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SOAC: STATE-OF-THE-ART CAR ENGINEERING
TESTS AT DEPARTMENT OF TRANSPORTATION
HIGH SPEED GROUND TEST CENTER. FINAL
TEST REPORT. VOLUME III. RIDE QUALITY
TESTS

Boeing Vertol Company

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Urban Mass Transportation
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16. Abstract This six-volume report presents the technical methodology, data samples, and results of tests conducted on the SOAC on the Rail Transit Test Track at the High Speed Ground Test Center in Pueblo, Colorado during the period April to July 1973. The UMTA-sponsored Urban Rail Supporting Technology Program, for which TSC is Systems Manager, emphasizes three major development task areas: facilities, technology and test program. Test program development comprises three sub-areas: vehicle testing, ways and structures testing and track geometry measurement. The objective of the SOAC program is to demonstrate the current state-of-the-art in rail rapid transit vehicle technology, with passenger convenience and operating efficiency as primary goals. The objectives of the Engineering Test program are to provide a set of SOAC engineering data and to further develop the methodology for providing transit vehicle comparisons. These objectives were met with the presentation of the test results in this report and the incorporation of refinement to the testing methodology into the General Vehicle Test Plan, GSP-064. In this series, Vol. I contains a description of the SOAC test program and vehicle, and a summary of the test results; Vol. II, Performance Test data; Vol. III, Ride Quality Test data; Vol. IV, Noise Test data; Vol. V, Structural, Voltage, and Radio Frequency Interference Test data; and Vol. VI a description of the Instrumentation System used for performance, ride quality and structural testing.					
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PREFACE

This test report, presenting the results of engineering tests on the State-of-the-Art Cars (SOAC), derives from the efforts of two agencies of the U.S. Department of Transportation: the Rail Programs Branch of the Urban Mass Transportation Administration's Office of Research and Development and the Transportation Systems Center.

The report is presented in six volumes. Volume I is a description of the program and a summary of the test results. Volumes II through V are organized to technical disciplines, as follows: Volume II, Performance; this volume, Volume III, Ride Quality; Volume IV, Noise; and Volume V, Structures, Voltage, and Radio Frequency Interference. Volume VI contains a description of the SOAC Instrumentation System used for Performance, Ride Quality, and Structural Testing.

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TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1	SUMMARY 1-1
1.1	Test Sequence 1-1
1.2	Test Procedures 1-1
1.3	Objectives 1-1
1.4	Status 1-2
2	TEST DESCRIPTION 2-1
2.1	Vibration Level Readings 2-1
2.2	Accelerometer Locations 2-1
2.3	Bang Test 2-2
2.4	Single-Car Coupler Vibration 2-2
3	INSTRUMENTATION 3-1
4	TEST PROCEDURES 4-1
5	PRELIMINARY DATA ANALYSIS 5-1
5.1	Data Collection 5-1
5.2	Effect of Speed 5-7
5.3	Effect of Track Section 5-8
5.4	Effect of Car Weight 5-8
5.5	Effect of Train Consist 5-9
5.6	Comparison of SOAC Ride Quality Data with SOAC Goals 5-9
APPENDIX A:	RIDE QUALITY POWER SPECTRAL DENSITY AND PEAK AMPLITUDE MACHINE PLOTS A-1

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LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
2-1	Sample Accelerometer Outputs for Car Body Vertical Acceleration (90,000-Pound Gross Weight, 80 MPH Speed)	2-3
5-1	Block Diagram for Ride Roughness Data Reduction System	5-2
5-2	Weighting Network Frequency Response for Horizontal Ride Roughness	5-3
5-3	Weighting Network Frequency Response for Vertical Ride Roughness	5-4
5-4	Effect of Speed on Aft Car Centerline Lateral Ride Roughness (High-Density Car)	5-10
5-5	Effect of Speed on Forward Car Centerline Vertical Ride Roughness (High-Density Car)	5-11
5-6	Effect of Speed on Mid-Car Centerline Vertical Ride Roughness (High-Density Car)	5-12
5-7	Effect of Speed on Aft Car Centerline Lateral Ride Roughness (High-Density Car)	5-13
5-8	Effect of Speed on Forward Car Centerline Vertical Ride Roughness (High-Density Car)	5-14
5-9	Effect of Speed on Mid-Car Centerline Vertical Ride Roughness (High-Density Car)	5-15
5-10	Effect of Speed on Aft Car Centerline Lateral Ride Roughness (Two-Car Train)	5-16
5-11	Effect of Speed on Forward Car Centerline Vertical Ride Roughness (Two-Car Train)	5-17
5-12	Effect of Speed on Mid-Car Centerline Vertical Ride Roughness (Two-Car Train)	5-18
5-13	Effect of Speed on No. 1 Axle Lateral Acceleration (High-Density Car)	5-19
5-14	Effect of Speed on No. 1 Axle Vertical Acceleration (High-Density Car)	5-20

<u>Figure</u>		<u>Page</u>
5-15	Effect of Speed on No. 1 Axle Lateral Acceleration (High-Density Car)	5-21
5-16	Effect of Speed on No. 1 Axle Vertical Acceleration (High-Density Car)	5-22
5-17	Effect of Speed on No. 1 Axle Lateral Acceleration (Two-Car Train)	5-23
5-18	Effect of Speed on No. 1 Axle Vertical Acceleration (Two-Car Train)	5-24
5-19	Effect of Track Section on Forward Car Centerline Vertical Ride Roughness of High- Density Car at 35 MPH Speed	5-25
5-20	Effect of Track Section on Mid-Car Centerline Vertical Ride Roughness of High-Density Car at 35 MPH Speed	5-26
5-21	Effect of Track Section on Forward Car Centerline Vertical Ride Roughness of High- Density Car at 80 MPH Speed	5-27
5-22	Effect of Track Section on Mid-Car Centerline Vertical Ride Roughness of High-Density Car at 80 MPH Speed	5-28
5-23	Effect of High-Density Car Gross Weight on Aft Car Centerline Lateral Ride Roughness at 45 MPH Speed	5-29
5-24	Effect of High-Density Car Gross Weight on Forward Car Centerline Vertical Ride Roughness at 45 MPH Speed	5-30
5-25	Effect of High-Density Car Gross Weight on Mid-Car Centerline Vertical Ride Roughness at 45 MPH Speed	5-31
5-26	Effect of High-Density Car Gross Weight on Aft Car Centerline Lateral Ride Roughness at 55 MPH Speed	5-32
5-27	Effect of High-Density Car Gross Weight on Forward Car Centerline Vertical Ride Roughness at 55 MPH Speed	5-33

<u>Figure</u>		<u>Page</u>
5-28	Effect of High-Density Car Gross Weight on Mid-Car Centerline Vertical Ride Roughness at 55 MPH Speed	5-34
5-29	Effect of High-Density Car Gross Weight on Aft Car Centerline Lateral Ride Roughness at 80 MPH Speed	5-35
5-30	Effect of High-Density Car Gross Weight on Forward Car Centerline Vertical Ride Roughness at 80 MPH Speed	5-36
5-31	Effect of High-Density Car Gross Weight on Mid-Car Centerline Vertical Ride Roughness at 80 MPH Speed	5-37
5-32	Effect of Gross Weight on High-Density Car No. 1 Axle Lateral Acceleration at 35 MPH Speed	5-38
5-33	Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 35 MPH Speed	5-39
5-34	Effect of Gross Weight on High-Density Car No. 1 Axle Lateral Acceleration at 45 MPH Speed	5-40
5-35	Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 45 MPH Speed	5-41
5-36	Effect of Gross Weight on High-Density Car No. 1 Axle Lateral Acceleration at 55 MPH Speed	5-42
5-37	Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 55 MPH Speed	5-43
5-38	Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 80 MPH Speed	5-44
5-39	Effect of Gross Weight on High-Density Car Axle Vertical Acceleration at 80 MPH Speed	5-45
5-40	Effect of Train Consist on Aft Car Centerline Lateral Ride Roughness	5-46

<u>Figure</u>		<u>Page</u>
5-41	Effect of Train Consist on Forward Car Centerline Vertical Ride Roughness	5-47
5-42	Effect of Train Consist on Mid-Car Centerline Vertical Ride Roughness	5-48
5-43	Effect of Train Consist on No. 1 Axle Lateral Acceleration at 35 MPH Speed	5-49
5-44	Effect of Train Consist on No. 1 Axle Vertical Acceleration at 35 MPH Speed	5-50
5-45	Effect of Train Consist on No. 1 Axle Lateral Acceleration at 45 MPH Speed	5-51
5-46	Effect of Train Consist on No. 1 Axle Vertical Acceleration at 45 MPH Speed	5-52
5-47	Effect of Train Consist on No. 1 Axle Lateral Acceleration at 80 MPH Speed	5-53
5-48	Effect of Train Consist on No. 1 Axle Vertical Acceleration at 80 MPH Speed	5-54
5-49	Comparison of High-Density Car Ride Quality vs. Goals	5-55
5-50	Comparison of Two-Car Train Ride Quality vs. Goals	5-56
A-1 thru A-167	Ride Quality Power Spectral Density and Peak Amplitude Machine Plots (See Index, Table A-1, Page A-2)	A-8 thru A-174

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1-1	Test Sequence Run Numbers	1-1
2-1	Bang Test Data	2-2
3-1	Ride Quality Accelerometer Locations	3-1
5-1	Summary of Baseline Ride Quality Data Comparison Plots	5-5
A-1	Index to Ride Quality Test Power Spectral Density and Peak Amplitude Machine Plots . . .	A-1

Section 1

SUMMARY

1.1 TEST SEQUENCE

Table 1-1 presents the test sequence run numbers.

TABLE 1-1. TEST SEQUENCE RUN NUMBERS

Car Weight (lb)	Run Numbers	
	Single Car (High Density)	Two-Car Train
90,000	132	-
105,000	120 140	139
113,000	147	-
130,000	148	-

1.2 TEST PROCEDURES

Test procedures used for ride quality testing were: SOAC-R-2001-TT, SOAC-R-3001-TT, and SOAC-R-4001-TT.

1.3 OBJECTIVES

The objectives of ride quality testing were to expand and improve the General Vehicle Test Plan (GSP-064) and to provide vehicle ride quality baseline engineering data for the State-of-the-Art car at the Department of Transportation's High Speed Ground Test Center (HSGTC), Pueblo, Colorado. This data will be used for comparison with data recorded at five transit properties in New York, Boston, Cleveland, Chicago, and Philadelphia.

1.4 STATUS

Ride quality data at seven car body locations and five truck locations has been recorded and collected over the six types of track construction on the 9-mile UMTA test track. The processed data is presented in 167 sets, each set containing spectrum analysis and power spectral density curves. The processed data was selected to obtain baseline comparison plots showing the effect of speed, track section, car weight, and train consist on vehicle vibration levels.

Data was collected for both resilient and steel wheels. However, the steel wheel data was taken prior to a car body structural modification and is therefore no longer valid.

It should be noted that wheel flats may have existed on the SOAC during the ride quality tests with resilient wheels. This may have proved erroneous data at the wheel fundamental rotational frequency. Previous ride quality testing indicated that the vehicle was sensitive to wheel flats near 80 mph.

