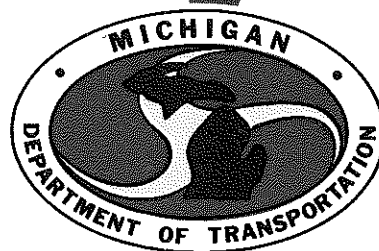
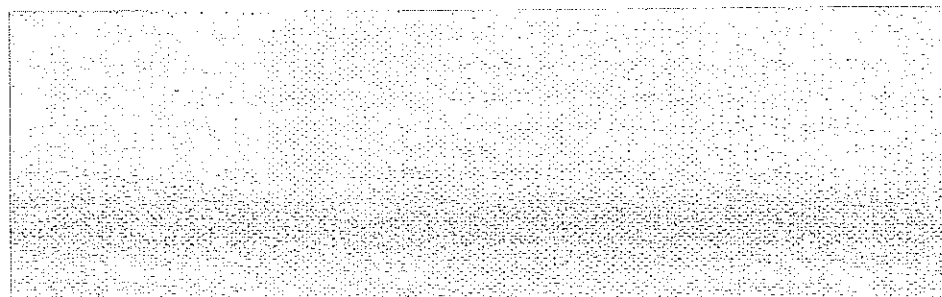


SIMPLIFIED TECHNIQUE FOR  
TRAFFIC NOISE LEVEL ESTIMATION



**TESTING AND RESEARCH DIVISION  
RESEARCH LABORATORY SECTION**



TD 893.6 T7 H37 1981 c. 2  
Simplified technique for  
traffic noise level  
estimation

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SIMPLIFIED TECHNIQUE FOR  
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Research Laboratory Section  
Testing and Research Division  
Research Project 72 G-189  
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Michigan Transportation Commission  
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Lansing, April 1981

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## ABSTRACT

Traffic noise is becoming increasingly detrimental to the quality of our urban and rural environments. Currently, it is the predominant and most widespread source of noise. Design and routing of highways and upgrading of our present facilities must include traffic noise as a consideration.

In city and county areas, there exists a need for predicting noise levels at sites very near to at-grade roadways carrying low speed, low volume traffic. This report is directed to that need.

The noise levels given in this report are state-of-the-art values based upon noise prediction procedures presented in Federal Highway Administration Report No. FHWA-RD-78-138 titled, "FHWA Level 2 Highway Traffic Noise Prediction Model, STAMINA 1.0," May 1979 (1).

This report includes tables with traffic noise levels of  $L_{eq}$  dbA instead of  $L_{10}$  as was included in the previous report (2).

## INTRODUCTION

The common unit for measuring noise is the decibel, abbreviated simply 'db.' The logarithmic decibel scale for sound level was first introduced by communication engineers many years ago. They simply took the logarithm of the amount of power change that occurred in an amplifier or attenuator and named this unit the 'Bell' in honor of Alexander Graham Bell. It was soon found that this unit was far too coarse, and it became common practice to use a unit one-tenth of a Bell, called the decibel.

In sound measurement, decibel levels are related to a reference sound pressure level of 0.0002 dyne/cm<sup>2</sup>. This particular level represents (approximately) the faintest sound that can be heard by the ear of a healthy young adult in an extremely quiet environment.

Therefore, any given decibel level represents the logarithm of the ratio between the sound pressure level of interest and the reference level. It can be seen for example, that a decibel level of 60 refers to a sound pressure one million ( $10^6$ ) times the reference level. In a like manner, a decibel level of 120 (near the pain threshold) represents a pressure which is a million million ( $10^{12}$ ) times the reference level.

Since the human ear detects sound in a nonlinear fashion over the audible frequency range of 16 to 16,000 Hz (cycles per second), the decibel unit must be weighted differently for each frequency. Of the various weightings available, it is accepted that so-called A-weighting, denoted as dbA, is the most practical measure of noise produced by today's highway vehicles. It correlates as well with human judgments of the acceptability of highway noise as do the more elaborate spectral analysis methods.

## TRAFFIC NOISE DESCRIPTOR

Knowledge of the average traffic noise level is not, in itself, necessarily sufficient if one is to define environmental acceptability. Some knowledge of the noise peaks and distribution is also required. Although several concepts have been proposed for characterizing these peaks and distribution, it has been decided that the noisier aspects of the traffic environment can be adequately defined using the temporal unit,  $L_{eq}$ . This is the equivalent steady state sound level which in a stated period of time (an hour in this report) would contain the same acoustic energy as the actual time-varying sound level during the same time period.

Five different procedures for determining the  $L_{eq}$  level have been approved by the Federal Highway Administration (FHWA) in FHPM 7-7-3, "Procedures for Abatement of Highway Traffic Noise and Construction

Noise," effective May 29, 1979. These methods are: 1) nomographs; 2) charts; 3) hand-held calculator programs; 4) Simplified Noise Analysis Procedure (SNAP 1.0) program; and, 5) Standard Method in Noise Analysis (STAMINA 1.0) program as described in FHWA Technical Advisories T 5040.15 (August 20, 1980) and FHWA T 5040.16 (August 22, 1980).

Since some of these methods require access to a computer or calculator and may be more complex than necessary for the preliminary prediction purposes of most city and county groups, it was concluded that a set of tables covering the proper variables would be more appropriate and useful.

The tables presented in this report (Tables 1 through 14) for estimating  $L_{eq}$  (dbA) noise levels were prepared utilizing FHWA Report No. FHWA-RD-78-138, "User's Manual, STAMINA 1.0," (1). This computer program is based on the modified line source model of NCHRP Report Nos. 117 and 144. Use of these tables in predicting  $L_{eq}$  (dbA) noise levels is demonstrated in the Appendix.

