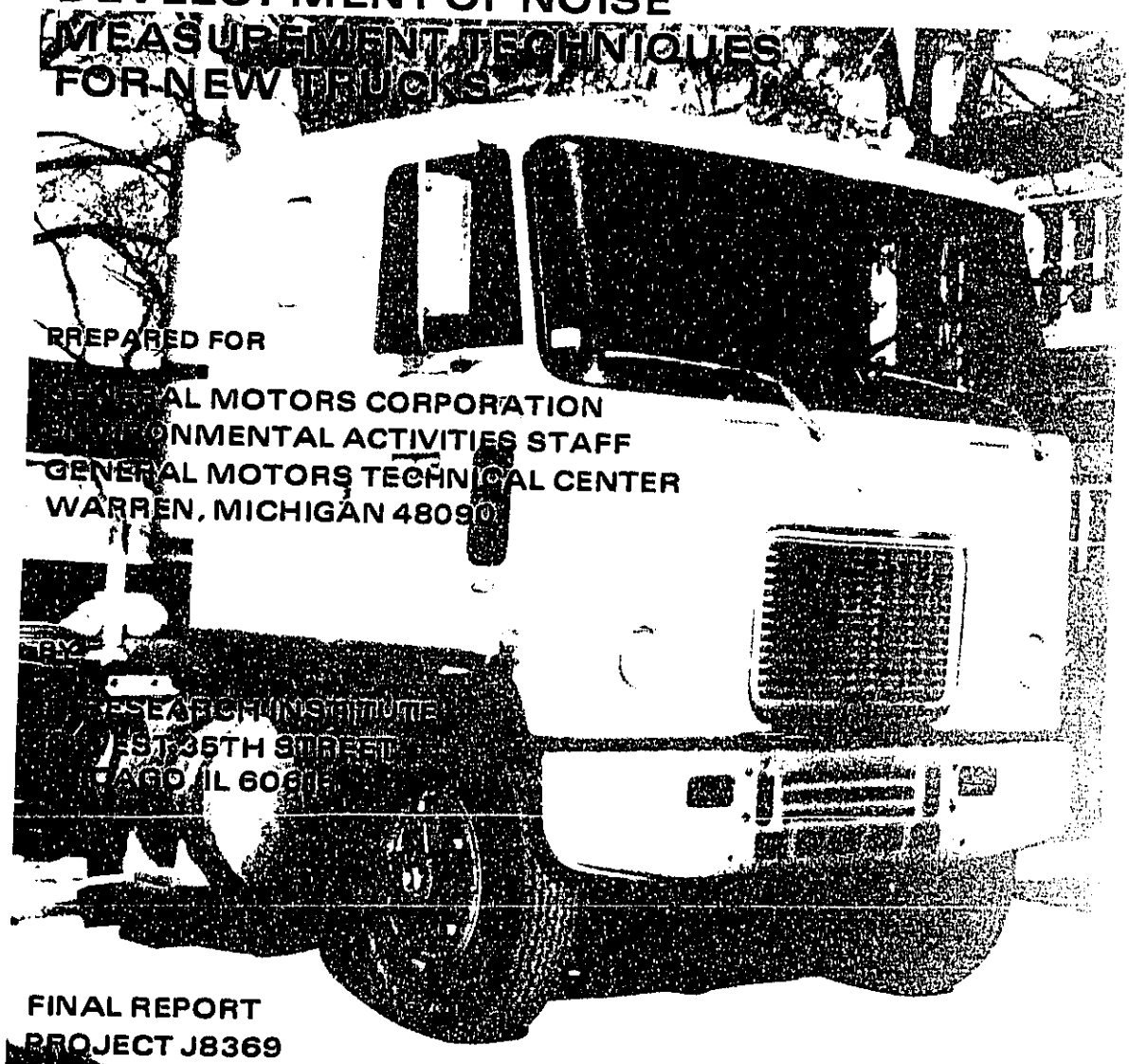
II-96-01
II-A-418

DEVELOPMENT OF NOISE MEASUREMENT TECHNIQUES FOR NEW TRUCKS



PREPARED FOR

AL MOTORS CORPORATION
NMENTAL ACTIVITIES STAFF
GENERAL MOTORS TECHNICAL CENTER
WARREN, MICHIGAN 48090

RESEARCH INSTITUTE
EST 35TH STREET
AGO, IL 60616

FINAL REPORT
PROJECT J8369
FEBRUARY 1980

Engineering Research Division
IIT Research Institute
10 West 35th Street
Chicago, Illinois 60616

IITRI Project J8369

DEVELOPMENT OF NOISE MEASUREMENT TECHNIQUES FOR NEW TRUCKS

Final Report

April, 1980

Prepared by

R. A. Hedeen
R. S. Norman
J. W. Kopec

for

General Motors Corporation
Environmental Activities Staff
General Motors Technical Center
Warren, Michigan 48090
Attn: Mr. Waldemar R. Semrau

FOREWORD

This research program in acoustics was initiated by the General Motors Corporation in July, 1979. The measurement phases of the project were conducted during August and November, 1979 at IITRI's Riverbank Acoustical Laboratory in Geneva, Illinois. For Phase I, a 1979 Chevrolet Chevette was used as a truck simulation. For the Phase 2 studies, three heavy-duty truck tractors were measured in the large reverberation room. IITRI personnel who participated on the project were R. S. Norman, J. W. Kopec, R. A. Hedeen, L. D. Williams, and D. Bauer. We wish to thank Mr. Waldemar R. Semrau of General Motors Corporation, Environmental Activities Staff, for his technical direction and active participation on the program. Overall program management was provided by Mr. Donald Whitney of General Motors Corporation.

Respectfully submitted,
IIT RESEARCH INSTITUTE

Robert A. Hedeen
Research Engineer
Engineering Division

Approved by:

R. S. Norman
Engineering Advisor
Engineering Division

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

1. INTRODUCTION

The current U.S. Environmental Protection Agency specification for new truck models requires a passby noise measurement for certification. Since passby tests can be influenced by wind, rain, humidity, ground condition, driver performance, truck position, and engine operation, other measurement techniques have been suggested. The idle-maximum-idle (IMI) test for a stationary vehicle is one possible alternative. To date, comparisons between passby and stationary tests have been incomplete. Therefore, the objective of Phase 1 of this program was to establish an accurate data base for comparison of different measurement techniques.

For this initial study, a small vehicle was chosen to simulate a larger truck. The smaller vehicle was easier to modify and more compatible with existing facilities. General Motors selected and supplied the appropriate vehicle for measurement: a 1979 Chevrolet Chevette. GM engineers also selected four methods to modify the vehicle so that its noise signature was substantially changed. This vehicle, with appropriate modified parts, was then shipped to IITRI's Riverbank Laboratory in Geneva, Illinois (50 miles west of Chicago). Our staff made acoustical measurements on the vehicle in its five configurations under the following conditions.

1. EPA passby test
2. IMI measurements outdoors in a free field environment
3. IMI measurements in Riverbank Reverberation Room No. 2
4. IMI measurements in Riverbank Reverberation Room No. 5

Based on the favorable results with the Chevette measurements, three heavy-duty truck tractors were sent to the Riverbank facility and measured in Room 5. In the following sections, results are presented for the two series of measurements.

2. PROGRAM OBJECTIVES

The primary objective of this program was to determine whether a stationary, indoor, transient noise measurement could be used as an alternate procedure to the standard EPA passby measurement for heavy trucks. The EPA procedure is similar to the passby method developed earlier by the Society of Automotive Engineers (SAE Procedure J366 b). The method selected to evaluate this alternate procedure was to simulate several trucks by operating a modified smaller vehicle. This vehicle, in several operating configurations was subjected to the EPA passby procedure and to sound power measurements in two reverberation rooms.

Since promising results were obtained with the small vehicle in an unloaded engine configuration, the objective was extended to determine the effects of engine load on the transient noise characteristics of full scale trucks. Three trucks were measured in a reverberation room with and without a dynamometer load to meet this objective.

3. SCALE MODEL TRUCK

For the first phase of this program, a small vehicle was chosen as a scale model truck. The Chevrolet Chevette was selected because it has a firing frequency similar to large truck engines: a four cylinder, four cycle engine with 5200 rpm maximum. Also, the Chevette would fit through the door of the smaller reverberation room at Riverbank (door width equal to 6 ft). The automobile characteristics were:

1979 Chevrolet Chevette

Serial Number:	1B6809Y260238
Engine:	1.6 Liter, 4 cylinder 74 HP @ 5200 RPM
Transmission:	4 speed manual

Temperature controlled cooling fan replaced by 5 blade direct drive fan.

Estimated Vehicle Volume = 200 ft^3.

Gross Weight = 2980 lbs.

The vehicle is shown in Figure 3.1 at the outdoor site. The Chevette could be modified easily to increase or decrease the noise level from the standard, factory condition. For the Phase 1 tests, five configurations were used:

	Configuration	Modification
I.	Standard	Install direct drive cooling fan without fan shroud.
II.	High Exhaust Noise	Disconnect muffler aft of catalytic converter.
III.	High Engine Noise	Remove hood and air cleaner (shown in Fig. 3.1)
IV.	Quiet	Remove cooling fan and add overkill muffler
V.	Reduced Power	Modify throttle to restrict motion to 66% of full throttle.

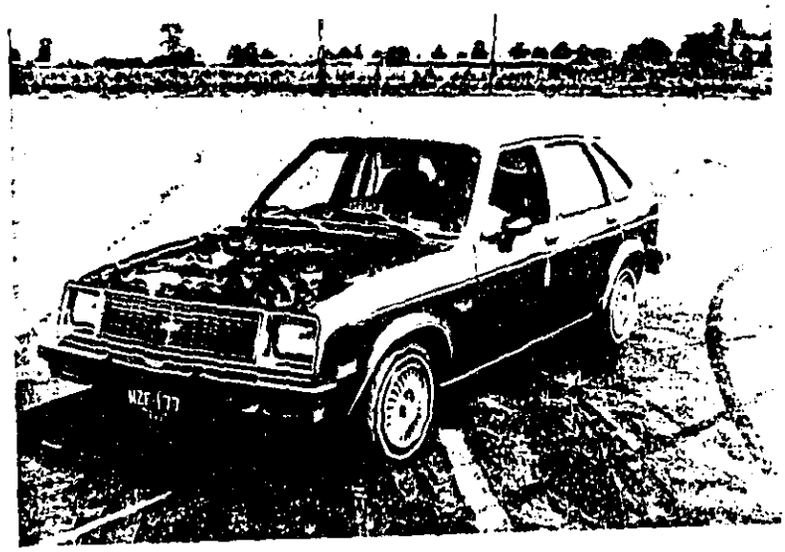


FIGURE 3.1 Chevette Test Vehicle at Passby Site. High Engine Noise Configuration.

For each of these five configurations, the Chevette was run up to four maximum engine speeds: 3500, 4000, 4500, and 5000 rpm. The vehicle was operated in gear 2 for the 3500 and 4000 rpm passbys, and in gear 1 for 4500 and 5000. Then, for the passby tests these five configurations and four engine speeds produced noise signatures for 20 simulated trucks.

In order to accurately reproduce the required maximum rpm in a passby test, General Motors staff engineers installed an ignition cutout circuit on the Chevette. The maximum engine rpm was then set by the driver before each test. A Bruel and Kjaer Type 2306 Graphic Level Recorder was used in the car to record the engine speed and assure that the proper peak level was reached. The test vehicle was then run through a series of passby tests and reverberation room measurements.

4. TEST SITES

4.1 Passby Site

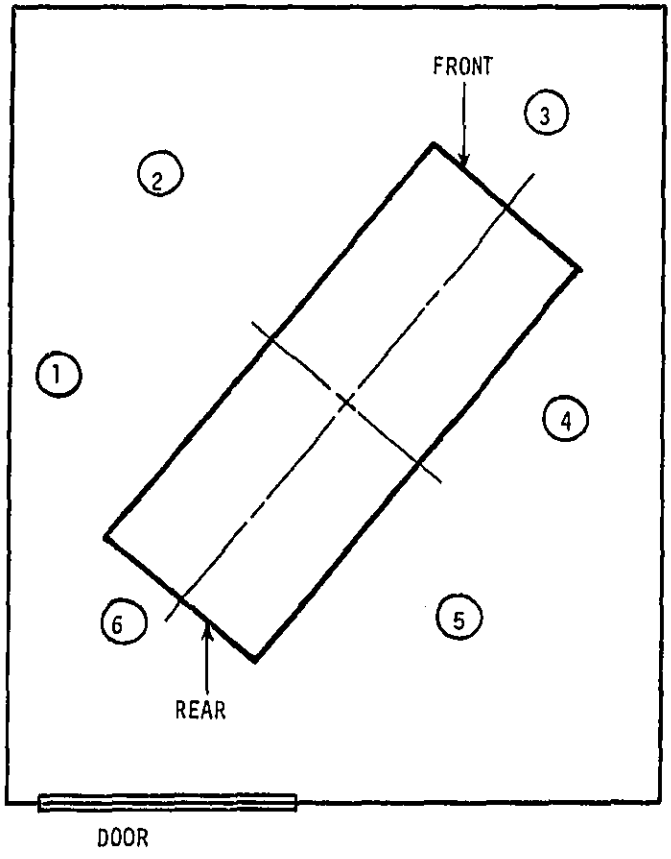
The Batavia High School parking lot was selected as the passby site. This sealed, asphalt surface had the required length, level surface, and freedom from reflecting structures. The test vehicle is shown at the passby site in Figure 4.1. The standard microphone position at 50 ft from the centerline of the vehicle path was used for the passby tests. Standard EPA passbys were made with 5 repeat runs being performed in each direction.

For later comparison purposes, non-standard, stationary measurements were also made. For a fixed vehicle position, a special test procedure was conceived: the IMC test or Idle-Max-Cutoff test. Here, the ignition cutoff was set at a prescribed level (e.g. 3500 rpm), and with the car in neutral the accelerator was fully depressed. The engine would accelerate rapidly to the maximum rpm, cut off, and decelerate to zero rpm. For these IMC tests, microphone measurements were made at four positions around the vehicle at 25 ft from the vehicle center. Finally, steady state readings were also made at the four 25 ft positions by holding the engine at a constant rpm (3500, 4000, 4500, and 5000).

4.2 Reverberation Room Number 2

At Riverbank Laboratory, there are six reverberation rooms. Two were chosen for this evaluation, since the test vehicle could be driven into these rooms. The smallest room was normally used for transmission loss measurements and had a volume of 6300 ft^3. The solid block walls had been previously covered with several coats of epoxy paint. Fixed panels in the room served to improve the diffusivity of the sound field. In Figure 4.2, the plan view of the room with an outline of the vehicle is shown to scale. Since the Chevette was a relatively large noise source in the room (approx. 3% of the room volume) several microphone positions were used to increase the sampling accuracy of the measurements. The six microphone positions were selected randomly to obtain samples all around the Chevette. The

FIGURE 4.1 Chevrolet Chevette during Passby Noise Measurements



MICROPHONE HEIGHT	
No.	Height, FT
1	4
2	6
3	8
4	5
5	7
6	8

Room Volume = 6300 FT^3

Scale: 1/4 in = 1 FT

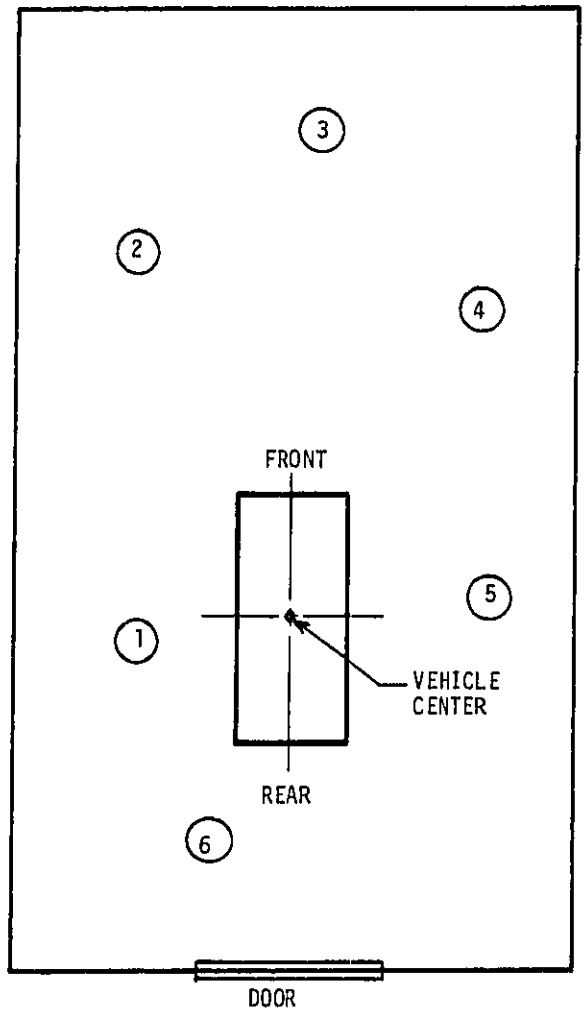
FIGURE 4.2 Plan View of Reverberation Room #2 Showing Microphone Locations

Chevette was greater than one-half wavelength from the walls of Room 2 for frequencies above about 250 Hz.

4.3 Reverberation Room Number 5

Room 5 is a new facility built at Riverbank in 1978 for specialized vehicle or large equipment noise measurements. A plan view of this room is shown in Figure 4.3. The room dimensions are 30 ft by 50 ft with a 25 ft ceiling. With respect to construction, the walls were built with a light weight, hollow concrete block. The floor was poured concrete, and a steel deck was used for the ceiling. Access to the room was provided at ground level through a 10 ft by 13 ft door. The Chevette occupied approximately 0.5% of the volume of Room 5 and was greater than one-half wavelength from the walls for frequencies above about 100 Hz. Again, six microphone positions were randomly selected around the vehicle.

During the first series of measurements with the Chevette (August, 1979), Room 5 was not configured as a typical reverberation room. The walls were not sealed, and no diffusers were installed. Therefore, during the August tests, Room 5 had rather poor reverberation characteristics. Prior to the Phase 2 measurements in Room 5 (November 1979), two coats of epoxy paint were applied to the room walls. Also, five fixed diffusers were added to the room. These skewed surfaces were constructed from corrugated sheets and mounted randomly around the room. Figure 4.4 compares the reverberation times of Room 5 before modification with the times for other Riverbank rooms. Figure 4.5 gives an indication of the change in reverberation time in Room 5 due to modification. The combination of lowered absorption from the sealed walls and the improved diffusitivity from the diffuser panels served to increase the reverberation time in all bands. Figure 4.6 shows the Chevette in Room 5 with two of the fixed diffusers in place behind the automobile. A third modification to Room 5 before the November truck tests was the installation of a ventilation system to remove the exhaust products when vehicles were operated in the room.



MICROPHONE HEIGHT	
No.	HEIGHT, FT
1	7.5
2	4
3	6
4	7
5	7
6	5

ROOM VOLUME = 37,500 FT^3

SCALE: 1/4 in = 2 FT

FIGURE 4.3 Plan View of Reverberation Room #5 Showing Microphone Locations

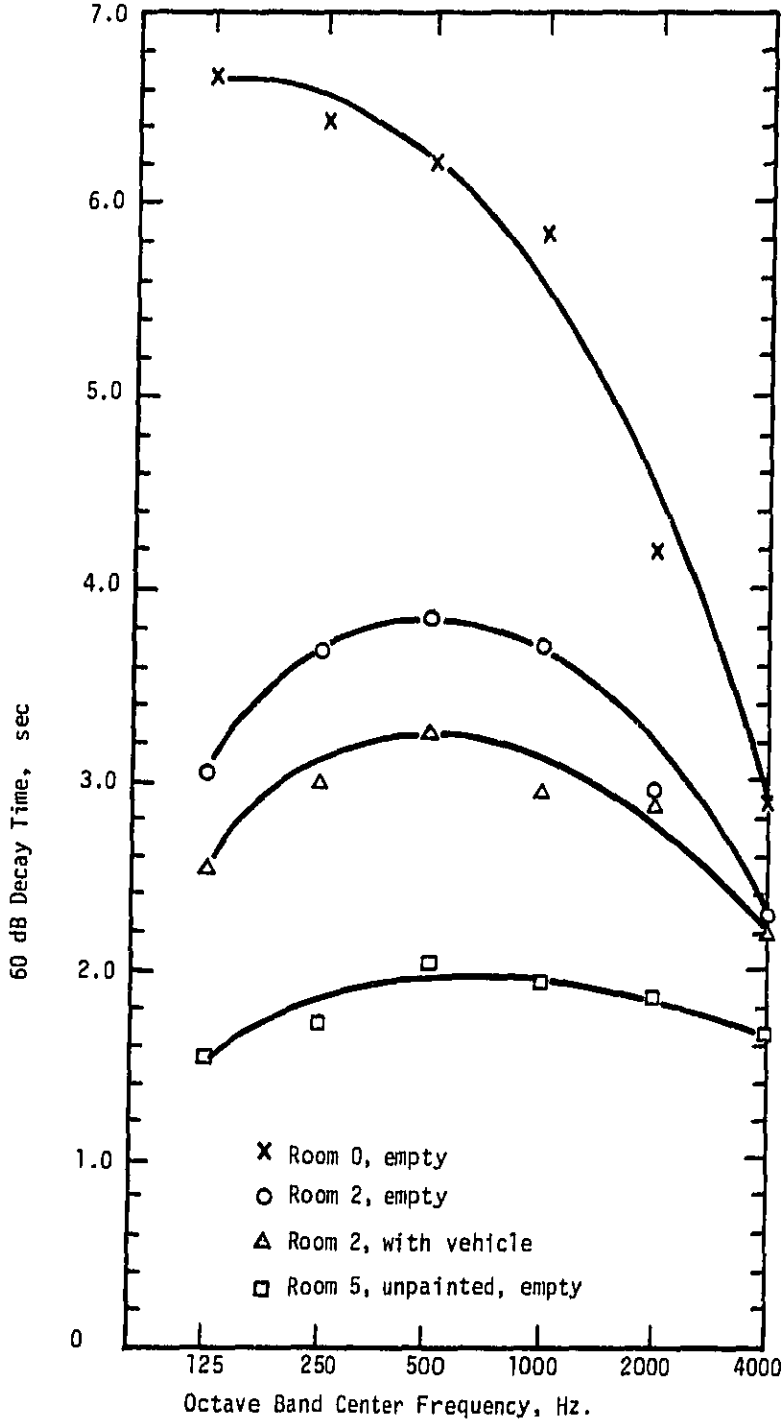


FIGURE 4.4 Comparison of Reverberation Times for Three Rooms

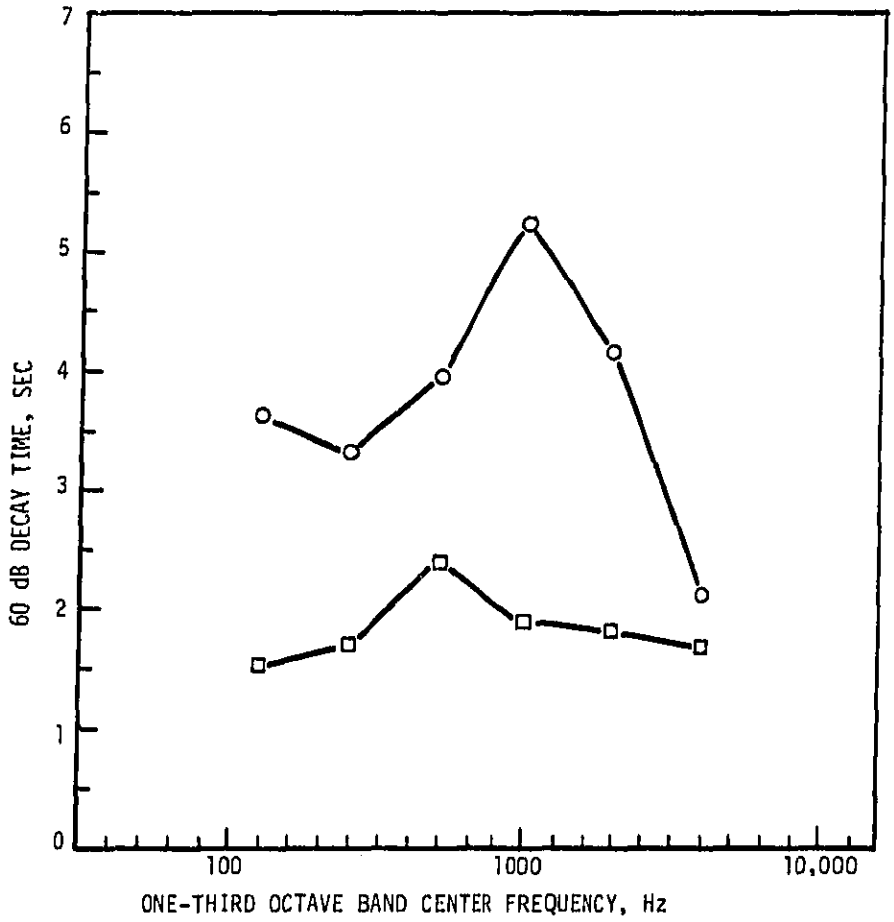


FIGURE 4.5 Reverberation Times for Room 5

(a) lower curve: 24 Jul '79, unpainted, no diffusers

(b) upper curve: 10 Jan '80, painted, diffusers in place

FIGURE 4.6 Chevette in Reverberation Room #5 after Room Modifications. Two Fixed Diffusers are Visible.

5. INSTRUMENTATION

The primary instrumentation system utilized two one-half inch, Bruel and Kjaer (B&K) condenser microphones recorded on a Nagra IV SJ tape recorder. Each channel was calibrated with a Gen Rad Omnical at a level of 94 dB at 1000 Hz. Unweighted recordings were made of all the vehicle runs as well as ILG reference sound source measurements in the reverberation rooms. Tapes were later analyzed using a B&K Type 2112 Spectrometer for A-weighting and a B&K Type 2306 Graphic Level Recorder. Detailed investigations of the tapes were performed with a Spectral Dynamics SD 301C Narrow Band Real Time Analyzer (RTA), a Gen Rad Model 1921 1/3 octave RTA with Multifilter, and a B&K Type 2131 1/3 octave RTA. Basic data handling tasks and some graphical displays were executed with the IITRI PDP-11/45 minicomputer.

A separate, backup instrumentation system was used for on-line, data evaluation. This system utilized a B&K Type 2203 Sound Level Meter with one-inch condenser microphone and a B&K Type 2306 Graphic Level Recorder. A-weighted chart records were then evaluated during the test program for measurement consistency. In Figure 5.1, the dual instrumentation system is shown in operation at the passby site.

FIGURE 5.1 Dual Microphone System at the Passby Site

6. PRESENTATION OF PHASE 1 RESULTS

6.1 Chevette Passby Tests

The first series of measurements was performed with the five Chevette configurations at the outdoor passby site. One microphone position was used so that five runs were made in each direction to obtain an overall dBA average. These average sound levels are presented in Figure 6.1. For four of the vehicle configurations, the progression of increasing sound level with increasing rpm is quite regular. However, for the high exhaust noise case the progression is erratic. With the muffler and rear tail pipe disconnected, the exhaust header terminates under the car. The exhaust noise spectrum is dominated by pure tones beginning at the basic firing frequency (See Appendix B, Narrow Band Spectra). Also, the noise generation is highly directional, emanating primarily out the sides and to the rear from beneath the car with very little radiating upwards. The basic data for all Phase 1 tests, both outdoors and indoors are presented in Table 6.1.

The relative noise levels for the five configurations were ordered properly beginning with the quiet configuration and increasing to the high exhaust case. The reduced power configuration behaved somewhat unexpectedly since it has higher noise levels than the standard configuration for two rpm values. As a comparison, the outdoor Chevette IMC (Idle-Max-Cutoff) measurements are shown in Figure 6.2. For all cases except high exhaust, the IMC values are higher by 1 to 4 dBA. Note that the high exhaust configuration produces almost the same level at the three highest rpm readings (Figure 6.2 vs. Figure 6.1) but is 5 dBA higher at 3500 rpm. Generally, the inertia-loaded engine of the IMC tests produces higher noise levels than the moving vehicle. Apparently, the distance to the vehicle in the end zone for passby tests was often greater than 50' at the moment of maximum noise level. This effect would produce lower passby readings.

After the Chevette was returned to GMC in September 1979, it was evaluated at the GMC Truck & Coach passby test site in Michigan for comparison purposes.

		TRANSIENT						
		Passby Average[1]			Outdoor IMC[2,3]		Room 2	Room 5
	RPM	L	R	Both	25'	50'	IMC	IMC
STANDARD	3500	69.2	72.4	70.8	79.5	73.5	98.7	90.8
	4000	72.2	73.8	73.0	82.0	76.0	101.4	93.5
	4500	73.9	76.0	75.0	84.5	78.5	104.1	95.5
	5000	76.1	77.2	76.7	86.3	80.3	107.2	97.3
HI EXHAUST	3500	80.8	84.8	82.8	94.3	88.3	109.4	102.3
	4000	90.0	90.4	90.2	96.0	90.0	110.7	105.2
	4500	89.5	89.9	89.7	96.2	90.2	112.3	106.8
	5000	90.0	89.8	89.9	96.4	90.4	113.1	107.4
HI ENGINE	3500	74.5	75.2	74.9	81.2	75.2	105.1	96.6
	4000	76.3	77.0	76.7	85.9	79.9	106.9	98.6
	4500	78.3	79.1	78.7	87.7	81.7	110.5	102.1
	5000	79.5	81.9	80.7	89.6	83.6	112.5	103.7
QUIET	3500	69.7	70.0	69.9	76.6	70.6	98.2	88.3
	4000	72.7	73.1	72.9	80.8	74.8	100.4	91.9
	4500	73.9	75.2	74.6	83.8	77.8	103.7	94.7
	5000	76.8	77.0	76.9	84.2	78.2	106.3	96.1
REDUCED POWER	3500	70.4	70.6	70.5	78.7	72.7	96.8	89.2
	4000	74.7	73.8	74.2	80.9	74.9	99.1	91.6
	4500	75.5	75.6	75.5	83.9	77.9	102.1	94.1
	5000	76.6	77.4	77.0	85.3	79.3	104.2	96.1

Table 6.1 Chevette Phase 1 Data Summary

	RPM	STEADY STATE Outdoor @ 25'	Room 2 uncorrected	Room 2 corrected[4]	Room 5 unpainted uncorrected	Room 5 painted corrected
STANDARD	3500	74.8	94.8	95.4	85.5	89.3
	4000	77.3	98.2	98.8	87.5	90.8
	4500	80.4	100.8	101.4	90.6	94.2
	5000	83.5	103.3	104.3	93.6	97.3
HI EXHAUST	3500	83.4	101.0	101.8	92.8	99.7
	4000	85.8	103.1	104.6	97.4	100.4
	4500	86.6	104.5	105.2	99.3	101.5
	5000	87.0	107.2	107.8	100.3	103.3
HI ENGINE	3500	76.9	97.8	98.5	88.1	92.2
	4000	78.3	100.5	101.3	91.4	95.4
	4500	81.4	103.3	103.8	94.3	98.1
	5000	84.3	106.1	106.8	96.7	100.5
[illegible]	3500	71.2	91.9	92.8	81.5	—
	4000	73.1	93.8	94.5	83.8	—
	4500	77.0	97.8	98.3	87.4	—
	5000	79.5	100.5	100.7	90.1	—
POWER	3500	74.6	93.8	94.2	86.5	—
	4000	77.6	96.8	97.4	88.0	—
	4500	80.3	99.6	100.1	91.2	—
	5000	82.6	102.3	103.1	93.8	—

NOTES

[1]Average of five runs in each direction. "Both" is average of left and right

[2]Average of four microphone positions

[3]50' levels calculated from 25' measurements minus 6 dB

[4]Corrected levels from Phase 2

[5]All values are A-weighted decibels re 20 μPa

Table 6.1 Chevette Phase 1 Data Summary[5] (concluded).