Section 2

TEST DESCRIPTION

2.1 VIBRATION LEVEL READINGS

Ride quality tests were conducted on the SOAC vehicles (single-car and two-car train) for speeds of 20, 35, 45, 55, and 80 mph over the six sections of the DOT test track. Table 1-1 presents a list of the weights and train consist used during the testing.

To delineate the rigid body and flexible modes of vibration of the vehicle during this test series, car body and journal box vertical, lateral, and longitudinal vibration levels were measured using accelerometers. The output of the accelerometers was recorded on magnetic tape, and readings were made at selected locations.

2.2 ACCELEROMETER LOCATIONS

The following rationale was applied to the selection of car body accelerometer locations:

1. Forward, mid and rear car centerline vertical accelerometers were located to obtain the effect of car body vertical flexible modes, and vertical/pitch rigid body modes on car body vibration.
2. Forward, mid and rear car centerline lateral accelerometers were located to obtain the effect of flexible and rigid lateral/yaw modes on car body vibration.
3. It was assumed that there was no longitudinal flexibility of the car, therefore only one longitudinal pickup was necessary to measure the rigid body motion.
4. Vertical mid-car centerline, mid-car righthand and mid-car lefthand accelerometers were used to determine the effect of the rigid body roll modes on vibration.
5. Forward car centerline lateral and forward car ceiling lateral were used to determine the effect of frame racking or car body torsion modes on vibration.

6. The location of journal box accelerometers was selected to determine truck response from track vertical, lateral, and cross level alignments.

Data was monitored on the vehicle by a test engineer using a strip chart recorder to ensure that each accelerometer was functioning properly and to provide a "quick look" of selected pickups.

Instrumentation, calibration, and data reduction were performed by Garrett AiResearch Co.

2.3 BANG TEST

A bang test of the journal box accelerometer brackets was performed to determine their resonant frequencies. A summary of this data is presented in Table 2-1.

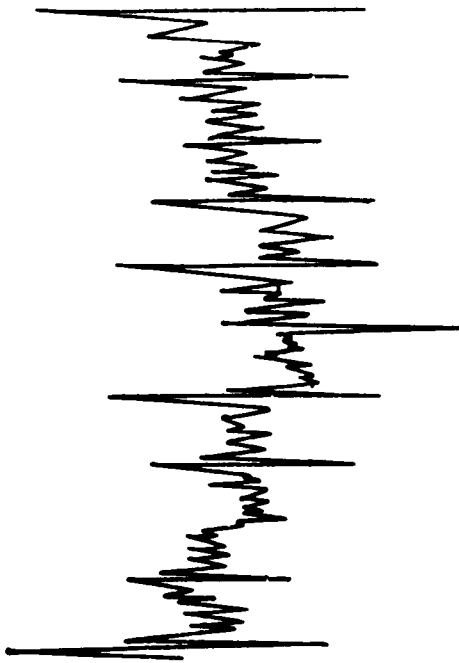
TABLE 2-1. BANG TEST DATA

Accelerometer Bracket Location	Resonant Frequency (Hz)
Fwd Axle, RH Journal Box, Front Truck, Vertical	250
Fwd Axle, RH Journal Box, Front Truck, Lateral	250
Aft Axle, RH Journal Box, Front Truck, Lateral	375
Fwd Axle, LH Journal Box, Front Truck, Vertical	400
Aft Axle, LH Journal Box, Front Truck, Vertical	300
Fwd Axle, RH Journal Box, Rear Truck, Lateral	300
Aft Axle, RH Journal Box, Rear Truck, Lateral	300
No. 1 Forward Traction Motor Housing Vertical	250
No. 1 Forward Traction Motor Housing Lateral	350

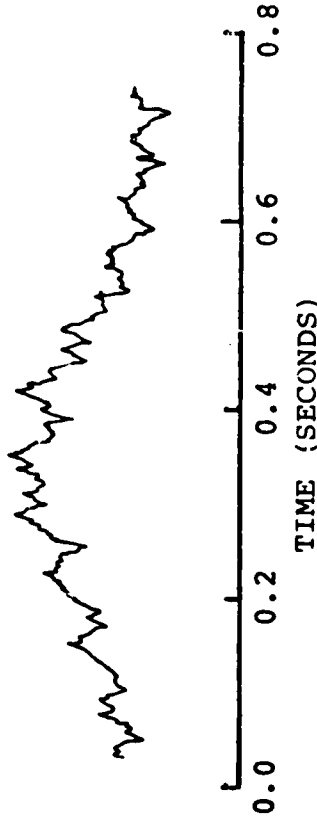
2.4 SINGLE-CAR COUPLER VIBRATION

During the ride quality testing, a vibration problem was observed in the rear of the high-density car. This problem, attributed to the coupler impacting the structure, was temporarily eliminated by installing wooden shims near the coupler anchor. Data illustrating the effect of the shims is shown in Figure 2-1. The coupler centering mechanism on Cars No. 1 and

NO COUPLER SHIMS
REAR OF CAR



COUPLER SHIMS
REAR OF CAR



2-3

NOTE

ALL PICKUPS .5G/IN.

NO COUPLER SHIMS
FRONT OF CAR



COUPLER SHIMS
FRONT OF CAR



Figure 2-1. Sample Accelerometer Outputs for Car Body Vertical Acceleration (90,000-pound Gross Weight, 80 MPH Speed).

2 was not operative and permitted the couplers to vibrate. This condition will not exist when the coupler centering mechanism is activated.

Section 3

INSTRUMENTATION

Schaevitz LSBC accelerometers were selected to measure vibration levels because they have an effective measurement capability in the desired frequency range of 0.1 to 30 Hz.

Accelerometers used to measure car floor accelerations were rigidly mounted directly to the underside of the floor support structure. The lateral accelerometer at the ceiling was mounted to a stanchion. Truck accelerometers were mounted to brackets rigidly attached to the journal boxes and traction motors.

Car body and journal box locations are shown in Table 3-1.

TABLE 3-1. RIDE QUALITY ACCELEROMETER LOCATIONS

Parameter	Direction	Range	Frequency
<u>CAR BODY</u>			
● <u>Linear Accelerations</u>			
Fwd car floor, truck centerline	Vertical	±.30 G	30 Hz
Fwd car floor, truck centerline	Lateral	±.30 G	30 Hz
Fwd car floor, truck centerline	Longitudi- nal	±.30 G	30 Hz
Centerline car floor, rear end	Vertical	±.30 G	30 Hz
Centerline car floor, rear end	Lateral	±.30 G	30 Hz
Fwd car floor LH, truck centerline	Vertical	±.30 G	30 Hz
Centerline car floor, mid-car	Vertical	±.30 G	30 Hz
Centerline car floor, mid-car	Lateral	±.30 G	30 Hz
Car floor RH, mid-car	Vertical	±.30 G	30 Hz
Car floor LH, mid-car	Vertical	±.30 G	30 Hz
Centerline car ceiling, mid-car	Lateral	±.30 G	30 Hz

TABLE 3-1. Continued

Parameter	Direction	Range	Frequency
● <u>Angular Accelerations</u>			
Mid-car centerline	Pitch		
	Roll	±0.4	5 Hz
	Yaw	Rad/Sec	
<u>TRUCK</u>			
● <u>Linear Accelerations</u>			
Fwd RH wheel, front	Vertical	±25 G	30 Hz
Fwd RH wheel, front	Lateral	±25 G	30 Hz
Aft RH wheel, front	Vertical	±25 G	30 Hz
Aft RH wheel, front	Lateral	±25 G	30 Hz
Fwd LH wheel, front	Vertical	±25 G	30 Hz
Aft LH wheel, front	Vertical	±25 G	30 Hz
Fwd RH wheel, rear	Lateral	±25 G	30 Hz
Aft RH wheel, rear	Lateral	±25 G	30 Hz
Fwd motor housing at cg	Vertical	±15 G	30 Hz
Fwd motor housing at cg	Lateral	±15 G	30 Hz

Section 4

TEST PROCEDURES

The procedures followed during ride quality testing were as follows:

1. Steady Speed Runs (SOAC-R-4001-TT)
 - a. Patch in ride quality instrumentation.
 - b. Accelerate to and maintain test point speed.
 - c. Prior to entering a test section, start recorders and mark tapes and data sheet with record number.
 - d. Provide event mark on tapes at beginning of test section (see attached test section locations).
 - e. Provide event mark at end of 20 seconds of record.
 - f. Stop recorders.
 - g. Proceed to next section or speed and repeat the above steps.
2. Acceleration Run (SOAC-R-2001-TT)
 - a. Proceed to start location and stop vehicles, location 120 CW or 150 CCW.
 - b. Start recorders and provide record number.
 - c. Initiate and maintain full acceleration.
 - d. Provide event mark at first motion.
 - e. Provide event mark at 40 mph indicated speed.
 - f. Stop recorders.
 - g. Stop vehicle.

3. Deceleration Run (SOAC-R-3001-TT)

- a. Proceed to start location at 60 mph, location 120 CW or 150 CCW.
- b. Start recorders and provide record number.
- c. Initiate full service braking.
- d. Provide event mark at initiation of braking.
- e. Provide event mark at complete stop.
- f. Stop recorders.

Section 5

PRELIMINARY DATA ANALYSIS

5.1 DATA COLLECTION

The ride quality vibration data was recorded on analog tapes and later digitized to obtain spectrum analysis and power spectral density curves. These data reduction techniques are the most useful means of analyzing a deterministic process. Spectrum analysis and a power spectral density permit identification of vibration contribution from modal characteristics of the car body structure.

Figure A-79 shows spectrum analysis and power spectral density curves. Both curves indicate that peak amplitudes occur at frequencies of 1.5, 7.5, 15, and 30 Hz, and are associated with response from a rigid body suspension mode, the first car body vertical bending mode, a higher order car body flexible mode, and component induced vibration, respectively. The filter bandwidth for the spectral density and spectrum analysis was 0.20 Hz in the 0 to 10 Hz range and 1.0 Hz for frequencies above 10 Hz. A listing and the curves of the processed data are presented in Appendix A (Figures A-1 through A-167).

The ride quality vibration data was further processed to produce the Ride Roughness data shown on the following baseline comparison plots. Ride roughness is a "figure-of-merit" to indicate the roughness of ride experienced by a typical passenger on a moving transit vehicle. The methodology for establishing this parameter is as defined in GSP-064, "General Vehicle Test Plans for Urban Rail Transit Cars." The specific equipment used for the SOAC data reduction is shown in Figure 5-1, with the main components being the GR 1/3 octave band shaper and the graphic level recorder. The actual response of the shaper for horizontal and vertical signal weighting is shown in Figures 5-2 and 5-3, respectively. The effective averaging time for the RMS weighted signal was 1 second. A summary of the baseline comparison plots is presented in Table 5-1 and the plots are shown in Figures 5-4 through 5-48.