The parameters and ranges selected are those which should satisfy most of the noise prediction needs of city and county highway agencies. The parameters and ranges established are:

- 1) DN - Distances between observer and center of near lane of 50 to 150 ft,
- 2) Q - Flow rates of 500 to 5,000 vehicles/hour,
- 3) S - Vehicle speeds of 30, 40, 50, and 60 mph,
- 4) P - Non-divided pavements of 2, 3, 4, and 5 lanes, and
- 5) T - Commercial traffic volumes of 1 to 10 percent.\*

There are several rules-of-thumb for estimating changes in noise levels when only one parameter such as distance (DN) or flow rate (Q) varies. In the case of a modified line source traffic model (as opposed to an individual vehicle point source) we have:

- 1) The doubling of flow rate (Q) increases  $L_{eq}$  by 3 db,
- 2) The doubling of distance (DN) decreases  $L_{eq}$  by 3 db.

---

\* Commercial traffic being defined as both medium and heavy trucks; medium trucks are defined as vehicles with two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 4,500 kilograms (9,900 lb) but less than 12,000 kilograms (26,400 lb). Heavy trucks are defined as vehicles with three or more axles and designed for the transportation of cargo. Generally, the gross weight is greater than 12,000 kilograms (3).

## ADDITION OF NOISE LEVELS

If there are two noise sources and the noise power of each is known, decibel levels cannot be added directly to get the total sound level. Instead, one must convert from decibels to sound pressures, add the pressures, and then reconvert to decibels. For example, if an automobile which is radiating a level of 80 dbA (as measured from some fixed distance) is located next to an identical automobile also radiating 80 dbA, the resultant noise field will have twice the power. This will not produce 160 dbA, but only 83 dbA, as doubling the power adds only 3 dbA to the existing level. If the power is doubled again by adding two more such vehicles, the net result would be 86 dbA. Again doubling (for a total of eight such vehicles) would result in a total of 89 dbA, and further doubling (sixteen vehicles) would add another 3 dbA to the level for a total of 92 dbA. Therefore, in a hypothetical situation it would take 16 automobiles, each emitting 80 dbA to equal one truck which is emitting 92 dbA.

Levels at an observer point receiving noise from two or more different roadway sources, such as a divided city street or in a quadrant of an intersection, can be determined by 'db addition' of the levels from each individual source as discussed in the Appendix.

## ADJUSTMENT FOR NON-UNIFORM TRAFFIC FLOWS

An interrupted flow adjustment of +3 dbA has been specified for observer points near a traffic signal or stop sign. Users of the prediction tables are directed to add 3 dbA to the  $L_{eq}$  values found in the tables whenever the site in question is within 300 ft of a controlled intersection.



TABLE 1  
Leq dba NOISE LEVELS FOR A TWO-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
500 vehicles per hour	60.6	63.5	65.8	67.7	63.0	65.4	67.4	69.1	64.5	66.8	68.6	70.2	66.8	68.9	70.6	72.0	50
Total Traffic Volume 1,000 vehicles per hour	59.3	62.1	64.4	66.4	61.6	64.1	66.1	67.8	63.2	65.4	67.2	68.8	65.5	67.5	69.2	70.6	70
	58.2	61.1	63.4	65.3	60.6	63.0	65.0	66.7	62.1	64.4	66.2	67.8	64.4	66.5	68.2	69.6	90
	57.4	60.2	62.5	64.5	59.7	62.2	64.2	65.9	61.3	63.5	65.4	66.9	63.6	65.7	67.3	68.7	110
	56.7	59.5	61.8	63.8	59.0	61.5	63.5	65.2	60.6	62.8	64.6	66.2	62.9	64.9	66.6	68.0	130
	56.1	58.9	61.2	63.1	58.4	60.8	62.8	64.5	59.9	62.2	64.0	65.6	62.3	64.3	66.0	67.4	150
Total Traffic Volume 1,000 vehicles per hour	63.3	66.2	68.6	70.6	65.8	68.3	70.3	72.0	67.4	69.7	71.5	73.1	69.9	71.9	73.6	75.0	50
	62.0	64.9	67.2	69.2	64.5	66.9	68.9	70.7	66.0	68.3	70.1	71.7	68.5	70.6	72.2	73.6	70
	60.9	63.8	66.2	68.2	63.4	65.9	67.9	69.6	65.0	67.3	69.1	70.7	67.5	69.5	71.2	72.6	90
	60.1	63.0	65.3	67.3	62.6	65.0	67.0	68.8	64.1	66.4	68.3	69.8	66.6	68.7	70.3	71.7	110
	59.4	62.3	64.6	66.6	61.9	64.3	66.3	68.0	63.4	65.7	67.5	69.1	65.9	68.0	69.6	71.0	130
150	58.7	61.7	64.0	66.0	61.2	63.7	65.7	67.4	62.8	65.1	66.9	68.5	65.3	67.3	69.0	70.4	150

TABLE 2  
 $L_{eq}$  dbA NOISE LEVELS FOR A TWO-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
50	65.2	68.1	70.4	72.4	67.6	70.1	72.1	73.8	69.2	71.5	73.3	74.9	71.6	73.7	75.3	76.8	50
70	63.8	66.7	69.1	71.0	66.3	68.7	70.7	72.5	67.8	70.1	71.9	73.5	70.3	72.3	74.0	75.4	70
90	62.8	65.7	68.0	70.0	65.2	67.7	69.7	71.4	66.8	69.1	70.9	72.5	69.2	71.3	72.9	74.3	90
110	61.9	64.8	67.2	69.1	64.4	66.8	68.8	70.6	66.0	68.2	70.1	71.6	68.4	70.4	72.1	73.5	110
130	61.2	64.1	66.5	68.4	63.7	66.1	68.1	69.8	65.2	67.5	69.3	70.9	67.6	69.7	71.4	72.8	130
150	60.6	63.5	65.8	67.8	63.1	65.5	67.5	69.2	64.6	66.9	68.7	70.3	67.0	69.1	70.8	72.2	150
Total Traffic Volume 1,500 vehicles per hour														50			
50	66.3	69.3	71.6	73.6	68.8	71.3	73.3	75.0	70.4	72.7	74.5	76.1	72.9	74.9	76.6	78.0	50
70	65.0	67.9	70.2	72.2	67.5	69.9	71.9	73.7	69.0	71.3	73.2	74.7	71.5	73.6	75.2	76.6	70
90	63.9	66.8	69.2	71.2	66.4	68.9	70.9	72.6	68.0	70.3	72.1	73.7	70.5	72.5	74.2	75.6	90
110	63.1	66.0	68.4	70.3	65.6	68.0	70.1	71.8	67.2	69.4	71.3	72.8	69.6	71.7	73.3	74.7	110
130	62.4	65.3	67.6	69.6	64.9	67.3	69.3	71.1	66.4	68.7	70.6	72.1	68.9	71.0	72.6	74.0	130
150	61.7	64.7	67.0	69.0	64.2	66.7	68.7	70.4	65.8	68.1	69.9	71.5	68.3	70.3	72.0	73.4	150
Total Traffic Volume 2,000 vehicles per hour														50			