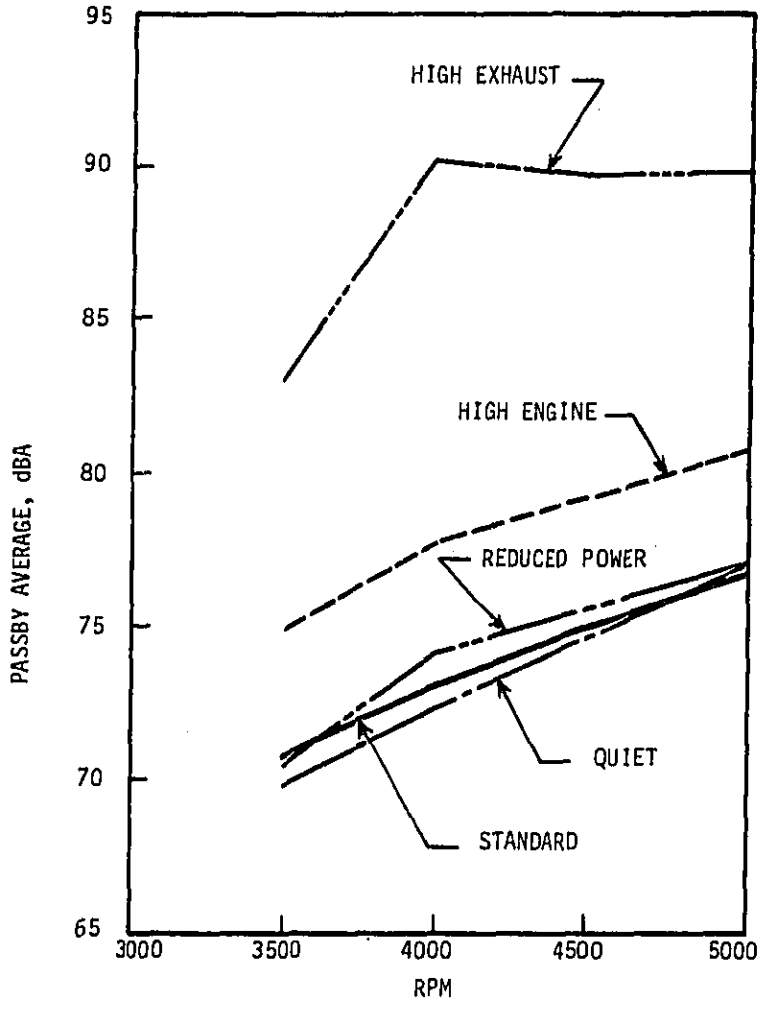


FIGURE 6.1 Chevette Passby Measurements. Average of Five Runs in Each Direction

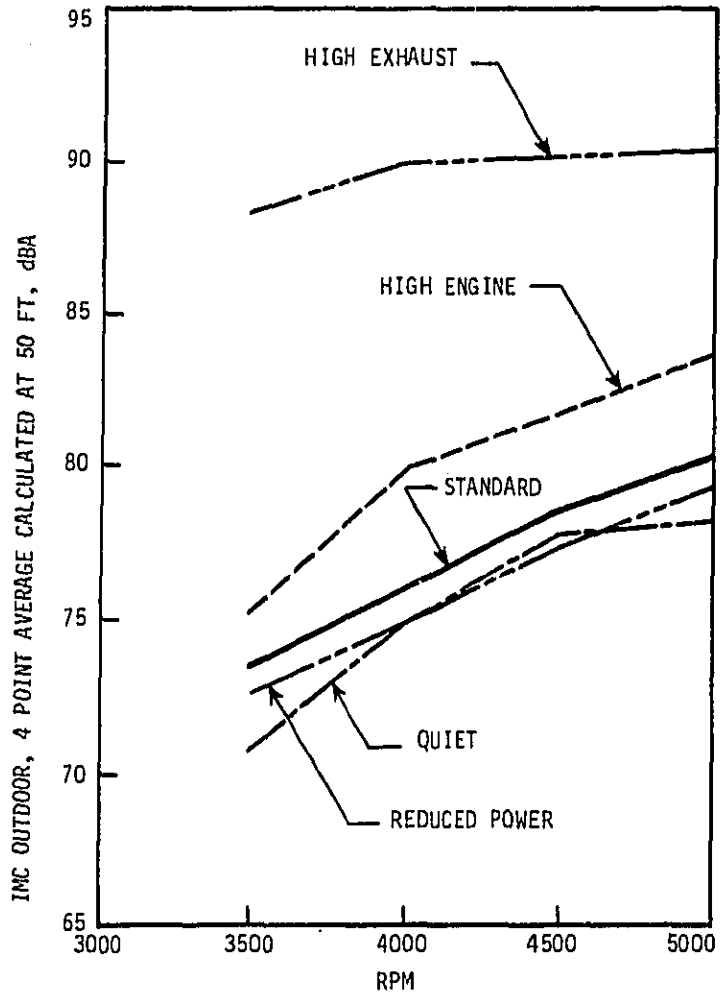


FIGURE 6.2 Chevette Outdoor IMC Measurements, at 25 ft from Vehicle Center corrected to 50 ft.

These measurements were conducted by GMC personnel with GMC instrumentation. The Truck & Coach data were provided by Mr. W. R. Semrau and are plotted against the Riverbank data in Figure 6.3. The correlation is generally good showing some of the data spread between facilities and time periods for passby tests. The 3500 rpm high exhaust point stands out beyond the normal spread. Based on Figures 6.1, 6.2, and 6.3, it appears that the high exhaust, 3500 rpm passby measurement at Riverbank produced an unreasonably low noise level.

6.2 Chevette Reverberation Room Tests

For the first series of measurements, comparisons of peak dBA sound levels were made between reverberation room and outdoor tests. Therefore, only trends and consistency of data were of interest. In Figures 6.4 and 6.5, the simple comparison of maximum dBA values is made between indoor IMC measurements and outdoor passby tests in both reverberation rooms.

It may be seen from Figures 6.4 and 6.5 that, as expected the reverberation room levels are consistently above the outdoor levels. The offset in the axes of the figures indicates the magnitude of the effect. For the individual configurations, the increasing trend with rpm is reasonable — except for the high exhaust noise. The data for four of the five configurations follow a generalized, linear increase.

The data for the four configurations are somewhat less scattered in Room 5 than in Room 2. Room 5 has six times the volume of Room 2 so that the Chevette occupies proportionally less volume; it is more difficult for the sound field in Room 5 to "see" it. Similarly, the vehicle is one-half wavelength from a wall for frequencies as low as 100 Hz in Room 5, but only down to 250 Hz in Room 2. The result of these scaling differences between rooms is that the sound field set up by the Chevette was more uniform across a wider frequency range in Room 5. The obvious conclusion was that further increases in the uniformity of the sound field would decrease the scatter still more. This increase could be attained by increasing the hardness of the reverberation room (and thus the reverberation time) and by compensating for any resonances the room might exhibit.

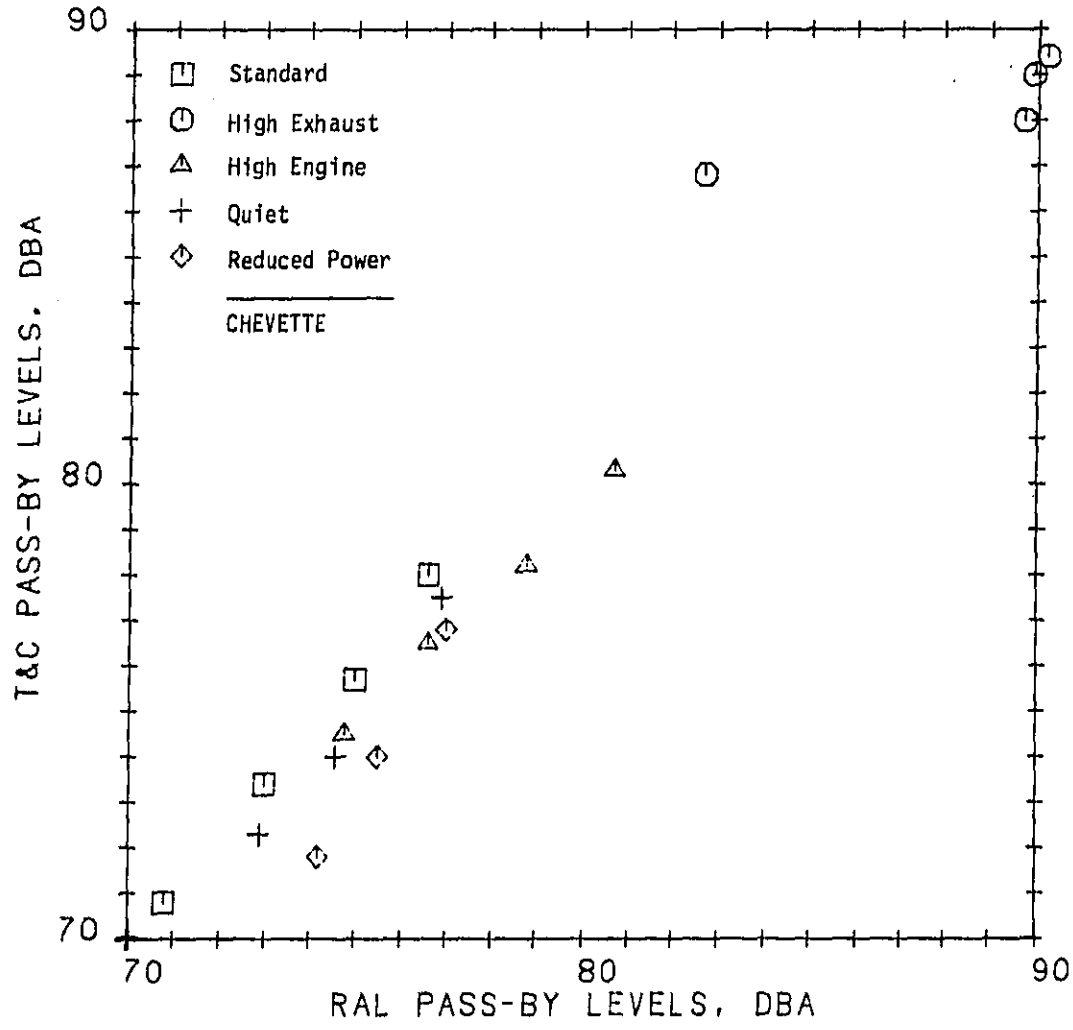


FIGURE 6.3 COMPARISON OF RAL/T&C PASS-BY LEVELS

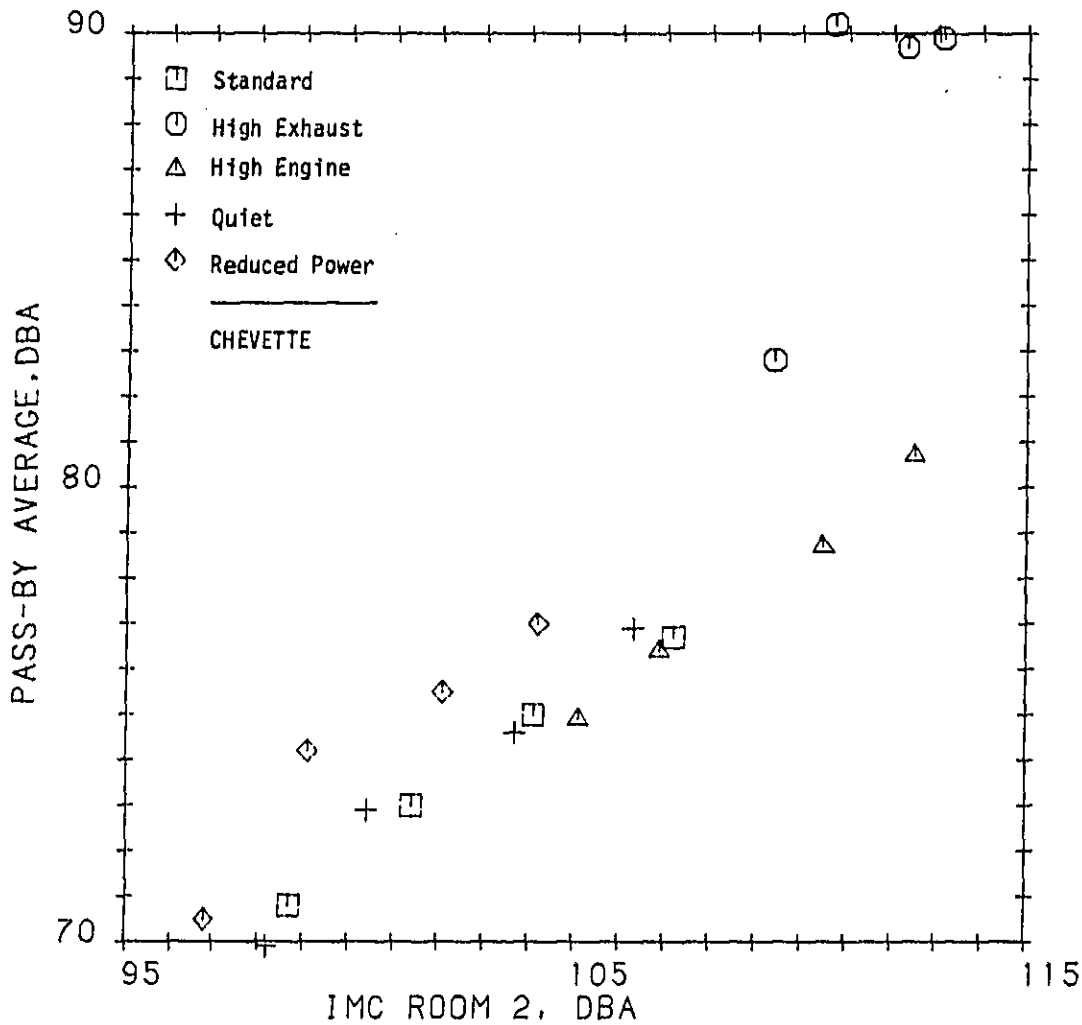


FIGURE 6.4 IMC/PASS-BY COMPARISON ROOM DATA UNCORRECTED

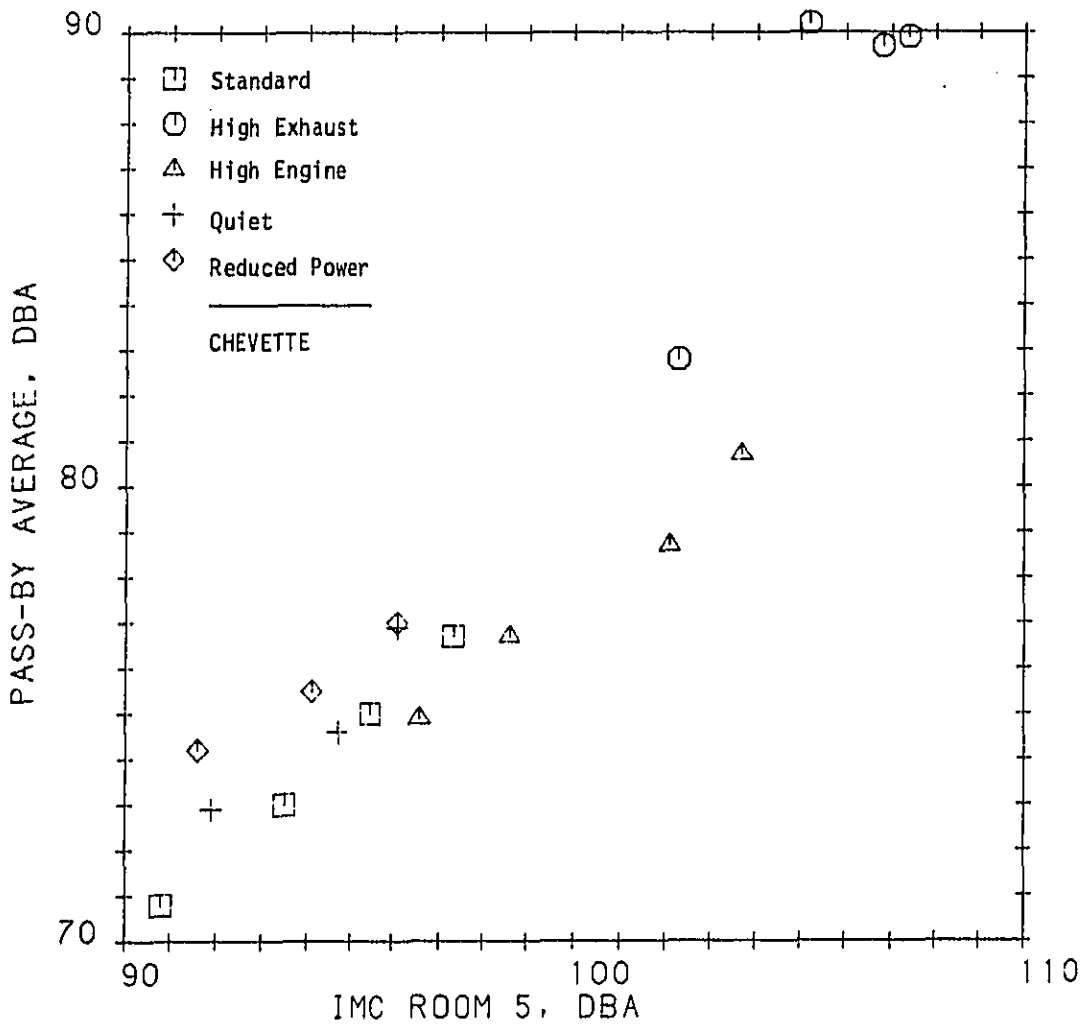


FIGURE 6.5 IMC/PASS-BY COMPARISON ROOM DATA UNCORRECTED

Except for the unusual behavior of the high exhaust configuration, the trends in Figures 6.4 and 6.5 were encouraging. Some preliminary statements were made at the conclusion of Phase 1:

1. The reverberation room trends were consistent with passby measurements for the standard, high engine, quiet, and reduced power configurations.
2. The high exhaust configuration produced unusual results.
3. The volume of the vehicle was probably too large for Room 2.
4. Room 5 reverberation characteristics should be improved.
5. Some room calibration with a reference sound source could decrease frequency dependent room effects.

Based on these conclusions, Phase 2 was initiated.

7. TRUCK SELECTION

After the completion of Phase 1 with the Chevette, the program was continued using three, heavy-duty truck tractors. The Motor Vehicle Manufacturers' Association had recently completed an extensive series of passby noise tests with three trucks at the Transportation Research Center in Ohio. Since these trucks were available, each of the three manufacturers agreed to send the trucks to Riverbank for a series of indoor measurements in November, 1979. The trucks had the following statistics:

1. General Motors Corporation

   Astro 95, COE
   DDAD 8V71T, 2 stroke, Turbocharged Diesel Engine
   Governed rpm = 2050

2. International Harvester

   Transtar II, COE
   Cummins, 6 cylinder in line, 4 stroke, Turbocharged

   Diesel Engine, Formula 290, 290 HP @ 1900 rpm
   Governed rpm = 2050

3. Ford Motor Company

   Custom Cab L800
   Ford Gasoline V8 Engine
   391 cu in, 195 HP @ 3600 rpm
   Governed rpm = 3800

These three tractors are shown in Figure 7.1. Since extensive passby information had already been obtained for these trucks, no truck passbys were made at Riverbank.

The major operational difference for the trucks was the addition of a dynamometer for engine loading. A Go-Power, water brake type, dynamometer was installed between the frame rails on each truck (Figure 7.2). Then, the engine could be loaded from a no-load condition up to rated horsepower by varying the water flow rate through the dynamometer. Figure 7.3 shows the International Harvester truck installed in Room 5 with the dynamometer in place. Note that Room 5 had been painted and had fixed diffusers installed for all truck tests.

FIGURE 7.1 Three Test Trucks Manufactured by General Motors Corp., International Harvester, and Ford Motor Corp.

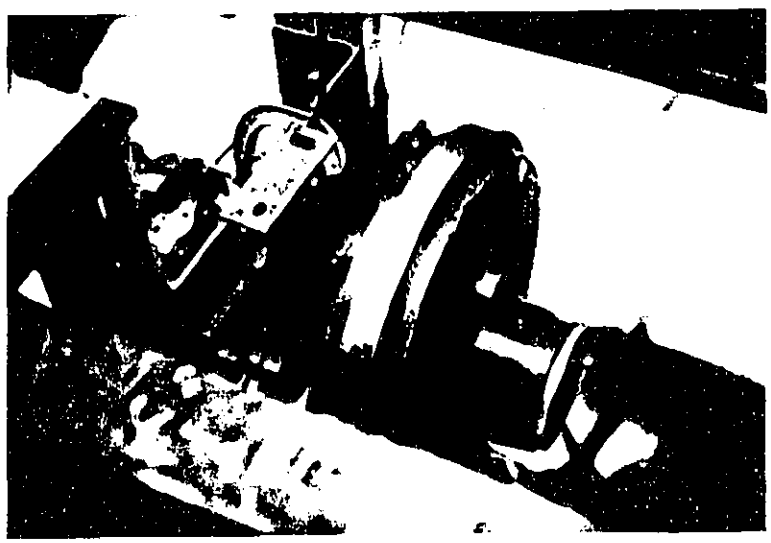


FIGURE 7.2 Go-Power Dynamometer Installed on the GMC Truck.

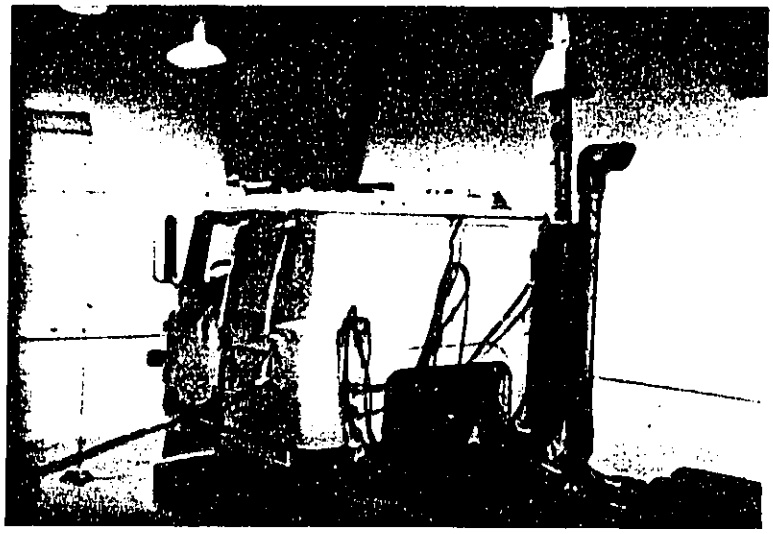


FIGURE 7.3 International Harvester Truck in Room 5.

8. PHASE 2 DATA ANALYSIS

8.1 Goals

In view of the conclusions reached at the end of Phase 1 (Section 6.2), we hoped to make corrections or adjustments to the basic sound pressure level measurements made in Room 5 during Phase 2 in order to remove the effect of the room itself from the data. Noise sources behave differently within reverberation rooms than they do in the open air. Not only is the developed sound pressure level higher but the frequency spectrum is changed, particularly at the lower frequencies due to absorption in the room and to the action of the room resonances attenuating some frequencies and accentuating others. By the use of an ILG Reference Sound Source, we sought to calibrate out the effect of the room in two steps:

1. Adjust for the room-dependent frequency response by playing the taped data through specially tuned filters which simulated free-field response.
2. Adjust for the room-dependent increase of sound pressure level by determining the sound power output of each of the trucks.

8.2 Reverberation Room Frequency Calibration

To accomplish Step 1, we determined a frequency dependent correction curve for each vehicle/reverberation room combination. The curves were determined by examining the spectrum shape of the ILG noise source in each reverberation room with the appropriate vehicle present. The free-field spectrum of the ILG was well known. The reverberation room spectrum curve was determined and superimposed over the free-field curve, and the two made to coincide at 1000 Hz. The 1000 Hz frequency was selected rather arbitrarily, although its use preserved the level of the 1000 Hz calibration signal at the beginning of every tape. The correction at this frequency was forced to be zero.

Comparing the two ILG spectra in this manner made the effect of the reverberation room and vehicle on the frequency content of the noise easily visible. An example of this superposition is illustrated in Figure 8.1. The solid curve represents the shape of the ILG spectrum in a free-field, without reference to absolute sound pressure levels. The dashed curve is the average spectrum from six microphone positions of the same ILG in Room 5 (after painting) with the Chevette in the room. It may easily be seen how the effect of the room boosts the mid-frequencies slightly and rolls of the higher frequencies.

The lower dotted curve in Figure 8.1 is the correction curve for this configuration of room and vehicle. It represents the inverse of the difference between the two ILG curves; that is, the corrections which must be applied to the reverberation room spectrum to make it resemble the free-field spectrum. Note how in this case it, in effect, removes the room by attentuating the mid-frequencies and boosting the highs.

This same procedure was also applied to the tape recorded ILG data of the Chevette in Room 5 before it was painted, in Room 2, and for the three trucks in painted Room 5. The correction curves for these cases are illustrated in Figure 8.2. In all cases, the reverberation room ILG data from which the curves are derived are the average over six microphone positions within the room. The ILG source was located on a small stand about four feet off the floor, in front of the vehicle. More complete data on the performance of the ILG source in the reverberation rooms may be found in Appendix D.

The curves of Figure 8.2 were dialed into a Gen Rad Model 1925 Multifilter, a filter which splits an input signal into 30 one-third octave bands, attentuates each band appropriately, and recombines the bands into a single filtered output signal. A tape recorded signal of one of the test runs was played through its individual room correction curve and then through an A-weighting network. The output of that was monitored on a graphic level recorder. The maximum, room corrected, A-weighted level of each test run-up was extracted from this graphic record to form the raw data of the indoor tests.

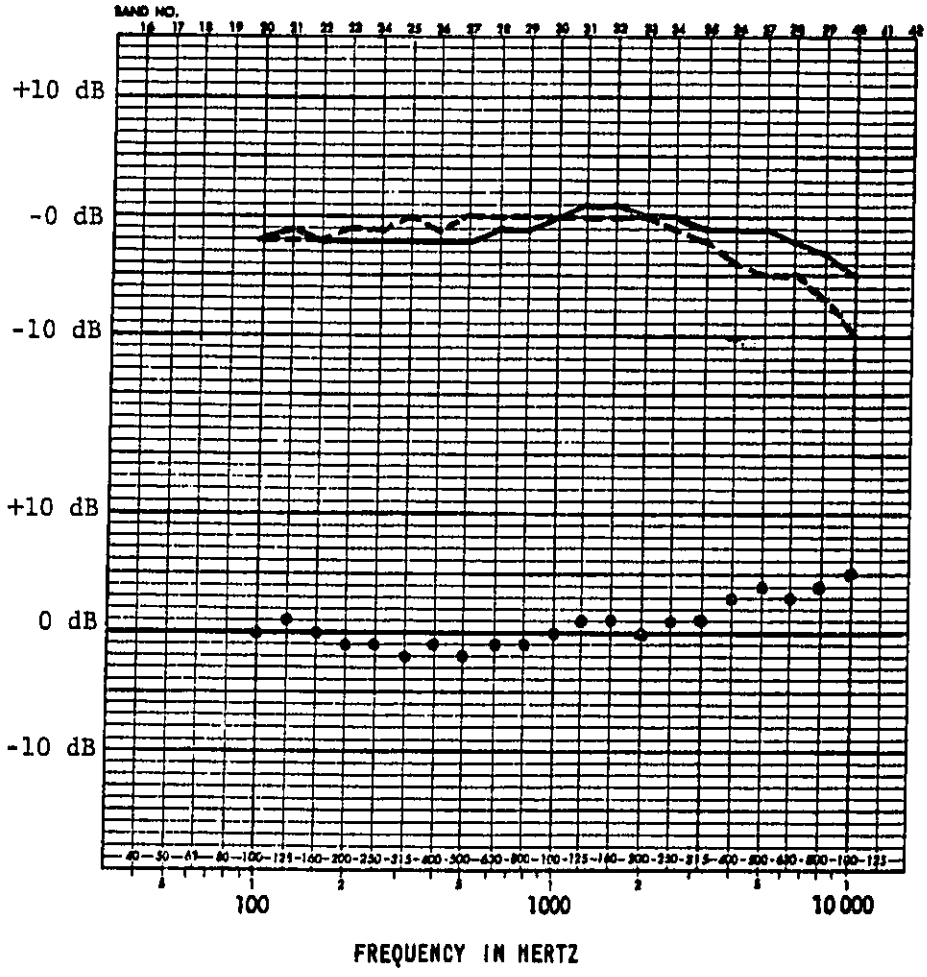
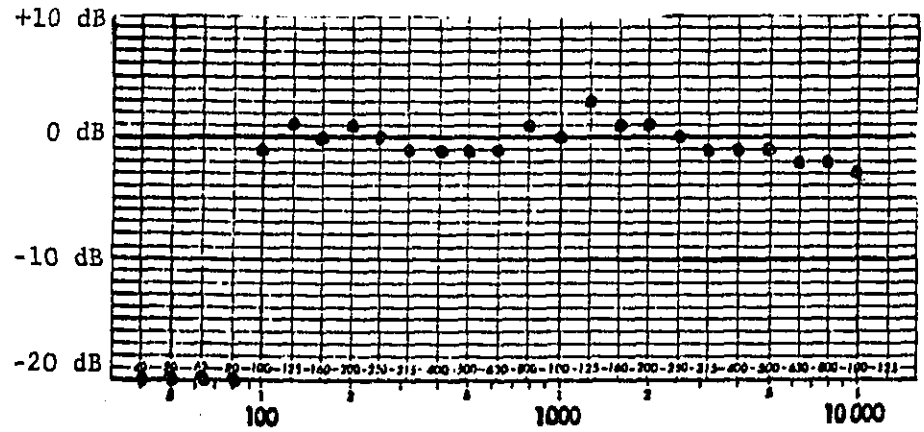
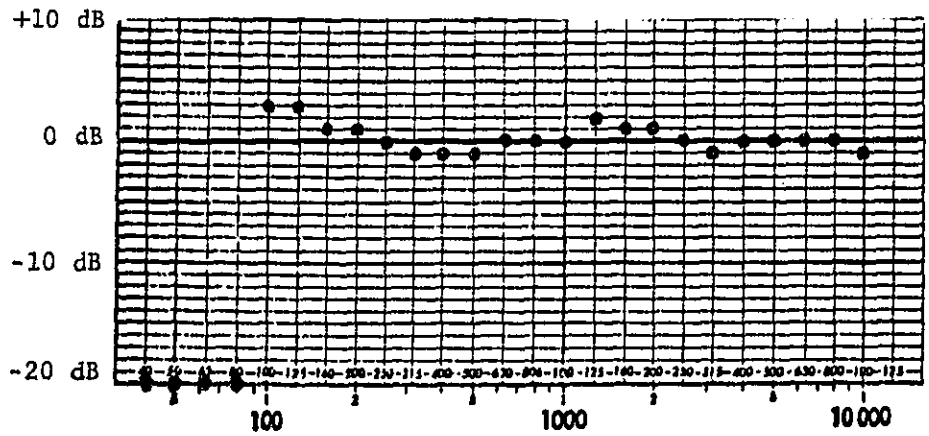