All baseline comparison plots were generated with identical scales to emphasize the important vibration trends and the effect of key parameters. These comparison plots show the

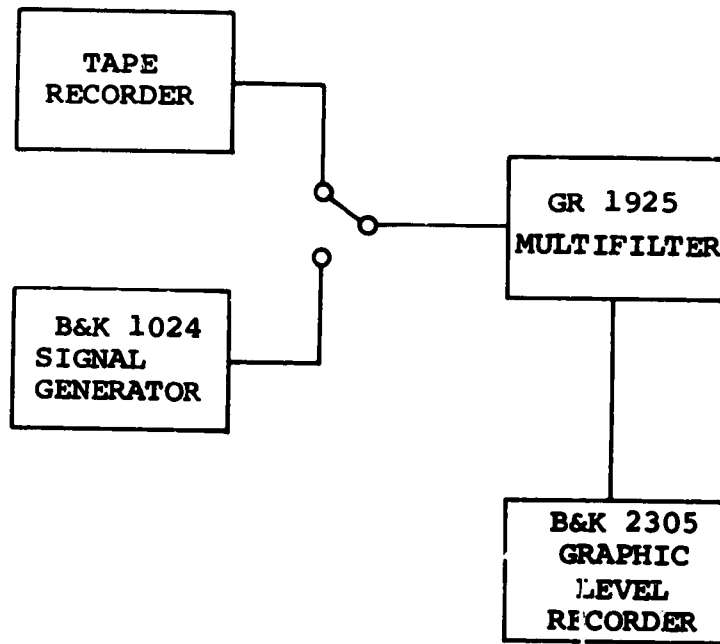


Figure 5-1. Block Diagram for Ride Roughness Data Reduction System

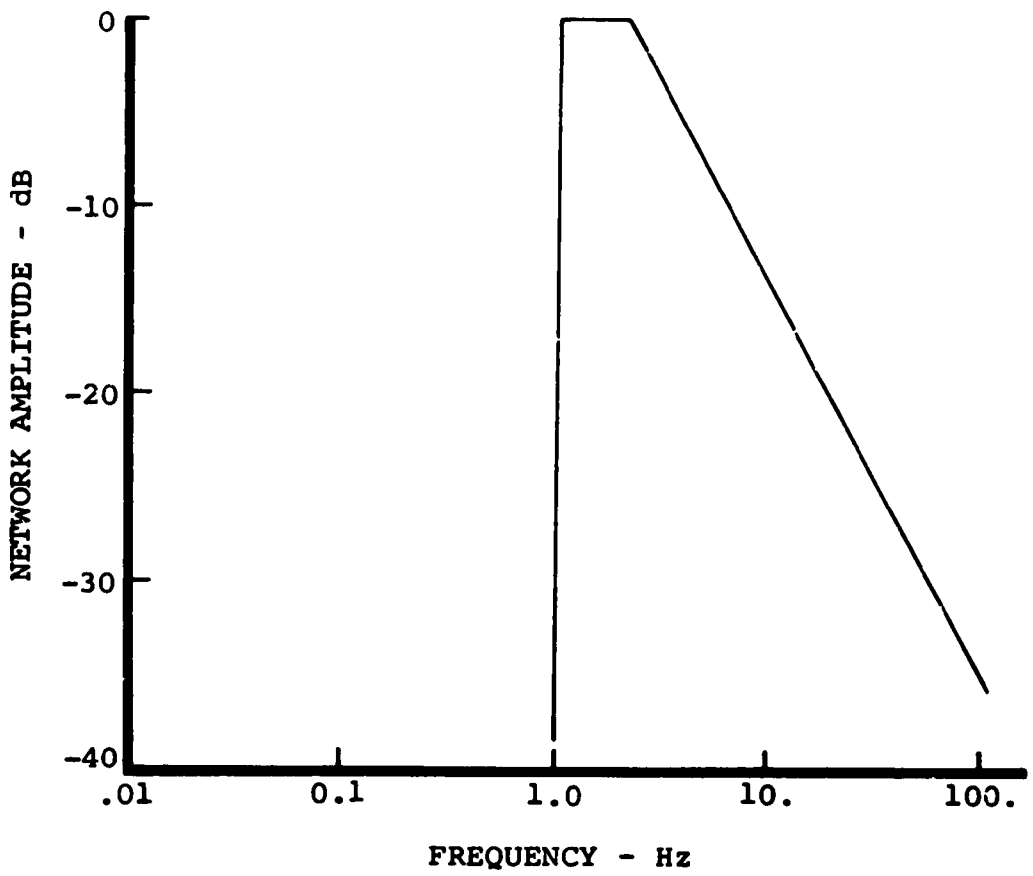


Figure 5-2. Weighting Network Frequency Response for Horizontal Ride Roughness

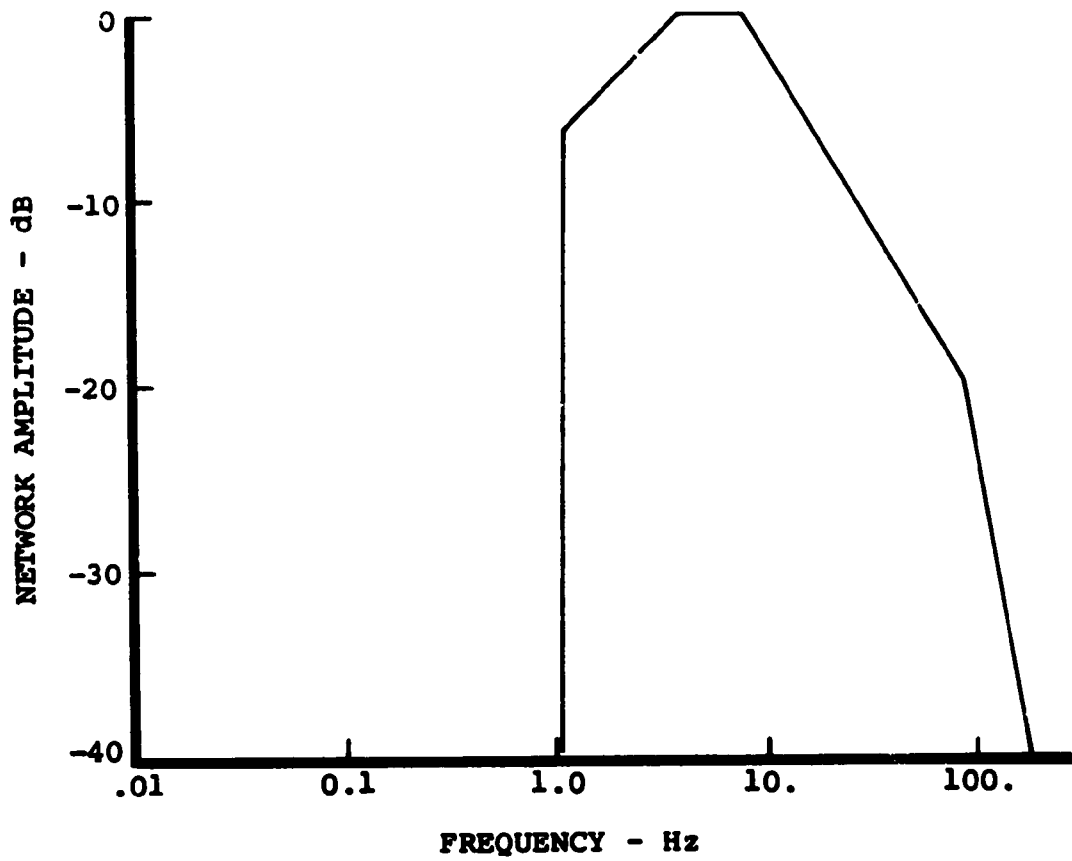


Figure 5-3. Weighting Network Frequency Response for Vertical Ride Roughness

TABLE 5-1. SUMMARY OF BASELINE RIDE QUALITY DATA COMPARISON PLOTS

Figure No.	Describes Effect of	Pickup Location*	Train Consist*	Car Weight (1000 lb)	Track Section	Speed (mph)
5-4	Speed	Aft car C/L lateral	HDC	90	I	20,35,45,55,80
5-5	Speed	Fwd car C/L vertical	HDC	90	I	20,35,45,55,80
5-6	Speed	Mid car C/L vertical	HDC	90	I	20,35,45,55,80
5-7	Speed	Aft car C/L lateral	HDC	105	I	20,35,45,55,80
5-8	Speed	Fwd car C/L vertical	HDC	105	I	20,35,45,55,80
5-9	Speed	Mid car C/L vertical	HDC	105	I	20,35,45,55,80
5-10	Speed	Aft car C/L lateral	Train	105	I	20,35,45,55,80
5-11	Speed	Fwd car C/L vertical	Train	105	I	20,35,45,55,80
5-12	Speed	Mid car C/L vertical	Train	105	I	20,35,45,55,80
5-13	Speed	Fwd axle RH JB front trk lat.	HDC	90	I	35,45,80
5-14	Speed	Fwd axle RH JB front trk vert.	HDC	90	I	35,45,80
5-15	Speed	Fwd axle RH JB front trk lat.	HDC	105	I	35,45,80
5-16	Speed	Fwd axle RH JB front trk vert.	HDC	105	I	35,45,80
5-17	Speed	Fwd axle RH JB front trk lat.	Train	105	I	35,45,80
5-18	Speed	Fwd axle RH JB front trk vert.	Train	105	I	35,45,80
5-19	Track section	Fwd car C/L vertical	HDC	105	I thru VI	35
5-20	Track section	Fwd car C/L vertical	HDC	105	I thru VI	35
5-21	Track section	Fwd car C/L vertical	HDC	105	I thru VI	80
5-22	Track section	Mid car C/L vertical	HDC	105	I thru VI	80
5-23	Gross weight	Aft car C/L lateral	HDC	90,105	I	45
5-24	Gross weight	Fwd car C/L vertical	HDC	90,105	I	45
5-25	Gross weight	Mid car C/L vertical	HDC	90,105	I	45
5-26	Gross weight	Aft car C/L lateral	HDC	90,105,130	I	55
5-27	Gross weight	Fwd car C/L vertical	HDC	90,105,130	I	55
5-28	Gross weight	Mid car C/L vertical	HDC	90,105,130	I	55
5-29	Gross weight	Aft car C/L lateral	HDC	90,105	I	80
5-30	Gross weight	Fwd car C/L vertical	HDC	90,105	I	80
5-31	Gross weight	Mid car C/L vertical	HDC	90,105	I	80

TABLE 5-1 - Continued

Figure No.	Describes Effect of	Pickup Location*	Train Consist*	Car Weight (1000 lb)	Track Section	Speed (mph)
5-32	Gross weight	Fwd axle RH JB front trk lat.	HDC	90,105	I	35
5-33	Gross weight	Fwd axle RH JB front trk vert.	HDC	90,105	I	35
5-34	Gross weight	Fwd axle RH JB front trk lat.	HDC	90,105	I	45
5-35	Gross weight	Fwd axle RH JB front trk vert.	HDC	90,105	I	45
5-36	Gross weight	Fwd axle RH JB front trk lat.	HDC	90,105,130	I	55
5-37	Gross weight	Fwd axle RH JB front trk vert.	HDC	90,105,130	I	55
5-38	Gross weight	Fwd axle RH JB front trk lat.	HDC	90,105	I	80
5-39	Gross weight	Fwd axle RH JB front trk vert.	HDC	90,105	I	80
5-40	Car config.	Aft car C/L lateral	HDC,Train	105	I	20,35,45,55,80
5-41	Car config.	Fwd car C/L vertical	HDC,Train	105	I	20,35,45,55,80
5-42	Car config.	Mid car C/L vertical	HDC,Train	105	I	20,35,45,55,80
5-43	Car config.	Fwd axle RH JB front trk lat.	HDC,Train	105	I	35
5-44	Car config.	Fwd axle RH JE front trk vert.	HDC,Train	105	I	35
5-45	Car config.	Fwd axle RH JB front trk lat.	HDC,Train	105	I	45
5-46	Car config.	Fwd axle RH JB front trk vert.	HDC,Train	105	I	45
5-47	Car config.	Fwd axle RH JB front trk lat.	HDC,Train	105	I	80
5-48	Car config.	Fwd axle RH JB front trk vert.	HDC,Train	105	I	80

*KEY: HDC, High-Density Car; JB, Journal Box; Trk, Truck

effect of speed, track section, car weight and train consist on vehicle ride roughness. The baseline processed data of Appendix A can be used to obtain absolute values of acceleration levels.