TABLE 3  
 $L_{eq}$  dbA NOISE LEVELS FOR A THREE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			15 Percent Commercial			DN, ft	
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph
50	60.3	63.1	65.4	67.4	64.9	66.9	68.6	63.9	66.2	68.0	69.6	66.5	68.6	70.3	71.7	71.7	50
70	59.0	61.8	64.1	66.1	63.6	65.6	67.3	62.6	64.9	66.7	68.3	65.3	67.3	69.0	70.4	70.4	70
90	58.0	60.8	63.1	65.1	62.6	64.6	66.4	61.6	63.9	65.7	67.3	64.3	66.3	68.0	69.4	69.4	90
110	57.2	60.0	62.3	64.3	61.8	63.8	65.5	60.8	63.1	64.9	66.5	63.5	65.5	67.2	68.6	68.6	110
130	56.5	59.3	61.6	63.6	61.1	63.1	64.9	60.1	62.4	64.2	65.8	62.8	64.8	66.5	67.9	67.9	130
150	55.9	58.7	61.0	63.0	60.5	62.5	64.3	59.5	61.8	63.6	65.2	62.2	64.2	65.9	67.3	67.3	150
Total Traffic Volume 500 vehicles per hour																	
50	62.8	65.7	68.1	70.1	65.4	67.9	69.9	71.6	67.1	69.3	71.2	69.4	71.5	73.2	74.6	74.6	50
70	61.5	64.4	66.8	68.8	64.2	66.6	68.6	70.3	65.8	68.1	69.9	68.2	70.2	71.9	73.3	73.3	70
90	60.5	63.5	65.8	67.8	63.2	65.6	67.6	69.4	64.8	67.1	68.9	67.2	69.2	70.9	72.3	72.3	90
110	59.7	62.6	65.0	67.0	62.4	64.8	66.8	64.0	66.3	68.1	69.7	66.4	68.4	70.1	71.5	71.5	110
130	59.0	62.0	64.3	66.3	61.7	64.1	66.1	67.9	63.3	65.6	67.4	65.7	67.7	69.4	70.8	70.8	130
150	58.4	61.4	63.7	65.7	61.1	63.5	65.5	67.3	62.7	65.0	66.8	65.1	67.1	68.8	70.2	70.2	150
Total Traffic Volume 1,000 vehicles per hour																	

TABLE 4  
 $L_{eq}$  dbA NOISE LEVELS FOR A THREE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft			
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph		
50	64.7	67.6	70.0	72.0	69.7	71.7	73.4	68.8	71.0	72.9	74.5	71.2	73.3	75.0	76.4	50
70	63.4	66.3	68.7	70.7	68.4	70.4	72.1	67.5	69.8	71.6	73.2	70.0	72.0	73.7	75.1	70
90	62.4	65.3	67.7	69.7	67.4	69.4	71.1	66.5	68.8	70.6	72.2	69.0	71.0	72.7	74.1	90
110	61.6	64.5	66.9	68.9	64.1	66.6	70.3	65.7	68.0	69.8	71.4	68.2	70.2	71.9	73.3	110
130	60.9	63.9	66.2	68.2	63.4	65.9	69.6	65.0	67.3	69.1	70.7	67.5	69.5	71.2	72.6	130
150	60.3	63.3	65.6	67.6	62.8	65.3	69.0	64.4	66.7	68.5	70.1	66.9	68.9	70.6	72.0	150
50	66.0	68.9	71.3	73.2	68.5	70.9	72.9	74.6	70.0	72.3	74.1	72.5	74.6	76.2	77.6	50
70	64.8	67.7	70.0	72.0	67.2	69.6	71.6	73.4	68.7	71.0	72.8	71.2	73.3	74.9	76.4	70
90	63.8	66.7	69.0	71.0	66.2	68.6	70.7	72.4	67.7	70.0	71.8	70.2	72.3	74.0	75.4	90
110	63.0	65.9	68.2	70.2	65.4	67.8	69.8	71.6	66.9	69.2	71.0	69.4	71.5	73.1	74.6	110
130	62.3	65.2	67.5	69.5	64.7	67.1	69.2	70.9	66.2	68.5	70.3	68.7	70.8	72.5	73.9	130
150	61.7	64.6	66.9	68.9	64.1	66.5	68.6	70.3	65.6	67.9	69.7	68.1	70.2	71.9	73.3	150

