0	66.5	71.5	74.0	78.5	98.5	98.5	101.0	97.5	80.5	75.0	73.5	71.0	66.0	64.0	59.0	57.0	54.5	52.5	51.0	50.0		
Comp.	Jet	250,315,400, 500,630	104.0		57.5	60.0	68.0	71.5	72.0	77.0	97.5	97.0	97.5	97.0	94.0	78.0	72.5	69.5	67.5	62.5	58.0	56.0	53.5	51.0	50.0	49.0		
Comp.	Jet	250,353,500, 707,1000	102.5	54.0	53.0	58.5	67.5	70.5	70.5	76.5	96.5	89.0	96.0	94.0	91.0	94.5	92.5	77.0	74.5	68.0	60.5	58.5	55.0	53.0	53.0	52.0	48.5	

1 Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

2 Standard level for overall judgment at 10 dB below that shown above.

TABLE C-3 (Continued)

MAXIMUM LEVELS OF STIMULI FOR TEST 3 (MULTIPLE TONES)

Stimulus: Standard or Comparison	Noise Type	F(Hz)	Sound Pressure Level in dB re 0.0002 dyn/sq. cm. One-Third Octave Band Center Frequency, Hz: OA	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10,000	12,500
Comp.	Jet	500,509,518, 527,536	100.0		49.0	54.0	63.0	65.0	66.0	67.0	68.5	69.0	75.5	100.0	86.5	67.5	66.0	62.0	62.0	57.5	54.0	51.5	49.0	46.5	46.0			
Comp.	Jet	500,530,561, 595,630	98.5		57.0	55.5	62.5	66.5	67.0	69.0	69.5	69.5	74.0	95.0	95.5	75.0	65.5	66.5	63.5	62.0	55.0	52.0	49.5	48.0	47.0			
Comp.	Jet	500,594,707, 841,1000	102.0		53.5	58.5	66.0	69.5	70.5	73.0	74.0	73.5	76.5	97.0	95.0	97.5	92.5	76.5	72.5	69.5	63.0	57.0	53.0	51.5	50.0	48.5		
Comp.	Jet	500,625,800, 1000,1250	101.5		51.5	57.5	66.0	69.5	70.5	72.0	72.5	73.0	77.0	96.5	93.5	95.5	92.5	93.0	76.0	72.5	67.0	60.5	56.5	53.0	52.0	50.0	48.0	
Comp.	Jet	500,707,1000, 1414,2000	98.5		53.5	56.5	63.5	69.0	68.5	70.5	71.5	71.5	73.5	94.0	88.5	92.0	88.5	82.0	87.0	86.5	70.0	63.0	55.5	51.5	51.5	48.5		
Comp.	Jet	1000,1017,1034, 1052,1070	96.0			54.0	62.5	64.5	65.5	66.5	68.0	68.0	66.0	65.5	64.5	71.5	95.5	84.0	63.0	70.5	58.5	56.5	50.5	50.0	48.0	48.0		
Comp.	Jet	1000,1057,1118, 1182,1250	94.5	51.5	55.5	56.0	61.0	64.5	64.0	67.0	67.5	66.5	64.5	64.5	62.5	68.5	92.0	91.5	70.0	64.0	64.0	56.0	51.5	48.5	46.0	44.5		
Comp.	Jet	1000,1089,1414, 1681,2000	96.5	49.5	52.0	56.5	64.0	67.5	68.0	70.5	71.5	70.0	69.0	69.0	67.0	71.5	91.5	91.0	91.5	87.0	70.5	65.0	58.5	54.0	50.0	48.0	43.5	
Comp.	Jet	1000,1250,1600, 2000,2500	95.5	50.0	49.5	55.5	62.5	67.5	68.0	69.0	70.0	70.0	68.0	68.0	66.5	70.5	90.5	91.5	87.5	86.0	80.5	66.0	61.5	54.0	50.5	48.5	43.5	
Comp.	Jet	1000,1414,2000, 2828,4000	94.5	47.5	49.5	55.5	63.5	68.0	67.5	69.5	70.5	70.0	68.0	68.5	67.0	71.0	91.5	93.5	88.0	86.5	77.0	80.0	78.5	62.5	55.5	47.5	44.0	
Comp.	Jet	2000,2034,2069, 2104,2140	91.0	50.0	57.0	59.0	62.0	65.5	65.5	67.0	68.0	68.5	66.5	66.0	64.0	64.5	63.0	61.5	66.5	90.5	78.5	57.0	58.0	49.5	52.5	46.0		
Comp.	Jet	2000,2115,2236, 2364,2500	90.5		48.5	54.5	62.5	66.0	67.0	69.0	69.5	68.5	67.5	67.5	65.5	65.5	64.0	62.5	65.5	88.0	86.5	64.0	56.5	54.5	51.0	46.5		
Comp.	Jet	2000,2378,2828, 3364,4000	90.5	47.5	53.0	56.5	64.5	68.0	68.5	70.0	72.0	71.0	69.0	69.0	67.0	67.5	65.5	64.0	66.5	87.0	84.0	82.5	79.0	63.0	53.5	49.0		
Comp.	Jet	2000,2500,3150, 4000,5000	89.5	51.5	50.5	57.5	63.5	68.0	69.0	70.5	71.5	71.0	69.5	69.0	67.0	67.5	65.0	65.5	66.5	86.5	82.0	78.5	77.5	75.5	57.5	51.5	43.0	
Comp.	Jet	2000,2828,4000, 5657,8000	89.0	51.0	50.0	57.0	65.0	67.5	69.5	71.0	71.5	71.5	69.0	69.0	67.0	67.5	66.0	64.5	66.5	87.0	76.5	79.5	77.5	68.0	72.0	67.0	52.0	
Comp.	Jet	4000,4068,4138, 4208,4280	84.5	48.5	53.0	58.5	64.5	67.5	68.5	70.5	71.5	71.0	69.5	69.5	67.5	67.5	65.0	64.0	63.0	60.0	56.5	58.5	82.5	71.5	49.5	48.5		
Comp.	Jet	4000,4229,4472, 4729,5000	85.0	49.5	52.0	56.0	66.0	69.0	69.0	70.5	72.0	71.0	70.0	70.0	68.0	69.0	67.0	65.5	63.5	61.0	57.5	58.5	80.5	80.0	58.5	48.5	46.5	
Comp.	Jet	4000,4757,5657, 6727,8000	86.5	50.5	53.5	60.0	68.0	70.5	73.0	74.5	75.0	74.5	72.0	72.0	70.0	70.5	69.0	68.0	66.0	63.5	59.5	60.0	80.0	77.5	78.0	71.5	56.0	42.5
Comp.	Jet	4000,5000,6300, 8000,10000	86.5	51.0	54.0	61.0	67.0	71.5	71.5	74.0	75.5	74.5	72.0	72.5	70.5	71.5	69.0	67.5	66.0	63.5	59.0	60.0	80.5	79.0	74.0	70.5	66.5	48.5
Comp.	Jet	4000,5657,8000, 11314	85.0	49.5	54.0	60.0	67.0	72.0	71.0	73.0	75.0	73.5	72.0	73.0	70.0	71.0	69.0	67.5	66.5	63.0	59.5	60.0	80.0	70.0	74.0	70.0	56.5	56.5
Comp.[3]	Jet	2500,2800[4]	90.0	58.0	62.0	67.5	74.0	78.0	79.0	80.0	82.5	81.5	79.0	80.0	77.5	78.5	76.5	75.0	73.5	71.0	74.5	71.0	61.5	58.5	56.0	53.0	47.0	
Comp.[3]	Jet	2500,5000[5]	90.5	56.5	59.5	67.0	74.0	79.0	79.0	80.5	82.5	82.0	79.0	80.0	77.5	78.0	76.5	76.0	73.5	70.5	73.5	64.5	61.0	58.5	56.0	53.0	47.0	
Comp.	Jet	250 thru 4000 with 250 Hz spacing	87.5			44.0	51.0	53.5	54.5	60.5	82.0	66.5	60.0	80.5	67.0	79.5	76.0	75.0	76.0	74.5	72.5	70.0	66.0	47.5	52.5			