Ride quality data taken over track Section I at a 105,000-pound car weight for two train consists is compared to the SOAC goal in Figures 5-49 and 5-50.

Instrumentation, calibrations and data reduction were performed by Garrett AiResearch Company.

5.2 EFFECT OF SPEED (Figures 5-4 through 5-18)

The effect of vehicle speed on car body and journal box acceleration levels is shown in Figures 5-4 through 5-18. Data are presented for resilient wheels on track Section I at several speeds and two car weights (90,000 and 105,000 pounds). Two train consists were investigated: a high-density car and a two-car train.

Figure 5-4 shows that the aft car centerline (C/L) lateral ride roughness at a 90,000-pound car weight is not affected by varying speed. Figures 5-5 and 5-6 show the vertical ride roughness at the forward end and mid-car C/L locations, respectively. Both channels exhibit some resonance (peaking) at 45 mph. Examination of the peak-amplitude spectrum charts found in Appendix A reveals that the dominant frequency is at 8 Hz, the first vertical bending mode of the car body. At 45 mph with the 30-inch diameter SOAC wheels, the driving force is also at 8 Hz. The mid-car vertical ride roughness also shows a resonance at 80 mph. Again, from the spectrum plots of Appendix A, the dominant frequency is found to be the second car body bending mode, 15 Hz.

Figure 5-7 shows the effect of speed on aft car C/L lateral ride roughness at a 105,000-pound car weight. The ride roughness levels are similar to the 90,000-pound car. The forward car C/L vertical ride roughness levels shown in Figure 5-8 are similar to the levels of the 90,000-pound car. The mid-car C/L vertical ride roughness (Figure 5-9) shows that the resonance at 80 mph is somewhat damped out for the 105,000-pound car.

Data showing the effect of speed for a two-car train at a 105,000-pound car weight is presented in Figures 5-10 through 5-12. Car body lateral levels at the aft car C/L location are not significantly affected by speed (Figure 5-10). Figure 5-11 shows the effect of speed on forward car C/L vertical levels. Figure 5-12 shows the mid-car C/L vertical levels. As shown, the two-car train has very little effect on the ride roughness levels.

Comparison plots showing the effect of speed on journal box

vertical and lateral accelerations are shown in Figures 5-13 through 5-18, as frequency spectrum analysis plots. (Data are presented for speeds of 35, 45 and 80 mph.) Vertical journal box accelerations (Figures 5-14, 5-16 and 5-18) are not affected by speed. In contrast, lateral acceleration levels are significantly higher than vertical levels and reach peak amplitudes at 80 mph for the single high-density car at 90,000- and 105,000-pound car weights (Figures 5-13 and 5-15). For the 105,000-pound train, peak levels occur at 45 mph and are shown in Figure 5-17.

5.3 EFFECT OF TRACK SECTION (Figures 5-19 through 5-22)

The effect of track section on car body ride roughness levels is shown in Figures 5-19 through 5-22. Data are presented for the 105,000-pound high-density car with resilient wheels at speeds of 35 and 80 mph.

Figure 5-19 shows that forward car C/L vertical levels are higher at 35 mph on track Sections I and II (119-pound welded rail, wooden ties; 100-pound welded rail, wooden ties; respectively).

Figure 5-20 indicates that the mid-car C/L vertical levels are also higher on track Sections I and II. This trend is also evident for the forward car C/L vertical levels at 80 mph (Figure 5-21). Figure 5-22 shows the levels at the mid-car C/L location at 80 mph.

5.4 EFFECT OF CAR WEIGHT (Figures 5-23 through 5-39)

The effect of car weight on car body and journal box vertical and lateral acceleration levels is shown in Figures 5-23 through 5-39. Data are presented for the high-density car with resilient wheels on track Section I at 45, 55 and 80 mph speeds.

Figures 5-23 and 5-24 show that the lateral ride roughness at the aft end C/L of the car and the vertical C/L ride roughness at forward end are not significantly affected by gross weight at a 45 mph speed. At 45 mph the vertical contribution at the mid-car C/L (Figure 5-25) is lower at 113,000 and 105,000 pounds than at the empty weight of 90,000 pounds.

Figure 5-26 shows the aft car C/L lateral ride roughness as a function of car weight. At the forward end of the car C/L and at the mid-car C/L, vertical ride roughness levels are lower at the 130,000-pound car weight (Figures 5-27 and 5-28) at 55 mph.

Figure 5-30 shows the effect of car weight on the forward car C/L vertical ride roughness at 80 mph. Figure 5-31 shows that vertical ride roughness at the mid-car C/L is significantly reduced at 105,000 pounds at 80 mph.

The effect of car weight on journal box vertical and lateral acceleration levels is shown in Figures 5-32 through 5-39. Data presented indicate that there is little change in journal box motions with increasing car weights throughout the speed range investigated, except for lateral vibration levels at 45 mph, where the levels are noticeably higher for 105,000 pounds than for 90,000 pounds.

5.5 EFFECT OF TRAIN CONSIST (Figures 5-40 through 5-48)

The effect of train consist on car body and journal box acceleration levels is presented in Figures 5-40 through 5-48. Data are shown for resilient wheels on track Section I at a 105,000-pound car weight. Two train consists were evaluated: a single high-density car and a two-car train.

Figure 5-40 indicates that the aft car C/L lateral ride roughness levels are not affected by train consist. Figures 5-41 and 5-42 show that the vertical vibrations at 45 mph at the forward end C/L and mid-car locations, respectively, are not affected by train consist.

Comparison plots showing the effect of train consist on journal box vertical and lateral accelerations are presented in Figures 5-43 through 5-48. Data are presented for a single high-density car and a two-car train. Vertical journal box accelerations are not affected by train consist at speeds of 35, 45, and 80 mph (Figures 5-44, 5-46, and 5-48, respectively). Lateral acceleration levels are significantly higher than vertical levels.

Figure 5-43 indicates that at 35 mph the lateral journal box acceleration levels are substantially higher for the single car. At 45 mph (Figure 5-45) the levels are higher with the train, and at 80 mph (Figure 5-47) the levels are significantly higher for the single car.

5.6 COMPARISON OF SOAC RIDE QUALITY DATA WITH SOAC GOAL

Figures 5-49 and 5-50 compare SOAC ride quality data to the SOAC goals for both lateral and vertical accelerations. The plots of lateral levels versus frequency for the two train consists (high-density car and two-car train) at the normal car weight of 105,000 pounds show that the results are significantly lower than the design goal.

Data comparing vertical acceleration levels to frequency for the two train consists indicate that the vehicle meets the SOAC goal with respect to response from vertical rigid car body modes (1 to 2 Hz), a higher order car body flexible mode (15 Hz), and component induced vibration (30 Hz) substantially lower than the goal.

NOTES

- 1) RESILIENT WHEELS
- 2) 90,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

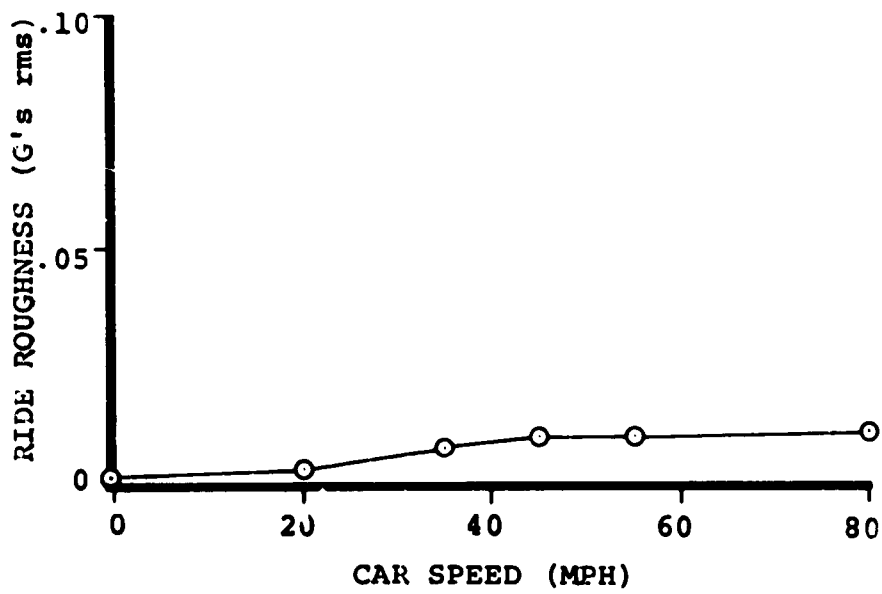


Figure 5-4. Effect of Speed on Aft Car Centerline Lateral Ride Roughness (High-Density Car)

NOTES

- 1) RESILIENT WHEELS
- 2) 90,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

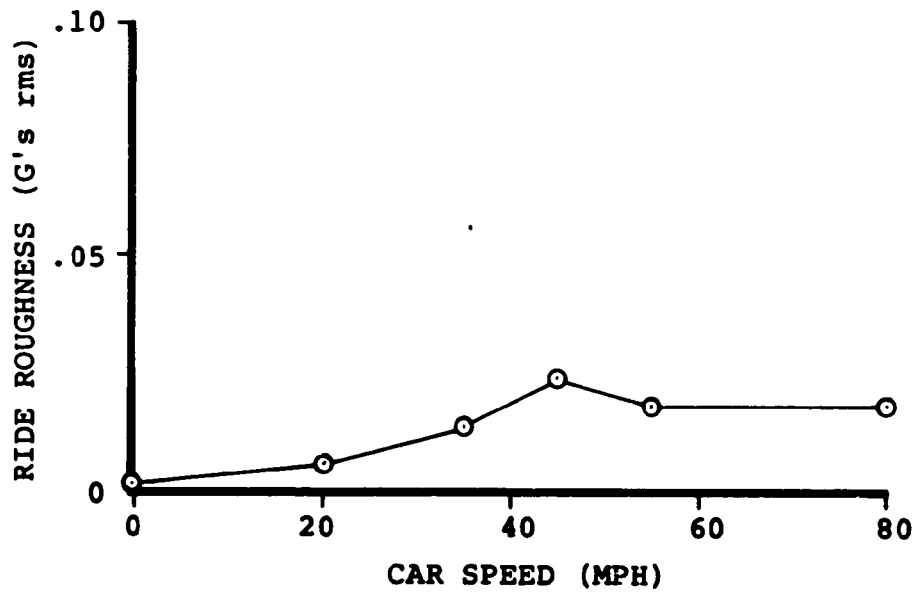


Figure 5-5. Effect of Speed on Forward Car Centerline Vertical Ride Roughness (High-Density Car)