Total Traffic Volume  
 1,500 vehicles per hour  
 2,000 vehicles per hour

TABLE 5  
 Leq dbA NOISE LEVELS FOR A THREE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	60 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
50	66.9	69.8	72.1	74.1	69.4	71.9	73.9	75.6	71.0	73.3	75.1	76.7	73.4	75.5	77.2	78.6	50
70	65.6	68.5	70.9	72.9	68.1	70.6	72.6	74.3	69.7	72.0	73.9	75.4	72.2	74.2	75.9	77.3	70
90	64.6	67.5	69.9	71.9	67.2	69.6	71.6	73.3	68.8	71.0	72.9	74.4	71.2	73.2	74.9	76.3	90
110	63.8	66.7	69.1	71.1	66.3	68.8	70.8	72.5	67.9	70.2	72.1	73.6	70.4	72.4	74.1	75.5	110
130	63.1	66.0	68.4	70.4	65.7	68.1	70.1	71.8	67.3	69.5	71.4	72.9	69.7	71.7	73.4	74.9	130
150	62.5	65.4	67.8	69.8	65.1	67.5	69.5	71.2	66.7	68.9	70.8	72.3	69.1	71.1	72.8	74.2	150
Total Traffic Volume																	
50	67.7	70.6	73.0	75.0	70.2	72.7	74.7	76.4	71.8	74.0	75.9	77.5	74.2	76.3	78.0	79.4	50
70	66.4	69.3	71.7	73.7	68.9	71.4	73.4	75.1	70.5	72.8	74.6	76.2	73.0	75.0	76.7	78.1	70
90	65.4	68.4	70.7	72.7	67.9	70.4	72.4	74.1	69.5	71.8	73.6	75.2	72.0	74.0	75.7	77.1	90
110	64.6	67.5	69.9	71.9	67.1	69.6	71.6	73.3	68.7	71.0	72.8	74.4	71.2	73.2	74.7	76.3	110
130	63.9	66.9	69.2	71.2	66.4	68.9	70.9	72.6	68.0	70.3	72.1	73.7	70.5	72.5	74.2	75.6	130
150	63.3	66.3	68.6	70.6	65.8	68.3	70.3	72.0	67.4	69.7	71.5	73.1	69.9	71.9	73.6	75.0	150
Total Traffic Volume																	
50	66.9	69.8	72.1	74.1	69.4	71.9	73.9	75.6	71.0	73.3	75.1	76.7	73.4	75.5	77.2	78.6	50
70	65.6	68.5	70.9	72.9	68.1	70.6	72.6	74.3	69.7	72.0	73.9	75.4	72.2	74.2	75.9	77.3	70
90	64.6	67.5	69.9	71.9	67.2	69.6	71.6	73.3	68.8	71.0	72.9	74.4	71.2	73.2	74.9	76.3	90
110	63.8	66.7	69.1	71.1	66.3	68.8	70.8	72.5	67.9	70.2	72.1	73.6	70.4	72.4	74.1	75.5	110
130	63.1	66.0	68.4	70.4	65.7	68.1	70.1	71.8	67.3	69.5	71.4	72.9	69.7	71.7	73.4	74.9	130
150	62.5	65.4	67.8	69.8	65.1	67.5	69.5	71.2	66.7	68.9	70.8	72.3	69.1	71.1	72.8	74.2	150

TABLE 6  
 $L_{eq}$  dbA NOISE LEVELS FOR A FOUR-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial					3 Percent Commercial					5 Percent Commercial					10 Percent Commercial					DN, ft			
	30 mph	40 mph	50 mph	60 mph	70.0 mph	30 mph	40 mph	50 mph	60 mph	71.4 mph	30 mph	40 mph	50 mph	60 mph	70.9 mph	30 mph	40 mph	50 mph	60 mph	72.5 mph		30 mph	40 mph	50 mph
Total Traffic Volume 1,000 vehicles per hour	50	62.9	65.8	68.1	70.0	65.3	67.7	69.7	71.4	66.8	69.1	70.9	72.5	69.1	71.2	72.9	74.3	50						
	70	61.7	64.6	66.9	68.8	64.1	66.5	68.5	70.2	65.6	67.8	69.7	71.3	67.9	70.0	71.7	73.1	70						
	90	60.8	63.6	65.9	67.9	63.1	65.6	67.6	69.3	64.7	66.9	68.7	70.3	67.0	69.0	70.7	72.1	90						
	110	60.0	62.8	65.1	67.1	62.4	64.8	66.8	68.5	63.9	66.1	68.0	69.5	66.2	68.3	69.9	71.3	110						
	130	59.3	62.2	64.5	66.4	61.7	64.1	66.1	67.8	63.2	65.5	67.3	68.9	65.5	67.6	69.3	70.7	130						
	150	58.8	61.6	63.9	65.8	61.1	63.5	65.5	67.2	62.6	64.9	66.7	68.3	65.0	67.0	68.7	70.1	150						
Total Traffic Volume 1,500 vehicles per hour	50	64.5	67.4	69.7	71.7	66.8	69.3	71.3	73.0	68.5	70.7	72.6	74.2	70.9	73.0	74.7	76.1	50						
	70	63.3	66.2	68.5	70.5	65.6	68.1	70.1	71.8	67.3	69.5	71.4	73.0	69.7	71.8	73.5	74.9	70						
	90	62.3	65.2	67.5	69.5	64.6	67.1	69.1	70.9	66.3	68.6	70.4	72.0	68.8	70.9	72.5	73.9	90						
	110	61.5	64.4	66.8	68.7	63.9	66.3	68.4	70.1	65.5	67.8	69.7	71.2	68.0	70.1	71.7	73.1	110						
	130	60.9	63.8	66.1	68.1	63.2	65.7	67.7	69.4	64.9	67.1	69.0	70.6	67.3	69.4	71.1	72.5	130						
	150	60.3	63.2	65.5	67.5	62.6	65.1	67.1	68.8	64.3	66.6	68.4	70.0	66.8	68.8	70.5	71.9	150						

TABLE 7  
 $L_{eq}$  dbA NOISE LEVELS FOR A FOUR-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft																		
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph																	
50	65.6	68.5	70.9	72.9	68.1	70.6	72.6	74.3	69.7	71.9	73.8	75.4	72.1	74.2	75.9	77.3	50														
70	64.4	67.3	69.7	71.7	66.9	69.4	71.4	73.1	68.5	70.7	72.6	74.2	70.9	73.0	74.7	76.1	70														
90	63.5	66.4	68.7	70.7	66.0	68.4	70.4	72.1	67.5	69.8	71.6	73.2	70.0	72.1	73.7	75.1	90														
110	62.7	65.6	68.0	69.9	65.2	67.6	69.6	71.4	66.8	69.0	70.9	72.4	69.2	71.3	72.9	74.3	110														
130	62.0	64.9	67.3	69.3	64.5	67.0	69.0	70.7	66.1	68.4	70.2	71.8	68.5	70.6	72.3	73.7	130														
150	61.4	64.4	66.7	68.7	63.9	66.4	68.4	70.1	65.5	67.8	69.6	71.2	68.0	70.0	71.7	73.1	150														
Total Traffic Volume 2,000 vehicles per hour														50	66.5	69.4	71.8	73.8	69.1	71.6	73.6	75.3	70.6	72.9	74.7	76.3	73.1	75.1	76.8	78.2	50
Total Traffic Volume 2,500 vehicles per hour														70	65.3	68.2	70.6	72.6	67.9	70.4	72.4	74.1	69.4	71.7	73.5	75.1	71.9	73.9	75.6	77.0	70
Total Traffic Volume 2,500 vehicles per hour														90	64.4	67.3	69.7	71.6	67.0	69.4	71.4	73.1	68.5	70.7	72.6	74.2	70.9	73.0	74.7	76.1	90
Total Traffic Volume 2,500 vehicles per hour														110	63.6	66.5	68.9	70.9	66.2	68.6	70.6	72.4	67.7	70.0	71.8	73.4	70.2	72.2	73.9	75.3	110
Total Traffic Volume 2,500 vehicles per hour														130	62.9	65.8	68.2	70.2	65.5	68.0	70.0	71.7	67.0	69.3	71.2	72.7	69.5	71.6	73.2	74.6	130
Total Traffic Volume 2,500 vehicles per hour														150	62.3	65.3	67.6	69.6	64.9	67.4	69.4	71.1	66.5	68.7	70.6	72.2	68.9	71.0	72.6	74.0	150