3 Standard level for overall judgment at 5 dB below that shown above.

4 Tone to noise ratio 5 dB at 2500 and 2800.

5 Tone to noise ratio 5 dB at 2500 - 5 dB at 5000.

APPENDIX D

RESULTS OF JUDGMENT TESTS

TABLE D-1 -- RESULTS OF TEST I (SINGLE TONES) FOR GROUP L USING LOUDNESS INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Oct.*	Oct.	250	-12.5
Oct.	Oct.	500	-16.5
Oct.	Oct.	1000	-12
Oct.	Oct.	2000	- 7
Oct.	Oct.	4000	- 7
Oct.	--	250	-14
Oct.	--	500	-16.5
Oct.	--	1000	-11.5
Oct.	--	2000	- 6.5
Oct.	--	4000	- 6
Noy**	Noy	250	-21
Noy	Noy	500	-14.5
Noy	Noy	1000	-16
Noy	Noy	2000	-13.5
Noy	Noy	4000	-17
Jet***	Jet	250	-10.5
Jet	Jet	500	- 6.5
Jet	Jet	1000	- 1.5
Jet	Jet	2000	- 5
Jet	Jet	4000	-12
Jet	--	250	- 9.5
Jet	--	500	- 6.5
Jet	--	1000	- 3.5
Jet	--	2000	- 0.5
Jet	--	4000	- 5

* Octave band of noise centered at tone frequencies.
** Broadband noise with spectrum similar to 40 noy contour.
*** Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

TABLE D-2 -- RESULTS OF TEST I (SINGLE TONES) FOR GROUP L USING ACCEPTABILITY INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Oct.*	Oct.	250	-18.5
Oct.	Oct.	500	-22.5
Oct.	Oct.	1000	-17
Oct.	Oct.	2000	-11
Oct.	Oct.	4000	-10.5
Jet**	--	250	-14
Jet	--	500	-11
Jet	--	1000	- 8
Jet	--	2000	- 8
Jet	--	4000	-11

* Octave band of noise centered at tone frequencies.

** Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

TABLE D-3 -- RESULTS OF TEST I (SINGLE TONES) FOR GROUP A USING ACCEPTABILITY INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Oct.*	Oct.	250	-18
Oct.	Oct.	500	-20.5
Oct.	Oct.	1000	-13.5
Oct.	Oct.	2000	- 8
Oct.	Oct.	4000	-10
Oct.	--	250	-18.5
Oct.	--	500	-19.5
Oct.	--	1000	-12.5
Oct.	--	2000	- 8
Oct.	--	4000	-10.5
Noy**	Noy	250	-22.5
Noy	Noy	500	-18
Noy	Noy	1000	-25.5
Noy	Noy	2000	-21
Noy	Noy	4000	-23
Jet***	Jet	250	-12
Jet	Jet	500	- 7.5
Jet	Jet	1000	- 9
Jet	Jet	2000	-12.5
Jet	Jet	4000	-18
Jet	--	250	-12
Jet	--	500	-12
Jet	--	1000	-11
Jet	--	2000	- 7.5
Jet	--	4000	-14.5

* Octave band of noise centered at tone frequencies.
** Broadband noise with spectrum similar to 40 noy contour.
*** Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

TABLE D-4 -- RESULTS OF TEST I (SINGLE TONES) FOR GROUP A USING LOUDNESS INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Oct.*	Oct.	250	-12.5
Oct.	Oct.	500	-13
Oct.	Oct.	1000	-10
Oct.	Oct.	2000	- 6.5
Oct.	Oct.	4000	- 8
Jet**	--	250	- 6.5
Jet	--	500	- 1.5
Jet	--	1000	- 0
Jet	--	2000	+ 1
Jet	--	4000	- 2

* Octave band of noise centered at tone frequencies.
** Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

TABLE D-5 -- RESULTS OF TEST II-A (MODULATED TONES)
USING ACCEPTABILITY INSTRUCTIONS

Stimulus						Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison					
Noise	Noise	Tone Freq.(Hz)	Modul. Rate(Hz)	% Modul.	Type Modul.	
Jet*	Jet	500	--	--	--	-13
Jet	Jet	500	5	100	AM	-12.5
Jet	Jet	500	25	100	AM	- 9
Jet	Jet	500	100	100	AM	-10
Jet	Jet	500	300	100	AM	- 9
Jet	Jet	2000	--	--	--	-12.5
Jet	Jet	2000	5	100	AM	-11.5
Jet	Jet	2000	25	100	AM	-10
Jet	Jet	2000	100	100	AM	- 8
Jet	Jet	2000	300	100	AM	- 5.5
Jet	Jet	500	5	± 2.5	FM	-16
Jet	Jet	500	25	± 5	FM	-15
Jet	Jet	500	100	± 16	FM	-14
Jet	Jet	500	300	± 28	FM	-13
Jet	Jet	2000	5	± 2.5	FM	-13.5
Jet	Jet	2000	25	± 2.5	FM	-11.5
Jet	Jet	2000	100	± 8	FM	-10.5
Oct. **	Oct.	2000	25	100	AM	- 5
Oct.	Oct.	500	25	± 5	FM	-14

* Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

** Octave band of noise centered at tone frequencies.

TABLE D-6 -- RESULTS OF TEST II-C (SINGLE TONES) USING ACCEPTABILITY INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Oct.*	Oct.	250	-21
Oct.	Oct.	500	-19
Oct.	Oct.	1000	-14
Oct.	Oct.	2000	-10
Oct.	Oct.	4000	-12
Oct.	--	250	-21
Oct.	--	500	-19.5
Oct.	--	1000	-13.5
Oct.	--	2000	- 8
Oct.	--	4000	-10
Noy **	Noy	250	-21
Noy	Noy	500	-19
Noy	Noy	1000	-26.5
Noy	Noy	2000	-24
Noy	Noy	4000	-24.5
Jet***	Jet	250	-10
Jet	Jet	500	-12
Jet	Jet	1000	- 8
Jet	Jet	2000	-12
Jet	Jet	4000	-17
Jet	--	250	- 8
Jet	--	500	-18
Jet	--	1000	-11
Jet	--	2000	- 9
Jet	--	4000	-17

* Octave band of noise centered at tone frequencies.
** Broadband noise with spectrum similar to 40 noy contour.
*** Broadband noise with spectrum similar to turbojet flyover at 2000 ft.

TABLE D-7 -- RESULTS OF TEST III (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet[1]	Jet	250	--15
Jet	Jet	500	-17.5
Jet	Jet	1000	-12
Jet	Jet	2000	-11.5
Jet	Jet	4000	-13
Jet[2]	Jet	8000	-13
Jet	Jet	250,268	-13
Jet	Jet	250,315	-13
Jet	Jet	250,500	-20.5
Jet	Jet	250,630	-18.5
Jet	Jet	250,1000	-18
Jet	Jet	500,536	-11.5
Jet	Jet	500,630	-15.5
Jet	Jet	500,1000	-19
Jet	Jet	500,1250	-17.5
Jet	Jet	500,2000	-18
Jet	Jet	1000,1070	-17
Jet	Jet	1000,1250	-11.5
Jet	Jet	1000,2000	-16.5
Jet	Jet	1000,2500	-17
Jet	Jet	1000,4000	-14
Jet	Jet	2000,2140	-14.5
Jet	Jet	2000,2500	-14 *
Jet	Jet	2000,2500	-18 *
Jet	Jet	2000,2500	-15 *
Jet	Jet	2000,2500	-14 *

1 Broadband noise with spectrum similar to turbojet. flyover at 2000 ft.
2 Standard level for judgment at 10 dB below that normally used.
* Average of 14.5 used in analysis.

TABLE D-7 -- RESULTS OF TEST III (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS - Continued

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet	Jet	2000,2500	-15.5*
Jet	Jet	2000,2500	-14 *
Jet	Jet	2000,2500	-16.5*
Jet	Jet	2000,2500	-14 *
Jet	Jet	2000,2500	-14 *
Jet	Jet	2000,2500	-15 *
Jet	Jet	2000,4000	-16
Jet	Jet	2000,5000	-16
Jet	Jet	2000,8000	-12.5
Jet	Jet	4000,4280	-12
Jet	Jet	4000,5000	-13
Jet	Jet	4000,8000	-14.5
Jet	Jet	4000,10000	-15
Jet	Jet	250,255,259, 264,268	-17.5
Jet	Jet	250,265,281, 297,315	-14.5
Jet	Jet	250,297,315 420,500	-20
Jet	Jet	250,315,400 500,630	-20
Jet	Jet	250,353,500, 707,1000	-19
Jet	Jet	500,509,518 527,536	-15
Jet	Jet	500,530.561 595,630	-13
Jet	Jet	500,594,707 841,1000	-20.5
Jet	Jet	500,625,800 1000,1250	-21
Jet	Jet	500,707,1000 1414,2000	-21.5

* Average of 14.5 used in analysis.

TABLE D-7 -- RESULTS OF TEST III (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS - Continued

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet	Jet	1000,1017,1034, 1052,1070	-16
Jet	Jet	1000,1057,1118, 1182,1250	-16.5
Jet	Jet	1000,1089,1414, 1681,2000	-18
Jet	Jet	1000,1250,1600, 2000,2500	-19
Jet	Jet	1000,1414,2000, 2828,4000	-19
Jet	Jet	2000,2034,2069, 2104,2140	-14
Jet	Jet	2000,2115,2236, 2364,2500	-14
Jet	Jet	2000,2378,2828, 3364,4000	-16
Jet	Jet	2000,2500,3150 4000,5000	-14
Jet	Jet	2000,2828,4000 5657,8000	-17
Jet	Jet	4000,4068,4138, 4208,4280	-13
Jet	Jet	4000,4229,4472, 4729,5000	-12.5
Jet	Jet	4000,4757,5657, 6727,8000	-13
Jet	Jet	4000,5000,6300, 8000,10000	-15
Jet	Jet	4000,5657,8000, 11314	-13
Jet + 1K**	Jet	1000,1070	-21
Jet + 1K**	Jet	1000,1250	-19.5
Jet + 1K**	Jet	1000,2000	- 4.5
Jet + 1K**	Jet	1000,2500	-24
Jet + 1K**	Jet	1000,4000	- 4.5

** Includes 1000 Hz tone in standard (tone-to-noise ratio - 25 dB)

TABLE D-7 -- RESULTS OF TEST III (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS - Concluded

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet[3]	Jet	2500,2800,[4]	-17.5
Jet[3]	Jet	2500,5000,[5]	-16.5
Jet	Jet	250 thru 4000 with 250 Hz spacing	-12.5

3 Standard level for judgment at 5 dB below that normally used.

4 Tone-to-noise ratio 5 dB at 2500 and 2800.

5 Tone-to-noise ratio 5 dB at 2500 -5 dB at 5000.

APPENDIX E

PURE TONE CORRECTIONS

TABLE E-1

Corrections* to be Added to 1/3rd Octave Band Perceived Noise Levels to Account for Discrete Frequency Components