Figure 8.1 ILG Comparison and Room Correction Curve for Chevette in Room Number 5 (Painted)

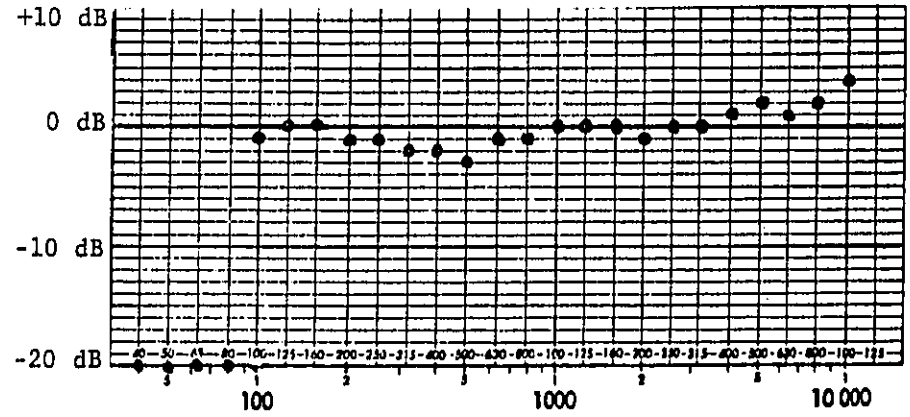


(a) Chevette, Room Number 5 (Unpainted)

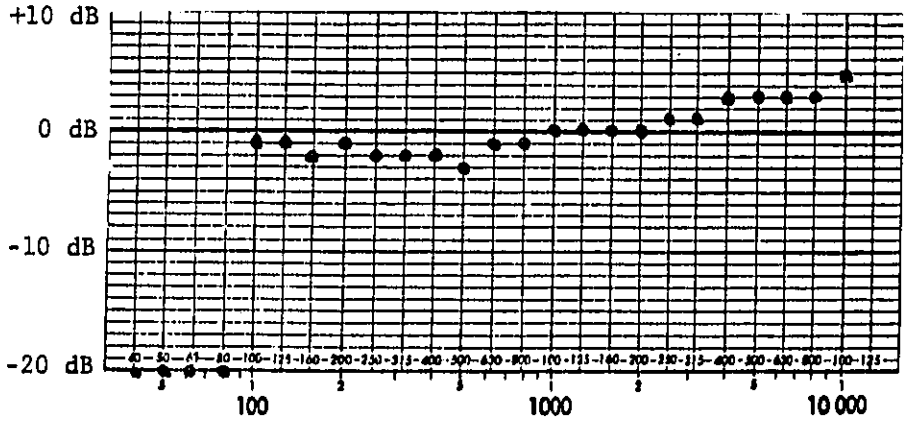


(b) Chevette, Room Number 2

Figure 8.2 Room Correction Curves

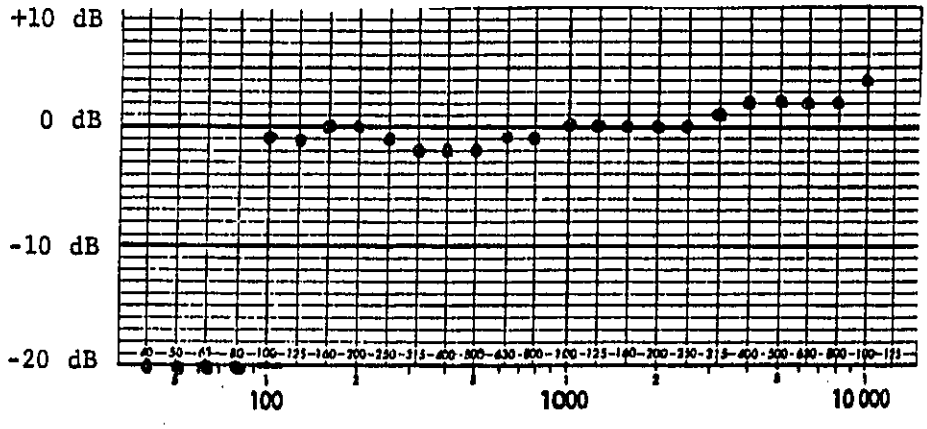


(c) GMC Truck, Room Number 5 (Painted)



(d) Ford Truck, Room Number 5 (Painted)

Figure 8.2 Room Correction Curves (contd)



(e) IH Truck, Room Number 5 (Painted)

Figure 8.2 Room Correction Curves (concl)

Each test configuration was repeated five times and monitored each time for six microphone positions. This method produced, for each test configuration, thirty data samples. These thirty points were processed for mean and standard deviation across microphone positions, run number, and totally. The results of this averaging analysis for each test configuration are reproduced and discussed in Appendix A of this report.

The success of these room correction curves in calibrating out differences in frequency response between reverberation rooms may be judged by examining Figures 8.3 and 8.4. Both figures compare the A-weighted sound pressure levels of the Chevette in various configurations in both reverberation rooms. The scatter of the points about a 45^{o} line is noticeably less for the corrected data.

8.3 Sound Power Determination

The frequency-corrected A-weighted sound pressure levels of each test configuration were then converted to A-weighted sound power levels, again using the ILG measurements. The known relationship between pressure and power levels in the ILG, both indoors and outdoors, was used. The defining equation is

$$L_w = L_p + L_{wr} - L_{pr}$$

where

L_w = A-weighted free-field power level of vehicle
L_p = A-weighted mean pressure level of vehicle in room
L_{wr} = A-weighted free-field power level of ILG = 87.0 dBA
L_{pr} = A-weighted pressure level of ILG in room.

The quantity ($L_{wr} - L_{pr}$) would appear to be the room correction factor previously described, but it is not. First, the room correction is a frequency functionwhile this is the difference between A-weighted overall levels. Secondly, the term L_{pr} is derived from the tape recorded data and was played through the appropriate room correction filter so that the quantity ($L_{wr} - L_{pr}$)

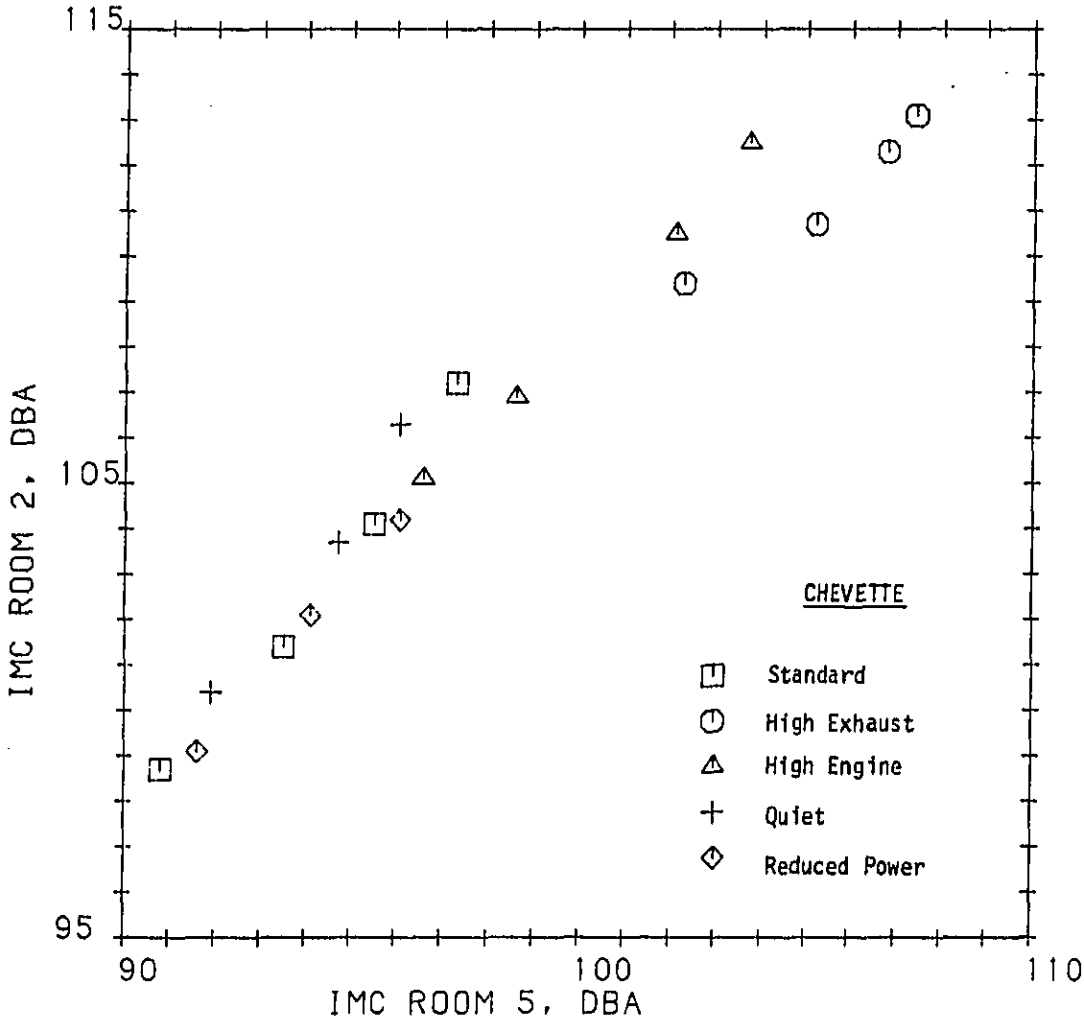


FIGURE 8.3 ROOM 2/ROOM 5 COMPARISON DATA UNCORRECTED

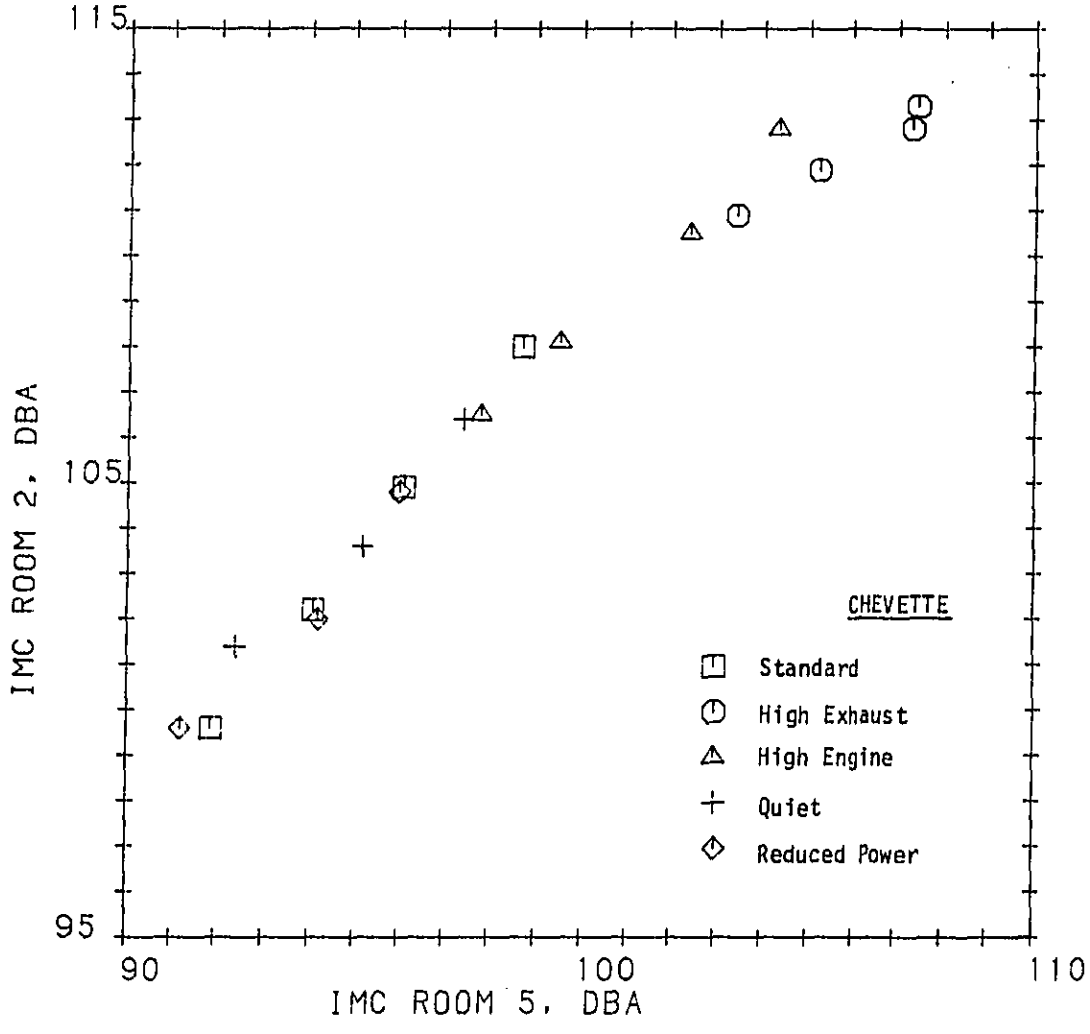


FIGURE 8.4 ROOM 2/ROOM 5 COMPARISON DATA CORRECTED

represents the adjusted difference between power and pressure in a free-field, specific for a given combination of vehicle and reverberation room. The quantity may also be considered as the absolute difference in level between the two ILG curves compared to produce a room correction curve and neglected when the curves were equated at 1000 Hz.

This method was used to derive the sound power level produced in a free-field (in units of dB re 1 pW) of each of the four vehicles. The constants to be added to the mean A-weighted, room corrected, sound pressure levels as measured in painted Room 5 in order to produce the A-weighted free-field sound power levels are as follows:

	Chevette	GMC	Ford	IH
$(L_{wr} - L_{pr})$	10.8 dB	11.9 dB	12.0 db	11.8 dB

Table 8.1 Sound Power Correction Values

Finally, the calculated sound power levels were converted to the expected sound pressure levels at a distance of 50 feet away across a reflecting plane. The familiar expression for this, for hemispherical radiation and units of feet is

$$L_p = L_w - 20 \log r + 2.3 \qquad (8.2)$$

Substituting r = 50 feet, we get

$$L_{p50'} = L_w - 31.7 \qquad (8.3)$$

This may be combined with the previous expression for L_w to produce the following relationships:

$$L_{p50'} = L_p - 20.9 \text{ dBA} \quad \text{(Chevette)} \qquad (8.4a)$$

$$L_{p50'} = L_p - 19.8 \text{ dBA} \quad \text{(GMC Truck)} \qquad (8.4b)$$

$$L_{p50'} = L_p - 19.7 \text{ dBA} \quad \text{(Ford Truck)} \qquad (8.4c)$$

$$L_{p50'} = L_p - 19.9 \text{ dBA} \quad \text{(IH Truck)} \qquad (8.4d)$$

where

$L_{p50'}$ = expected A-weighted sound pressure level at 50'

L_p = room corrected, A-weighted sound pressure level measured indoors.

9. PRESENTATION OF PHASE 2 RESULTS

9.1 Chevette Tests

Before Phase 2 began, Room 5 was painted with two coats of epoxy paint and five diffusing panels were installed. Both modifications were made in order to improve the diffusivity of the reverberation room. Additionally, a ventilation system was installed to remove exhaust gases from the room during testing (cf. Section 4.3). Three configurations of Chevette (standard, high exhaust noise, and high engine noise) were then rerun in Room 5. Figure 9.1 illustrates the changes in IMC peak levels due to the modifications. The points are tightly correlated to a 45 ^{o} line; the y-intercept has been shifted upwards perhaps 1.5 dB. The room has become harder and thus the reverberant sound levels have increased.

The results of the Chevette reruns are summarized in Table 9.1 The peak A-weighted sound levels are presented, followed by the A-weighted sound power levels (dB re 1_{pW}) calculated from equation 8.1 and by the A-weighted levels expected at a 50 feet distance outdoors, calculated by equation 8.4. The sound levels in the room are an average of five run-ups measured at six microphone positions. Details of each measurement series may be found in Appendix A. Also presented in Table 9.1, for comparison purposes, are previously measured sound levels for the outdoor run-up and passby tests of Phase 1, taken from Table 6.1. (It should be noted here that the outdoor run-up tests were measured at a distance of 25 feet, and then converted to 50 foot levels by subtracting 6 dB. There is inconclusive evidence that the attenuation rate at the Batavia High School site may have been nearer 5 dB).

The predicted versus measured L_{p50}, for both run-up and passby tests are illustrated in Figures 9.2 and 9.3. The points in Figure 9.2 were expected to lie closest to a 45^{o} line since the IMC run-up operating condition was the same indoors and outdoors. The high engine noise points lie below the line, indicating that the prediction overestimates the noise levels in the ground plane.

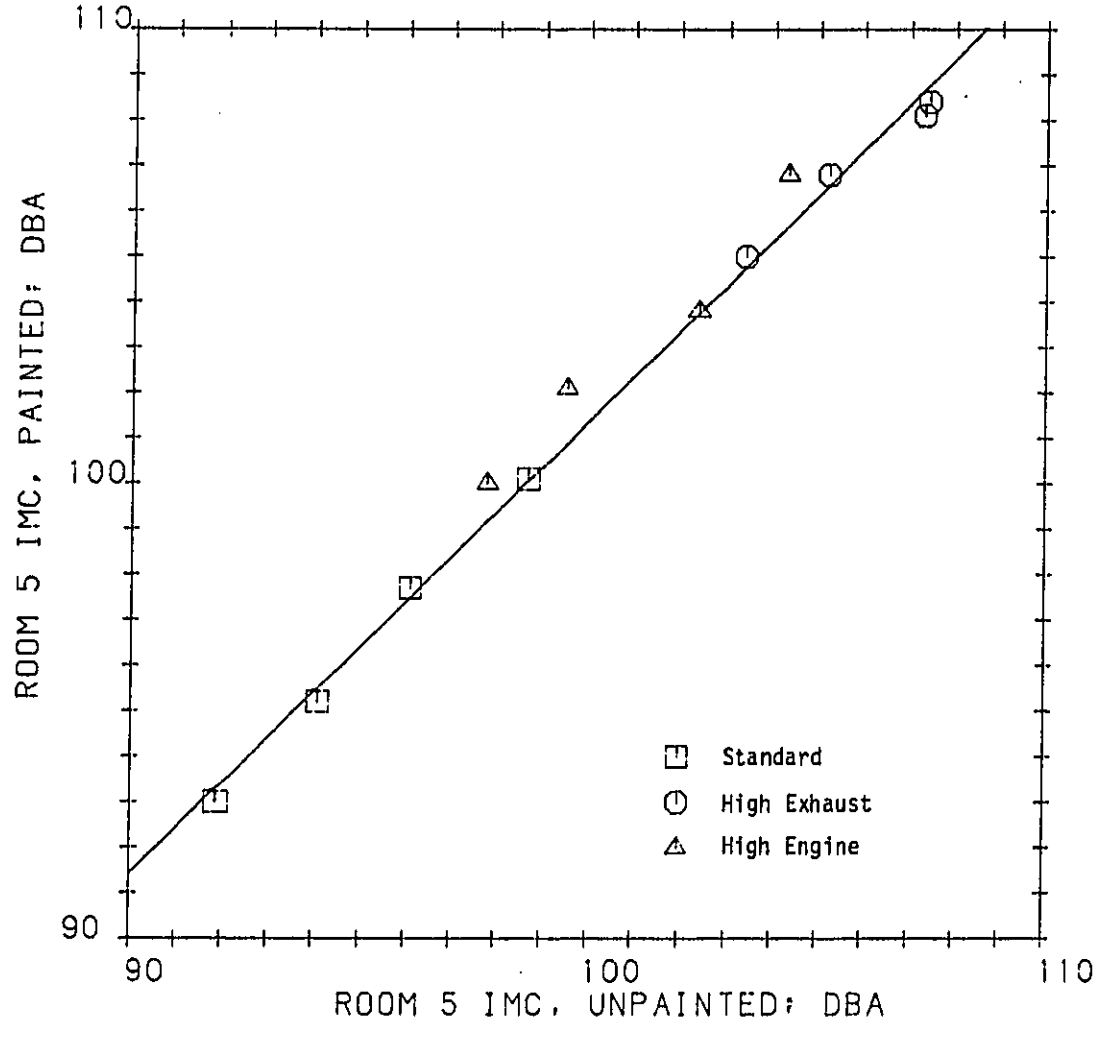


FIGURE 9.1 CORRECTED ROOM 5 IMC LEVELS, CHEVETTE

	3500	4000	4500	5000	
Standard	93.0	95.2	97.7	100.1	L_p, Sound pressure (Appendix A)
Hi Engine	100.0	102.1	103.8	106.8	
Hi Exhaust	105.0	106.8	108.1	108.4	

	3500	4000	4500	5000	
Standard	103.8	106.0	108.5	110.9	L_w, Sound power (eq. 8.1)
Hi Engine	110.8	112.9	114.6	117.6	
Hi Exhaust	115.8	117.6	118.9	119.2	

	3500	4000	4500	5000	
Standard	72.1	74.3	76.8	79.2	$L_{p50'}$, predicted Sound Pressure @ 50' (eq. 8.4a)
Hi Engine	79.1	81.2	82.9	85.9	
Hi Exhaust	84.1	85.9	87.2	87.5	

	3500	4000	4500	5000	
Standard	73.5	76.0	78.5	80.3	Outdoor IMC level (Table 6.1)
Hi Engine	75.2	79.9	81.7	83.6	
Hi Exhaust	88.3	90.0	90.2	90.4	

	3500	4000	4500	5000	
Standard	70.8	73.0	75.0	76.7	Passby level (Table 6.1
Hi Engine	74.9	76.7	78.7	80.7	
Hi Exhaust	82.8	90.2	89.7	89.9	

Table 9.1 Phase 2 Chevette Data Summary
A-weighted decibels re 20 μPa

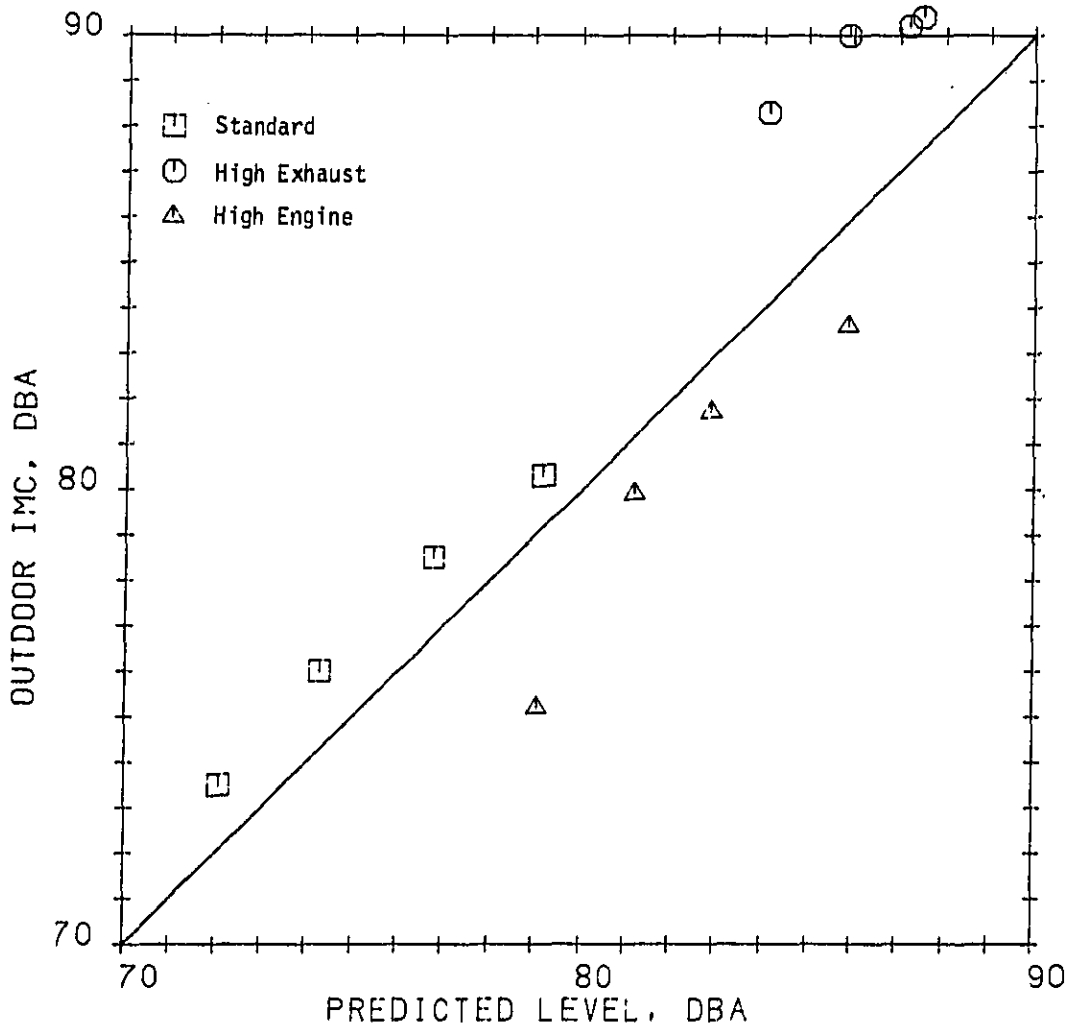


FIGURE 9.2 CHEVETTE, PREDICTED VS. IMC LEVELS @ 50'

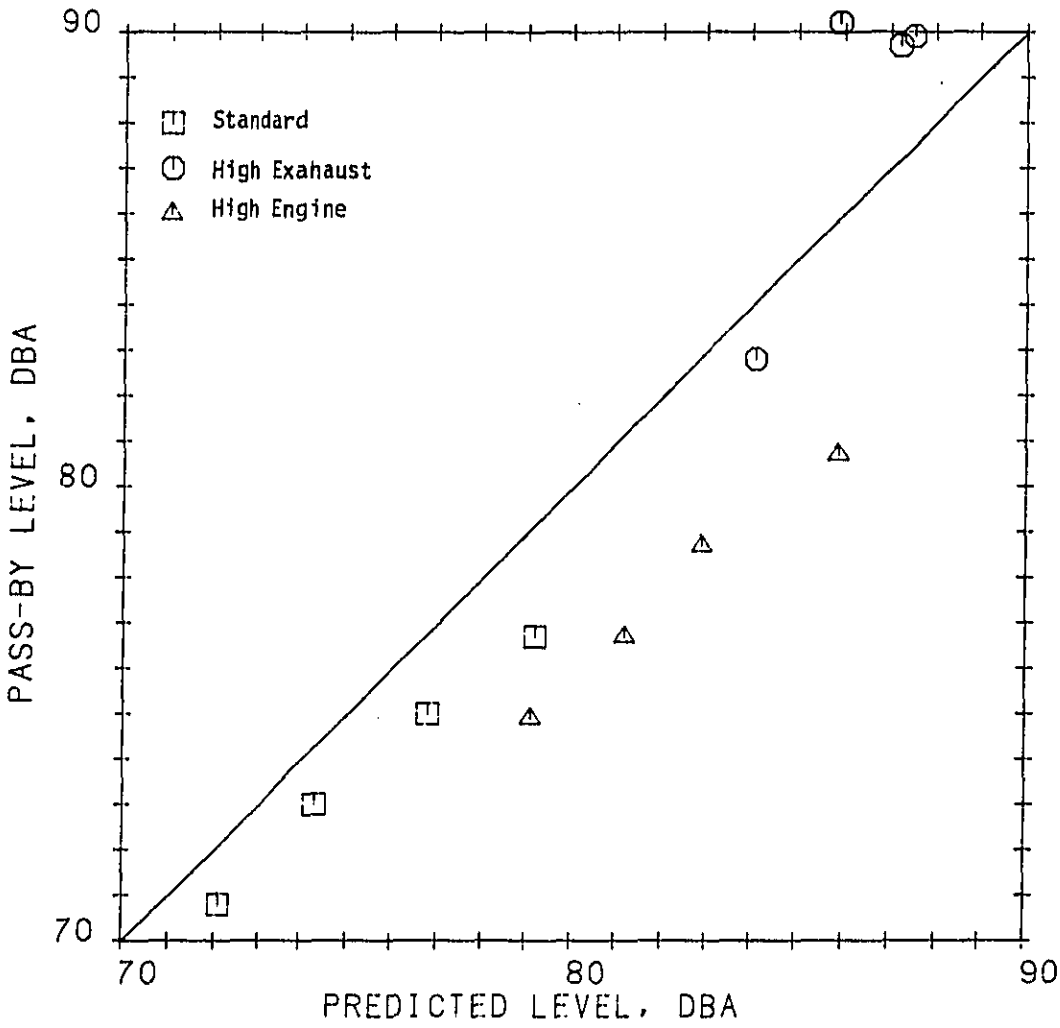


FIGURE 9.3 CHEVETTE, PREDICTED VS. PASS-BY LEVELS @ 50'

The standard and high exhaust noise points lie above the line, indicating that the prediction underestimates the noise levels.

We believe that the deviation from prediction is due to the effects of directivity of the sources. The predicted levels, being derived from reverberation room measurements, average the total source noise from all directions. The two modified Chevette configurations, however, are strongly directional and the measured pressure levels will depend on the location of the measuring microphones.

The high engine noise configuration, sans hood and air cleaner, would radiate noise most strongly vertically. Microphones located near the ground (4') to the side of the vehicle, as was the case in these measurements, would underestimate the total radiated noise. Conversely, the high exhaust noise configuration would have a tendency to radiate most strongly to the sides; the measuring microphones in this case would overestimate the total noise.

Figure 9.3 illustrates a similar analysis. Here, the measured levels along the ordinate are those of the Chevette, for the same configurations and engine speeds, in passby. The predicted levels are the same reverberation room run-up data.

By comparison with the outdoor run-ups of Figure 9.2, two points may be noted concerning the agreement of passby levels with prediction.

1) The high exhaust noise case remains essentially unchanged: measured is a little above prediction (with the obvious exclusion of the 3500 rpm point which is widely removed from the group).
2) The standard and high engine noise cases keep the same relationship to each other but are shifted downward about 3 dB from the run-up prediction.