TABLE 8  
 $L_{eq}$  dbA NOISE LEVELS FOR A FOUR-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
50	67.5	70.4	72.7	74.7	69.9	72.4	74.4	76.1	71.5	73.7	75.6	77.2	73.9	76.0	77.6	79.0	50
70	66.3	69.2	71.5	73.5	68.7	71.2	73.2	74.9	70.3	72.5	74.4	76.0	72.7	74.8	76.4	77.8	70
90	65.3	68.2	70.6	72.5	67.8	70.2	72.2	73.9	69.3	71.6	73.4	75.0	71.8	73.8	75.5	76.9	90
110	64.6	67.4	69.8	71.8	67.0	69.4	71.5	73.2	68.6	70.8	72.7	74.2	71.0	73.0	74.7	76.1	110
130	63.9	66.8	69.1	71.1	66.3	68.8	70.8	72.5	67.9	70.2	72.0	73.6	70.3	72.4	74.0	75.4	130
150	63.3	66.2	68.5	70.5	65.8	68.2	70.2	71.9	67.3	69.6	71.4	73.0	69.7	71.8	73.5	74.9	150
Total Traffic Volume													3,500 vehicles per hour	50			
50	68.1	71.0	73.3	75.3	70.5	73.0	75.0	76.7	72.1	74.4	76.2	77.8	74.6	76.7	78.3	79.7	50
70	66.9	69.8	72.1	74.1	69.3	71.8	73.8	75.5	70.9	73.2	75.0	76.6	73.4	75.4	77.1	78.5	70
90	65.9	68.8	71.2	73.2	68.4	70.8	72.8	74.6	70.0	72.2	74.1	75.7	72.4	74.5	76.2	77.6	90
110	65.2	68.1	70.4	72.4	67.6	70.0	72.1	73.8	69.2	71.5	73.3	74.9	71.7	73.7	75.4	76.8	110
130	64.5	67.4	69.7	71.7	66.9	69.4	71.4	73.1	68.5	70.8	72.6	74.2	71.0	73.1	74.7	76.1	130
150	63.9	66.8	69.2	71.1	66.3	68.8	70.8	72.5	68.0	70.2	72.1	73.6	70.4	72.5	74.1	75.6	150



TABLE 9  
 $L_{eq}$  dbA NOISE LEVELS FOR A FOUR-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
50	68.6	71.5	73.9	75.9	71.1	73.6	75.6	77.3	72.7	75.0	76.8	78.4	75.2	77.2	78.9	80.3	50
70	67.4	70.3	72.7	74.7	69.9	72.4	74.4	76.1	71.5	73.8	75.6	77.2	73.9	76.0	77.7	79.1	70
90	66.5	69.4	71.7	73.7	69.0	71.4	73.4	75.2	70.5	72.8	74.7	76.2	73.0	75.1	76.7	78.1	90
110	65.7	68.6	71.0	72.9	68.2	70.6	72.7	74.4	69.8	72.0	73.9	75.5	72.2	74.3	75.9	77.4	110
130	65.0	67.9	70.3	72.3	67.5	70.0	72.0	73.7	69.1	71.4	73.2	74.8	71.6	73.6	75.3	76.7	130
150	64.4	67.4	69.7	71.7	66.9	69.4	71.4	73.1	68.5	70.8	72.6	74.2	71.0	73.0	74.7	76.1	150
Total Traffic Volume														4,500 vehicles per hour			
50	69.1	72.0	74.4	76.4	71.7	74.1	76.1	77.8	73.2	75.5	77.3	78.9	75.6	77.7	79.4	80.8	50
70	67.9	70.8	73.2	75.2	70.4	72.9	74.9	76.6	72.0	74.2	76.1	77.7	74.4	76.5	78.2	79.6	70
90	66.9	69.9	72.2	74.2	69.5	72.0	74.0	75.7	71.0	73.3	75.2	76.7	73.5	75.6	77.2	78.6	90
110	66.2	69.1	71.5	73.4	68.7	71.2	73.2	74.9	70.3	72.5	74.4	76.0	72.7	74.8	76.4	77.9	110
130	65.5	68.4	70.8	72.8	68.1	70.5	72.5	74.2	69.6	71.9	73.7	75.3	72.1	74.1	75.8	77.2	130
150	64.9	67.8	70.2	72.2	67.5	69.9	71.9	73.7	69.0	71.3	73.1	74.7	71.5	73.5	75.2	76.6	150