Band Center Frequency	SPL of Toned Band Above Non-Toned Adjacent Bands 3	4	6	8	10	12	14	16	18	20	25
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.2	.35	.5	.9
125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.55	.69	.9	1.6
160	0.0	0.0	0.0	0.0	0.0	0.0	.53	1.1	1.3	1.7	2.35
200	0.0	0.0	0.0	0.0	.3	.65	1.0	1.5	1.8	2.25	3.10
250	0.0	0.0	.1	.3	.7	1.0	1.4	1.9	2.3	2.8	3.8
315	0.0	0.0	.3	.60	1.05	1.4	1.8	2.35	2.86	3.75	4.8
400	0.0	.2	.6	.9	1.4	1.8	2.4	3.0	3.6	4.4	6.2
500	0.0	.4	.8	1.2	1.7	2.3	2.85	3.5	4.25	5.1	7.2
630	0.0	.58	.95	1.4	2.05	2.7	3.4	4.1	4.8	5.8	8.3
800	0.0	.6	1.0	1.5	2.1	2.7	3.45	4.1	4.8	5.8	8.45
1000	0.0	.5	.9	1.5	2.0	2.6	3.25	4.0	4.45	5.7	8.1
1250	0.0	.39	.8	1.2	1.75	2.25	2.88	3.55	4.05	5.1	7.15
1600	0.0	.3	.7	1.1	1.6	2.3	2.8	3.3	3.9	4.8	6.8
2000	.1	.5	.9	1.3	1.9	2.6	3.4	3.9	4.5	5.6	7.9
2500	.3	.7	1.2	1.6	2.4	3.2	4.1	4.8	5.4	6.6	9.6
3150	.6	.9	1.5	1.9	2.8	3.6	4.5	5.5	6.0	7.6	10.8
4000	.6	.8	1.3	1.9	2.5	3.2	4.0	4.9	5.4	6.9	9.7
5000	.3	.6	1.1	1.6	2.0	2.6	3.2	4.0	4.5	5.8	8.0
6300		.2	.8	1.1	1.5	1.8	2.4	3.0	3.4	4.3	5.7
8000	0.00	0.0	.4	.6	.9	1.2	1.6	2.0	2.5	2.9	4.3
10,000	0.0	0.0	0.0	.1	.3	.5	.9	1.3	1.6	2.0	3.4

* Corrections to the nearest one-tenth decibel result from the interpolation of data and are not intended to imply absolute degree of accuracy.

This table was furnished by private correspondence with John Little, 10 January 1967, Boeing Company, Seattle, Washington

TABLE E-2 -- KRYTER AND PEARSONS TONE CORRECTIONS*

1/3 Octave Band, Center Frequency in Hz	SPL OF TONED BAND ABOVE ADJACENT BANDS (dB)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
80																									
100																									
125																									
160																									
200												0.3	0.6	0.8	1.0	1.2	1.4	1.6	1.7	1.8	2.0	2.2	2.3	2.5	2.5
250							0.2	0.6	1.0	1.4	1.6	1.8	2.2	2.5	2.9	3.2	3.5	3.8	4.0	4.3	4.5	4.8	5.0	5.3	5.5
320				0.7	1.2	1.8	2.0	2.4	2.7	3.0	3.3	3.5	3.8	4.1	4.5	4.8	5.0	5.4	5.7	6.0	6.4	6.7	7.0	7.2	7.4
400			1.0	1.7	2.4	3.0	3.4	3.8	4.1	4.5	4.8	5.0	5.4	5.6	6.0	6.3	6.5	6.8	7.1	7.4	7.6	7.8	8.0	8.3	8.5
500		1.3	2.1	2.8	3.5	3.9	4.4	4.8	5.1	5.5	5.8	6.1	6.5	6.8	7.1	7.3	7.5	7.8	8.0	8.3	8.5	8.6	8.8	8.9	9.0
630		1.5	2.4	3.0	3.6	4.0	4.5	5.0	5.4	5.8	6.1	6.4	6.7	7.0	7.4	7.6	8.0	8.3	8.5	8.8	9.0	9.2	9.4	9.6	9.7
800	0.3	1.8	2.6	3.4	3.0	4.5	5.0	5.3	5.8	6.2	6.6	7.0	7.4	7.6	8.0	8.4	8.6	8.8	9.1	9.4	9.5	9.8	10.0	10.2	10.3
1000	0.5	2.0	3.0	3.8	4.5	5.0	5.5	5.9	6.3	6.7	7.1	7.5	7.9	8.3	8.6	8.9	9.1	9.5	9.8	10.0	10.2	10.5	10.7	10.9	11.0
1250	1.5	2.9	3.7	4.4	5.0	5.4	5.9	6.3	6.8	7.2	7.6	8.0	8.3	8.6	9.0	9.2	9.5	9.8	10.0	10.3	10.5	10.8	11.1	11.3	11.4
1600	1.7	3.3	4.1	4.8	5.5	6.0	6.5	7.0	7.5	7.8	8.2	8.5	8.8	9.1	9.5	9.8	10.2	10.5	10.8	11.0	11.3	11.6	11.8	12.0	12.2
2000	2.2	3.8	4.8	5.6	6.2	6.7	7.2	7.6	8.0	8.5	8.8	9.1	9.5	9.9	10.2	10.5	10.8	11.1	11.4	11.6	11.9	12.2	12.4	12.6	12.5
2500	2.5	4.2	5.2	6.0	6.6	7.2	7.6	8.0	8.4	8.8	9.2	9.5	9.9	10.2	10.5	10.8	11.2	11.5	11.8	12.2	12.5	12.9	13.2	13.6	14.0
3200	3.0	4.6	5.6	6.4	7.0	7.5	8.1	8.6	9.0	9.5	9.9	10.2	10.6	11.0	11.3	11.6	12.0	12.3	12.6	13.0	13.3	13.5	13.8	14.0	14.3
4000	3.0	4.6	5.6	6.4	7.0	7.5	8.0	8.4	8.8	9.2	9.6	10.0	10.4	10.7	11.1	11.4	11.7	12.0	12.4	12.6	12.9	13.1	13.4	13.6	14.0
5000	3.0	4.3	5.2	5.8	6.2	6.6	7.0	7.3	7.5	7.8	8.0	8.3	8.4	8.6	8.8	9.0	9.3	9.5	9.8	10.0	10.2	10.5	10.7	10.9	11.0
6300	1.7	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.3	4.5	4.6	4.7	4.9	5.0	5.1	5.2	5.4	5.5	6.0	6.1	6.2	6.3	6.4	6.5
8000	0.4	0.5	0.4	0.4	0.4	0.4	0.6	0.7	0.9	0.8	1.0	0.9	1.0	1.2	1.2	1.2	1.1	1.3	1.2	2.0	2.0	1.9	1.9	1.9	2.0
10,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* This table was obtained from extrapolation of previous data. Ref. 4