NOTES

- 1) RESILIENT WHEELS
- 2) 90,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

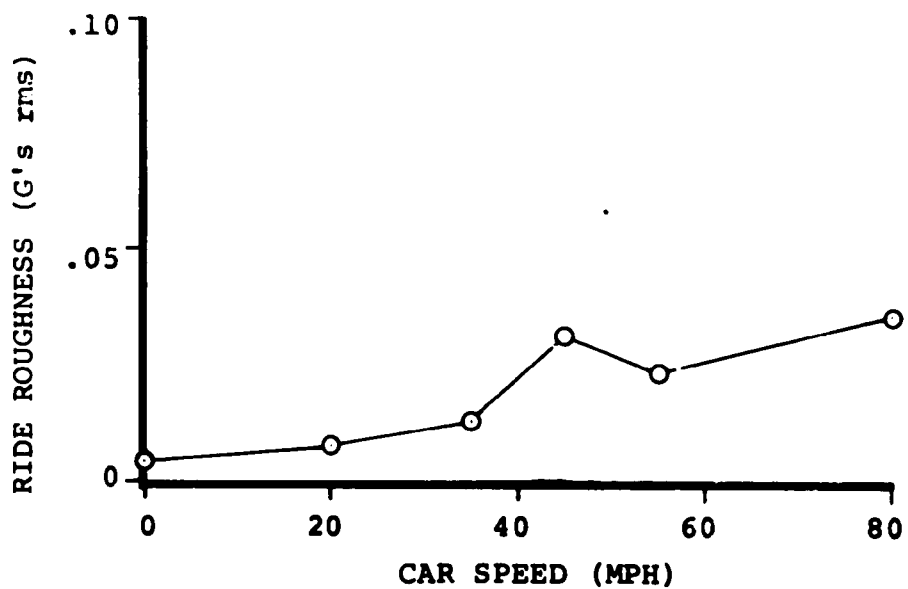


Figure 5-6. Effect of Speed on Mid-Car Centerline Vertical Ride Roughness (High-Density Car)

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

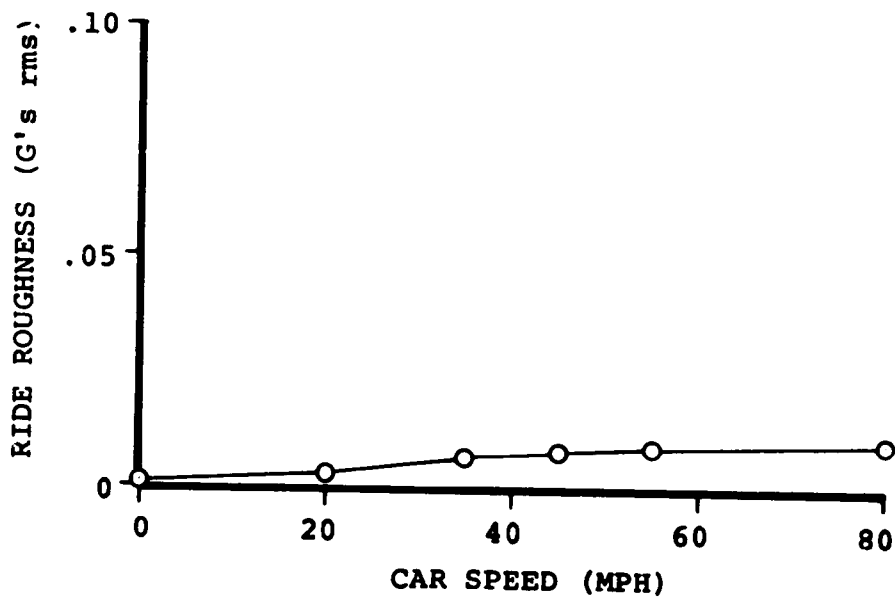


Figure 5-7. Effect of Speed on Aft Car Centerline Lateral Ride Roughness (High-Density Car)

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

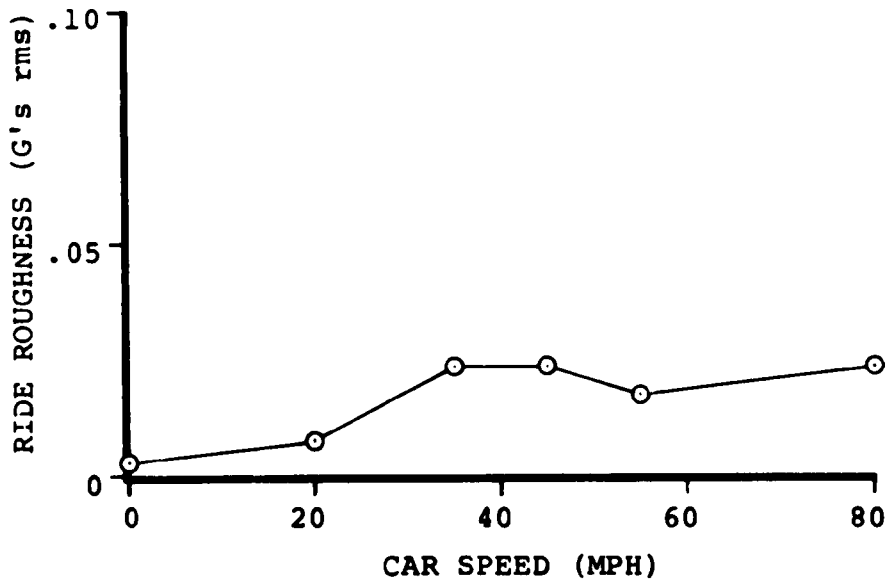


Figure 5-8. Effect of Speed on Forward Car Centerline Vertical Ride Roughness (High-Density Car)

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000 LB. GROSS WEIGHT
- 3) TRACK SECTION I

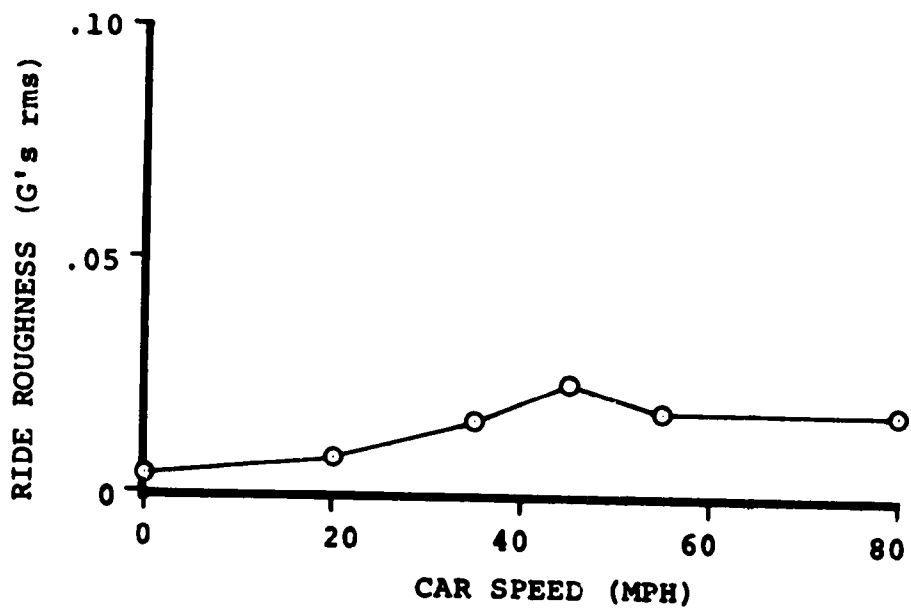


Figure 5-9. Effect of Speed on Mid-Car Centerline Vertical Ride Roughness (High-Density Car)

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

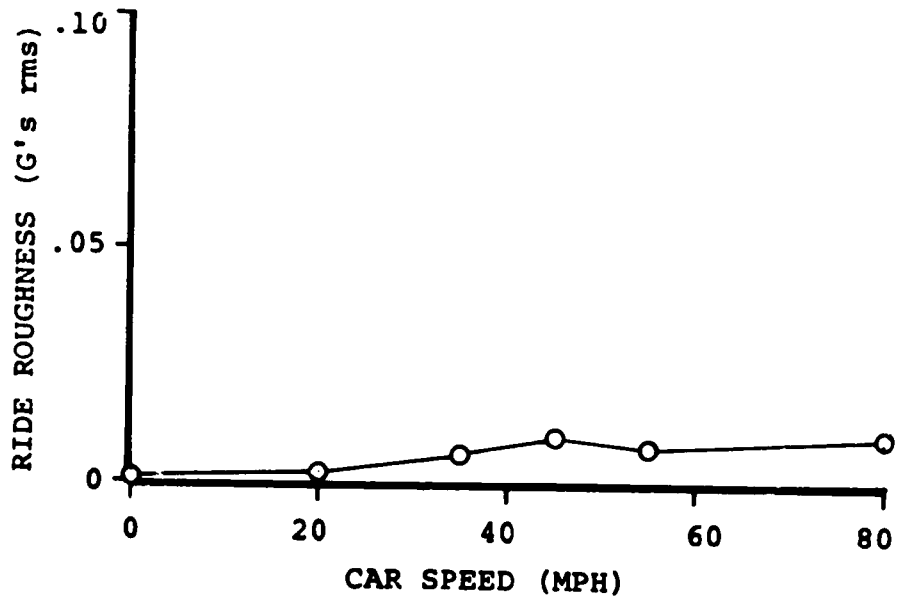


Figure 5-10. Effect of Speed on Aft Car Centerline Lateral Ride Roughness (Two-Car Train)