TABLE 10  
 $L_{eq}$  dbA NOISE LEVELS FOR A FIVE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
50	62.3	65.2	67.6	69.6	64.8	67.3	69.3	71.0	66.4	68.6	70.5	72.1	68.8	70.9	72.6	74.0	50
70	61.1	64.1	66.4	68.4	63.6	66.1	68.1	69.8	65.2	67.5	69.3	70.9	67.7	69.7	71.4	72.8	70
90	60.2	63.2	65.5	67.5	62.7	65.2	67.2	68.9	64.3	66.6	68.4	70.0	66.8	68.8	70.5	71.9	90
110	59.5	62.4	64.8	66.7	62.0	64.4	66.5	68.2	63.6	65.8	67.7	69.3	66.0	68.1	69.7	71.2	110
130	58.8	61.8	64.1	66.1	61.3	63.8	65.8	67.5	62.9	65.2	67.0	68.6	65.4	67.4	69.1	70.5	130
150	58.3	61.2	63.6	65.5	60.8	63.2	65.3	67.0	62.4	64.6	66.5	68.0	64.8	66.9	68.5	69.9	150
50	64.1	67.0	69.3	71.3	66.6	69.0	71.0	72.7	68.1	70.4	72.2	73.8	70.6	72.7	74.3	75.7	50
70	62.9	65.8	68.2	70.2	65.4	67.9	69.9	71.6	67.0	69.2	71.1	72.7	69.4	71.5	73.2	74.6	70
90	62.0	64.9	67.3	69.3	64.5	67.0	69.0	70.7	66.1	68.3	70.2	71.8	68.5	70.6	72.3	73.7	90
110	61.2	64.2	66.5	68.5	63.7	66.2	68.2	69.9	65.3	67.6	69.4	71.0	67.8	69.8	71.5	72.9	110
130	60.6	63.5	65.9	67.9	63.1	65.6	67.6	69.3	64.7	66.9	68.8	70.4	67.1	69.2	70.9	72.3	130
150	60.0	63.0	65.3	67.3	62.5	65.0	67.0	68.7	64.1	66.4	68.2	69.8	66.6	68.6	70.3	71.7	150

Total Traffic Volume  
 1,000 vehicles per hour

Total Traffic Volume  
 1,500 vehicles per hour

TABLE 11  
 $L_{eq}$  dbA NOISE LEVELS FOR A FIVE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
	Total Traffic Volume																
50	65.3	68.2	70.6	72.6	67.8	70.3	72.3	74.0	69.4	71.6	73.5	75.1	71.8	73.9	75.6	77.0	50
70	64.2	67.1	69.4	71.4	66.7	69.1	71.1	72.8	68.2	70.5	72.3	73.9	70.7	72.8	74.4	75.8	70
90	63.2	66.2	68.5	70.5	65.7	68.2	70.2	71.9	67.3	69.6	71.4	73.0	69.8	71.8	73.5	74.9	90
110	62.5	65.4	67.8	69.8	65.0	67.5	69.5	71.2	66.6	68.8	70.7	72.3	69.0	71.1	72.8	74.2	110
130	61.9	64.8	67.1	69.1	64.4	66.8	68.8	70.5	65.9	68.2	70.0	71.6	68.4	70.4	72.1	73.5	130
150	61.3	64.2	66.6	68.5	63.8	66.2	68.3	70.0	65.4	67.6	69.5	71.1	67.8	69.9	71.5	73.0	150
50	66.3	69.2	71.5	73.5	68.8	71.2	73.2	75.0	70.4	72.6	74.5	76.0	72.8	74.9	76.5	77.9	50
70	65.1	68.0	70.4	72.4	67.6	70.1	72.1	73.8	69.2	71.5	73.3	74.9	71.7	73.7	75.4	76.8	70
90	64.2	67.1	69.5	71.5	66.7	69.2	71.2	72.9	68.3	70.6	72.4	74.0	70.7	72.8	74.5	75.9	90
110	63.5	66.4	68.7	70.7	66.0	68.4	70.4	72.2	67.5	69.8	71.7	73.2	70.0	72.1	73.7	75.1	110
130	62.8	65.7	68.1	70.1	65.3	67.8	69.8	71.5	66.9	69.2	71.0	72.6	69.4	71.4	73.1	74.5	130
150	62.3	65.2	67.5	69.5	64.8	67.2	69.2	70.9	66.3	68.6	70.4	72.0	68.8	70.9	72.5	73.9	150

TABLE 12  
 $L_{eq}$  dbA NOISE LEVELS FOR A FIVE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft				
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph			
50	67.1	70.0	72.3	74.3	69.6	72.0	74.0	75.8	71.1	73.4	75.3	76.8	73.6	75.7	77.3	78.7	50
70	65.9	68.8	71.2	73.2	68.4	70.9	72.9	74.6	70.0	72.3	74.1	75.7	72.4	74.5	76.2	77.6	70
90	65.0	67.9	70.3	72.3	67.5	70.0	72.0	73.7	69.1	71.3	73.2	74.8	71.5	73.6	75.3	76.7	90
110	64.3	67.2	69.5	71.5	66.8	69.2	71.2	72.9	68.3	70.6	72.4	74.0	70.8	72.9	74.5	75.9	110
130	63.6	66.5	68.9	70.9	66.1	68.6	70.6	72.3	67.7	70.0	71.8	73.4	70.1	72.2	73.9	75.3	130
150	63.1	66.0	68.3	70.3	65.6	68.0	70.0	71.7	67.1	69.4	71.2	72.8	69.6	71.6	73.3	74.7	150
Total Traffic Volume 3,000 vehicles per hour														50			
50	67.7	70.7	73.0	75.0	70.2	72.7	74.7	76.4	71.8	74.1	75.9	77.5	74.3	76.3	78.0	79.4	50
70	66.6	69.5	71.9	73.8	69.1	71.5	73.6	75.3	70.7	72.9	74.8	76.4	73.1	75.2	76.8	78.3	70
90	65.7	68.6	71.0	72.9	68.2	70.6	72.6	74.4	69.8	72.0	73.9	75.4	72.2	74.3	75.9	77.3	90
110	64.9	67.8	70.2	72.2	67.4	69.9	71.9	73.6	69.0	71.3	73.1	74.7	71.5	73.5	75.2	76.6	110
130	64.3	67.2	69.6	71.5	66.8	69.2	71.3	73.0	68.4	70.6	72.5	74.1	70.8	72.9	74.5	76.0	130
150	63.7	66.6	69.0	71.0	66.2	68.7	70.7	72.4	67.8	70.1	71.9	73.5	70.3	72.3	74.0	75.4	150
Total Traffic Volume 3,500 vehicles per hour														50			