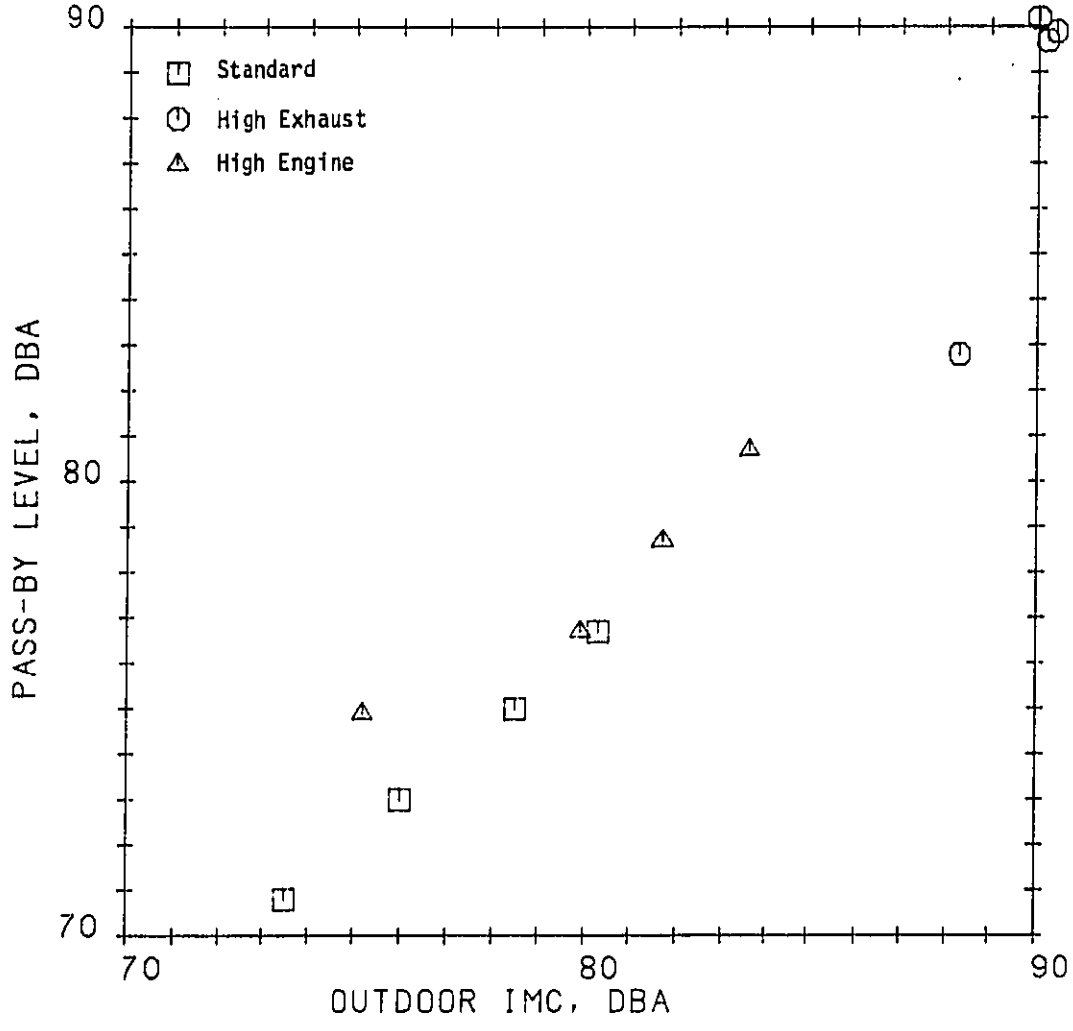


FIGURE 9.4 CHEVETTE PASS-BY VERSUS OUTDOOR IMC LEVELS

Figure 9.4 plots the passby data against the outdoor run-up; the same 3 dB difference is observed. The outdoor run-up values are higher than the corresponding passby values. Differences in loading on the engine may explain part of the disparity. Another possible explanation would consider the "slant effect". In contrast to the stationary IMC test, the Chevette in passby was constantly changing its distance from the microphone. It was 50 feet from the microphone at only one instant, and that was usually not the instant of maximum noise level.

9.2 Truck Tests

For the truck measurements, several loading conditions were used to evaluate load effects on the maximum dBA value. The following abbreviations were used:

Abbreviation	Meaning
IMI	Idle-Max-Idle
NCE	Neutral, Clutch Engaged
DNL	Dynamometer not loaded
SS	Steady State, Constant Governed RPM
WOT	Wide Open Throttle, Using IMI Procedure except starting from an "approach" rpm
SAI	Start at Idle, for beginning IMI Procedure

Three dynamometer loading conditions were used for each truck, in addition to each engine's own inertia. Load 3 used the gearing used during tests at TRC, but that load was discontinued halfway through the tests because it was felt that the results were too similar to load 2. The IMI (NCE) tests were also dropped, for similar reasons. Each truck was measured in three configurations:

1. Standard Configuration
2. Fan disconnected
3. Fan disconnected and extra muffler added.

A chart of the test plan for the truck measurements appears in Table 9.2. It includes which combinations of vehicle and load were run, the "approach" speeds, gearing and so forth.

	IMI (NCE)	IMI (DNL)	LOAD #1 SS	LOAD #1 WOT	LOAD #2 SS	LOAD #2 WOT	LOAD #2 SAI	LOAD #3 SS	LOAD #3 WOT	LOAD #3 SAI
GMC				From 1300		From 1300			From 1300	
Standard	●	●	60 HP	●	95 HP	●	—	30 HP	●	●
No Fan	●	●	40 HP	●	85 HP	●	—	30 HP	●	●
No Fan/Xtra Muff	●	●	40 HP	●	95 HP	●	—	30 HP	●	●
IH				From 1200		From 1200			From 1200	
Standard	●	●	50 HP	●	130 HP	●	—	10 HP	●	●
No Fan	—	●	50 HP	●	140 HP	●	●	—	—	—
No Fan/Xtra Muff	—	●	50 HP	●	140 HP	●	●	—	—	—
FORD				From 2000		From 2000				
Standard	—	●	25 HP	●	85 HP	●	●	—	—	—
No Fan	—	●	40 HP	●	90 HP	●	●	—	—	—
No Fan/Xtra Muff	—	●	35 HP	●	90 HP	●	●	—	—	—
Gearing		1:1	1:1		1:1			TRC/5th gear		

Table 9.2 Phase 2 Truck Test Plan

The basic room-corrected maximum dBA levels are listed in Table 9.3 for all the truck measurements. The IMI-DNL values were obtained with the trucks in gear but no load on the drive shaft from the dynamometer. These results are consistent for the three configurations: dBA levels decrease as the fan is turned off and as a special, overkill muffler is added in series with the standard truck muffler. The three loading conditions have little effect on the GMC truck noise. The International Harvester truck has lower values for Load 3 while the Ford truck produces similar values for the IMI-DNL, Load 1, and Load 2 conditions.

In an analysis similar to that done for the Chevette, these levels were converted to sound power levels using equation 8.1 (Table 9.4) and then converted to the sound levels expected in a free-field at a distance of 50 feet by equation 8.4 (Table 9.5). Also included in Table 9.5 are 50 foot passby sound levels determined by H. L. Blachford Engineering at TRC for the same vehicles.

A comparison of the reverberation room based predicted sound levels with the corresponding measured passby levels is illustrated in Figures 9.5, 9.6, and 9.7 for the three trucks. The fit of the points to the 45^{o} line is within 3 dB for the worst cases and generally better than that. Somewhat surprisingly, the lower loads (IMI and load 1) provide a better fit for most cases. It must be remembered that a prediction based on a stationary run-up is being compared with a non-stationary passby. The same disparity between the levels of stationary and moving vehicles observed with the Chevette (cf. Section 9.1) probably also apply to these trucks. For reference, the range of acceleration times for the differently loaded truck configurations are listed in Table 9.6.

	IMI (NCE)	IMI (DNL)	LOAD #1 SS	LOAD #1 WOT	LOAD #2 SS	LOAD #2 WOT	LOAD #2 SAI	LOAD #3 SS	LOAD #3 WOT	LOAD #3 SAI
GMC										
Standard	103.9	104.0	103.0	103.8	103.0	103.9	—	102.5	103.5	103.4
No Fan	99.9	99.6	99.0	99.7	99.0	100.2	—	98.5	99.6	99.2
No Fan/Xtra Muff	98.9	98.6	98.5	99.2	98.0	99.4	—	98.0	98.6	98.5
IH										
Standard	104.9	104.3	102.5	103.1	103.0	104.0	—	101.0	102.5	104.6
No Fan	—	102.0	99.0	100.7	99.0	102.8	102.7	—	—	—
No Fan/Xtra Muff	—	100.1	98.0	100.4	99.5	102.3	102.0	—	—	—
FORD										
Standard	—	102.6	101.3	102.4	101.7	103.0	103.0	—	—	—
No Fan	—	99.6	97.3	100.2	98.7	101.3	101.7	—	—	—
No Fan/Xtra Muff	—	98.3	96.3	98.6	98.0	99.1	99.9	—	—	—

Table 9.3 Sound Levels of Phase 2 Trucks in Room 5;
A-weighted decibels re 20 μPa

	IMI (NCE)	IMI (DNL)	LOAD #1 SS	LOAD #1 WOT	LOAD #2 SS	LOAD #2 WOT	LOAD #2 SAI	LOAD #3 SS	LOAD #3 WOT	LOAD #3 SAI
GMC										
Standard	115.8	115.9	114.9	115.7	114.9	115.8	—	114.4	115.4	115.3
No Fan	111.8	111.5	110.9	111.6	110.9	112.1	—	110.4	111.5	111.1
No Fan/Xtra Muff	110.8	110.5	110.4	111.1	109.9	111.3	—	109.9	110.5	110.4
IH										
Standard	116.7	116.1	114.3	114.9	114.8	115.8	—	112.8	114.3	116.4
No Fan	—	113.8	110.8	112.5	110.8	114.6	114.5	—	—	—
No Fan/Xtra Muff	—	111.9	109.8	112.2	111.3	114.1	113.8	—	—	—
FORD										
Standard	—	114.6	113.3	114.4	113.7	115.0	115.0	—	—	—
No Fan	—	111.6	109.3	112.2	110.7	113.3	113.7	—	—	—
No Fan/Xtra Muff	—	110.3	108.3	110.6	110.0	111.1	111.9	—	—	—

Table 9.4 Sound Power Levels of Phase 2 Trucks;
A-weighted decibels re 1 pW

	IMI (NCE)	IMI (DNL)	LOAD #1 SS	LOAD #1 WOT	LOAD #2 SS	LOAD #2 WOT	LOAD #2 SAI	LOAD #3 SS	LOAD #3 WOT	LOAD #3 SAI	MEASURED PASSBY BLACHFORD/TRC
GMC											
Standard	84.1	84.2	83.2	84.0	83.2	84.1	—	82.7	83.7	83.6	81.0
No Fan	80.1	79.8	79.2	79.9	79.2	80.1	—	78.7	79.8	79.4	78.6
No Fan/ Xtra Muff	79.1	78.8	78.7	79.4	78.2	79.6	—	78.2	78.8	78.7	78.5
IH											
Standard	85.0	84.4	82.6	83.2	83.1	84.1	—	81.1	82.6	84.7	81.5
No Fan	—	82.1	79.1	80.8	79.1	82.9	82.8	—	—	—	80.7
No Fan/ Xtra Muff	—	80.2	78.1	80.5	79.6	82.4	82.1	—	—	—	80.1
FORD											
Standard	—	82.9	81.6	82.7	82.0	83.3	83.3	—	—	—	82.6
No Fan	—	79.9	77.6	80.5	79.0	81.6	82.0	—	—	—	81.1
No Fan/ Xtra Muff	—	78.6	76.6	78.9	78.3	79.4	80.2	—	—	—	78.2

Table 9.5 Predicted Sound Levels at 50' for Phase 2 Trucks; A-weighted decibels re 20 μPa.

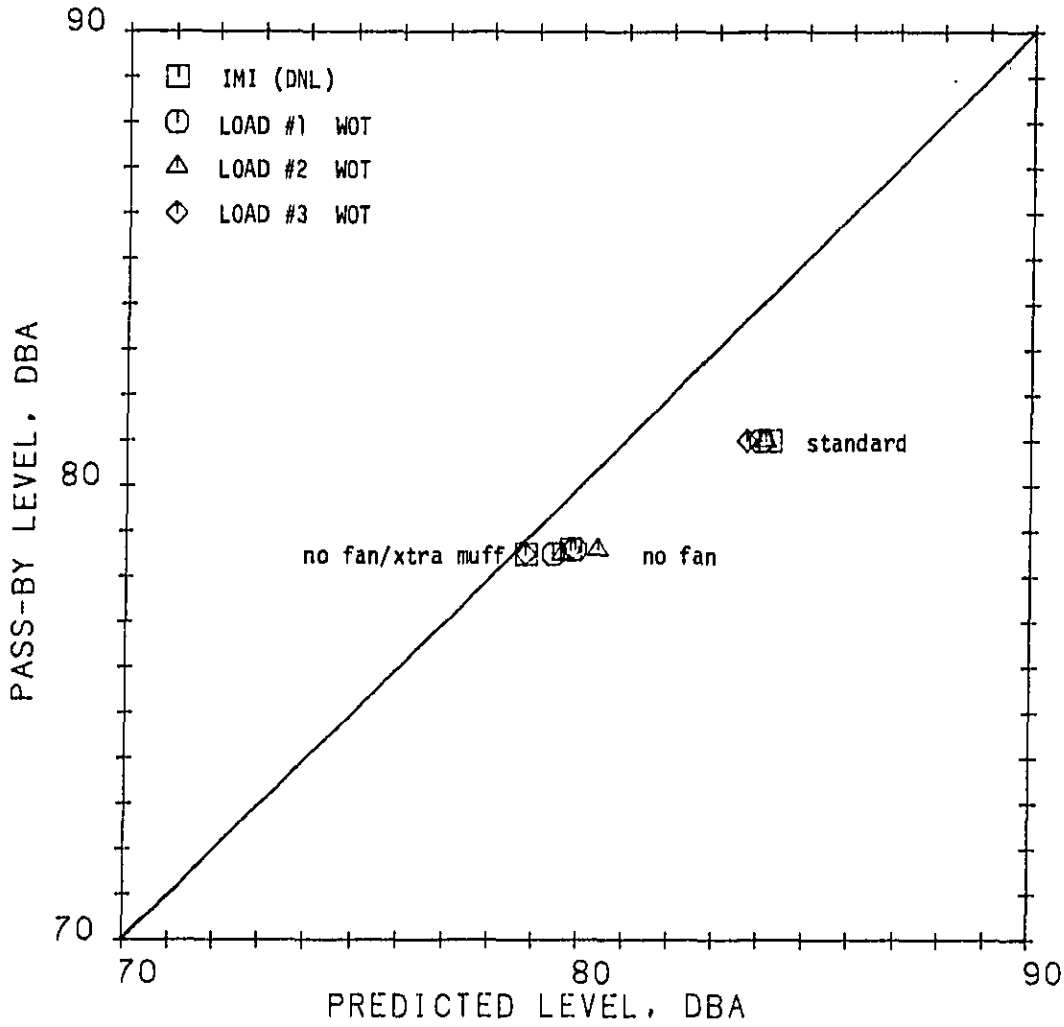


FIGURE 9.5 GMC TRUCK PREDICTED VS. PASS-BY LEVELS

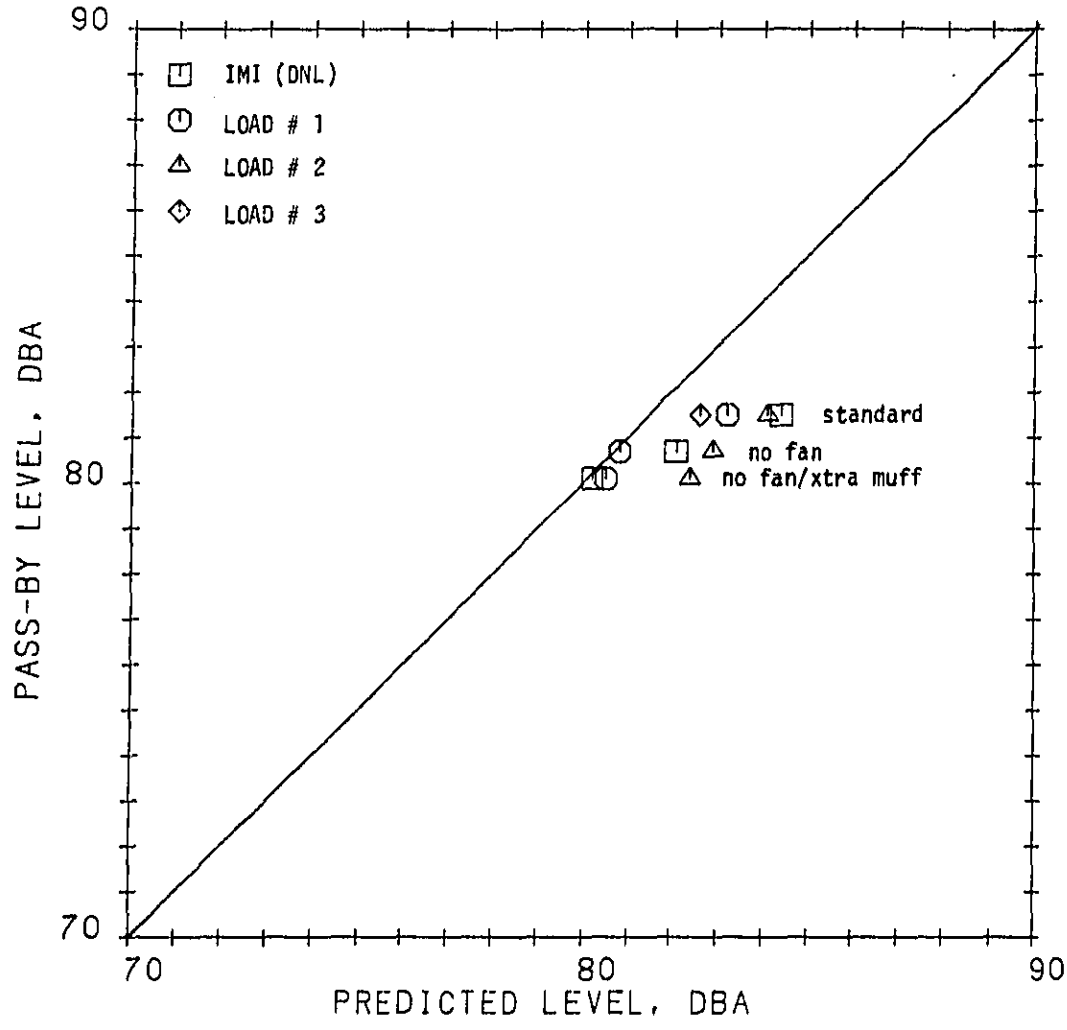


FIGURE 9.6 IH TRUCK PREDICTED VS. PASS-BY LEVELS

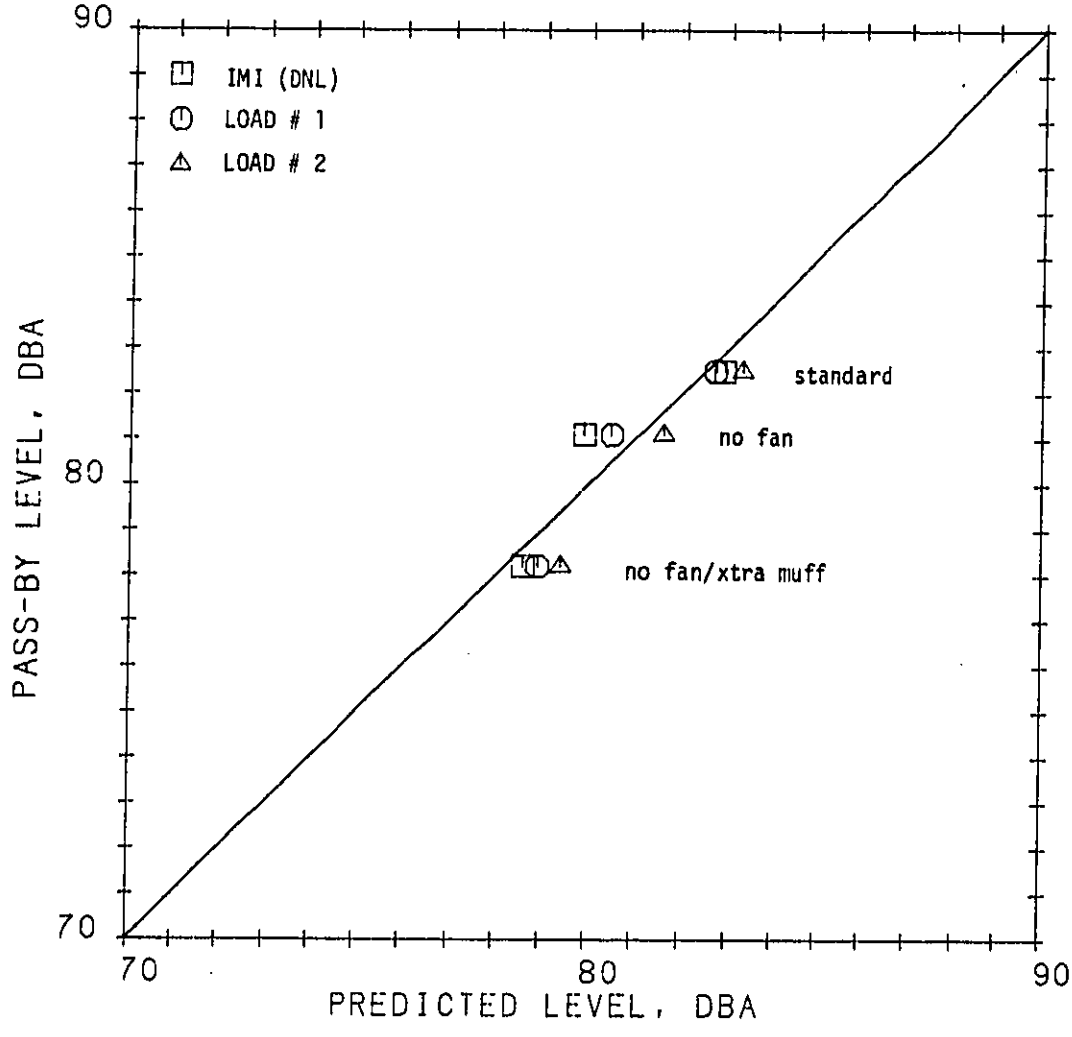


FIGURE 9.7 FORD TRUCK PREDICTED VS. PASS-BY LEVELS

	IMI (NCE)	IMI (DNL)	LOAD #1 WOT	LOAD #2 WOT	SAI
GMC					
Standard	—	2	3-4	4-4.5	—
No Fan	—	1.5	2.5-4	3-4	—
No Fan/Xtra Muff	—	1.5	2.5	3.5-4.5	—
IH					
Standard	—	1	1-1.2	2.5-3	—
No Fan	—	1	1.2-2	1.5-3.5	3-4
No Fan/Xtra Muff	—	1	1-1.2	2-3	2.5-4
FORD					
Standard	—	1.5	1-1.5	3-6.5	4-10.5
No Fan	—	1.5-2	1.2-1.5	2.5-5	4.5-10
No Fan/Xtra Muff	—	1.2-1.5	1-1.2	2.5-5	3.5-12

Table 9.6 Range of Acceleration Times in Seconds for Phase 2 Trucks.

10. RESULTS AND CONCLUSIONS

The following results can be derived from this research project:

1. A modified Chevrolet Chevette could be used as a representation of several, large trucks.

2. Transient sound measurements can be made in reverberation rooms while retaining individual vehicle characteristics.

3. The sound field in a large reverberation room ($1064m^3$) is relatively uniform even if a large truck is used as the sound source.

4. There are strong indications that a vehicle sound power test in a reverberation room can be used to predict 50 ft. passby sound pressure levels. The prediction is appropriate for uniform hemispherical sound radiation.

5. The change in sound level produced by vehicle modification can be accurately measured in a reverberation room.

6. There is a strong possibility that a reverberation room measurement can be used as an alternate procedure to a passby test. The effects of different types of dynamometer loading must still be evaluated.

In order to obtain the necessary information on dynamometer loading, the next phase of this research would be to measure several trucks using a roll-dynamometer. Such a dynamometer facility would permit rapid measurement of truck noise. Vehicles would be driven into a reverberation room onto a roll dynamometer and measured during an IMI sequence.

Therefore, no time would be required for dynamometer mounting and demounting.

In conclusion, this concept appears to be feasible and should be pursued to achieve a simple, efficient room test procedure.

APPENDIX A: REVERBERATION ROOM DATA

Included in this appendix are the A-weighted, room corrected sound pressure levels for all vehicles in all reverberation rooms. Thirty values serve to characterize a specific combination of vehicle configuration and room: five runs at six microphone positions. The tables indicate five runs as a convenience. There were actually fifteen run-ups for each test sequence as follows: Five run-ups with microphones at positions one and two, then five more run-ups with microphones at positions three and four, and five final run-ups with microphones at positions five and six.

Figure A1 identified the numbers on each table. The mean and standard deviation of the data were calculated across runs and across microphone positions, as well as for the entire set of thirty. Additionally, at the bottom of each table are the average of the means across both microphone positions and runs. Note how, while the mean values are the same the spread of the data is greater when averaged across microphone position than when averaged across run number. This is an indication of the similarity of truck run-ups and of the spatial variability within the reverberation room.

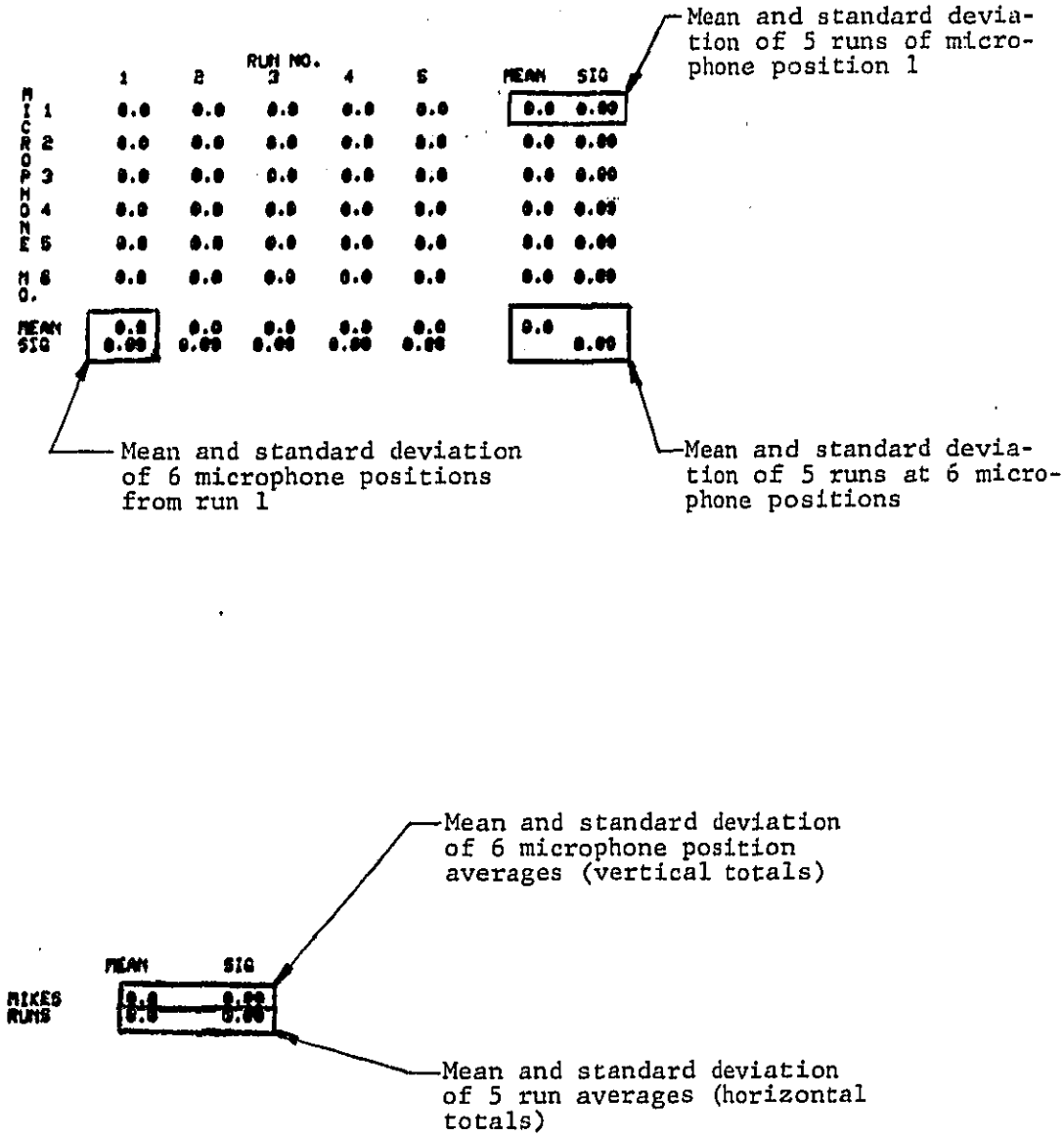


Figure A1. Key to data charts

PHASE 1 DATA - ROOM CORRECTED

CHEVETTE, STANDARD, 3500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.0	98.0	100.0	99.5	99.5	99.1	0.94
2	96.5	98.5	99.5	99.5	99.5	98.8	1.30
3	100.0	99.0	100.0	101.0	100.5	100.1	0.74
4	99.0	98.5	100.0	101.0	100.0	99.8	0.97
5	99.0	100.5	100.0	101.0	101.0	100.4	0.84
6	98.0	99.0	99.5	99.0	98.5	98.8	0.57
MEAN	98.6	99.0	99.8	100.2	99.9	99.6	
SIG	1.20	0.86	0.26	0.93	0.88		1.06

	MEAN	SIG
MIKES	99.6	0.68
RUNS	99.6	0.71

TT5 -- STOP

CHEVETTE, STANDARD, 4000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.5	102.0	100.5	102.5	102.5	102.1	0.87
2	102.0	102.5	101.0	102.0	102.0	101.9	0.55
3	103.0	102.0	103.0	103.0	102.0	102.6	0.55
4	102.0	102.0	102.0	102.5	102.0	102.1	0.22
5	102.0	102.0	102.5	103.0	102.5	102.4	0.42
6	102.0	102.5	102.0	102.0	102.5	102.2	0.27
MEAN	102.3	102.2	101.9	102.5	102.3	102.2	
SIG	0.42	0.26	0.93	0.45	0.27		0.54

	MEAN	SIG
MIKES	102.2	0.26
RUNS	102.2	0.22

TT5 -- STOP

CHEVETTE, STANDARD, 4500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	105.5	105.0	105.0	105.0	105.0	105.1	0.22
2	104.5	104.0	104.5	105.0	105.0	104.6	0.42
3	105.0	105.5	105.5	106.0	106.0	105.6	0.42
4	104.5	105.0	105.0	105.0	105.0	104.9	0.22
5	105.0	106.0	104.0	104.5	104.5	104.9	0.76
6	104.5	104.5	104.0	104.5	105.0	104.5	0.35
MEAN	104.8	105.0	104.7	105.0	105.1	104.9	
SIG	0.41	0.71	0.61	0.55	0.49		0.54