APPENDIX F

(Addendum to Report)

SUMMARY RESULTS OF MULTIPLE TONE TEST REPEAT

APPENDIX F

(Addendum to Report)

Summary Results of Multiple Tone Test Repeat

The results of Test III using single tone stimuli in noise are not in agreement with those of Test I and II as shown in Fig. 11 of this report. As mentioned in the discussion section, a possible reason for the discrepancy might be due to differences in the test instructions given for Test III. Therefore, it was decided to repeat Test III using the instructions employed in Test I and II (see Appendix A). The results of the test repeat are given in this addendum.

For ease in comparing the repeated test with the original test results, we have duplicated the figures in the body of the report relating to Test III adding the results obtained in the repeat as darker lines. In addition, the results for the repeat of Test III are shown in Table F-1. This table is similar to those given in Appendix D for the other tests. Figure F-1 shows the results of the repeated Test III plotted on Fig. 11-B. Note that the results of the repeated tests are in close agreement with those of Test Series I and II.

As shown in Fig. F-2, the PNL differences between tone plus noise and the noise alone using the pure tone corrections of both Little, and Kryter and Pearsons lie closer to zero for the repeated Test III than the original. This indicates closer agreement of calculated values with the judgment results (perfect agreement occurs at zero). However, as shown in Fig. F-2, the median values which were representative of the three tests did not change appreciably with the re-run of Test III. The main effect was to reduce the variability among the different tests.

Figure F-3 shows the result of the tests employing multiple tone stimuli mixed with broadband noise. The results using the tone corrected perceived noise level are now in closer agreement with the judgment results than previously obtained with the former Test III results.

Although there is still an overcorrection for the judgment data around 2000 Hz, the overcorrection is less in the case of the repeated Test III. This effect may also be noted in the 4000 Hz case, in particular for the two-tone complexes.

Figure F-4 shows the results of the judgments of equal noisiness for multiple tones as a function of number of tones. As in the previous figures, the results using the tone corrected perceived noise level are in closer agreement with the judgment results for the repeated Test III than for the original Test III.

The results shown in Figs. F-1 through F-4 indicate that the present methods of correcting the perceived noise level calculation to account for the additional noisiness attributed to the multiple-pure-tone components is adequate. Further, the Test III repeat results indicate that the qualifications previously mentioned in the body of the report unnecessary when making final conclusions 2 and 3.

Although the subjects in the original Test III may have made their judgments partially on the basis of loudness, the relation between single and multiple tone judgment results remained relatively constant over the two tests. The major difference in the results of the two tests is represented by the difference in the results with single-tone stimuli.

TABLE F-1 -- RESULTS OF TEST III-B (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet[1]	Jet	250	-17.0
Jet	Jet	500	-20.5
Jet	Jet	1000	-19.0
Jet	Jet	2000	-17.0
Jet	Jet	4000	-16.0
Jet[2]	Jet	8000	
Jet	Jet	250,268	-19.5
Jet	Jet	250,315	-13.5
Jet	Jet	250,500	-20.5
Jet	Jet	250,630	-20.5
Jet	Jet	250,1000	-22.5
Jet	Jet	500,536	-17.5
Jet	Jet	500,630	-21.0
Jet	Jet	500,1000	-19.5
Jet	Jet	500,1250	-21.0
Jet	Jet	500,2000	-21.0
Jet	Jet	1000,1070	-20.0
Jet	Jet	1000,1250	-17.5
Jet	Jet	1000,2000	-21.0
Jet	Jet	1000,2500	-22.5
Jet	Jet	1000,4000	-22.0
Jet	Jet	2000,2140	-15.5
Jet	Jet	2000,2500	-13.5*
Jet	Jet	2000,2500	-17.0*
Jet	Jet	2000,2500	-19.5*
Jet	Jet	2000,2500	-18.5*

1 Broadband noise with spectrum similar to turbojet. flyover at 2000 ft.
2 Standard level for judgment at 10 dB below that normally used.
* Average of 17.5 used in analysis.

TABLE F-1 -- RESULTS OF TEST III-B (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS - Continued

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet	Jet	2000,2500	-18.5*
Jet	Jet	2000,2500	-18.5*
Jet	Jet	2000,2500	-21.0*
Jet	Jet	2000,2500	-17.0*
Jet	Jet	2000,2500	-17.0*
Jet	Jet	2000,2500	-18.5
Jet	Jet	2000,4000	-17.0
Jet	Jet	2000,5000	-18.5
Jet	Jet	2000,8000	-17.5
Jet	Jet	4000,4280	-13.5
Jet	Jet	4000,5000	-15.0
Jet	Jet	4000,8000	-17.5
Jet	Jet	4000,10000	-19.0
Jet	Jet	250,255,259, 264,268	-24.0
Jet	Jet	250,265,281, 297,315	-19.5
Jet	Jet	250,297,315, 420,500	-19.5
Jet	Jet	250,315,400, 500,630	-19.5
Jet	Jet	250,353,500, 707,1000	-20.0
Jet	Jet	500,509,518, 527,536	-21.5
Jet	Jet	500,530,561, 595,630	-17.5
Jet	Jet	500,594,707, 841,1000	-22.5
Jet	Jet	500,625,800, 1000,1250	-23.5
Jet	Jet	500,707,1000, 1414,2000	-22.5

* Average of 17.5 used in analysis.