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

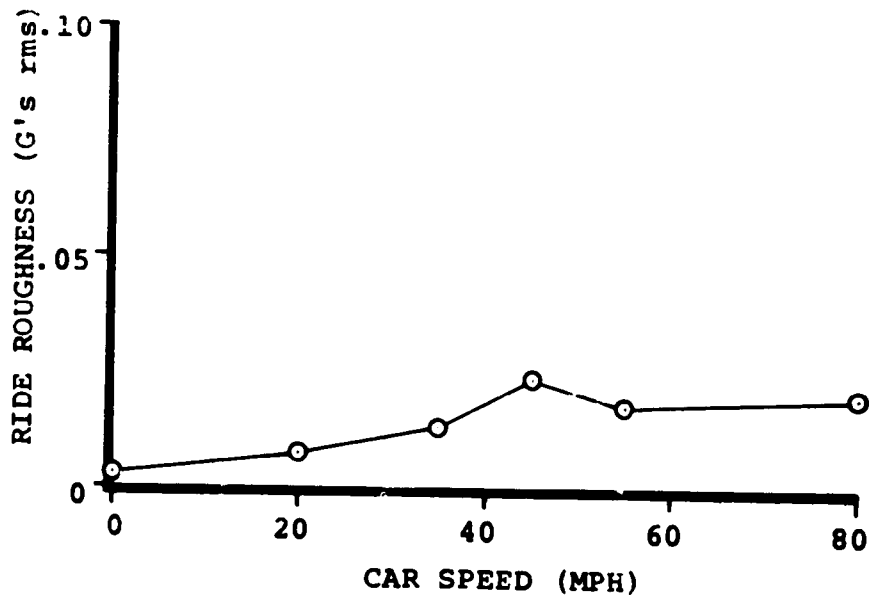


Figure 5-11. Effect of Speed on Forward Car Centerline Vertical Ride Roughness (Two-Car Train)

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT
- 3) TRACK SECTION I

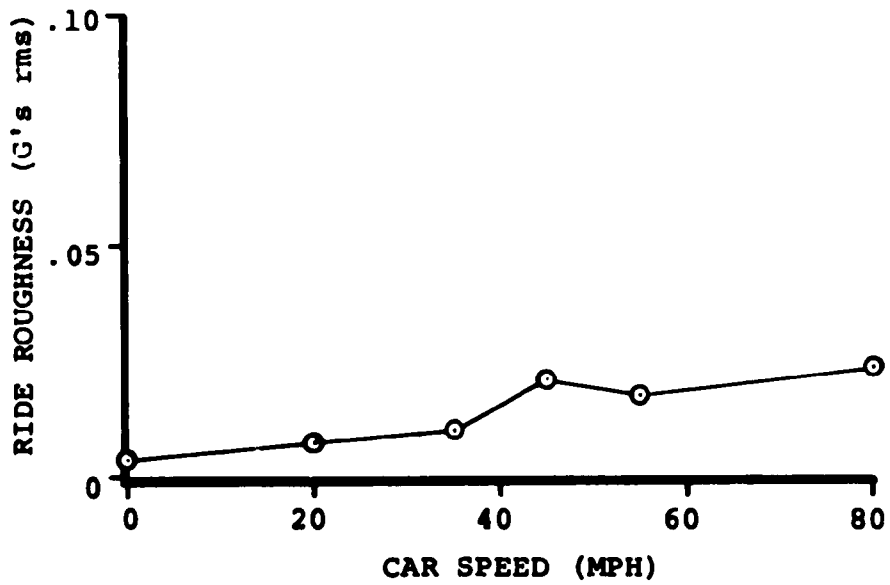


Figure 5-12. Effect of Speed on Mid-Car Centerline Vertical Ride Roughness (Two-Car Train)

NOTES

- 1) RESILIENT WHEELS
- 2) 90,000-LB GROSS WEIGHT

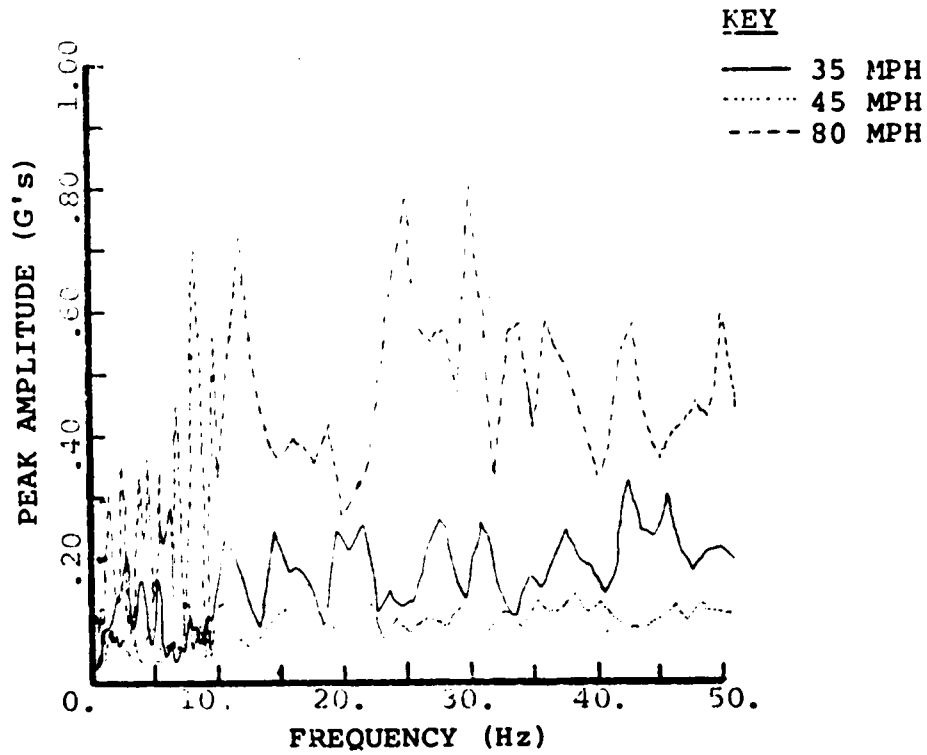


Figure 5-13. Effect of Speed on No. 1 Axle Lateral Acceleration (High-Density Car).

NOTES

- 1) FRONT TRUCK, FORWARD AXLE
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 90,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

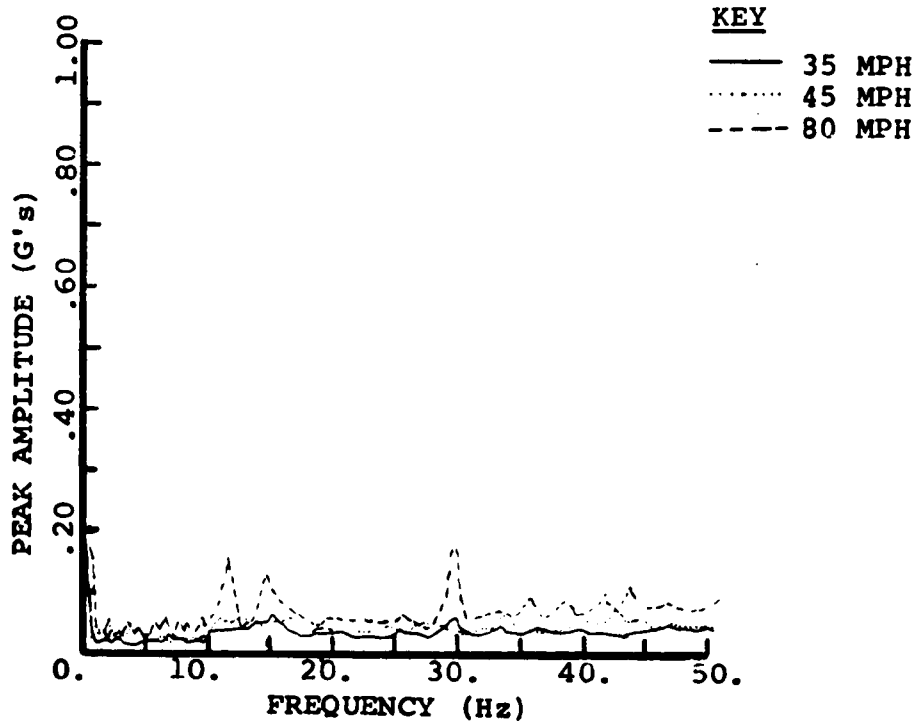


Figure 5-14. Effect of Speed on No. 1 Axle Vertical Acceleration (High-Density Car)

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

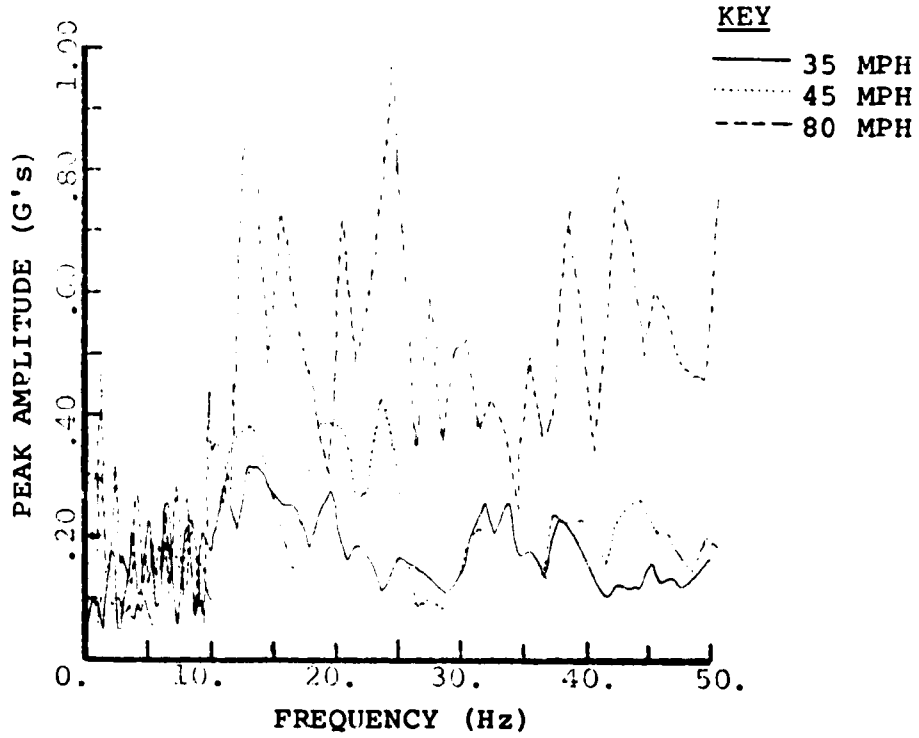


Figure 5-15. Effect of Speed on No. 1 Axle Lateral Acceleration (High-Density Car).

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

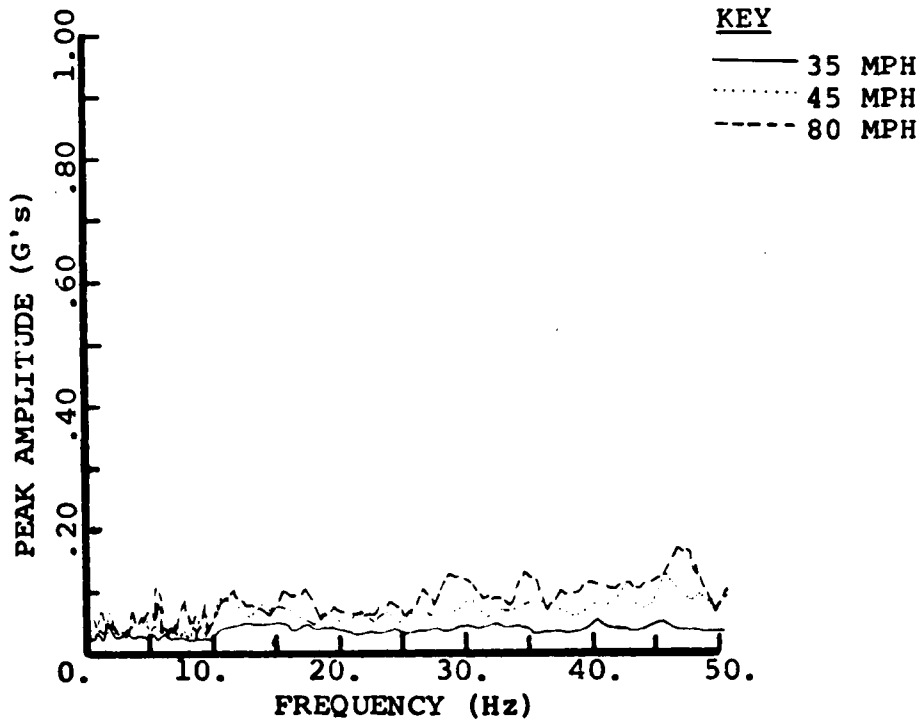


Figure 5-16. Effect of Speed on No. 1 Axle Vertical Acceleration (High-Density Car).