	MEAN	SIG
MIKES	104.9	0.40
RUNS	104.9	0.17

TT5 -- STOP

CHEVETTE, STANDARD, 5000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	108.5	108.5	108.0	108.0	108.0	108.2	0.27
2	107.5	108.5	108.5	109.0	108.5	108.4	0.55
3	108.5	108.5	108.5	108.5	108.0	108.4	0.22
4	108.0	107.0	108.0	108.5	107.5	107.8	0.57
5	107.0	107.0	108.0	108.0	107.5	107.5	0.50
6	107.0	108.0	107.5	107.5	108.0	107.6	0.42
MEAN	107.8	108.0	108.1	108.3	107.9	108.0	
SIG	0.69	0.74	0.38	0.52	0.38		0.55

	MEAN	SIG
MIKES	108.0	0.40
RUNS	108.0	0.18

TT5 -- STOP

CHEVETTE, STANDARD, 3500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	91.0	91.5	91.0	91.5	91.5	91.3	0.27
2	92.5	92.5	93.0	93.5	94.0	93.1	0.65
3	92.5	92.5	92.0	92.0	93.0	92.4	0.42
4	92.5	93.0	92.5	92.0	92.0	92.4	0.42
5	91.0	92.5	92.0	90.0	90.0	91.2	1.14
6	90.0	90.5	90.0	90.0	90.0	90.1	0.22
MEAN	91.7	92.2	91.9	91.7	92.0	91.9	
SIG	1.07	0.92	1.08	1.34	1.60		1.16

	MEAN	SIG
MIKES	91.9	1.10
RUNS	91.9	0.20

TT5 -- STOP

CHEVETTE, STANDARD, 4000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	94.0	95.0	94.5	95.0	94.0	94.5	0.50
2	95.0	95.0	95.5	94.5	94.5	94.9	0.42
3	95.0	95.0	95.0	94.0	95.0	94.8	0.45
4	94.0	94.0	94.0	94.0	94.0	94.0	0.00
5	93.0	93.0	93.0	94.0	94.0	93.4	0.55
6	92.0	92.5	92.5	92.5	93.0	92.5	0.35
MEAN	94.0	94.2	94.2	94.1	94.1	94.1	
SIG	1.17	1.11	1.16	0.84	0.66		0.94

	MEAN	SIG
MIKES	94.1	0.93
RUNS	94.1	0.11

TT5 -- STOP

CHEVETTE, STANDARD, 4500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	95.0	95.5	95.5	95.0	95.5	95.3	0.27
2	96.5	97.0	96.5	97.5	97.0	96.9	0.42
3	97.5	97.0	96.5	97.5	97.0	97.1	0.42
4	96.0	96.0	96.0	96.0	96.0	96.0	0.00
5	96.0	96.0	96.0	96.0	95.5	95.9	0.22
6	94.5	96.0	95.0	94.5	95.0	95.0	0.61
MEAN	96.0	96.3	95.9	96.2	96.1	96.1	
SIG	1.07	0.61	0.58	1.24	0.84		0.85

	MEAN	SIG
MIKES	96.1	0.84
RUNS	96.1	0.14

TT5 -- STOP

CHEVETTE, STANDARD, 5000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	97.0	98.0	97.0	97.5	97.5	97.4	0.42
2	99.0	99.5	100.0	100.0	99.5	99.6	0.42
3	99.0	99.5	99.5	99.0	99.5	99.3	0.27
4	99.0	99.5	98.5	99.0	99.0	99.0	0.35
5	98.0	98.5	98.5	99.0	99.0	98.6	0.42
6	98.0	98.0	98.0	97.5	98.0	97.9	0.22
MEAN	98.4	98.9	98.7	98.8	98.8	98.7	
SIG	0.82	0.75	1.07	0.98	0.82		0.85

	MEAN	SIG
MIKES	98.7	0.84
RUNS	98.7	0.18

TT5 -- STOP

TT5 -- STOP
>

CHEVETTE, HIGH ENGINE NOISE, 3500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.0	107.0	106.5	107.0	107.0	106.4	1.30
2	105.0	108.0	107.5	108.0	108.0	107.4	1.30
3	106.0	106.0	106.0	106.0	106.5	106.1	0.22
4	107.0	107.5	107.5	108.0	107.5	107.5	0.35
5	105.0	105.0	105.0	105.5	105.0	105.1	0.22
6	105.5	105.5	105.0	106.0	106.0	105.6	0.42
MEAN	105.5	106.6	106.4	106.9	106.8	106.5	
SIG	1.02	1.18	1.13	1.08	1.08		1.13

	MEAN	SIG
MIKES	106.5	0.97
RUNS	106.5	0.54

CHEVETTE, HIGH ENGINE NOISE, 4000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	108.5	108.0	108.5	108.0	108.0	108.2	0.27
2	108.0	108.0	108.5	108.0	108.0	108.1	0.22
3	109.0	108.0	108.0	108.0	108.0	108.2	0.45
4	109.0	109.0	108.0	109.0	108.5	108.7	0.45
5	108.0	108.0	108.0	108.0	107.5	107.9	0.22
6	106.0	107.0	108.0	107.0	108.0	107.3	0.84
MEAN	108.2	108.0	108.2	108.0	108.0	108.1	
SIG	1.11	0.63	0.26	0.63	0.32		0.62

	MEAN	SIG
MIKES	108.1	0.48
RUNS	108.1	0.08

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 4500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	110.5	110.0	110.5	110.5	110.5	110.4	0.22
2	111.0	111.5	111.5	112.0	112.0	111.6	0.42
3	111.0	111.0	111.0	110.0	110.5	110.7	0.45
4	110.0	110.5	109.0	109.5	110.0	109.8	0.57
5	110.0	110.0	110.0	110.0	110.0	110.0	0.00
6	110.0	110.5	110.5	110.5	110.0	110.3	0.27
MEAN	110.4	110.6	110.5	110.5	110.6	110.5	
SIG	0.49	0.58	0.86	0.86	0.77		0.68

	MEAN	SIG
MIKES	110.5	0.64
RUNS	110.5	0.07

TTS -- STOP

CHEVETTE, HIGH ENGINE NOISE, 5000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	112.0	112.0	112.0	112.0	112.0	112.0	0.00
2	113.0	112.0	112.0	112.5	113.0	112.5	0.50
3	114.0	113.5	113.5	113.0	114.0	113.6	0.42
4	114.0	114.0	114.0	112.0	113.0	113.5	0.89
5	112.0	112.0	112.5	112.0	112.5	112.2	0.27
6	113.0	113.0	113.0	113.0	113.0	113.0	0.00
MEAN	113.1	112.8	112.9	112.4	113.0	112.8	
SIG	0.89	0.88	0.82	0.49	0.66		0.74

	MEAN	SIG
MIKES	112.8	0.67
RUNS	112.8	0.23

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 3500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	99.5	99.5	99.0	99.0	99.2	0.27
2	97.0	98.0	96.5	98.0	97.0	97.3	0.67
3	99.0	99.0	99.5	99.0	99.5	99.2	0.27
4	96.5	97.0	96.5	97.0	97.0	96.8	0.27
5	97.5	97.0	96.5	97.5	97.0	97.1	0.42
6	96.0	96.5	96.0	95.5	95.0	95.8	0.57
MEAN	97.7	98.0	97.7	97.8	97.7	97.8	
SIG	1.26	1.21	1.63	1.33	1.63		1.33

	MEAN	SIG
MIKES	97.8	1.36
RUNS	97.8	0.14

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 4000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	99.5	99.5	99.5	99.5	99.4	0.22
2	100.0	100.0	100.0	99.5	100.0	99.9	0.22
3	100.0	100.0	100.0	100.0	100.0	100.0	0.00
4	99.5	100.0	99.0	99.0	99.5	99.4	0.42
5	99.0	100.0	100.0	100.0	99.0	99.6	0.55
6	98.0	98.5	98.5	98.5	98.5	98.4	0.22
MEAN	99.3	99.7	99.5	99.4	99.4	99.5	
SIG	0.76	0.61	0.63	0.58	0.58		0.61

	MEAN	SIG
MIKES	99.5	0.57
RUNS	99.5	0.15

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 4500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.0	102.0	102.0	103.0	102.0	102.2	0.45
2	103.0	102.5	101.0	104.0	103.0	102.8	1.10
3	102.0	103.0	102.5	102.5	102.0	102.4	0.42
4	103.0	104.0	104.0	102.5	103.5	103.4	0.65
5	102.0	102.5	102.0	101.0	102.0	101.9	0.55
6	101.0	101.0	101.0	101.0	101.0	101.0	0.00
MEAN	102.2	102.6	102.2	102.5	102.3	102.4	
SIG	0.75	1.00	1.11	1.17	0.88		0.94

	MEAN	SIG
MIKES	102.4	0.82
RUNS	102.4	0.17

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 5000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	105.0	104.5	104.5	104.0	105.0	104.6	0.42
2	104.5	104.0	104.0	104.0	104.0	104.1	0.22
3	103.0	102.5	104.5	104.0	105.0	103.9	1.04
4	104.5	105.0	106.0	106.0	106.0	105.5	0.71
5	104.0	104.0	104.5	104.0	105.0	104.3	0.45
6	102.5	103.0	103.0	103.5	103.0	103.0	0.35
MEAN	104.0	103.9	104.5	104.3	104.8	104.3	
SIG	0.97	0.93	0.97	0.88	1.03		0.94

	MEAN	SIG
MIKES	104.3	0.84
RUNS	104.3	0.35

TT5 -- STOP

CHEVETTE, HIGH EXHAUST, 3500 RPM (ROOM #3)

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	111.0	111.0	110.0	111.5	110.0	110.7	0.67
2	112.5	112.5	112.5	112.5	112.5	112.5	0.00
3	110.0	110.0	110.0	110.0	110.0	110.0	0.00
4	110.0	111.0	111.0	111.0	110.5	110.7	0.45
5	110.5	111.0	111.0	110.0	111.0	110.7	0.45
6	110.0	110.0	110.0	110.0	110.0	110.0	0.00
MEAN	110.8	111.0	110.8	110.9	110.8	110.9	
SIG	0.98	0.92	0.99	1.03	0.98		0.92

	MEAN	SIG
MIKES	110.9	0.92
RUNS	110.9	0.10

TTS -- STOP

CHEVETTE, HIGH EXHAUST, 4000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	110.0	110.0	110.0	110.0	110.0	110.0	0.00
2	114.0	113.0	113.0	113.0	113.0	113.2	0.45
3	110.5	110.5	111.0	110.5	110.5	110.6	0.22
4	112.5	112.5	112.5	112.5	112.5	112.5	0.00
5	113.0	113.0	113.0	113.0	113.0	113.0	0.00
6	111.0	111.5	111.0	112.0	111.0	111.3	0.45
MEAN	112.1	111.9	111.9	112.0	111.8	111.9	
SIG	1.57	1.29	1.25	1.29	1.33		1.26

	MEAN	SIG
MIKES	111.9	1.33
RUNS	111.9	0.08

TTS -- STOP

CHEVETTE, HIGH EXHAUST, 4500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	114.0	114.0	114.0	114.0	114.0	114.0	0.00
2	112.5	112.0	112.5	112.5	112.5	112.4	0.22
3	112.5	112.5	113.0	112.5	113.0	112.7	0.27
4	112.0	112.0	112.0	112.0	112.0	112.0	0.00
5	113.0	113.5	113.5	113.5	113.5	113.4	0.22
6	111.0	112.0	112.0	112.0	112.0	111.8	0.45
MEAN	112.6	112.7	112.9	112.8	112.9	112.8	
SIG	1.00	0.88	0.82	0.82	0.82		0.82

	MEAN	SIG
MIKES	112.8	0.84
RUNS	112.8	0.12

TT5 -- STOP

CHEVETTE, HIGH EXHAUST, 5000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	114.5	114.5	114.5	114.0	114.0	114.3	0.27
2	113.0	113.0	113.0	113.0	113.0	113.0	0.00
3	113.0	113.0	112.5	113.0	113.0	112.9	0.22
4	112.5	112.5	112.0	112.0	112.0	112.2	0.27
5	114.0	114.0	114.0	114.0	114.0	114.0	0.00
6	113.0	113.0	113.0	113.0	114.0	113.2	0.45
MEAN	113.4	113.4	113.3	113.2	113.4	113.3	
SIG	0.75	0.75	0.93	0.75	0.82		0.75

	MEAN	SIG
MIKES	113.3	0.77
RUNS	113.3	0.08

TT5 -- STOP

CHEVETTE, HIGH EXHAUST, 3500 RPM (ROOM #5, UNPAINTED)

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	104.0	103.0	104.0	103.0	103.5	103.5	0.50
2	103.0	103.0	102.5	102.5	103.0	102.8	0.27
3	103.0	103.0	103.0	103.0	103.5	103.1	0.22
4	102.5	102.0	102.0	102.0	102.0	102.1	0.22
5	104.5	104.5	104.5	104.0	105.0	104.5	0.35
6	104.0	104.0	104.0	104.0	104.0	104.0	0.00
MEAN	103.6	103.3	103.4	103.1	103.6	103.4	
SIG	0.77	0.88	0.98	0.80	1.00		0.84

	MEAN	SIG
MIKES	103.4	0.86
RUNS	103.4	0.18

TTS -- STOP

CHEVETTE, HIGH EXHAUST, 4000 RPM (ROOM #5, UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.0	104.0	104.0	103.5	103.5	103.8	0.27
2	104.0	104.5	104.5	104.5	105.0	104.5	0.35
3	103.0	103.5	103.5	103.5	104.0	103.5	0.35
4	104.0	104.0	104.0	104.5	104.0	104.1	0.22
5	108.0	108.0	107.5	107.5	107.5	107.7	0.27
6	106.0	106.0	106.0	106.0	106.0	106.0	0.00
MEAN	105.2	105.3	105.2	105.2	105.2	105.2	
SIG	1.83	1.70	1.53	1.56	1.52		1.52

	MEAN	SIG
MIKES	105.2	1.61
RUNS	105.2	0.06

TTS --- STOP

CHEVETTE, HIGH EXHAUST, 4500 RPM (ROOM #5, UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	106.5	107.5	107.0	107.0	107.5	107.1	0.42
2	107.0	106.5	107.5	107.0	107.5	107.1	0.42
3	107.0	107.5	107.0	107.5	107.0	107.2	0.27
4	105.5	105.5	105.5	106.0	105.5	105.6	0.22
5	108.5	108.5	108.0	108.5	108.5	108.4	0.22
6	108.0	108.0	108.0	108.0	108.5	108.1	0.22
MEAN	107.2	107.4	107.2	107.4	107.5	107.3	
SIG	1.07	1.08	0.93	0.88	1.11		0.95

	MEAN	SIG
MIKES	107.3	0.98
RUNS	107.3	0.13

TTS -- STOP

CHEVETTE, HIGH EXHAUST, 5000 RPM (ROOM #5, UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	107.0	107.0	107.5	107.5	107.5	107.3	0.27
2	107.0	107.0	107.0	107.0	107.5	107.1	0.22
3	107.0	107.0	107.0	107.5	107.0	107.1	0.22
4	106.0	106.0	106.0	106.0	106.5	106.1	0.22
5	108.5	109.0	108.5	108.0	108.5	108.5	0.35
6	107.5	108.0	108.5	108.5	108.0	108.1	0.42
MEAN	107.2	107.4	107.5	107.5	107.5	107.4	
SIG	0.82	1.03	0.97	0.86	0.71		0.83

	MEAN	SIG
MIKES	107.4	0.85
RUNS	107.4	0.12

TT5 -- STOP

CHEVETTE, **QUIET** , 3500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	97.0	98.0	98.5	98.0	97.5	97.8	0.57
2	99.0	100.0	100.0	99.0	100.0	99.6	0.55
3	99.0	98.5	98.0	98.5	99.0	98.6	0.42
4	100.0	98.5	99.0	100.0	100.0	99.5	0.71
5	98.5	98.0	98.0	98.0	98.0	98.1	0.22
6	98.0	98.5	98.5	98.0	98.0	98.2	0.27
MEAN	98.7	98.6	98.7	98.6	98.9	98.7	
SIG	1.02	0.74	0.75	0.80	1.08		0.83

	MEAN	SIG
MIKES	98.7	0.76
RUNS	98.7	0.09

TT5 -- STOP

CHEVETTE, **QUIET** , 4000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	101.5	100.5	101.5	101.0	100.9	0.65
2	101.0	101.0	101.5	101.0	101.0	101.1	0.22
3	100.5	100.5	101.0	101.0	100.5	100.7	0.27
4	102.0	102.0	102.0	101.5	102.0	101.9	0.22
5	101.0	101.5	101.5	101.5	101.5	101.4	0.22
6	102.0	102.0	102.0	102.0	101.5	101.9	0.22
MEAN	101.1	101.4	101.4	101.4	101.3	101.4	
SIG	0.80	0.58	0.58	0.38	0.52		0.56

	MEAN	SIG
MIKES	101.4	0.50
RUNS	101.4	0.13

TT5 -- STOP

CHEVETTE, QUIET 4500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	104.0	104.5	104.5	104.0	104.5	104.3	0.27
2	104.0	104.5	104.0	104.0	104.5	104.2	0.27
3	103.0	103.0	103.0	103.5	103.5	103.2	0.27
4	104.0	103.5	104.0	102.5	104.0	103.6	0.65
5	102.5	102.0	102.5	103.5	103.0	102.7	0.57
6	103.0	104.0	103.0	103.0	103.0	103.2	0.45
MEAN	103.5	103.7	103.6	103.4	103.8	103.6	
SIG	0.66	0.97	0.77	0.58	0.69		0.71

	MEAN	SIG
MIKES	103.6	0.62
RUNS	103.6	0.15

TT5 -- STOP

CHEVETTE, **QUIET** 5000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	106.0	105.5	106.0	106.0	105.5	105.8	0.27
2	107.5	107.5	108.0	107.0	107.0	107.4	0.42
3	107.5	108.0	105.5	107.0	107.5	107.2	0.96
4	107.0	106.5	106.5	106.0	106.0	106.4	0.42
5	104.5	105.0	106.0	106.0	105.0	105.3	0.67
6	105.0	106.0	106.0	106.0	106.0	105.8	0.45
MEAN	106.4	106.5	106.4	106.4	106.3	106.4	
SIG	1.29	1.16	0.88	0.52	0.93		0.92

	MEAN	SIG
MIKES	106.4	0.83
RUNS	106.4	0.10

TT5 -- STOP

CHEVETTE, QUIET 3500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	89.0	90.0	90.0	90.0	90.0	89.8	0.45
2	89.0	89.0	89.0	89.0	89.0	89.0	0.00
3	89.0	89.0	89.0	90.0	90.0	89.4	0.55
4	91.0	90.0	90.0	90.0	89.5	90.1	0.55
5	90.5	90.5	90.0	90.0	90.5	90.3	0.27
6	88.5	89.5	89.0	89.0	89.0	89.0	0.35
MEAN	89.6	89.7	89.5	89.7	89.7	89.6	
SIG	1.00	0.61	0.55	0.52	0.61		0.64

	MEAN	SIG
MIKES	89.6	0.56
RUNS	89.6	0.08

TT5 -- STOP

CHEVETTE, QUIET 4000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	91.0	91.0	91.0	92.0	91.5	91.3	0.45
2	93.0	92.5	93.5	93.5	93.5	93.2	0.45
3	93.0	93.0	93.0	93.0	93.0	93.0	0.00
4	93.0	93.0	93.0	92.5	93.0	92.9	0.22
5	91.0	92.0	92.5	91.0	90.5	91.5	0.82
6	92.0	92.0	92.0	92.0	92.0	92.0	0.00
MEAN	92.3	92.3	92.6	92.4	92.4	92.4	
SIG	0.98	0.76	0.89	0.88	1.13		0.88

	MEAN	SIG
MIKES	92.4	0.83
RUNS	92.4	0.12

TTS -- STOP

CHEVETTE, QUIET 4500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	94.5	94.0	95.0	95.0	94.0	94.5	0.50
2	95.0	95.5	96.0	95.0	96.0	95.5	0.50
3	95.0	96.0	96.5	96.0	96.5	96.0	0.61
4	95.0	95.0	94.0	94.5	95.0	94.7	0.45
5	95.0	95.5	96.0	95.0	96.0	95.5	0.50
6	95.0	94.5	94.0	94.5	95.0	94.6	0.42
MEAN	94.9	95.1	95.4	95.0	95.5	95.2	
SIG	0.20	0.74	1.08	0.55	0.92		0.73

	MEAN	SIG
MIKES	95.2	0.62
RUNS	95.2	0.24

TTS -- STOP

CHEVETTE, **QUIET** 5000 RPM R00M #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	98.0	98.0	98.0	98.0	98.2	0.45
2	99.0	99.0	99.0	99.0	99.0	99.0	0.00
3	97.5	97.0	96.0	96.5	96.0	96.6	0.65
4	98.0	97.5	97.0	97.0	97.5	97.4	0.42
5	96.5	97.0	96.5	97.0	97.0	96.8	0.27
6	96.0	96.0	95.0	95.5	96.0	95.7	0.45
MEAN	97.8	97.5	97.1	97.3	97.4	97.4	
SIG	1.25	1.02	1.43	1.21	1.17		1.16

	MEAN	SIG
MIKES	97.4	1.18
RUNS	97.4	0.26

TT5 -- STOP

CHEVETTE, **REDUCED POWER** 3500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	97.5	98.0	98.5	97.5	97.0	97.7	0.57
2	96.0	97.0	97.0	97.0	97.0	96.8	0.45
3	98.0	98.0	98.0	98.0	97.5	97.9	0.22
4	97.0	97.0	97.0	97.5	97.0	97.1	0.22
5	96.5	97.0	97.0	96.5	96.5	96.7	0.27
6	96.5	96.0	96.0	96.0	96.0	96.1	0.22
MEAN	97.0	97.2	97.3	97.1	96.9	97.1	
SIG	0.74	0.75	0.88	0.74	0.52		0.70

	MEAN	SIG
MIKES	97.1	0.67
RUNS	97.1	0.19

TT5 -- STOP

CHEVETTE, **REDUCED POWER** 4000RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	100.0	100.0	99.0	100.0	99.6	0.55
2	100.0	99.5	99.5	99.0	99.5	99.5	0.35
3	100.0	100.0	100.0	100.0	100.0	100.0	0.00
4	99.0	99.0	99.0	100.0	99.5	99.3	0.45
5	100.0	100.0	100.0	100.0	99.0	99.8	0.45
6	99.5	99.0	99.5	99.0	99.0	99.2	0.27
MEAN	99.6	99.6	99.7	99.5	99.5	99.6	
SIG	0.49	0.49	0.41	0.55	0.45		0.45

	MEAN	SIG
MIKES	99.6	0.30
RUNS	99.6	0.06

TT5 -- STOP

CHEVETTE, REDUCED POWER 4500 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.0	102.0	102.0	102.0	102.0	102.0	0.00
2	102.0	102.0	102.0	102.0	102.0	102.0	0.00
3	102.0	102.0	103.0	102.0	102.0	102.2	0.45
4	101.0	101.5	102.0	101.5	101.5	101.5	0.35
5	102.5	102.0	102.5	102.5	103.0	102.5	0.35
6	102.0	102.5	102.0	102.0	101.0	101.9	0.55
MEAN	101.9	102.0	102.3	102.0	102.0	102.0	
SIG	0.49	0.32	0.42	0.32	0.66		0.45

	MEAN	SIG
MIKES	102.0	0.33
RUNS	102.0	0.14

TT5 -- STOP

CHEVETTE, **REDUCED POWER** 5000 RPM (ROOM #2)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.5	104.5	105.0	104.5	104.5	104.6	0.22
2	104.5	104.5	106.0	105.0	105.0	105.0	0.61
3	106.0	106.0	106.0	105.0	106.0	105.8	0.45
4	105.0	104.0	105.0	104.5	104.0	104.5	0.50
5	104.0	104.5	104.0	104.5	104.0	104.2	0.27
6	104.5	105.0	104.5	104.0	105.0	104.6	0.42
MEAN	104.8	104.8	105.1	104.6	104.8	104.8	
SIG	0.69	0.69	0.80	0.38	0.76		0.65

	MEAN	SIG
MIKES	104.8	0.56
RUNS	104.8	0.20

TT5 -- STOP

CHEVETTE, **REDUCED POWER** 3500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	89.5	89.0	88.5	89.0	89.0	89.0	0.35
2	89.0	90.0	89.0	90.0	90.0	89.6	0.55
3	90.0	90.0	90.5	90.5	90.5	90.3	0.27
4	90.0	89.5	89.0	89.0	89.0	89.3	0.45
5	90.0	90.0	90.0	90.0	90.0	90.0	0.00
6	88.0	88.0	88.0	88.0	88.0	88.0	0.00
MEAN	89.5	89.5	89.3	89.5	89.5	89.4	
SIG	0.80	0.80	0.93	0.92	0.92		0.82

	MEAN	SIG
MIKES	89.4	0.82
RUNS	89.4	0.10

TT5 -- STOP

CHEVETTE, REDUCED POWER 4000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	90.5	90.5	90.5	92.5	92.0	91.3	0.97
2	90.5	91.5	91.0	92.5	92.0	91.6	0.79
3	92.0	91.0	91.0	92.0	92.0	91.6	0.55
4	91.5	90.5	91.0	91.0	91.5	91.1	0.42
5	91.0	91.0	92.0	91.0	91.5	91.3	0.45
6	90.5	90.0	90.0	90.0	90.0	90.1	0.22
MEAN	91.0	90.8	91.0	91.6	91.6	91.2	
SIG	0.63	0.52	0.66	1.00	0.77		0.75

	MEAN	SIG
MIKES	91.2	0.55
RUNS	91.2	0.37

TT5 -- STOP

CHEVETTE, REDUCED POWER 4500 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	95.0	94.5	94.5	94.0	95.0	94.6	0.42
2	94.0	94.0	94.0	94.5	94.0	94.1	0.22
3	94.5	94.5	95.0	94.5	95.0	94.7	0.27
4	94.0	94.0	93.0	94.0	94.0	93.8	0.45
5	95.0	95.0	95.0	94.5	93.0	94.6	0.87
6	92.5	93.0	93.0	93.0	93.0	92.9	0.22
MEAN	94.2	94.2	94.2	94.1	94.1	94.2	
SIG	0.93	0.68	0.92	0.58	0.89		0.76

	MEAN	SIG
MIKES	94.2	0.69
RUNS	94.2	0.07

TTS -- STOP

CHEVETTE, **REDUCED POWER** 5000 RPM (ROOM #5 UNPAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	96.0	96.5	95.0	95.0	96.0	95.7	0.67
2	96.5	96.5	97.0	96.0	96.0	96.4	0.42
3	98.0	97.0	96.5	97.0	96.0	97.0	0.74
4	97.0	97.0	96.0	95.0	96.0	96.3	0.84
5	94.5	96.5	96.0	96.0	95.0	95.7	0.82
6	95.0	94.5	94.0	94.5	94.5	94.5	0.35
MEAN	96.3	96.4	95.9	95.7	95.6	96.0	
SIG	1.29	0.93	1.08	0.92	0.66		0.98

	MEAN	SIG
MIKES	96.0	0.84
RUNS	96.0	0.37

TT5 -- STOP

PHASE 2 DATA - ROOM CORRECTED

CHEVETTE, STANDARD, 3500 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	92.0	92.0	92.0	92.5	92.5	92.2	0.27
2	94.0	94.0	93.5	94.5	94.5	94.1	0.42
3	93.0	92.5	92.5	93.0	92.5	92.7	0.27
4	94.0	94.0	94.0	94.0	94.0	94.0	0.00
5	92.0	93.0	93.0	92.0	92.5	92.5	0.50
6	92.5	90.5	92.5	92.0	91.5	91.9	0.84
MEAN	93.0	92.8	93.0	93.1	93.0	93.0	
SIG	0.92	1.33	0.74	1.05	1.11		0.98

	MEAN	SIG
MIKES	93.0	0.94
RUNS	93.0	0.11

TTS -- STOP

CHEVETTE, STANDARD, 4000 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	94.5	94.0	94.5	94.5	95.0	94.5	0.35
2	95.0	96.0	96.0	95.5	95.0	95.5	0.50
3	95.0	95.5	95.5	96.0	95.0	95.4	0.42
4	96.5	96.5	96.0	96.0	95.0	96.0	0.61
5	94.5	94.5	94.5	95.0	95.0	94.7	0.27
6	95.0	94.0	94.5	94.0	95.0	94.5	0.50
MEAN	95.1	95.2	95.2	95.2	95.0	95.2	
SIG	0.74	1.07	0.75	0.82	0.00		0.71

	MEAN	SIG
MIKES	95.2	0.63
RUNS	95.2	0.10

TT5 -- STOP

CHEVETTE, STANDARD, 4500 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	96.0	97.0	96.5	96.0	96.5	96.4	0.42
2	98.0	98.0	98.0	98.0	98.5	98.1	0.22
3	99.0	98.5	98.5	99.0	98.0	98.6	0.42
4	97.5	98.5	97.5	98.0	98.0	97.9	0.42
5	97.0	97.0	97.0	97.0	97.0	97.0	0.00
6	98.0	97.0	97.5	97.5	97.5	97.5	0.35
MEAN	97.7	97.7	97.5	97.7	97.6	97.7	
SIG	1.02	0.75	0.71	1.02	0.74		0.80

	MEAN	SIG
MIKES	97.7	0.79
RUNS	97.7	0.05

TT5 -- STOP

CHEVETTE, STANDARD, 5000 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	100.0	100.0	100.0	100.0	100.0	0.00
2	100.5	100.5	101.0	100.5	101.0	100.7	0.27
3	100.0	100.0	100.0	100.0	100.0	100.0	0.00
4	100.5	100.0	101.0	100.5	101.0	100.6	0.42
5	99.0	99.0	99.0	99.5	99.0	99.1	0.22
6	100.0	100.0	100.0	100.0	100.0	100.0	0.00
MEAN	100.0	99.9	100.2	100.1	100.2	100.1	
SIG	0.55	0.49	0.75	0.38	0.75		0.57

	MEAN	SIG
MIKES	100.1	0.57
RUNS	100.1	0.11

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 3500 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	99.5	99.5	100.0	100.0	99.8	0.27
2	100.0	99.0	100.0	100.0	100.0	99.8	0.45
3	101.0	101.0	101.0	101.5	101.0	101.1	0.22
4	99.0	99.0	100.0	99.5	100.0	99.5	0.50
5	99.0	99.5	100.0	99.5	100.0	99.6	0.42
6	100.0	100.5	100.0	100.0	100.0	100.1	0.22
MEAN	99.9	99.8	100.1	100.1	100.2	100.0	
SIG	0.75	0.82	0.49	0.74	0.41		0.64

	MEAN	SIG
MIKES	100.0	0.58
RUNS	100.0	0.16

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 4000 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	101.0	101.0	101.0	101.0	101.0	101.0	0.00
2	102.0	102.0	102.0	102.0	102.0	102.0	0.00
3	102.5	103.0	103.0	104.0	103.0	103.1	0.55
4	102.0	102.5	102.0	102.0	102.0	102.1	0.22
5	102.0	101.5	102.0	102.0	104.0	102.4	0.97
6	102.0	101.0	101.0	101.0	103.0	101.7	0.89
MEAN	101.9	101.9	101.9	102.1	102.6	102.1	
SIG	0.49	0.82	0.75	1.10	1.05		0.85