TABLE F-1 -- RESULTS OF TEST III-B (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS - Continued

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet	Jet	1000,1017,1034, 1052,1070	-20.5
Jet	Jet	1000,1057,1118, 1182,1250	-19.5
Jet	Jet	1000,1089,1414, 1681,2000	-20.5
Jet	Jet	1000,1250,1600, 2000,2500	-22.0
Jet	Jet	1000,1414,2000, 2828,4000	-23.0
Jet	Jet	2000,2034,2069, 2104,2140	-18.0
Jet	Jet	2000,2115,2236, 2364,2500	-17.5
Jet	Jet	2000,2378,2828, 3364,4000	-18.0
Jet	Jet	2000,2500,3150, 4000,5000	-18.5
Jet	Jet	2000,2828,4000, 5657,8000	-19.5
Jet	Jet	4000,4068,4138, 4208,4280	-13.0
Jet	Jet	4000,4229,4472, 4729,5000	-12.5
Jet	Jet	4000,4757,5657, 6727,8000	-19.0
Jet	Jet	4000,5000,6300, 8000,10000	-21.5
Jet	Jet	4000,5657,8000, 11314	-19.0
Jet + 1K**	Jet	1000,1070	-20.0
Jet + 1K**	Jet	1000,1250	-16.5
Jet + 1K**	Jet	1000,2000	- 4.0
Jet + 1K**	Jet	1000,2500	-23.0
Jet + 1K**	Jet	1000,4000	-

** Includes 1000 Hz tone in standard (tone-to-noise ratio-25 dB)

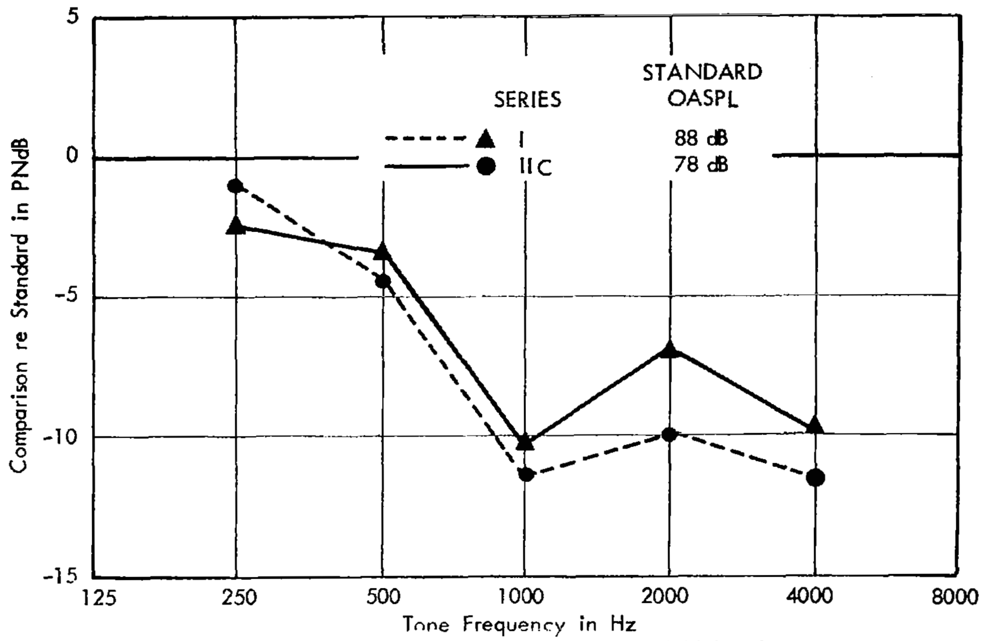
TABLE F-1 -- RESULTS OF TEST III-B (MULTIPLE TONES) USING ACCEPTABILITY/NOISINESS INSTRUCTIONS - Concluded

Stimulus			Comparison 50% Level (Judged Equality Level in dB re Max)
Standard	Comparison		
Noise	Noise	Tone Frequency (Hz)	
Jet[3]	Jet	2500,2800[4]	-19.0
Jet[3]	Jet	2500,5000[5]	-18.0
Jet	Jet	250 thru 4000 with 250 Hz spacing	-13.0

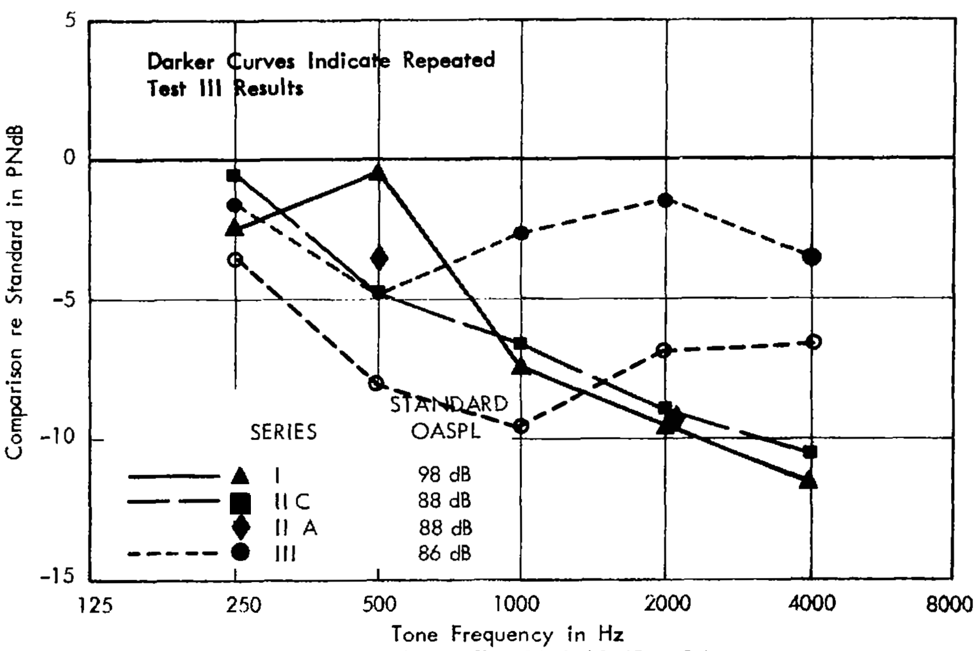
3 Standard level for judgment at 5 dB below that normally used.