TABLE 13  
 $L_{eq}$  dba NOISE LEVELS FOR A FIVE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			DN, ft					
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph				
Total Traffic Volume 4,500 vehicles per hour	50	68.3	71.2	73.6	75.6	70.8	73.3	75.3	77.0	72.4	74.7	76.5	78.1	74.8	76.9	78.6	80.0	50
	70	67.2	70.1	72.4	74.4	69.7	72.1	74.1	75.9	71.2	73.5	75.4	76.9	73.7	75.8	77.4	78.8	70
	90	66.3	69.2	71.5	73.5	68.8	71.2	73.2	74.9	70.3	72.6	74.4	76.0	72.8	74.9	76.5	77.9	90
	110	65.5	68.4	70.8	72.8	68.0	70.5	72.5	74.2	69.6	71.8	73.7	75.3	72.0	74.1	75.8	77.2	110
	130	64.9	67.8	70.1	72.1	67.4	69.8	71.8	73.6	68.9	71.2	73.1	74.6	71.4	73.5	75.1	76.5	130
Total Traffic Volume 4,000 vehicles per hour	50	64.3	67.2	69.6	71.6	66.8	69.3	71.3	73.0	68.4	70.6	72.5	74.1	70.8	72.9	74.6	76.0	150
	70	68.8	71.7	74.1	76.1	71.3	73.8	75.8	77.5	72.9	75.2	77.0	78.6	75.4	77.4	79.1	80.5	50
	90	67.7	70.6	72.9	74.9	70.2	72.6	74.6	76.4	71.8	74.0	75.9	77.4	74.2	76.3	77.9	79.3	70
	110	66.8	69.7	72.0	74.0	69.3	71.7	73.7	75.5	70.8	73.1	75.0	76.5	73.3	75.4	77.0	78.4	90
	130	66.0	68.9	71.3	73.3	68.5	71.0	73.0	74.7	70.1	72.4	74.2	75.8	72.6	74.6	76.3	77.7	110
Total Traffic Volume 4,500 vehicles per hour	130	65.4	68.3	70.6	72.6	67.9	70.3	72.3	74.1	69.5	71.7	73.6	75.1	71.9	74.0	75.6	77.0	130
	150	64.8	67.7	70.1	72.1	67.3	69.8	71.8	73.5	68.9	71.2	73.0	74.6	71.3	73.4	75.1	76.5	150

TABLE 14  
 Leq dbA NOISE LEVELS FOR A FIVE-LANE AT-GRADE ROADWAY

DN, ft	1 Percent Commercial			3 Percent Commercial			5 Percent Commercial			10 Percent Commercial			15 Percent Commercial			DN, ft	
	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph	30 mph	40 mph	50 mph		60 mph
50	69.3	72.2	74.6	76.5	71.8	74.2	76.3	78.0	73.4	75.6	77.5	79.1	75.8	77.9	79.5	81.0	50
70	68.1	71.0	73.4	75.4	70.6	73.1	75.1	76.8	72.2	74.5	76.3	77.9	74.7	76.7	78.4	79.8	70
90	67.2	70.1	72.5	74.5	69.7	72.2	74.2	75.9	71.3	73.6	75.4	77.0	73.8	75.8	77.5	78.9	90
110	66.5	69.4	71.7	73.7	69.0	71.4	73.4	75.2	70.6	72.8	74.7	76.2	73.0	75.1	76.7	78.1	110
130	65.8	68.7	71.1	73.1	68.3	70.8	72.8	74.5	69.9	72.2	74.0	75.6	72.4	74.4	76.1	77.5	130
150	65.3	68.2	70.5	72.5	67.8	70.2	72.2	74.0	69.3	71.6	73.5	75.0	71.8	73.9	75.5	76.9	150

Total Traffic Volume  
 5,000 vehicles per hour

## REFERENCES

1. Rudder, F. F., Jr., "User's Manual: FHWA Level 2 Highway Traffic Noise Prediction Model, STAMINA 1.0," Prepared for the U. S. Department of Transportation, Federal Highway Administration Report No. FHWA-RD-78-138, May 1979.
2. Grove, G. H., "Simplified Technique for Traffic Noise Level Estimation," Michigan Department of Transportation, Research Laboratory Report No. R-946, December 1974.
3. "Highway Capacity Manual, 1965," Highway Research Board, Special Report 87.

## APPENDIX

1. Examples for predicting noise levels.
2. Addition of decibel levels.



## USING THE TABLES TO PREDICT $L_{eq}$ dbA NOISE LEVELS

### EXAMPLE 1

Given a two-lane at-grade roadway with a total traffic volume of 1,200 vehicles per hour traveling at 55 mph with a 5 percent commercial traffic volume; the receiver is 50 ft from the center of the near lane; and, the site is located 175 ft from a controlled intersection.

From Table 1:  $Q = 1000$ ,  $S = 50$ ,  $T = 5$  percent,  $DN = 50$ ;  $L_{eq} = 71.5$  dbA

Table 2:  $Q = 1500$ ,  $S = 50$ ,  $T = 5$  percent,  $DN = 50$ ;  $L_{eq} = 73.3$  dbA

Interpolating for  $Q1200$  gives a factor of  $2/5$  of the difference between  $Q1000$  and  $Q1500$ .

Therefore:  $L_{eq}$  for  $Q1200 = 71.5 + 2/5 (73.3 - 71.5) = 72.2$  dbA.

Since the site is located within 300 ft of a controlled intersection, 3 db is added.

$$L_{eq} = 75 \text{ dbA}^*$$

\* Due to the method of approximation  $L_{eq}$  values should be rounded to the nearest decibel.

## EXAMPLE 2

Given a four-lane at-grade roadway with a total traffic volume of 3,750 vehicles per hour traveling at 50 mph with a 7 percent commercial traffic volume; and, the receiver is 90 ft from the center of the near lane.