	MEAN	SIG
MIKES	102.1	0.71
RUNS	102.1	0.30

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 4500 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO.: 1	2	3	4	5	MEAN	SIG
1	104.0	104.5	104.5	104.5	105.0	104.5	0.35
2	104.0	104.0	104.0	104.0	104.5	104.1	0.22
3	103.0	104.0	104.0	103.0	104.0	103.6	0.55
4	104.0	104.0	104.0	103.5	103.5	103.8	0.27
5	103.0	103.5	103.0	104.0	103.5	103.4	0.42
6	104.0	104.0	103.0	102.5	103.0	103.3	0.67
MEAN	103.7	104.0	103.8	103.6	104.0	103.8	
SIG	0.52	0.32	0.61	0.74	0.74		0.58

	MEAN	SIG
MIKES	103.8	0.44
RUNS	103.8	0.17

TT5 -- STOP

CHEVETTE, HIGH ENGINE NOISE, 5000 RPM (ROOM #5 PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	107.0	106.0	106.5	107.0	106.5	106.6	0.42
2	107.0	107.0	108.0	107.0	107.0	107.2	0.45
3	107.0	107.0	107.0	108.0	107.0	107.2	0.45
4	108.0	107.5	107.0	107.5	107.0	107.4	0.42
5	106.0	106.0	106.0	107.0	106.0	106.2	0.45
6	106.0	106.0	106.0	105.0	106.0	105.8	0.45
MEAN	106.9	106.6	106.8	107.0	106.6	106.8	
SIG	0.75	0.66	0.76	1.02	0.49		0.72

	MEAN	SIG
MIKES	106.8	0.64
RUNS	106.8	0.18

TT5 -- STOP

CHEVETTE, HIGH EXHAUST, 3500 RPM (ROOM #5, PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.5	105.5	105.5	105.5	105.5	105.3	0.45
2	104.5	104.5	104.0	104.5	104.5	104.4	0.22
3	106.0	106.5	106.0	106.0	106.0	106.1	0.22
4	104.5	104.0	104.5	104.0	104.0	104.2	0.27
5	106.0	105.5	105.5	105.5	105.5	105.6	0.22
6	104.0	104.0	104.5	104.0	104.0	104.1	0.22
MEAN	105.0	105.1	105.1	105.0	105.0	105.0	
SIG	0.86	1.00	0.77	0.86	0.86		0.81

	MEAN	SIG
MIKES	105.0	0.83
RUNS	105.0	0.05

TTS -- STOP

CHEVETTE, HIGH EXHAUST, 4000 RPM (ROOM #5, PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	105.0	105.5	106.0	106.0	106.0	105.7	0.45
2	106.0	106.0	106.5	107.0	107.0	106.5	0.50
3	106.5	107.0	106.5	108.0	108.0	107.3	0.76
4	106.0	106.5	106.5	106.5	106.5	106.4	0.22
5	108.0	108.5	108.5	108.5	108.5	108.4	0.22
6	106.0	106.0	106.0	106.0	106.0	106.0	0.00
MEAN	106.3	106.7	106.8	107.1	107.1	106.8	
SIG	0.99	1.07	0.93	1.05	1.05		0.99

	MEAN	SIG
MIKES	106.8	0.98
RUNS	106.8	0.32

TTS -- STOP

CHEVETTE, HIGH EXHAUST, 4500 RPM (ROOM #5, PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	107.0	107.0	107.0	106.5	106.5	106.8	0.27
2	108.0	108.0	108.0	108.0	108.0	108.0	0.00
3	108.0	108.0	108.5	108.5	108.5	108.3	0.27
4	109.0	109.0	109.0	109.0	109.0	109.0	0.00
5	108.5	108.0	108.5	108.0	108.5	108.3	0.27
6	108.0	108.0	108.0	108.5	108.0	108.1	0.22
MEAN	108.1	108.0	108.2	108.2	108.2	108.1	
SIG	0.66	0.63	0.68	0.86	0.86		0.70

	MEAN	SIG
MIKES	108.1	0.72
RUNS	108.1	0.07

TT5 -- STOP

CHEVETTE, HIGH EXHAUST, 5000 RPM (ROOM #5, PAINTED)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	107.5	107.5	108.0	108.5	108.5	108.0	0.50
2	108.5	108.5	108.5	108.5	108.5	108.5	0.00
3	108.5	108.0	108.0	108.5	108.5	108.3	0.27
4	108.0	108.5	108.5	109.0	109.0	108.6	0.42
5	108.0	109.0	109.0	109.0	109.0	108.8	0.45
6	108.0	108.0	108.0	108.0	108.0	108.0	0.00
MEAN	108.1	108.3	108.3	108.6	108.6	108.4	
SIG	0.38	0.52	0.41	0.38	0.38		0.43

	MEAN	SIG
MIKES	108.4	0.33
RUNS	108.4	0.21

TTS -- STOP

GMC TRUCK, STANDARD, IMI (NCE)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.0	104.0	103.0	103.5	104.0	103.7	0.45
2	104.0	104.0	104.0	104.0	104.0	104.0	0.00
3	104.5	104.0	104.0	104.5	104.0	104.2	0.27
4	104.0	104.0	104.0	104.5	104.0	104.1	0.22
5	104.5	104.0	104.0	104.0	104.0	104.1	0.22
6	103.0	103.5	103.0	103.0	102.0	102.9	0.55
MEAN	104.0	103.9	103.7	103.9	103.7	103.9	
SIG	0.55	0.20	0.52	0.58	0.82		0.55

	MEAN	SIG
MIKES	103.9	0.48
RUNS	103.9	0.15

TT5 -- STOP

GMC TRUCK, STANDARD, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.0	104.0	104.0	104.0	103.5	103.9	0.22
2	104.5	104.0	104.0	104.0	104.0	104.1	0.22
3	104.5	104.0	104.5	104.5	104.0	104.3	0.27
4	104.5	104.5	104.0	104.0	104.0	104.2	0.27
5	104.0	104.5	104.0	104.5	104.0	104.2	0.27
6	103.0	103.0	103.0	103.0	103.0	103.0	0.00
MEAN	104.1	104.0	103.9	104.0	103.8	104.0	
SIG	0.58	0.55	0.49	0.55	0.42		0.50

	MEAN	SIG
MIKES	104.0	0.49
RUNS	104.0	0.13

TT5 -- STOP

GMC TRUCK, STANDARD, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	103.5	103.5	103.5	103.5	103.5	103.5	0.00
2	104.0	104.0	104.0	104.0	104.0	104.0	0.00
3	104.5	104.5	104.5	104.5	104.0	104.4	0.22
4	104.0	104.0	104.0	104.5	104.0	104.1	0.22
5	104.0	104.0	104.0	104.5	104.0	104.1	0.22
6	103.0	102.5	103.0	102.5	102.5	102.7	0.27
MEAN	103.9	103.8	103.9	104.0	103.7	103.8	
SIG	0.52	0.69	0.52	0.80	0.61		0.60

	MEAN	SIG
MIKES	103.8	0.61
RUNS	103.8	0.09

TT5 -- STOP

GMC TRUCK, STANDARD, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	104.0	104.0	104.0	104.0	103.5	103.9	0.22
2	104.0	104.0	104.0	103.5	103.0	103.7	0.45
3	104.0	104.0	104.5	104.5	104.5	104.3	0.27
4	104.0	104.0	104.0	104.0	104.5	104.1	0.22
5	104.0	104.0	104.0	104.0	104.0	104.0	0.00
6	103.0	103.0	103.0	103.5	103.0	103.1	0.22
MEAN	103.8	103.8	103.9	103.9	103.8	103.9	
SIG	0.41	0.41	0.49	0.38	0.69		0.46

	MEAN	SIG
MIKES	103.9	0.42
RUNS	103.9	0.07

TT5 -- STOP

GMC TRUCK, STANDARD, LOAD #3

MICROPHONE NO.	RUN NO.: 1	2	3	4	5	MEAN	SIG
1	103.0	103.0	102.5	102.5	102.5	102.7	0.27
2	103.0	103.0	103.5	103.0	103.0	103.1	0.22
3	104.0	104.0	104.5	104.0	104.0	104.1	0.22
4	104.0	104.0	104.5	104.0	104.0	104.1	0.22
5	104.0	104.0	103.5	104.0	104.5	104.0	0.35
6	102.5	103.0	102.5	102.0	103.0	102.6	0.42
MEAN	103.5	103.5	103.6	103.3	103.6	103.5	
SIG	0.66	0.55	0.89	0.88	0.77		0.72

	MEAN	SIG
MIKES	103.5	0.71
RUNS	103.5	0.11

TT5 -- STOP

GMC TRUCK, STANDARD, SAI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	103.0	104.0	103.5	103.0	103.0	103.3	0.45
2	103.5	103.0	103.0	104.0	103.0	103.3	0.45
3	104.0	103.5	104.0	103.5	104.0	103.8	0.27
4	104.0	104.0	104.0	104.0	103.0	103.8	0.45
5	103.5	103.5	103.0	103.0	103.5	103.3	0.27
6	103.0	103.0	102.0	102.5	102.5	102.6	0.42
MEAN	103.5	103.5	103.3	103.4	103.2	103.4	
SIG	0.45	0.45	0.76	0.61	0.52		0.54

	MEAN	SIG
MIKES	103.4	0.44
RUNS	103.4	0.14

TT5 -- STOP

GMC TRUCK, NO FAN, IMI (NCE)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	100.0	100.0	100.0	99.5	99.9	0.22
2	100.0	100.0	99.5	100.0	99.5	99.8	0.27
3	100.0	100.0	100.0	100.0	100.0	100.0	0.00
4	100.0	100.5	100.0	101.0	100.0	100.3	0.45
5	100.0	99.5	100.5	99.5	100.0	99.9	0.42
6	99.5	99.0	99.0	99.0	99.0	99.1	0.22
MEAN	99.9	99.9	99.9	100.0	99.7	99.9	
SIG	0.20	0.52	0.52	0.66	0.41		0.46

	MEAN	SIG
MIKES	99.9	0.40
RUNS	99.9	0.10

TTS -- STOP

GMC TRUCK, NO FAN, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	99.0	99.0	99.0	99.0	99.2	0.45
2	100.0	100.0	100.0	99.5	99.5	99.8	0.27
3	100.0	100.0	99.5	100.0	99.5	99.8	0.27
4	100.0	100.0	99.5	100.0	100.0	99.9	0.22
5	99.5	100.0	100.0	99.5	100.0	99.8	0.27
6	99.0	99.0	99.0	99.0	99.0	99.0	0.00
MEAN	99.8	99.7	99.5	99.5	99.5	99.6	
SIG	0.42	0.52	0.45	0.45	0.45		0.44

	MEAN	SIG
MIKES	99.6	0.38
RUNS	99.6	0.11

TT5 -- STOP

GMC TRUCK, NO FAN, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.5	99.5	100.0	100.0	100.0	99.8	0.27
2	100.0	99.0	99.0	99.5	100.0	99.5	0.50
3	99.5	99.5	99.5	99.5	100.0	99.6	0.22
4	99.5	99.5	100.0	100.0	99.5	99.7	0.27
5	100.5	100.0	100.5	100.0	100.5	100.3	0.27
6	99.0	99.0	99.0	99.5	99.0	99.1	0.22
MEAN	99.7	99.4	99.7	99.8	99.9	99.7	
SIG	0.52	0.38	0.61	0.27	0.52		0.46

	MEAN	SIG
MIKES	99.7	0.40
RUNS	99.7	0.16

TT5 -- STOP

GMC TRUCK, NO FAN, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	100.0	100.0	100.0	100.0	100.0	0.00
2	100.0	100.0	100.0	100.0	100.0	100.0	0.00
3	100.0	100.0	100.5	100.5	100.5	100.3	0.27
4	101.0	101.0	100.5	101.0	101.5	101.0	0.35
5	101.0	101.0	100.5	100.0	100.0	100.5	0.50
6	99.0	99.0	99.5	99.0	99.5	99.2	0.27
MEAN	100.2	100.2	100.2	100.1	100.3	100.2	
SIG	0.75	0.75	0.41	0.66	0.69		0.62

	MEAN	SIG
MIKES	100.2	0.61
RUNS	100.2	0.04

TT5 -- STOP

GMC TRUCK, NO FAN, LOAD #3

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.5	99.0	99.0	100.0	99.5	99.2	0.57
2	99.5	100.0	99.0	99.0	100.0	99.5	0.50
3	99.5	99.5	100.0	100.0	100.0	99.8	0.27
4	99.5	100.0	100.0	100.0	99.5	99.8	0.27
5	100.0	100.5	100.0	100.0	100.0	100.1	0.22
6	99.0	99.0	99.0	99.0	99.0	99.0	0.00
MEAN	99.4	99.7	99.5	99.7	99.7	99.6	
SIG	0.52	0.61	0.55	0.52	0.41		0.50

	MEAN	SIG
MIKES	99.6	0.41
RUNS	99.6	0.15

TTS -- STOP

GMC TRUCK, NO FAN, SAI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	99.0	99.0	100.0	98.5	99.1	0.55
2	99.5	99.0	99.0	99.0	99.0	99.1	0.22
3	99.0	99.0	99.0	99.0	99.5	99.1	0.22
4	99.0	99.0	99.5	99.0	99.5	99.2	0.27
5	100.0	99.5	100.0	99.5	100.0	99.8	0.27
6	98.5	98.5	99.0	98.5	98.5	98.6	0.22
MEAN	99.2	99.0	99.3	99.2	99.2	99.2	
SIG	0.52	0.32	0.42	0.52	0.61		0.46

	MEAN	SIG
MIKES	99.2	0.38
RUNS	99.2	0.10

TTS -- STOP

GMC TRUCK, NO FAN, EXTRA MUFFLER, IMI (NCE)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.5	98.5	98.5	99.0	98.5	98.6	0.22
2	98.5	98.5	98.5	99.0	99.0	98.7	0.27
3	99.0	99.0	99.0	100.0	99.5	99.3	0.45
4	99.5	98.5	99.0	99.0	99.0	99.0	0.35
5	99.0	99.0	99.0	99.0	99.0	99.0	0.00
6	97.5	98.0	98.0	97.5	98.0	97.8	0.27
MEAN	98.7	98.6	98.7	99.0	98.9	98.8	
SIG	0.68	0.38	0.41	0.80	0.52		0.55

	MEAN	SIG
MIKES	98.8	0.52
RUNS	98.8	0.15

TT5 -- STOP

GMC TRUCK, NO FAN, EXTRA MUFFLER, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	98.5	98.5	98.0	98.0	98.4	0.42
2	99.0	98.5	98.5	99.0	99.0	98.8	0.27
3	99.0	98.5	99.0	99.0	99.0	98.9	0.22
4	99.0	99.0	99.0	99.0	99.0	99.0	0.00
5	99.0	99.0	99.0	98.0	99.0	98.8	0.45
6	97.5	98.0	97.5	98.0	98.0	97.8	0.27
MEAN	98.8	98.6	98.6	98.5	98.7	98.6	
SIG	0.61	0.38	0.58	0.55	0.52		0.50

	MEAN	SIG
MIKES	98.6	0.45
RUNS	98.6	0.09

TT5 -- STOP

GMC TRUCK, NO FAN, EXTRA MUFFLER, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	99.0	99.0	99.0	99.0	99.0	99.0	0.00
2	99.0	98.5	98.5	99.0	98.5	98.7	0.27
3	100.0	99.0	98.5	99.0	99.0	99.1	0.55
4	99.5	99.5	99.5	100.0	99.5	99.6	0.22
5	100.0	100.0	99.5	99.5	100.0	99.8	0.27
6	98.0	99.0	98.0	99.0	99.0	98.6	0.55
MEAN	99.3	99.2	98.9	99.3	99.2	99.2	
SIG	0.76	0.52	0.61	0.42	0.52		0.56

	MEAN	SIG
MIKES	99.2	0.48
RUNS	99.2	0.17

TT5 -- STOP

GMC TRUCK, NO FAN, EXTRA MUFFLER, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	99.0	99.5	100.0	99.5	99.6	0.42
2	99.0	99.0	99.0	99.0	99.5	99.1	0.22
3	99.5	99.5	99.5	99.5	99.5	99.5	0.00
4	99.0	99.0	99.0	98.5	99.0	98.9	0.22
5	100.0	100.0	100.5	100.0	100.0	100.1	0.22
6	99.5	99.0	99.0	99.0	99.0	99.1	0.22
MEAN	99.5	99.3	99.5	99.4	99.4	99.4	
SIG	0.45	0.42	0.58	0.61	0.38		0.47

	MEAN	SIG
MIKES	99.4	0.44
RUNS	99.4	0.09

TT5 -- STOP

GMC TRUCK, NO FAN, EXTRA MUFFLER, LOAD #3

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.5	98.0	98.5	98.5	98.0	98.3	0.27
2	99.0	98.5	98.5	98.5	98.5	98.6	0.22
3	98.5	98.5	98.5	98.5	98.5	98.5	0.00
4	99.0	99.0	99.5	99.0	99.0	99.1	0.22
5	99.0	99.0	99.0	98.5	99.5	99.0	0.35
6	97.5	97.5	97.5	98.5	98.0	97.8	0.45
MEAN	98.6	98.4	98.6	98.6	98.6	98.6	
SIG	0.58	0.58	0.66	0.20	0.58		0.51

	MEAN	SIG
MIKES	98.6	0.47
RUNS	98.6	0.08

TT5 -- STOP

GMC TRUCK, NO FAN, EXTRA MUFFLER, SAI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.5	98.0	98.5	98.0	98.5	98.3	0.27
2	98.5	99.0	98.0	99.0	99.0	98.7	0.45
3	98.0	98.5	98.0	99.0	98.5	98.4	0.42
4	99.0	99.0	99.0	98.5	99.0	98.9	0.22
5	98.0	99.0	98.5	98.0	99.0	98.5	0.50
6	98.0	97.5	97.5	98.0	98.0	97.8	0.27
MEAN	98.3	98.5	98.3	98.4	98.7	98.5	
SIG	0.41	0.63	0.52	0.49	0.41		0.49

	MEAN	SIG
MIKES	98.5	0.38
RUNS	98.5	0.16

TT5 -- STOP

IH TRUCK, IMI (NCE)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	107.0	106.0	104.5	105.0	105.0	105.6	1.00
2	105.0	104.0	104.0	104.5	104.5	104.4	0.42
3	107.0	105.0	105.0	105.0	104.5	105.4	0.97
4	106.0	104.5	104.0	104.0	104.0	104.6	0.87
5	107.5	105.0	104.0	104.5	105.0	105.4	1.35
6	105.0	103.0	102.5	103.0	104.0	103.6	1.00
MEAN	106.4	104.7	104.1	104.4	104.5	104.9	
SIG	1.08	1.02	0.84	0.75	0.45		1.13

	MEAN	SIG
MIKES	104.9	0.77
RUNS	104.9	0.90

TT5 -- STOP

IH TRUCK, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	107.0	103.0	104.0	104.5	104.0	104.7	1.50
2	104.0	103.0	103.0	103.0	103.0	103.2	0.45
3	106.5	104.5	104.0	104.5	104.5	104.9	0.97
4	105.5	104.0	104.0	104.0	104.0	104.3	0.67
5	106.5	104.0	104.0	105.0	104.0	104.8	1.10
6	105.0	103.0	102.5	103.0	103.0	103.4	0.97
MEAN	105.9	103.6	103.6	104.1	103.8	104.3	
SIG	1.13	0.66	0.66	0.84	0.61		1.12

	MEAN	SIG
MIKES	104.3	0.75
RUNS	104.3	0.95

TT5 -- STOP

IH TRUCK, LOAD #1

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	104.0	104.0	104.0	104.0	103.0	103.8	0.45
2	103.0	103.0	102.0	102.5	102.5	102.6	0.42
3	104.0	103.0	103.0	103.0	103.0	103.2	0.45
4	103.0	103.0	103.0	103.0	103.0	103.0	0.00
5	103.0	104.0	103.5	104.0	104.0	103.7	0.45
6	102.0	102.0	102.5	102.0	102.0	102.1	0.22
MEAN	103.2	103.2	103.0	103.1	103.0	103.1	
SIG	0.75	0.75	0.71	0.80	0.66		0.69

	MEAN	SIG
MIKES	103.1	0.65
RUNS	103.1	0.11

TT5 -- STOP

IH TRUCK, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	105.0	104.5	104.0	104.0	104.5	104.4	0.42
2	104.0	103.5	103.5	103.5	103.5	103.6	0.22
3	104.5	104.0	104.0	104.5	104.0	104.2	0.27
4	104.0	103.5	103.0	103.0	103.0	103.3	0.45
5	106.0	105.0	105.0	105.0	105.0	105.2	0.45
6	103.0	102.5	103.0	103.0	103.0	102.9	0.22
MEAN	104.5	103.9	103.8	103.9	103.9	104.0	
SIG	1.02	0.88	0.76	0.82	0.82		0.84

	MEAN	SIG
MIKES	104.0	0.84
RUNS	104.0	0.29

TT5 -- STOP

IH TRUCK, LOAD #3

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.5	102.5	104.0	103.0	104.0	103.3	0.76
2	102.5	102.5	103.5	103.0	103.0	102.9	0.42
3	104.5	103.0	104.0	103.0	103.0	103.5	0.71
4	105.0	104.0	104.0	104.0	104.0	104.2	0.45
5	105.0	104.0	104.0	103.0	104.0	104.0	0.71
6	104.0	103.0	103.5	103.0	103.0	103.3	0.45
MEAN	104.0	103.2	103.8	103.2	103.5	103.6	
SIG	1.16	0.68	0.26	0.41	0.55		0.71

	MEAN	SIG
MIKES	103.6	0.50
RUNS	103.6	0.37

TT5 -- STOP

IH TRUCK, SAI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	106.0	104.0	103.5	103.0	103.5	104.1	1.17
2	105.0	104.0	104.0	104.0	104.0	104.2	0.45
3	105.5	104.0	104.5	104.0	104.5	104.5	0.61
4	106.0	105.0	105.0	104.5	104.5	105.0	0.61
5	106.0	105.0	105.5	105.0	105.0	105.3	0.45
6	105.5	104.5	103.5	104.0	104.5	104.5	0.74
MEAN	105.7	104.4	104.4	104.1	104.4	104.6	
SIG	0.41	0.49	0.82	0.66	0.52		0.80

	MEAN	SIG
MIKES	104.6	0.47
RUNS	104.6	0.62

TT5 -- STOP

IH TRUCK, NO FAN, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	103.5	102.0	102.5	102.0	102.0	102.4	0.65
2	103.0	101.0	100.5	100.0	100.5	101.1	1.17
3	103.5	101.0	101.0	101.0	101.0	101.6	1.12
4	103.0	101.0	101.0	102.0	100.5	101.6	1.00
5	105.0	102.5	102.5	102.0	102.5	103.0	1.19
6	104.0	101.0	101.0	101.0	101.0	101.8	1.34
MEAN	103.7	101.5	101.5	101.4	101.3	102.0	
SIG	0.75	0.66	0.86	0.82	0.82		1.19

	MEAN	SIG
MIKES	102.0	0.69
RUNS	102.0	1.03

TT5 -- STOP

IH TRUCK, NO FAN, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.5	100.5	100.5	100.0	100.0	100.3	0.27
2	100.0	99.0	99.0	100.0	100.0	99.6	0.55
3	101.0	101.0	101.0	101.0	101.0	101.0	0.00
4	100.5	100.5	100.5	100.5	100.5	100.5	0.00
5	102.0	102.0	101.0	101.5	101.0	101.5	0.50
6	101.0	101.0	100.0	101.0	101.0	100.8	0.45
MEAN	100.9	100.8	100.4	100.7	100.6	100.7	
SIG	0.68	0.98	0.75	0.61	0.49		0.69

	MEAN	SIG
MIKES	100.7	0.65
RUNS	100.7	0.18

TT5 -- STOP

IH TRUCK, NO FAN, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	103.5	104.0	103.0	103.0	103.0	103.3	0.45
2	102.5	103.0	103.0	102.5	102.0	102.6	0.42
3	103.0	102.5	103.0	102.5	102.5	102.7	0.27
4	103.0	102.5	102.0	102.0	102.0	102.3	0.45
5	104.5	103.0	103.0	103.0	103.0	103.3	0.67
6	103.5	102.5	102.0	102.5	102.5	102.6	0.55
MEAN	103.4	103.0	102.7	102.6	102.5	102.8	
SIG	0.68	0.58	0.52	0.38	0.45		0.58

	MEAN	SIG
MIKES	102.8	0.41
RUNS	102.8	0.35

TT5 -- STOP

IH TRUCK, NO FAN, LOAD #2 SAI

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	103.0	103.0	103.0	102.5	102.5	102.8	0.27
2	103.0	102.0	102.5	102.5	102.0	102.4	0.42
3	103.0	102.5	102.0	102.5	103.0	102.6	0.42
4	103.0	102.5	102.0	102.5	102.5	102.5	0.35
5	104.0	103.0	103.0	103.0	103.0	103.2	0.45
6	103.0	102.0	102.0	102.0	102.5	102.3	0.45
MEAN	103.2	102.5	102.4	102.5	102.6	102.7	
SIG	0.41	0.45	0.49	0.32	0.38		0.47

	MEAN	SIG
MIKES	102.7	0.32
RUNS	102.7	0.30

TT5 -- STOP

IH TRUCK, NO FAN, EXTRA MUFFLER, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	101.0	100.5	100.0	100.0	100.5	100.4	0.42
2	101.0	100.0	101.0	100.0	100.0	100.4	0.55
3	100.5	100.5	100.0	102.0	99.5	100.6	0.94
4	100.5	100.0	100.0	100.0	100.0	100.1	0.22
5	100.5	100.5	100.5	100.0	100.0	100.3	0.27
6	99.0	98.5	99.0	98.5	99.0	98.8	0.27
MEAN	100.5	100.1	100.1	100.2	99.9	100.1	
SIG	0.74	0.77	0.66	1.11	0.52		0.76

	MEAN	SIG
MIKES	100.1	0.66
RUNS	100.1	0.22

TT5 -- STOP

IH TRUCK, NO FAN, EXTRA MUFFLER, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.5	100.0	100.5	100.5	100.0	100.3	0.27
2	99.5	99.5	99.5	99.5	100.0	99.6	0.22
3	100.0	100.5	101.0	100.5	100.0	100.4	0.42
4	100.0	100.0	100.5	100.5	100.5	100.3	0.27
5	101.0	101.0	101.5	102.0	102.0	101.5	0.50
6	100.0	99.5	99.5	99.5	100.0	99.7	0.27
MEAN	100.2	100.1	100.5	100.5	100.5	100.4	
SIG	0.52	0.58	0.80	0.92	0.80		0.70

	MEAN	SIG
MIKES	100.4	0.69
RUNS	100.4	0.18

TT5 -- STOP

IH TRUCK, NO FAN, EXTRA MUFFLER, LOAD #2

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	102.0	102.5	102.5	102.5	102.5	102.4	0.22
2	103.0	102.0	102.5	102.5	102.0	102.4	0.42
3	102.5	102.0	102.5	102.5	102.5	102.4	0.22
4	102.0	102.0	102.0	102.0	102.0	102.0	0.00
5	103.5	102.0	102.5	102.5	102.0	102.5	0.61
6	102.0	102.0	102.0	102.0	102.0	102.0	0.00
MEAN	102.5	102.1	102.3	102.3	102.2	102.3	
SIG	0.63	0.20	0.26	0.26	0.26		0.36

	MEAN	SIG
MIKES	102.3	0.24
RUNS	102.3	0.17

TT5 -- STOP

IH TRUCK, NO FAN, EXTRA MUFFLER, LOAD #2 SAI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.5	102.0	102.0	102.0	102.0	102.1	0.22
2	102.0	101.0	102.0	102.0	102.0	101.8	0.45
3	102.0	102.0	102.0	102.0	102.0	102.0	0.00
4	102.0	102.0	102.0	102.0	102.0	102.0	0.00
5	103.0	102.0	102.0	102.0	102.5	102.3	0.45
6	102.5	101.0	101.5	101.0	101.5	101.5	0.61
MEAN	102.3	101.7	101.9	101.8	102.0	102.0	
SIG	0.41	0.52	0.20	0.41	0.32		0.42

	MEAN	SIG
MIKES	102.0	0.27
RUNS	102.0	0.24

TT5 -- STOP

FORD TRUCK, STANDARD, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	103.0	102.0	103.0	102.0	102.0	102.4	0.55
2	102.5	103.0	103.0	103.0	102.5	102.8	0.27
3	102.5	103.5	103.5	102.5	103.0	103.0	0.50
4	102.5	102.5	103.0	103.0	102.5	102.7	0.27
5	102.5	102.5	102.5	102.5	102.5	102.5	0.00
6	102.0	102.5	102.0	102.5	102.5	102.3	0.27
MEAN	102.5	102.7	102.9	102.6	102.5	102.6	
SIG	0.32	0.52	0.52	0.38	0.32		0.41

	MEAN	SIG
MIKES	102.6	0.26
RUNS	102.6	0.14

TT5 -- STOP

FORD TRUCK, STANDARD, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.5	102.5	102.0	102.5	102.0	102.3	0.27
2	102.5	103.0	103.0	102.5	102.5	102.7	0.27
3	103.0	102.0	102.0	102.5	103.0	102.5	0.50
4	102.5	102.5	102.5	102.5	102.5	102.5	0.00
5	102.5	102.0	102.0	102.0	102.0	102.1	0.22
6	102.0	102.0	102.0	102.0	102.0	102.0	0.00
MEAN	102.5	102.3	102.3	102.3	102.3	102.4	
SIG	0.32	0.41	0.42	0.26	0.41		0.35

	MEAN	SIG
MIKES	102.4	0.27
RUNS	102.4	0.09

TT5 -- STOP

FORD TRUCK, STANDARD, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.5	102.0	102.5	102.0	102.0	102.2	0.27
2	102.5	102.0	102.5	102.5	102.5	102.4	0.22
3	103.0	103.0	103.0	103.0	103.0	103.0	0.00
4	103.0	103.0	103.0	103.0	103.0	103.0	0.00
5	103.0	103.5	104.0	102.5	102.5	103.1	0.65
6	104.0	104.0	104.0	104.0	103.5	103.9	0.22
MEAN	103.0	103.0	103.2	102.9	102.8	103.0	
SIG	0.55	0.80	0.68	0.68	0.52		0.63

	MEAN	SIG
MIKES	103.0	0.60
RUNS	103.0	0.16

TT5 -- STOP

FORD TRUCK, STANDARD, SAI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.5	103.0	102.5	102.0	102.0	102.4	0.42
2	103.0	102.5	102.0	102.5	102.5	102.5	0.35
3	103.0	103.0	103.0	103.0	103.0	103.0	0.00
4	104.0	103.0	103.0	102.5	103.0	103.1	0.55
5	103.0	103.0	103.0	102.5	103.0	102.9	0.22
6	104.0	104.0	103.0	103.5	104.0	103.7	0.45
MEAN	103.3	103.1	102.8	102.7	103.0	103.0	
SIG	0.61	0.49	0.42	0.52	0.66		0.55