4 Tone-to-noise ratio 5 dB at 2500 and 2800.

5 Tone-to-noise ratio 5 dB at 2500 -5 dB at 5000.



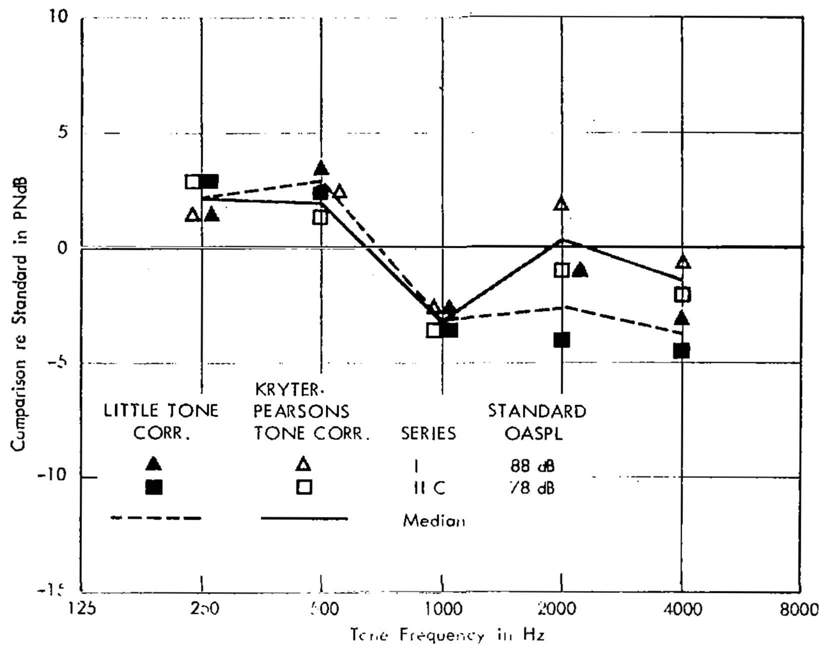
A. BROADBAND NOY NOISE AS STANDARD



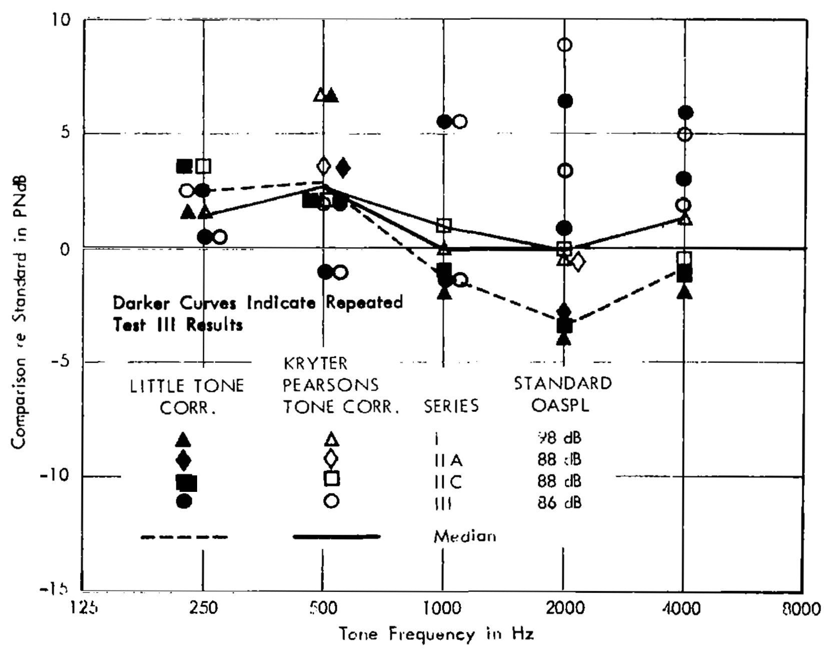
B. BROADBAND JET NOISE AS STANDARD

FIGURE 11. JUDGMENT OF EQUAL NOISINESS FOR DIFFERENT TEST SERIES - SINGLE TONE PLUS BROADBAND NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND NOISE (STANDARD)

FIGURE F-1. RESULTS OF TEST III (Repeated) SHOWN ON FIGURE 11



A. BROADBAND NOY NOISE AS STANDARD



B. BROADBAND JET NOISE AS STANDARD

FIGURE 14. JUDGMENTS OF EQUAL NOISINESS FOR DIFFERENT TEST SERIES CORRECTED FOR PURE TONE CONTENT - SINGLE TONE PLUS BROADBAND NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND NOISE (STANDARD)