From Table 8:  $Q = 3500$ ,  $S = 50$ ,  $T = 5$  percent,  $DN = 90$ ;  $L_{eq} = 74.1$  dbA

Table 9:  $Q = 4000$ ,  $S = 50$ ,  $T = 5$  percent,  $DN = 90$ ;  $L_{eq} = 74.7$  dbA

Interpolating for  $Q3750$  gives a factor of  $1/2$  of the difference between  $Q3500$  and  $Q4000$ .

Therefore:  $L_{eq}$  for  $Q3750$  and  $T = 5$  percent =  $74.1 + 1/2 (74.7 - 74.1) = 74.4$  dbA.

Table 8:  $Q = 3500$ ,  $S = 50$ ,  $T = 10$  percent,  $DN = 90$ ;  $L_{eq} = 76.2$  dbA

Table 9:  $Q = 4000$ ,  $S = 50$ ,  $T = 10$  percent,  $DN = 90$ ;  $L_{eq} = 76.7$  dbA

Using the interpolation factor for  $Q3750$  as above.

Therefore:  $L_{eq}$  for  $Q3750$  and  $T = 10$  percent =  $76.2 + 1/2 (76.7 - 76.2) = 76.4$  dbA.

Interpolation factor for  $T = 7$  percent is  $2/5$ .

Therefore:  $L_{eq}$  for  $Q3750$  and  $T = 7$  percent =  $74.4 + 2/5 (76.4 - 74.4) = 75.2$  dbA.

$$L_{eq} = 75 \text{ dbA}^*$$

\* Due to the method of approximation  $L_{eq}$  values should be rounded to the nearest decibel.

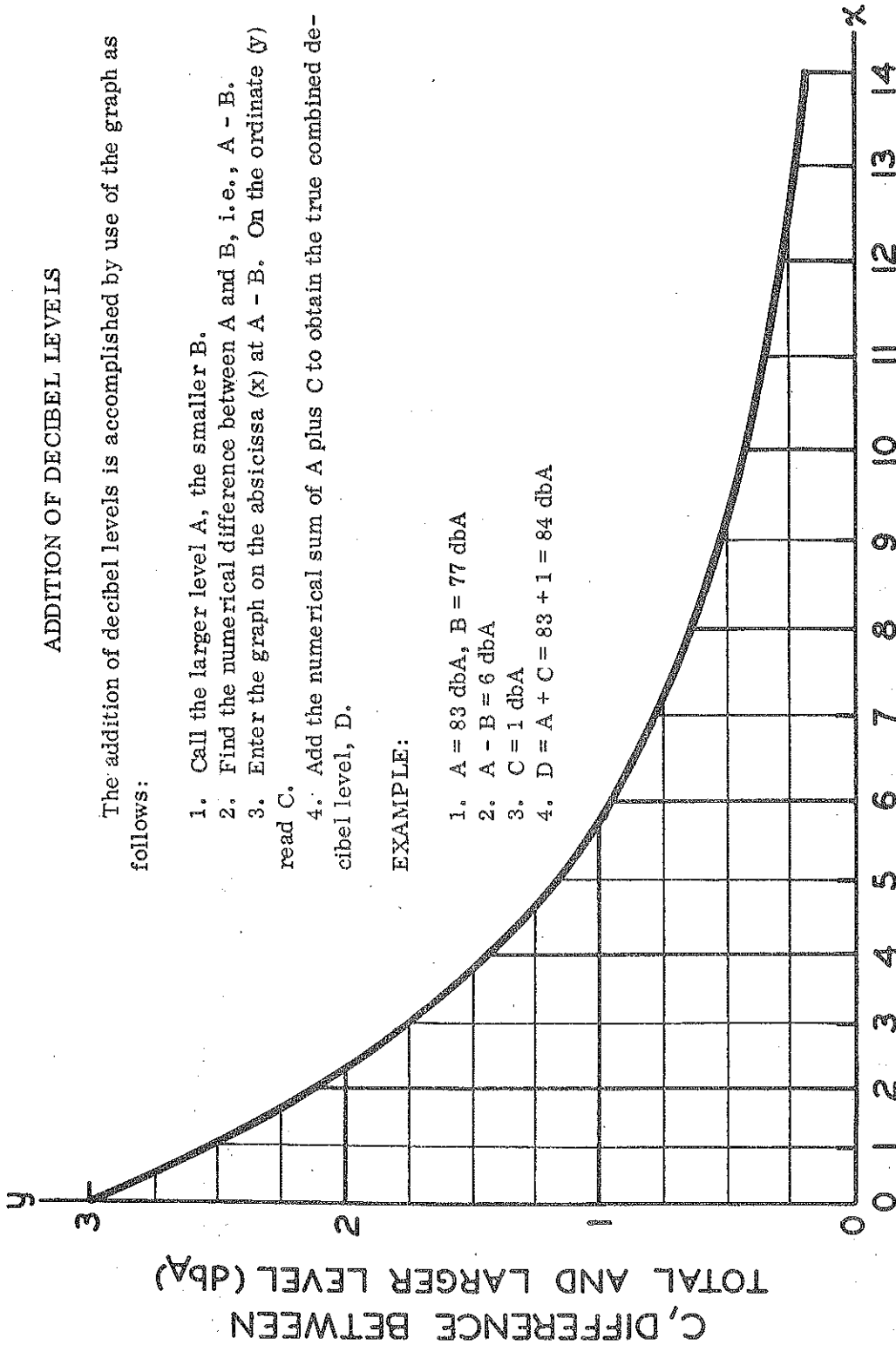
## ADDITION OF DECIBEL LEVELS

The addition of decibel levels is accomplished by use of the graph as follows:

1. Call the larger level A, the smaller B.
2. Find the numerical difference between A and B, i.e.,  $A - B$ .
3. Enter the graph on the abscissa (x) at  $A - B$ . On the ordinate (y) read C.
4. Add the numerical sum of A plus C to obtain the true combined decibel level, D.

**EXAMPLE:**

1.  $A = 83 \text{ dbA}$ ,  $B = 77 \text{ dbA}$
2.  $A - B = 6 \text{ dbA}$
3.  $C = 1 \text{ dbA}$
4.  $D = A + C = 83 + 1 = 84 \text{ dbA}$



**A-B, DIFFERENCE BETWEEN TWO LEVELS BEING ADDED (dbA)**