	MEAN	SIG
MIKES	103.0	0.47
RUNS	103.0	0.24

TT5 -- STOP

FORD TRUCK, SMALL FAN, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.0	100.0	100.0	100.0	100.0	100.0	0.00
2	98.5	98.0	98.0	98.5	98.5	98.3	0.27
3	100.0	100.0	100.0	100.0	100.0	100.0	0.00
4	99.0	99.0	99.0	99.0	99.0	99.0	0.00
5	100.5	100.5	101.0	100.5	100.5	100.6	0.22
6	99.0	100.0	100.0	99.0	99.0	99.4	0.55
MEAN	99.6	99.7	99.8	99.6	99.6	99.6	
SIG	0.77	0.92	1.03	0.77	0.77		0.80

	MEAN	SIG
MIKES	99.6	0.82
RUNS	99.6	0.09

TT5 -- STOP

FORD TRUCK, SMALL FAN, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	101.0	102.0	102.0	101.0	100.5	101.3	0.67
2	99.0	99.0	99.5	99.0	99.0	99.1	0.22
3	100.5	100.5	101.0	100.5	100.5	100.6	0.22
4	99.0	99.0	99.5	99.5	99.0	99.2	0.27
5	100.5	100.0	101.0	100.5	101.5	100.7	0.57
6	100.0	100.0	100.0	100.0	100.0	100.0	0.00
MEAN	100.1	100.2	100.6	100.1	100.2	100.2	
SIG	0.84	1.11	1.00	0.74	0.97		0.89

	MEAN	SIG
MIKES	100.2	0.89
RUNS	100.2	0.21

TT5 -- STOP

FORD TRUCK, SMALL FAN, LOAD #2

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	102.0	102.0	102.0	101.5	102.0	101.9	0.22
2	101.5	100.0	100.0	100.0	100.0	100.3	0.67
3	102.0	101.0	101.5	101.0	101.0	101.3	0.45
4	101.0	100.0	100.0	100.5	100.5	100.4	0.42
5	102.0	102.0	102.0	102.0	102.0	102.0	0.00
6	100.5	101.0	102.0	102.0	101.5	101.4	0.65
MEAN	101.5	101.1	101.3	101.2	101.2	101.3	
SIG	0.63	0.89	0.99	0.82	0.82		0.80

	MEAN	SIG
MIKES	101.3	0.71
RUNS	101.3	0.17

TT5 -- STOP

FORD TRUCK, SMALL FAN, SHI

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	102.0	102.5	102.5	102.0	102.0	102.2	0.27
2	101.5	101.0	100.0	100.5	101.0	100.8	0.57
3	102.5	102.0	102.5	102.5	102.0	102.3	0.27
4	102.0	101.0	101.0	100.5	100.0	101.0	0.74
5	102.5	102.0	102.0	102.0	102.0	102.1	0.22
6	101.0	102.0	102.0	102.0	101.0	101.6	0.55
MEAN	101.9	101.8	101.8	101.7	101.4	101.7	
SIG	0.58	0.61	0.98	0.86	0.82		0.76

	MEAN	SIG
MIKES	101.7	0.65
RUNS	101.7	0.20

TT5 -- STOP

FORD TRUCK, SMALL FAN, EXTRA MUFFLER, IMI (DNL)

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.0	98.5	98.0	98.0	98.0	98.1	0.22
2	99.0	98.0	99.0	98.0	98.0	98.4	0.55
3	98.5	98.5	99.0	99.0	98.5	98.7	0.27
4	99.0	99.0	98.5	99.0	98.5	98.8	0.27
5	98.0	98.5	98.0	98.0	98.5	98.2	0.27
6	98.0	98.0	97.5	97.0	97.0	97.5	0.50
MEAN	98.4	98.4	98.4	98.2	98.1	98.3	
SIG	0.49	0.38	0.61	0.75	0.58		0.55

	MEAN	SIG
MIKES	98.3	0.47
RUNS	98.3	0.14

TT5 -- STOP

FORD TRUCK, SMALL FAN, EXTRA MUFFLER, LOAD #1

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	98.5	98.5	98.5	98.0	98.5	98.4	0.22
2	99.0	99.0	98.0	98.0	99.0	98.6	0.55
3	99.0	99.0	98.5	99.0	99.0	98.9	0.22
4	99.0	99.0	99.0	99.0	99.0	99.0	0.00
5	99.0	98.5	99.0	98.0	99.0	98.7	0.45
6	98.0	98.0	97.5	97.0	97.0	97.5	0.50
MEAN	98.8	98.7	98.4	98.2	98.6	98.6	
SIG	0.42	0.41	0.58	0.75	0.80		0.61

	MEAN	SIG
MIKES	98.6	0.53
RUNS	98.6	0.22

TTS -- STOP

FORD TRUCK, SMALL FAN, EXTRA MUFFLER, LOAD #2

MICROPHONE NO.	RUN NO: 1	2	3	4	5	MEAN	SIG
1	99.0	99.5	99.0	99.0	99.0	99.1	0.22
2	99.0	98.5	98.5	99.0	99.0	98.8	0.27
3	99.0	99.0	99.0	99.0	99.0	99.0	0.00
4	100.0	99.0	98.5	98.5	99.0	99.0	0.61
5	100.0	100.0	99.5	99.0	99.0	99.5	0.50
6	99.0	99.0	99.0	99.0	98.5	98.9	0.22
MEAN	99.4	99.2	98.9	98.9	98.9	99.1	
SIG	0.52	0.52	0.38	0.20	0.20		0.40

	MEAN	SIG
MIKES	99.1	0.25
RUNS	99.1	0.20

TT5 -- STOP

FORD TRUCK, SMALL FAN, EXTRA MUFFLER, SHI

MICROPHONE NO.	RUN NO. 1	2	3	4	5	MEAN	SIG
1	100.5	100.5	100.0	100.0	100.0	100.2	0.27
2	100.0	100.0	99.0	100.0	99.0	99.6	0.55
3	100.0	100.0	100.0	100.0	100.0	100.0	0.00
4	100.0	100.0	100.0	100.5	100.0	100.1	0.22
5	100.5	100.0	100.0	100.0	100.0	100.1	0.22
6	100.0	99.0	99.0	99.0	99.0	99.2	0.45
MEAN	100.2	99.9	99.7	99.9	99.7	99.9	
SIG	0.26	0.49	0.52	0.49	0.52		0.47

	MEAN	SIG
MIKES	99.9	0.38
RUNS	99.9	0.20

TTS -- STOP

APPENDIX B: NARROW BAND SPECTRA

Included in this appendix are plots of representative narrow band (15 Hz bandwidth), A-weighted spectra for three Chevette configurations — standard, high engine noise, and high exhaust noise — in each of three test modes — passby, outdoor run-up, and indoor run-up. The rated speed for each example is 4000 RPM. The indoor run-ups were recorded in the #5 reverberation before it was painted.

These spectra should be considered primarily as indications of the relative A-weighted frequency structure of the vehicles and not as indicating absolute sound pressure levels at any particular frequency. This is due to the method of obtaining the spectra from the real-time-analyzer. As the data tape was played through the analyzer, the operator monitored the output and pressed the hold button when he judged that the maximum sound level had been reached. The captured spectrum was then plotted. Variability in the operator's response time and judgement almost insures that each spectrum was captured at a different instant with respect to the maximum sound level, and hence the amplitude of individual frequency peaks will vary from plot to plot. A smaller variation in frequency is also observed due to those noise sources which were speed-dependent. The engine speed was not controllable from plot-to-plot. This variation in engine speed may be noted by observing the position of the large peak at the exhaust fundamental. This peak should be at a frequency of 133 Hz for the nominal 4000 RPM of the plots.