FIGURE F-2. RESULTS OF TEST III (Repeated) SHOWN ON FIGURE 14

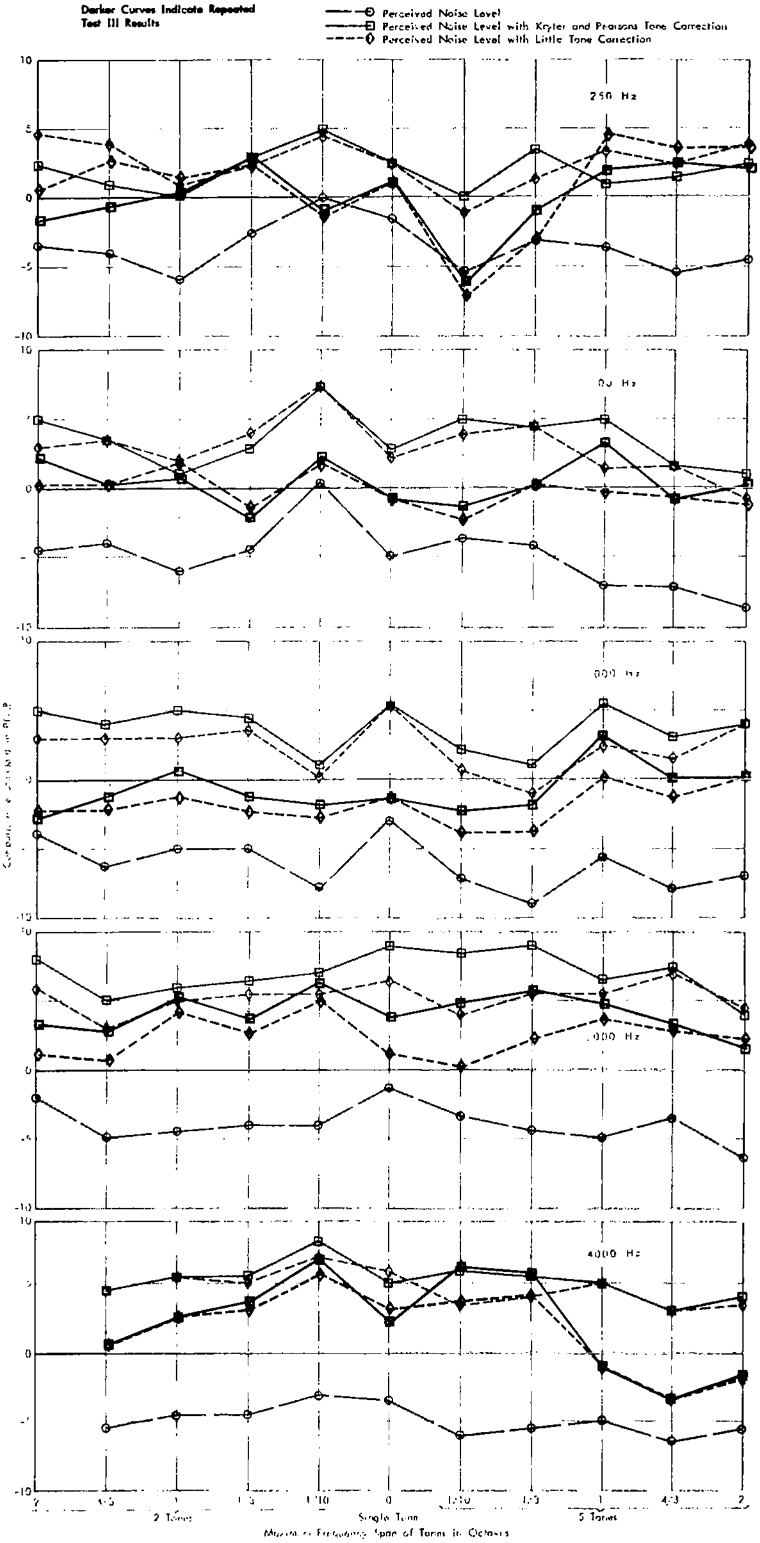


FIGURE 1- JUDGMENTS OF EQUAL NOISINESS - SINGLE AND MULTIPLE TONES IN NOISE, BROADBAND JET NOISE (COMPARISONS) JUDGED EQUAL TO BROADBAND JET NOISE (STANDARD)

FIGURE F-3. RESULTS OF TEST III (Repeated) SHOWN ON FIGURE 19

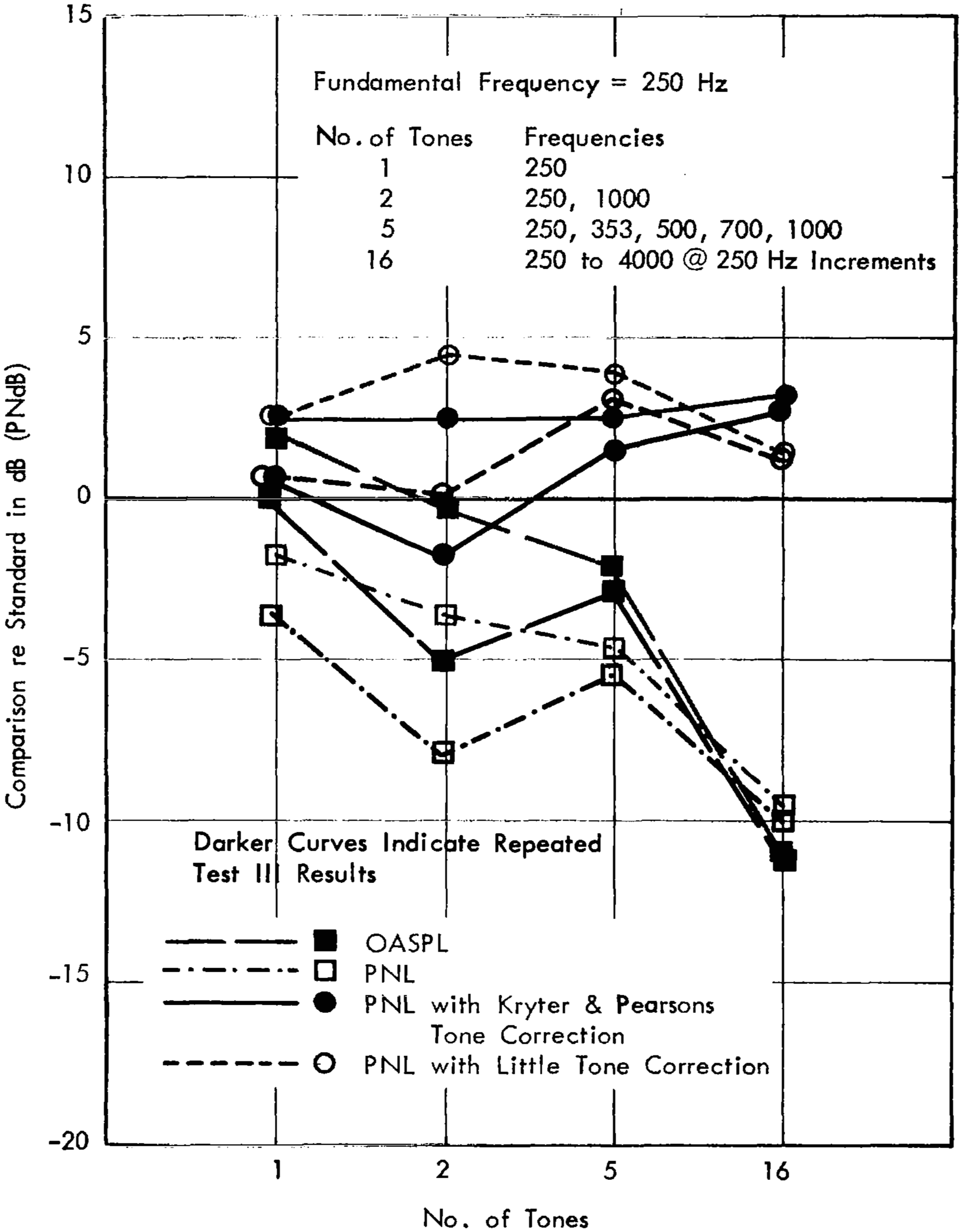


FIGURE 20. JUDGMENTS OF EQUAL NOISINESS - MULTIPLE TONES WITH 250 Hz FUNDAMENTAL IN NOISE (COMPARISON) JUDGED EQUAL TO BROADBAND JET NOISE

FIGURE F-4. RESULTS OF TEST III (Repeated) SHOWN ON FIGURE 20

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