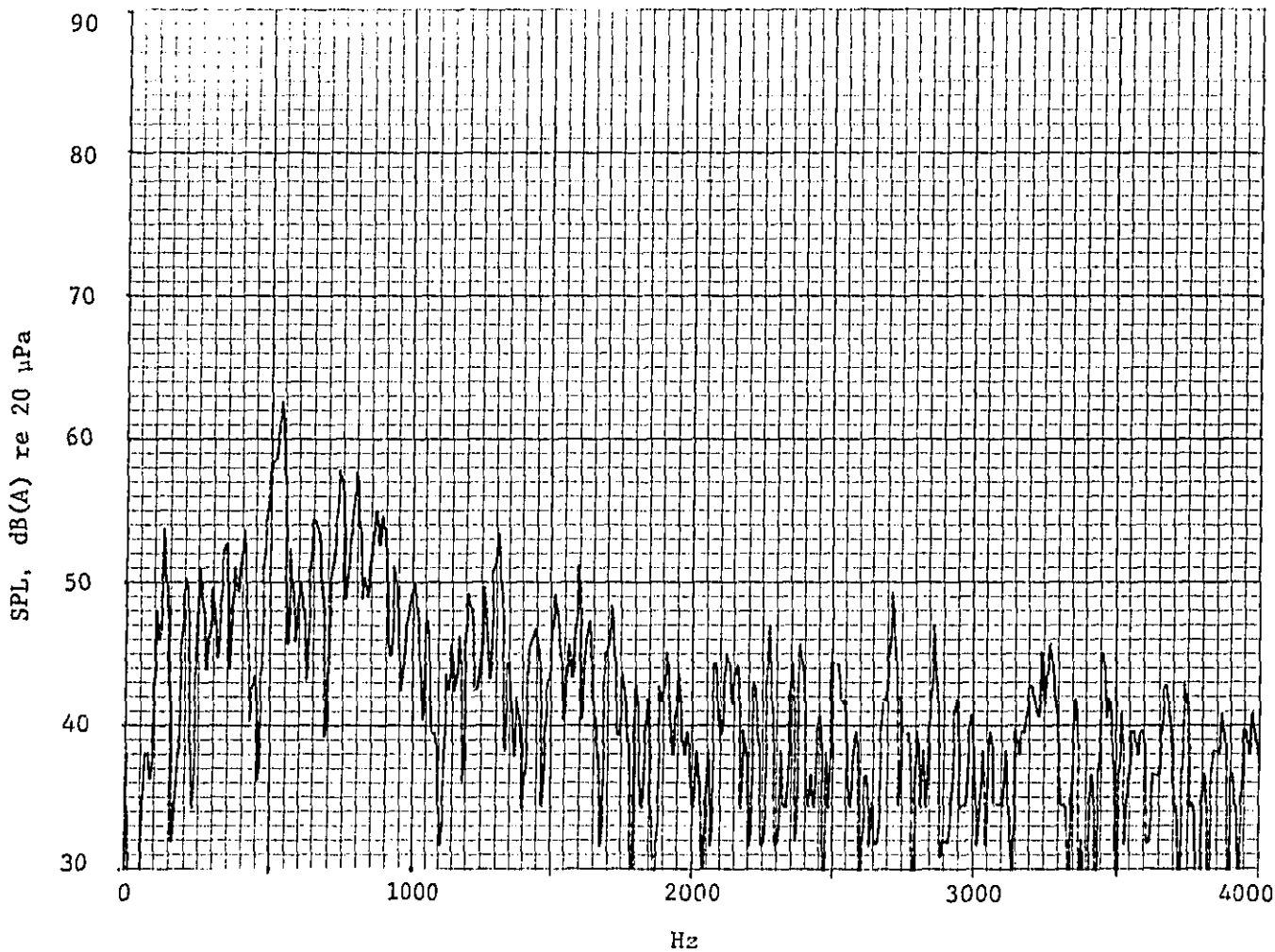


Figure B1. Chevette passby,4000 RPM, standard noise

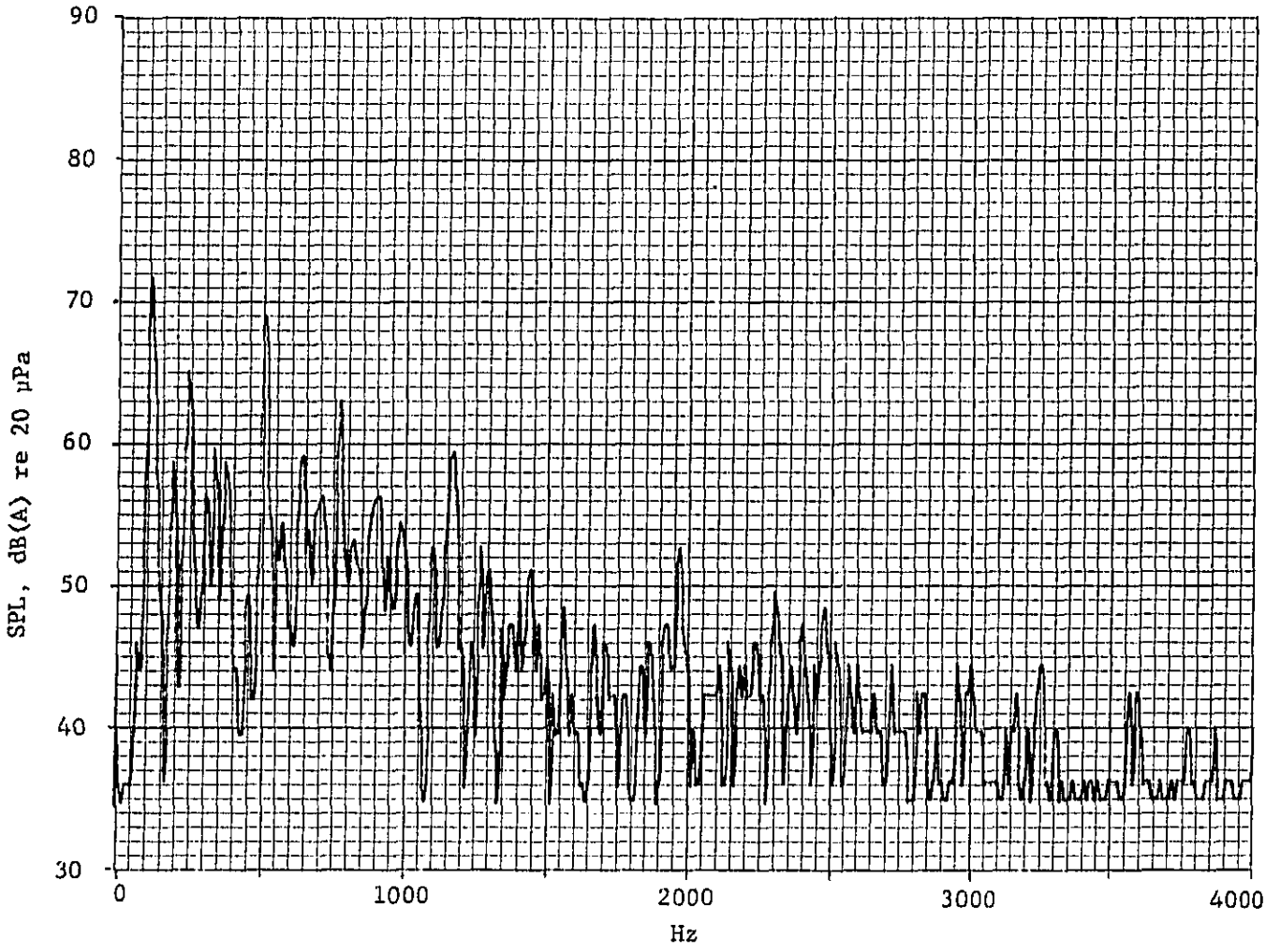


Figure B2. Chevette passby, 4000 RPM, high engine noise

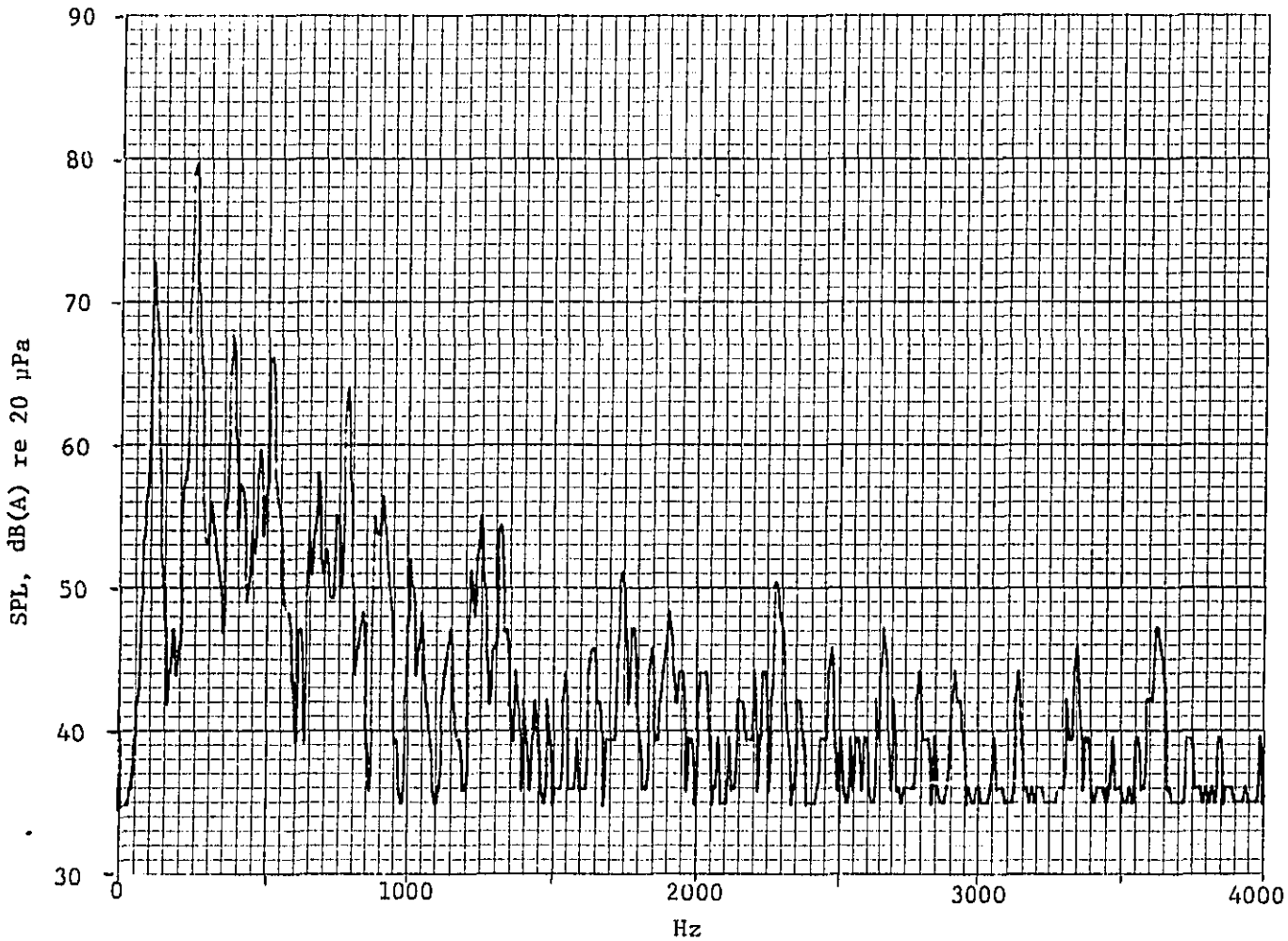


Figure B3. Chevette passby, 4000 RPM, high exhaust noise

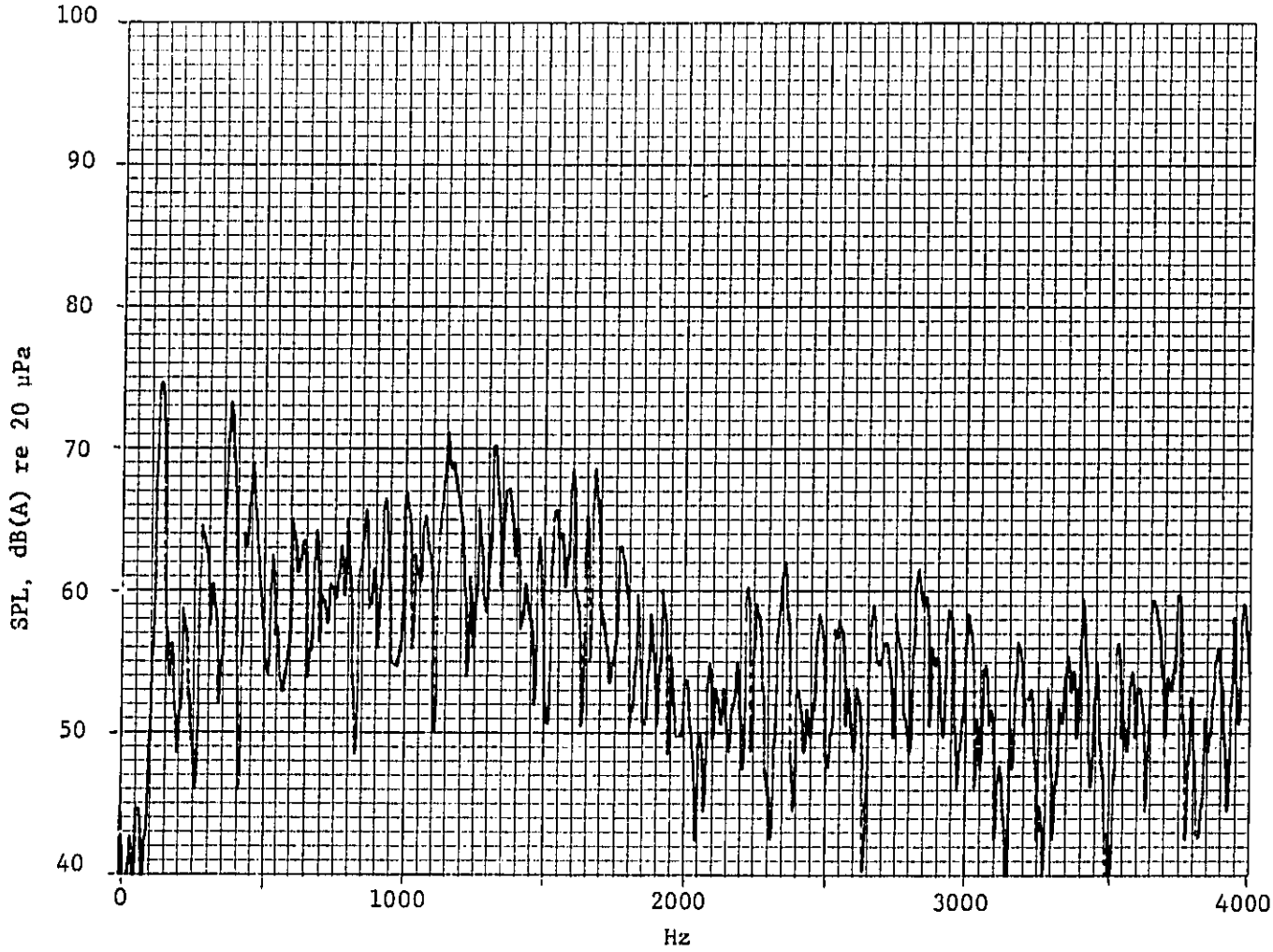


Figure B4. Chevette IMI (room 2), 4000 RPM, standard noise

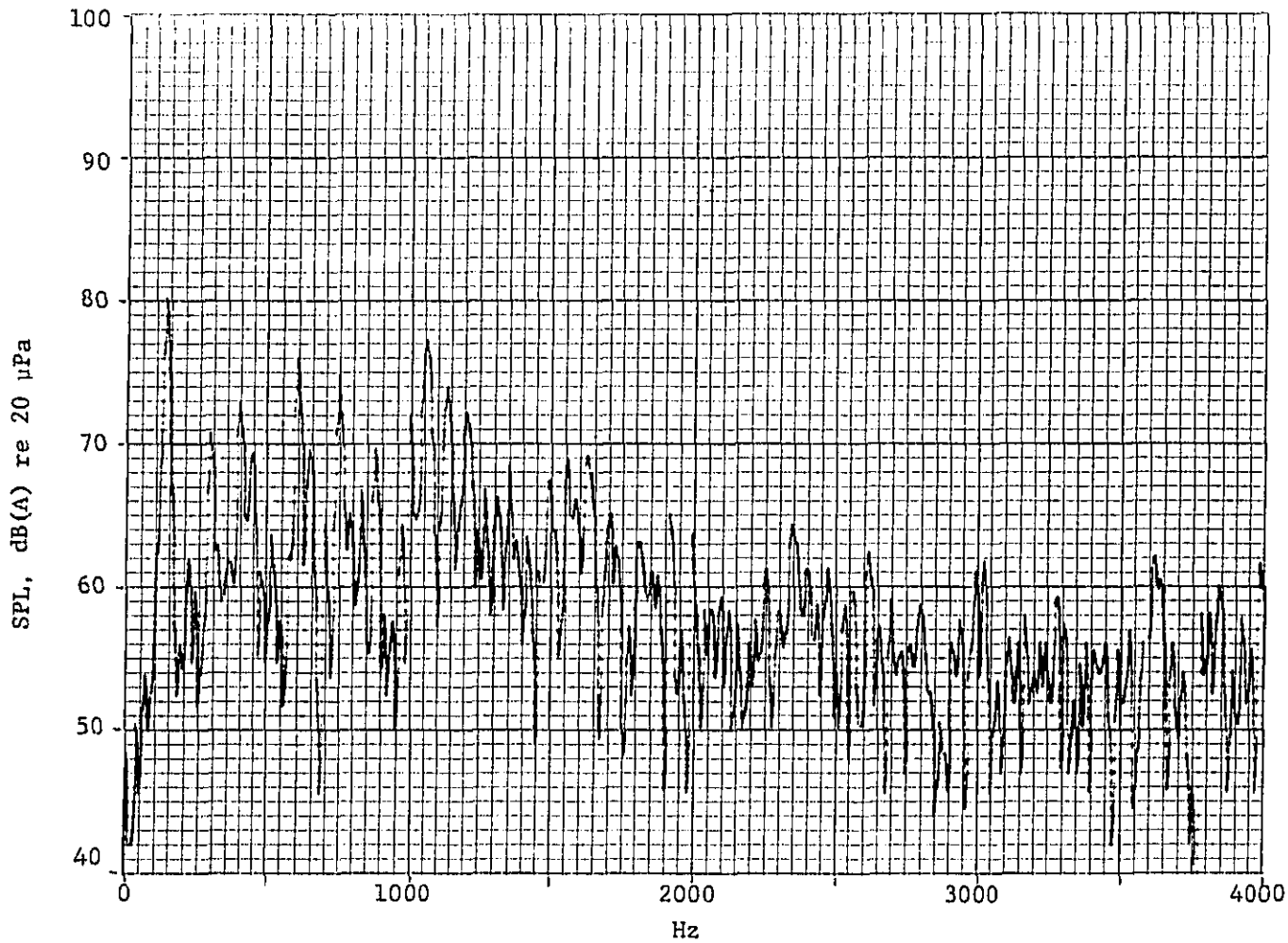


Figure B5. Chevette IMI (room 2), 4000 RPM, high engine noise

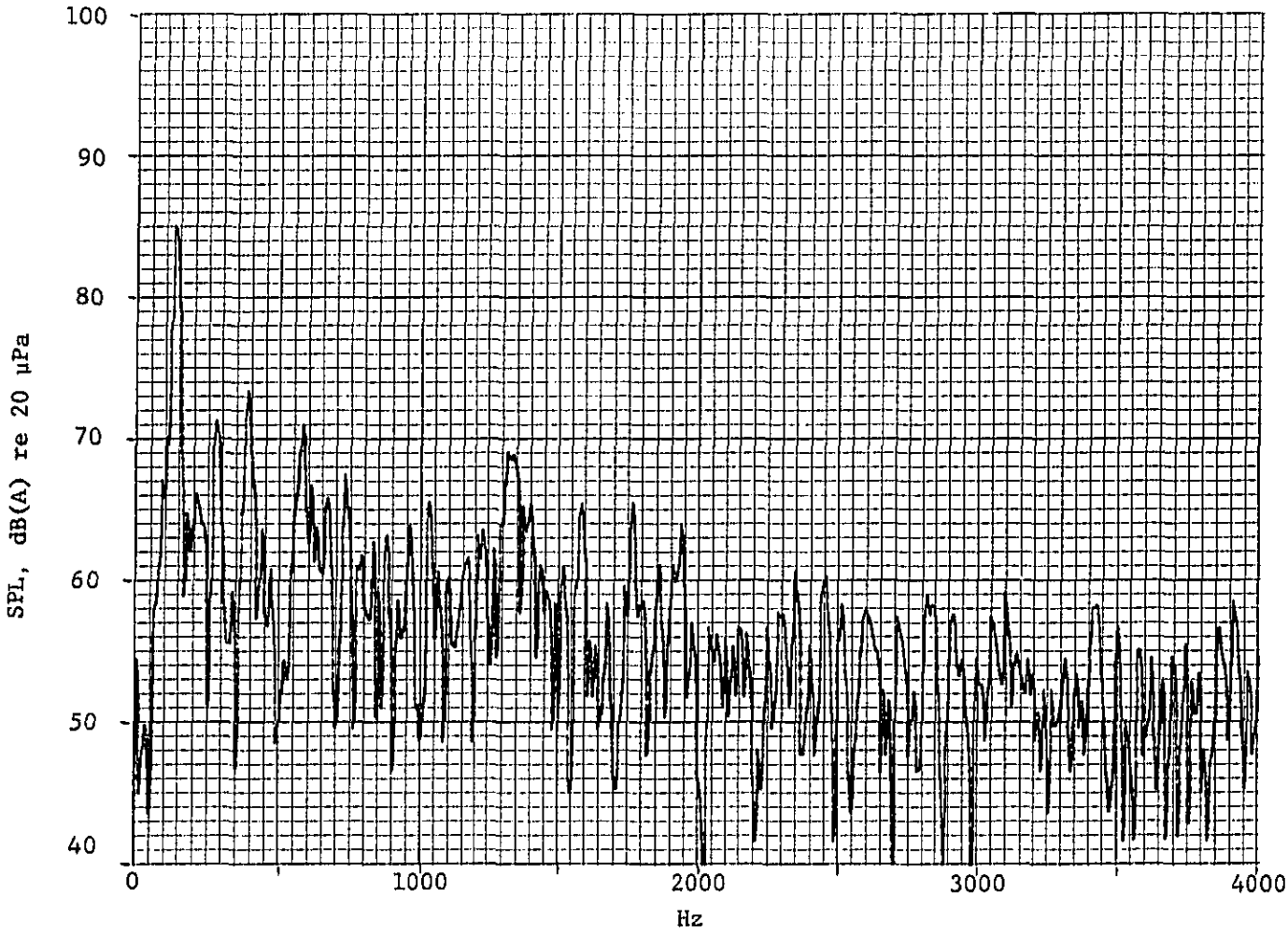


Figure B6. Chevette IMI (room 2), 4000 RPM, high exhaust noise

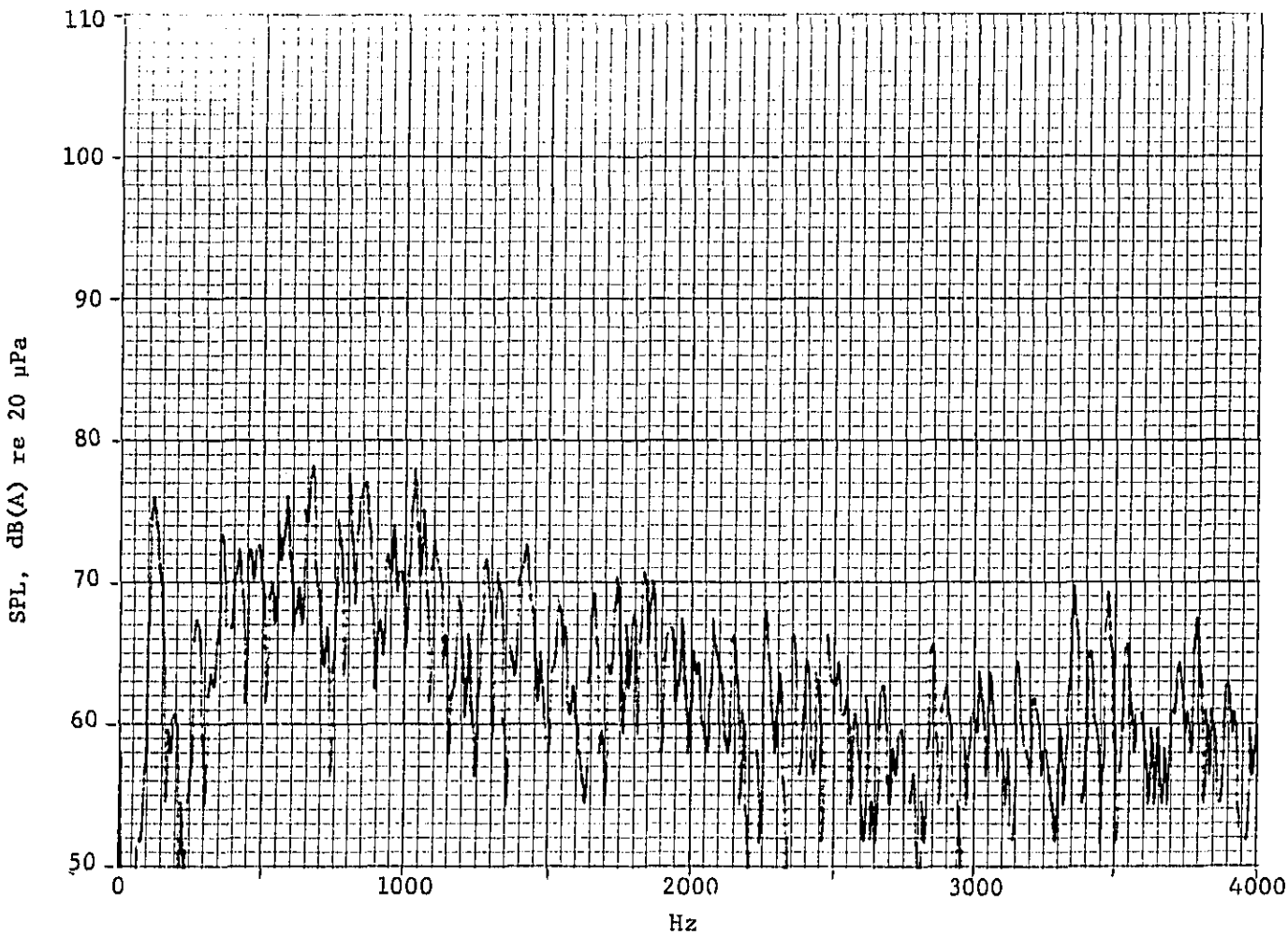


Figure B7. Chevette IMI (room 5), 4000 RPM, standard noise

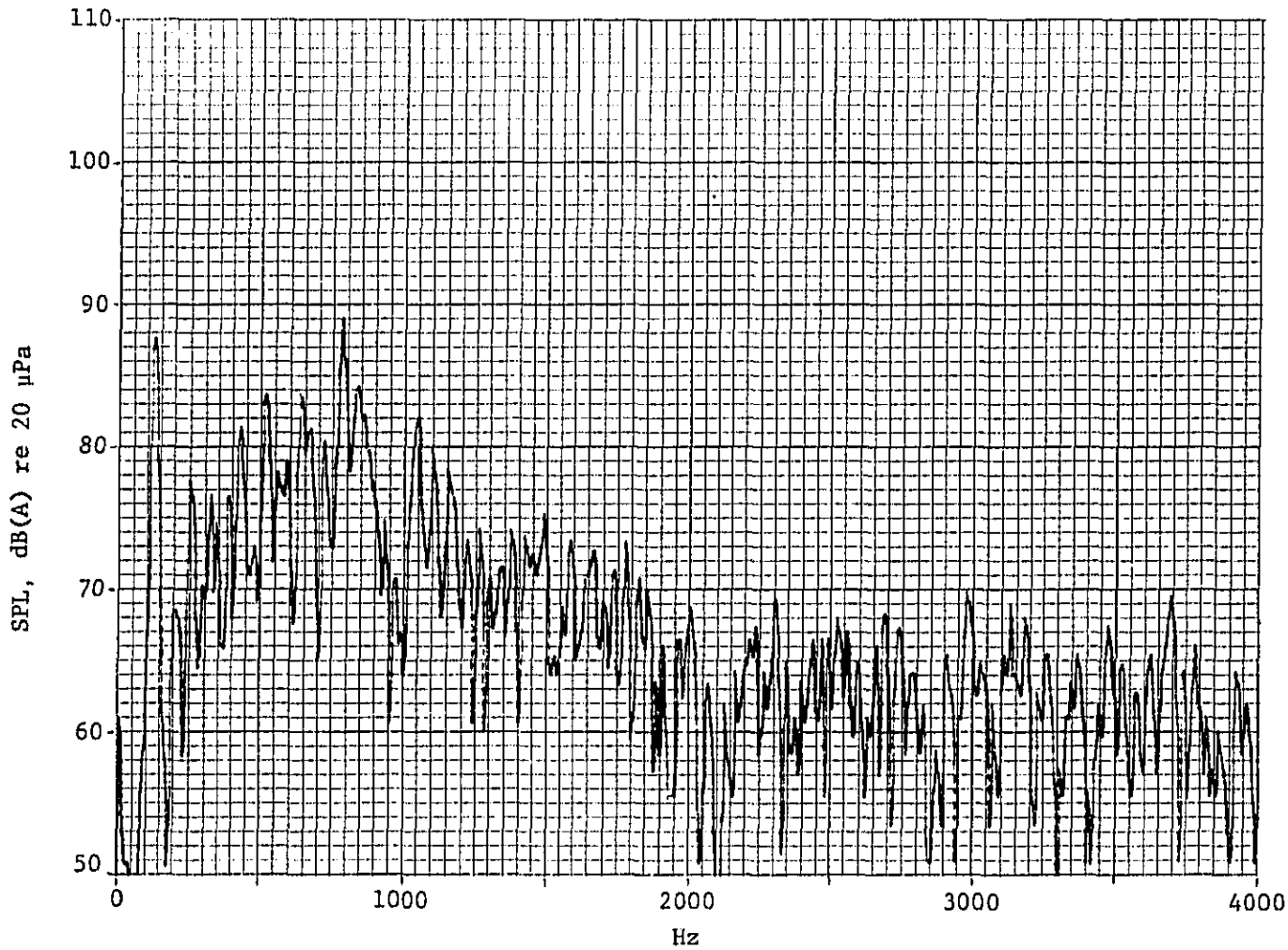


Figure B8. Chevette IMI (room 5), 4000 RPM, high engine noise

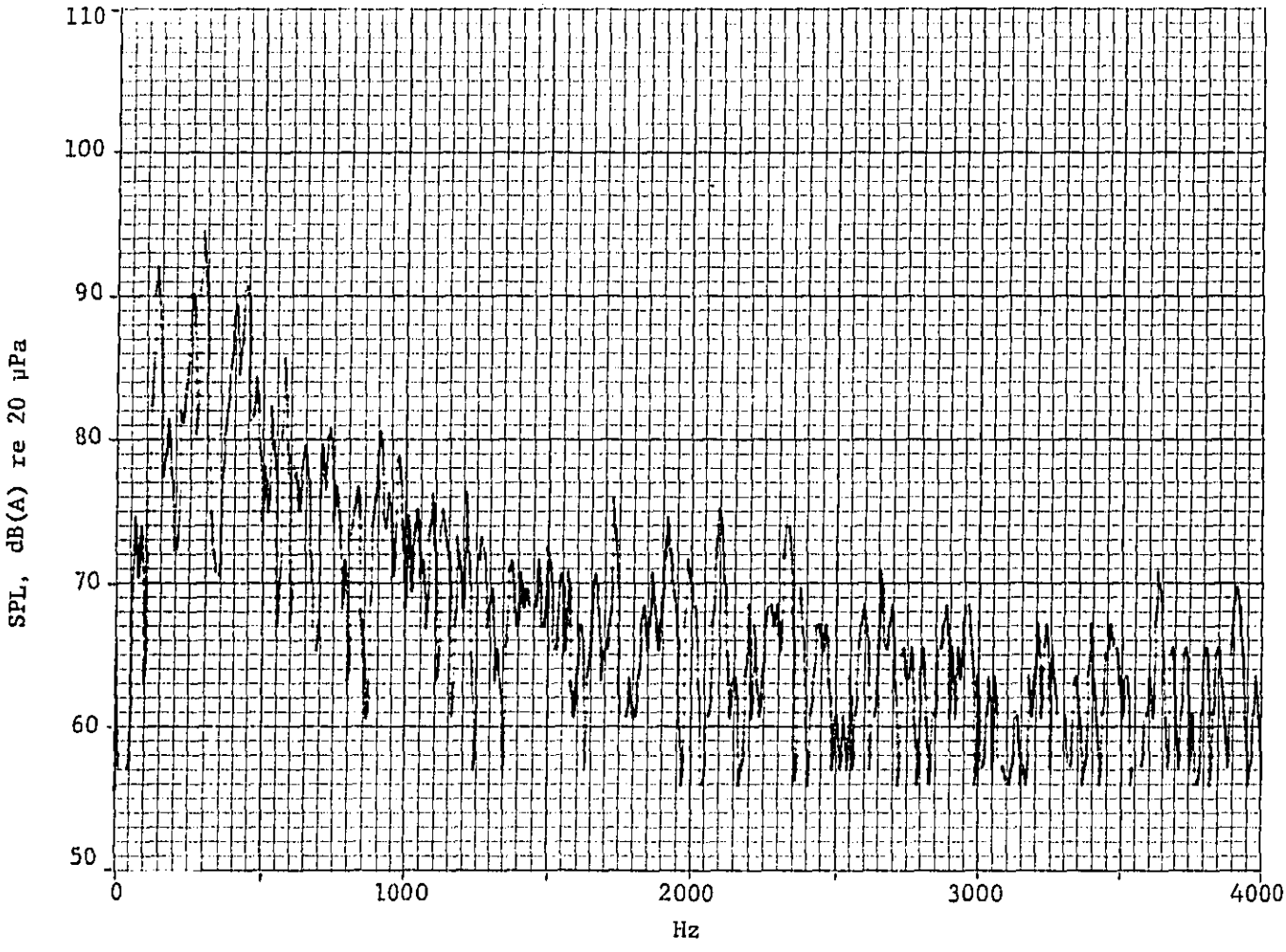


Figure B9. Chevette IMI (room 5), 4000 RPM, high exhaust noise

APPENDIX C: ONE-THIRD OCTAVE SPECTRA

The Figure C1 through C4 indicate maximum A-weighted one third octave band pressure levels for several representative cases of vehicle run-ups in the reverberation room. They were acquired from tape recorded data processed through a B&K Type 2131 real time analyzer set to "max hold". In this mode of operation, each one-third octave band behaved like a sound level meter set to max hold. Increasing signal level caused each band level to rise and remain at its highest level.

Figures of this kind may be misleading unless one keeps in mind that all bands do not necessarily reach their maximum level at the same time. A spectral peak which increases in frequency during the sampling period would result in a "smeared" spectrum under this mode of operation as it would cause a high to be reached sequentially in several adjacent bands. This effect may be seen in Figure C1 in the area around 125 Hz where the exhaust system fundamental shifts as the engine speed is increased.

With that warning in mind, it should be noted that such frequency shifting was only observed in the vicinity of the exhaust fundamental. The remaining frequency bands are rather accurate assessments of the maximum A-weighted levels attained during run-up. Beyond that, the spectra speak for themselves. It is interesting to observe, in the three truck spectra, the effect of altering the operating condition of the vehicle.

There is practically no difference between the maximum levels of standard and fan-disabled trucks in the lower frequency bands but the addition of an extra muffler has a dramatic effect in this region. At higher frequencies, disabling the fan lowers the maximum levels appreciably but the further addition of an extra muffler produces no additional attenuation.

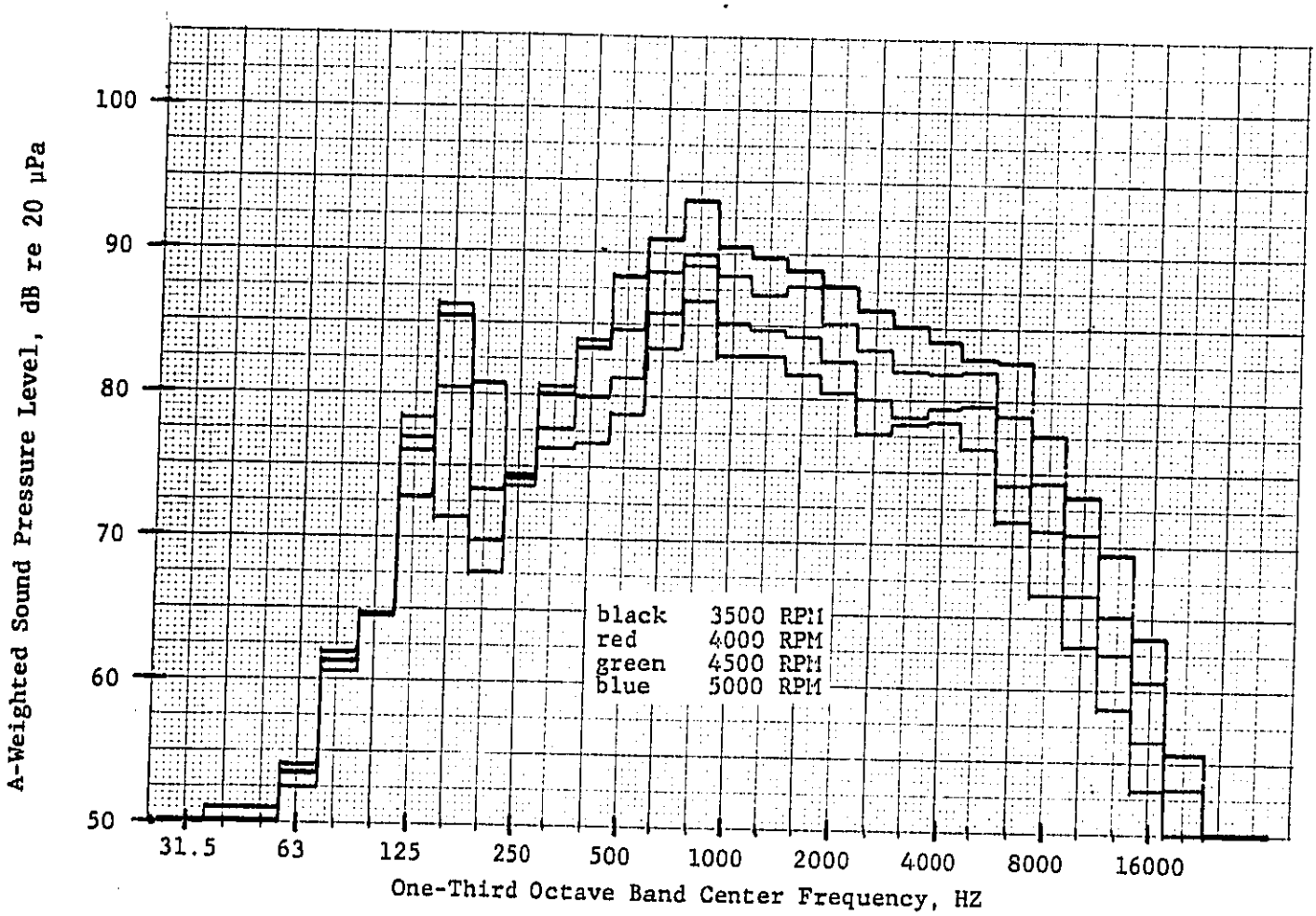


Figure C1 Chevette, Maximum Spectrum Level Standard Configuration
Room Number 5 (painted), Mike Number 3

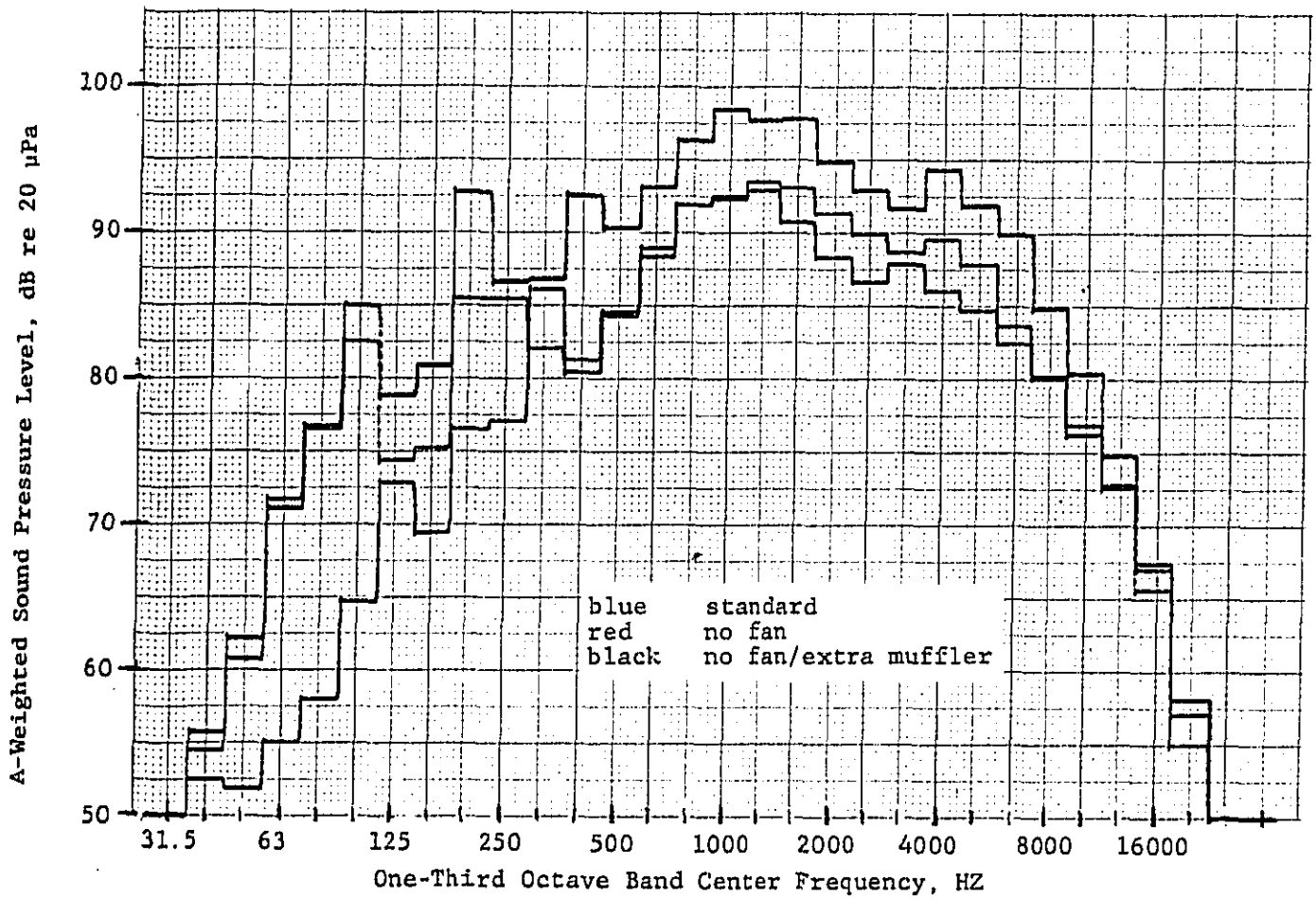


Figure C2 GMC Truck, Maximum Spectrum Level IMI Test, Room Number 5 (painted), Mike Number 3

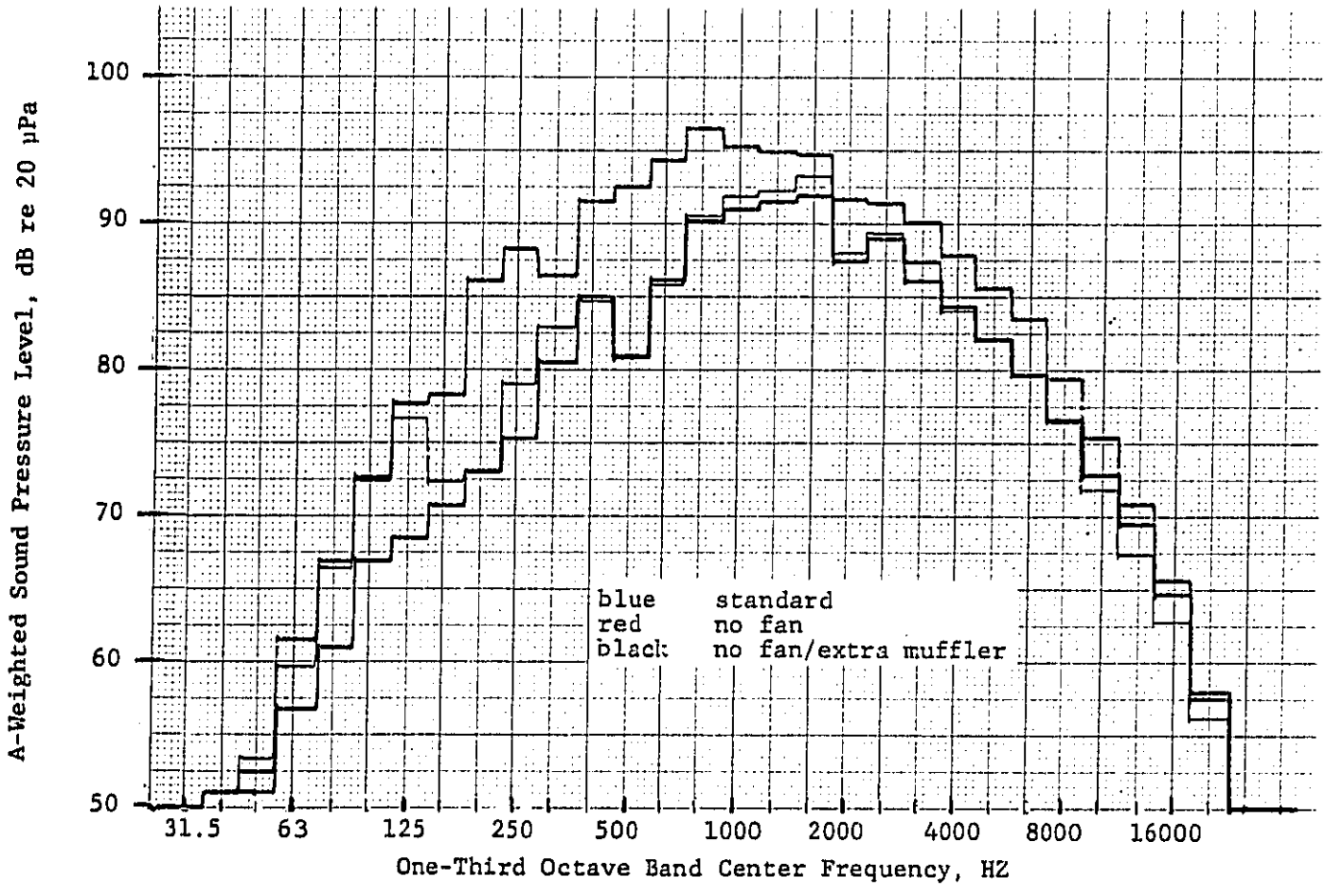


Figure C3 Ford Truck, Maximum Spectrum Level IMI Test, Room Number 5 (painted), Mike Number 3

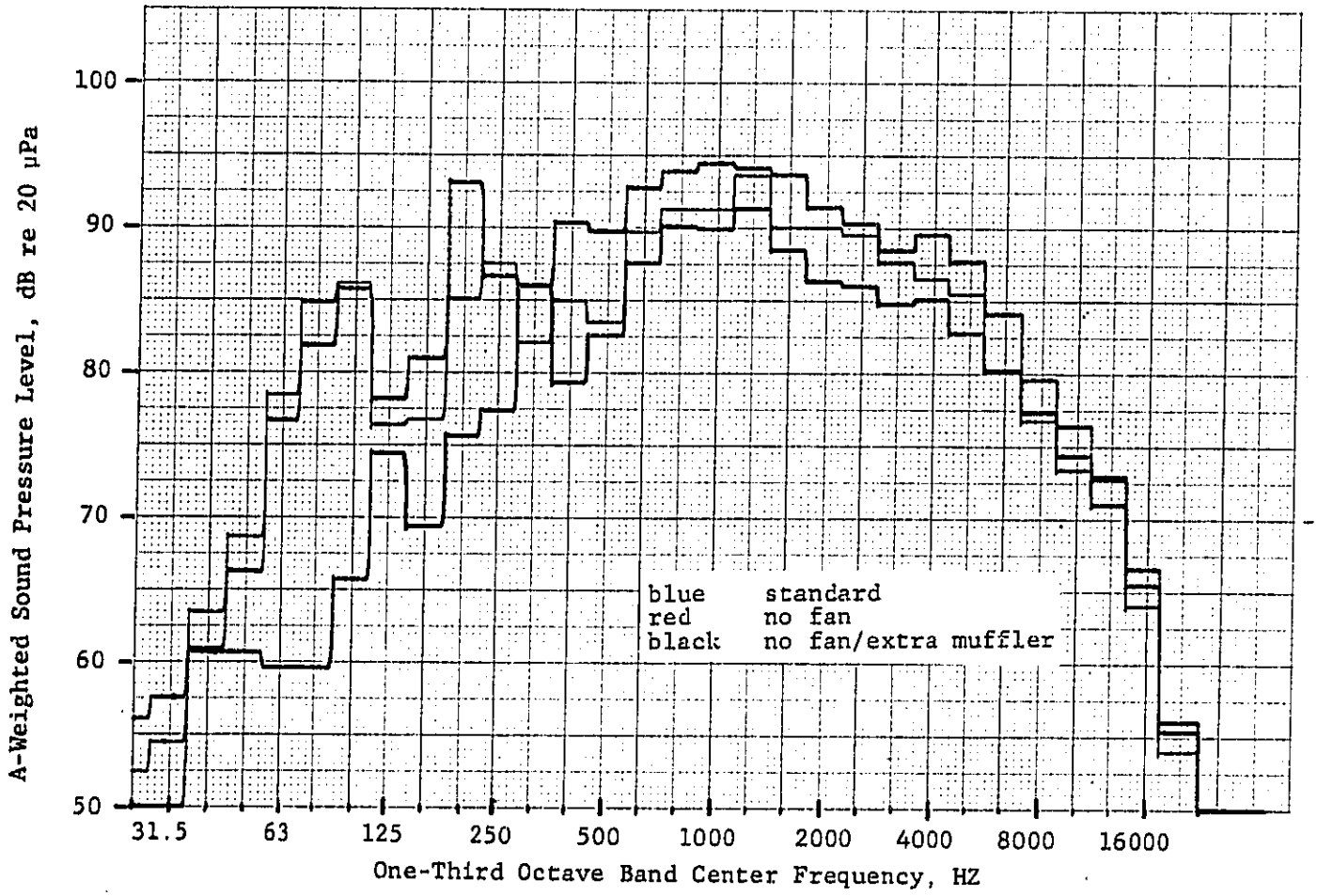


Figure C4 IH Truck, Maximum Spectrum Level IMI Test, Room Number 5 (painted), Mike Number 3

APPENDIX D: ILG LEVELS

One measure of the diffusivity of the sound fields in the reverberation rooms is the variation in sound level of the ILG Reference Sound Source as it and the receiving microphone are shifted around in the room.

Tables D-1 and D-2 tabulate the variation in A-weighted level with Room 5 empty and with the Chevette in it. The four ILG positions are on the floor to the front and rear and to either side of the vehicle. The microphone positions are the same as in the other tests of this report. There is 0.2 dB difference between the cases, indicating that the Chevette has little influence on the diffusivity of the room.

Table D-3 tabulates the same type of variation over six microphones for one ILG position in each of Room 2, Room 5 unpainted, and Room 5 painted. The ILG position was on a stand before the front of the Chevette (or where the front would be for the empty room cases). The microphone positions are the same as in the other tests. It can be seen how the presence of the vehicle makes increasingly little difference as the reverberation room becomes larger and more reverberant.

Finally, tabulated below are the A-weighted sound levels of the ILG in painted Room 5 with various vehicles present. The values are the average over six microphone positions, and are appropriately room-created. These are the values of L_{pr} used in Section 8.3.

	Chevette	GMC	Ford	IH
L_{pr}	76.2	75.1	75.0	75.2

TABLE D-1 VARIATION OF ILG LEVELS IN PAINTED ROOM #5 (EMPTY ROOM)

MICROPHONE NO.	ILG POS. 1	2	3	4	MEAN	SIG
1	76.5	77.0	77.0	79.5	77.7	1.35
2	79.0	78.0	79.0	77.5	78.4	0.75
3	78.5	76.5	76.0	76.0	76.9	1.19
4	79.0	78.5	77.0	78.5	78.3	0.87
5	77.0	82.0	76.5	77.0	78.8	2.59
6	77.5	77.5	81.0	77.5	78.7	1.75
MEAN	78.0	78.7	78.1	77.8	78.2	
SIG	1.07	1.97	1.89	1.21		1.50

TABLE D-2 VARIATION OF ILG LEVELS IN PAINTED ROOM #5 (VEHICLE IN ROOM)

MICROPHONE NO.	ILG POS. 1	2	3	4	MEAN	SIG
1	75.0	76.0	76.5	80.5	77.6	2.42
2	79.0	77.0	77.0	77.0	77.6	1.00
3	78.0	76.0	76.0	76.0	76.6	1.00
4	79.0	78.0	77.0	77.0	77.8	0.96
5	76.0	83.0	77.0	76.5	79.2	3.28
6	77.0	77.0	81.0	77.5	78.5	1.93
MEAN	77.6	78.7	77.8	77.7	78.0	
SIG	1.63	2.64	1.80	1.59		1.84

Microphone Position

	1	2	3	4	5	6	AVG
empty	83.0	83.0	83.0	82.5	83.0	82.0	82.7
Chevette	82.0	81.5	83.0	81.0	82.0	81.0	81.8

a) Room 2

Microphone Position

	1	2	3	4	5	6	AVG
empty	73.0	72.0	72.0	71.5	72.5	71.0	72.0
Chevette	72.0	71.5	72.0	71.5	72.5	70.5	71.7

b) Room 5, unpainted

Microphone Position

	1	2	3	4	5	6	AVG
empty	77.0	77.0	77.0	77.0	76.5	76.5	76.6
Chevette	77.0	76.5	77.0	76.5	76.5	76.5	76.6

c) Room 5, painted

Table D-3 ILG Variation Between Microphone Positions for Reverberation Rooms. Chevette both present and absent from rooms. ILG on stand before front of vehicle. A-weighted sound levels re 20 μPa.