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

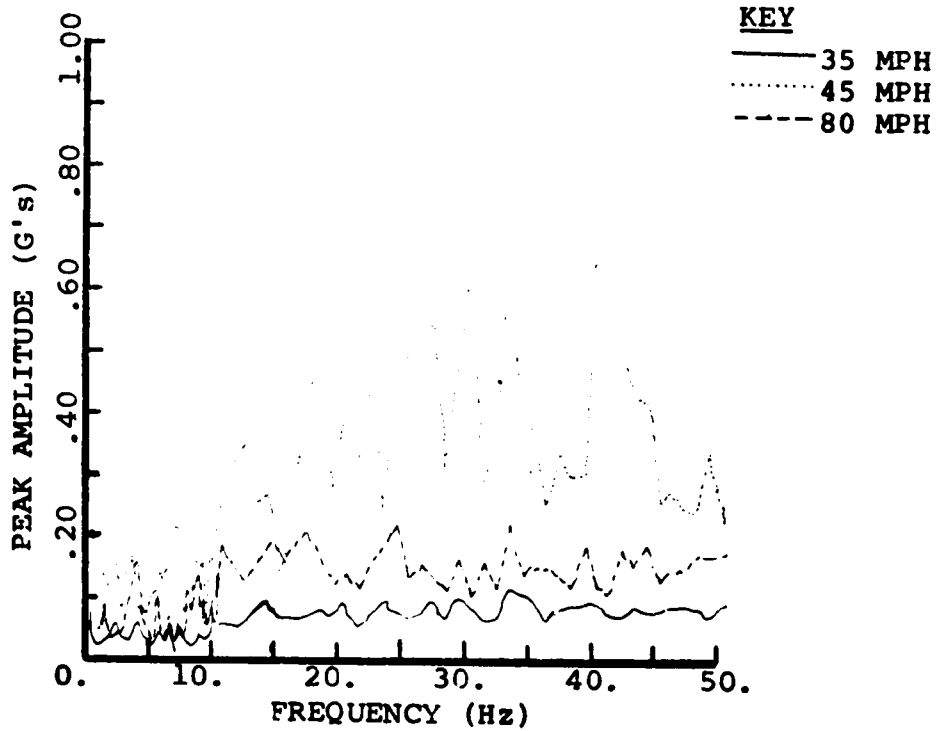
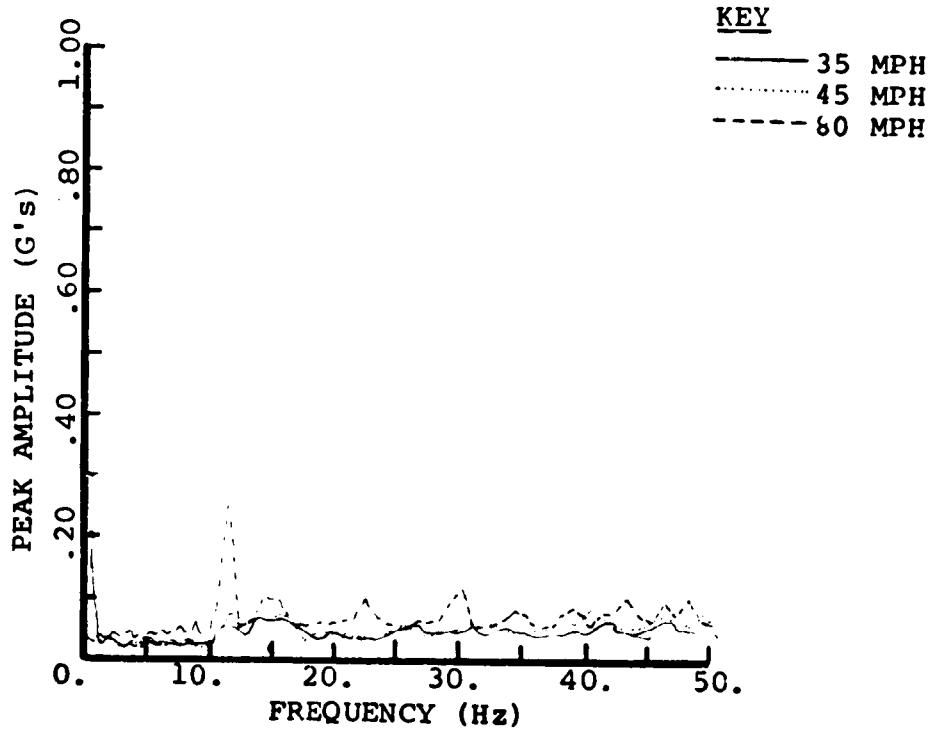


Figure 5-17. Effect of Speed on Λ Axle Lateral Acceleration (Two-Car Train).

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I



*Figure 5-18. Effect of Speed on No. 1 Axle Vertical Acceleration
(Two-Car Train)*

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT

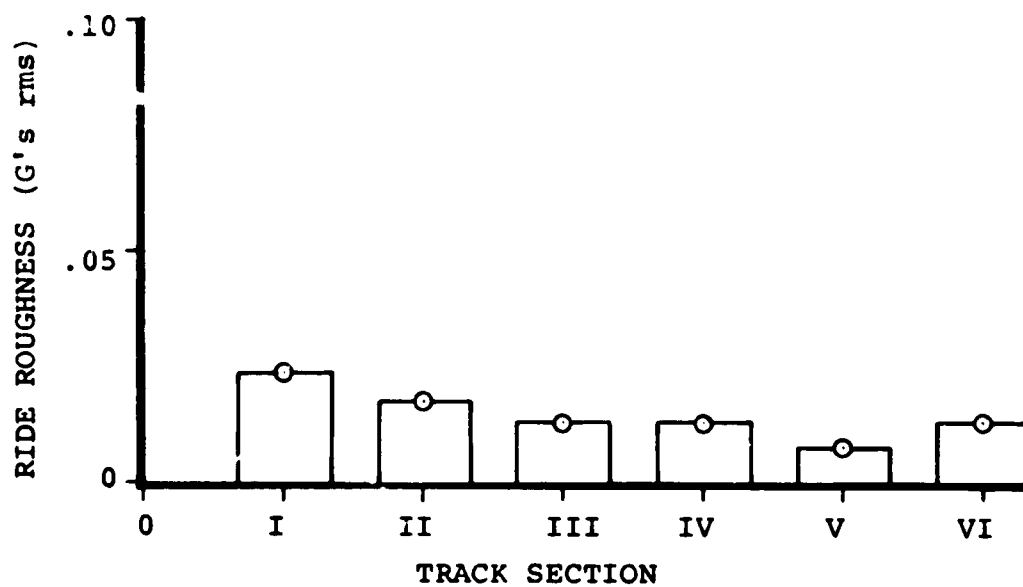


Figure 5-19. Effect of Track Section on Forward Car Centerline Vertical Ride Roughness of High-Density Car at 35 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT

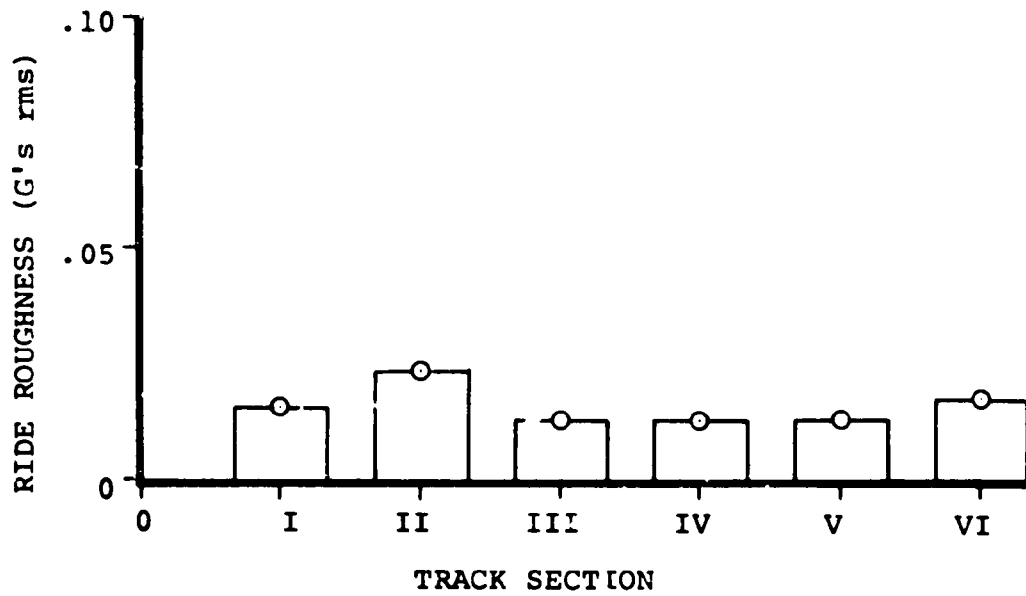


Figure 5--20. Effect of Track Section on Mid-Car Centerline Vertical Ride Roughness of High-Density Car at 35 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT

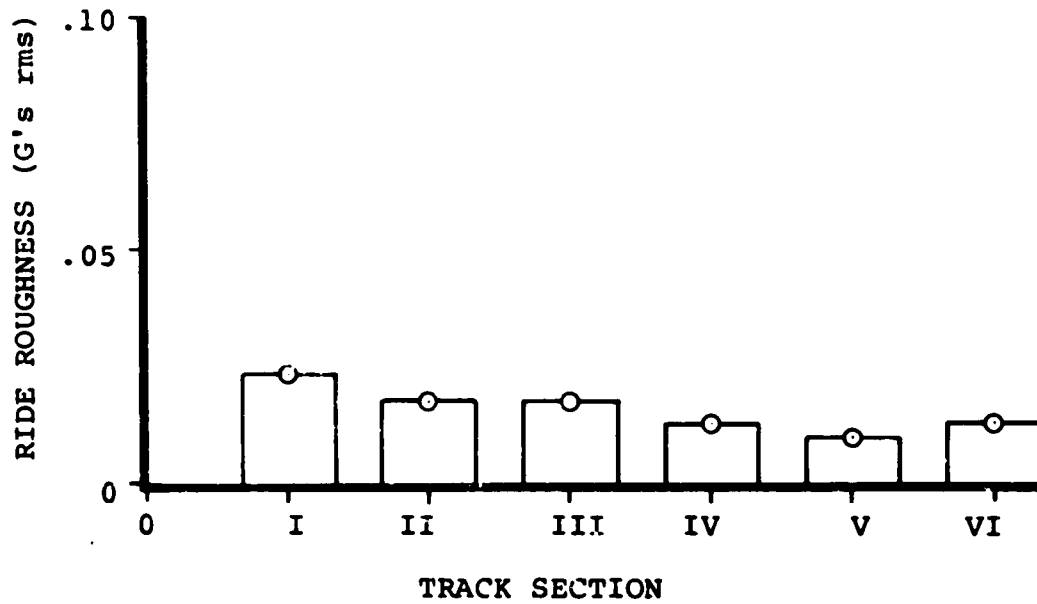


Figure 5-21. Effect of Track Section on Forward Car Centerline Vertical Ride Roughness of High-Density Car at 80 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB. GROSS WEIGHT

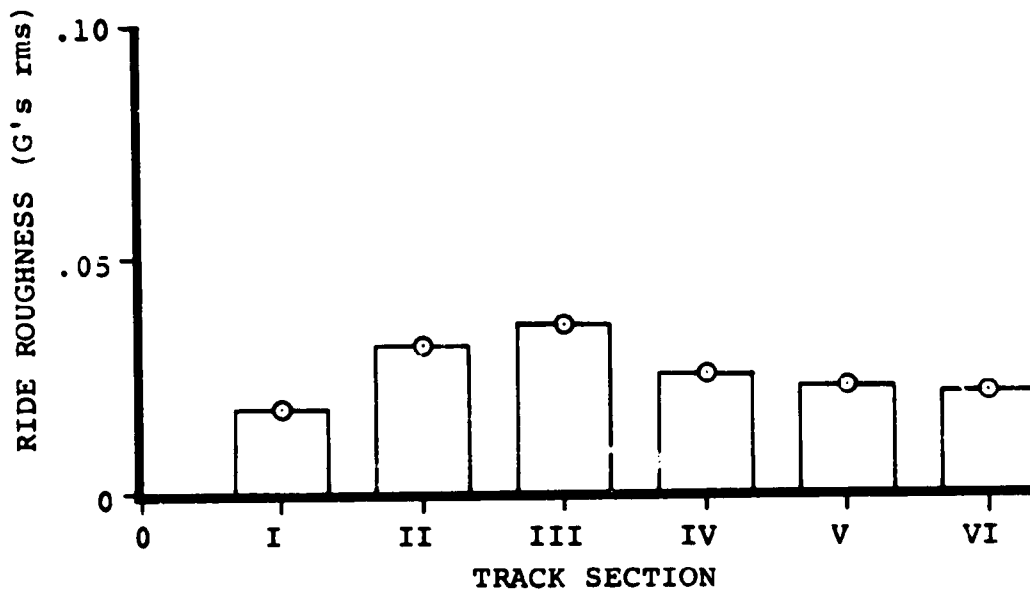


Figure 5-22. Effect of Track Section on Mid-Car Centerline Vertical Ride Roughness of High-Density Car at 80 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

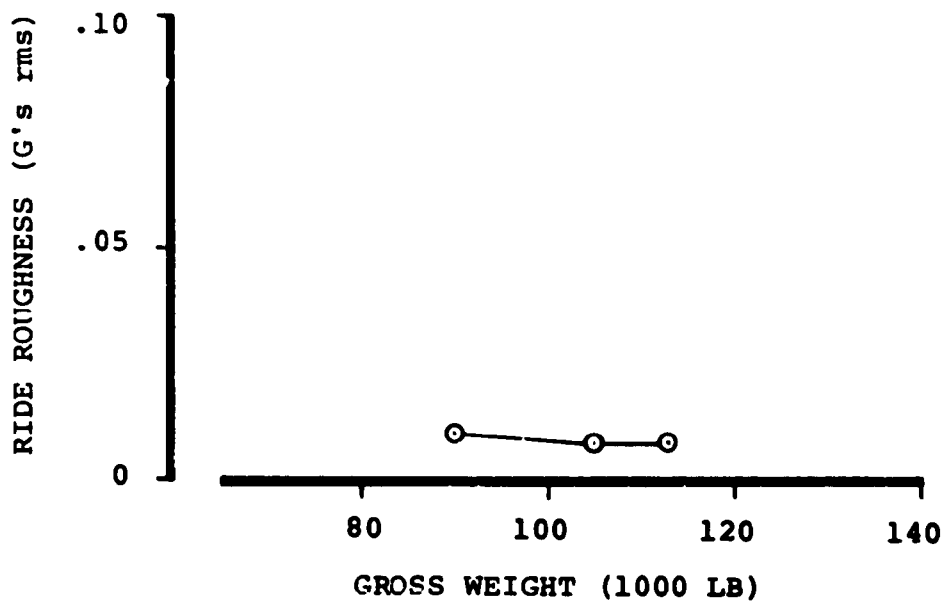


Figure 5-23. Effect of High-Density Car Gross Weight on Aft Car Centerline Lateral Ride Roughness at 45 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

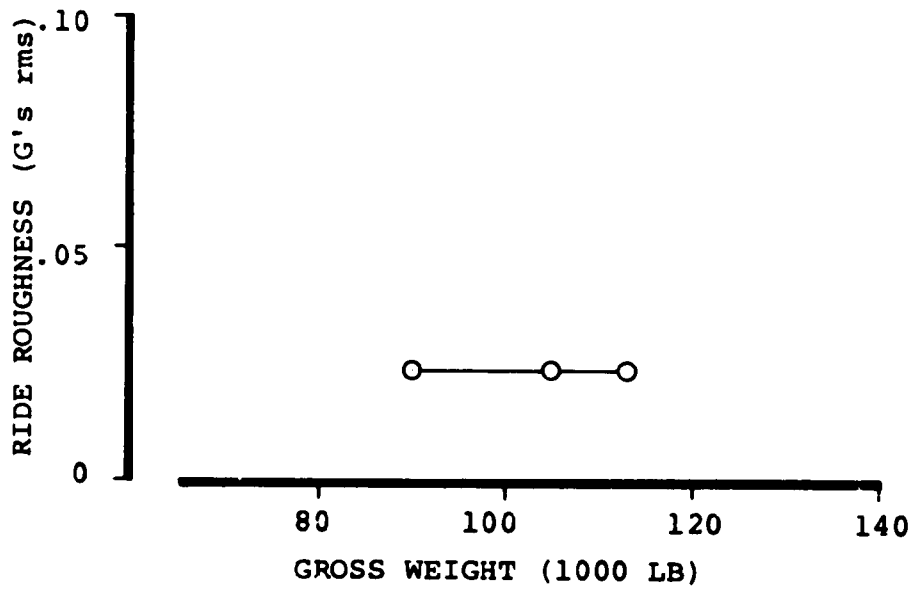


Figure 5-24. Effect of High-Density Car Gross Weight on Forward Car Centerline Vertical Ride Roughness at 45 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

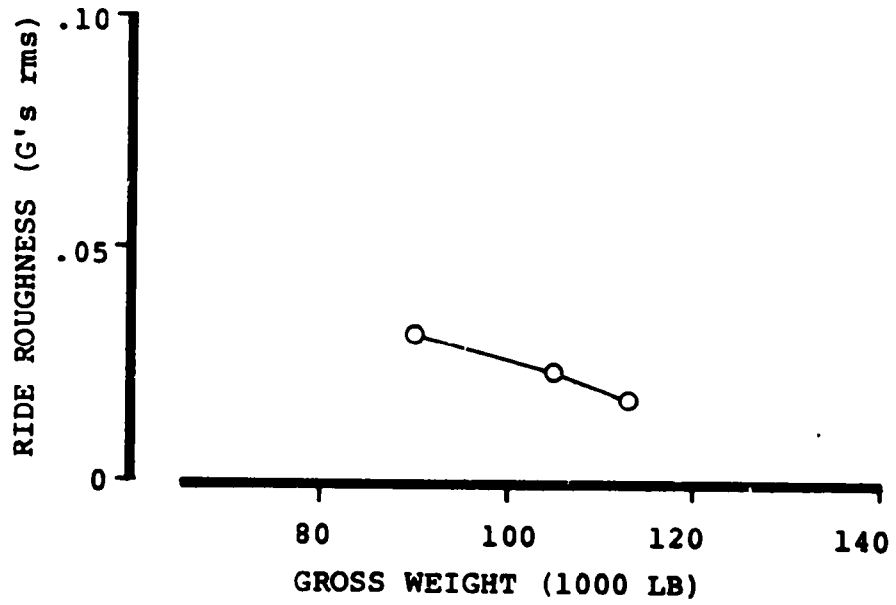


Figure 5-25. Effect of High-Density Car Gross Weight on Mid-Car Centerline Vertical Ride Roughness at 45 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

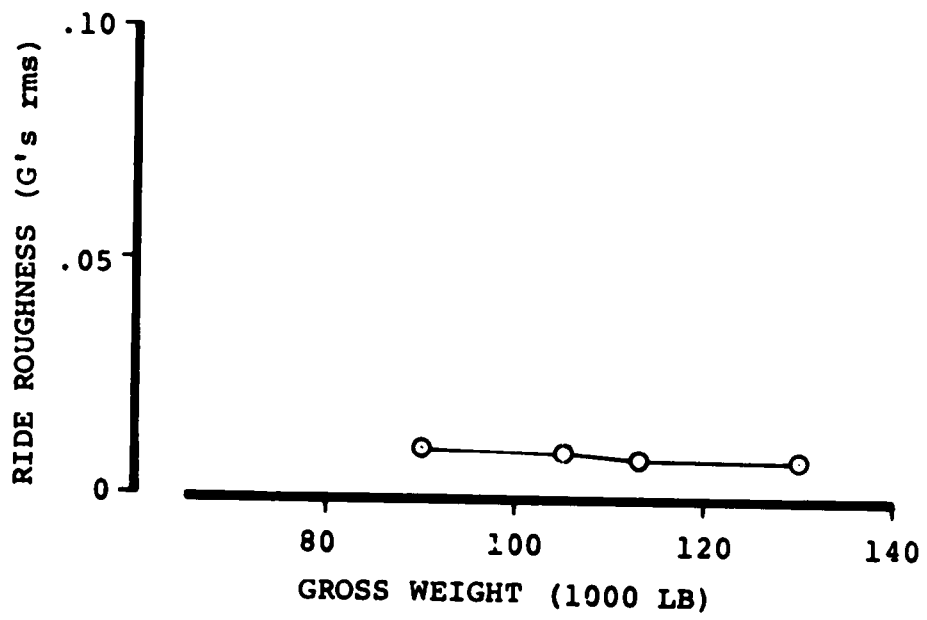


Figure 5-26. Effect of High-Density Car Gross Weight on Aft Car Centerline Lateral Ride Roughness at 55 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

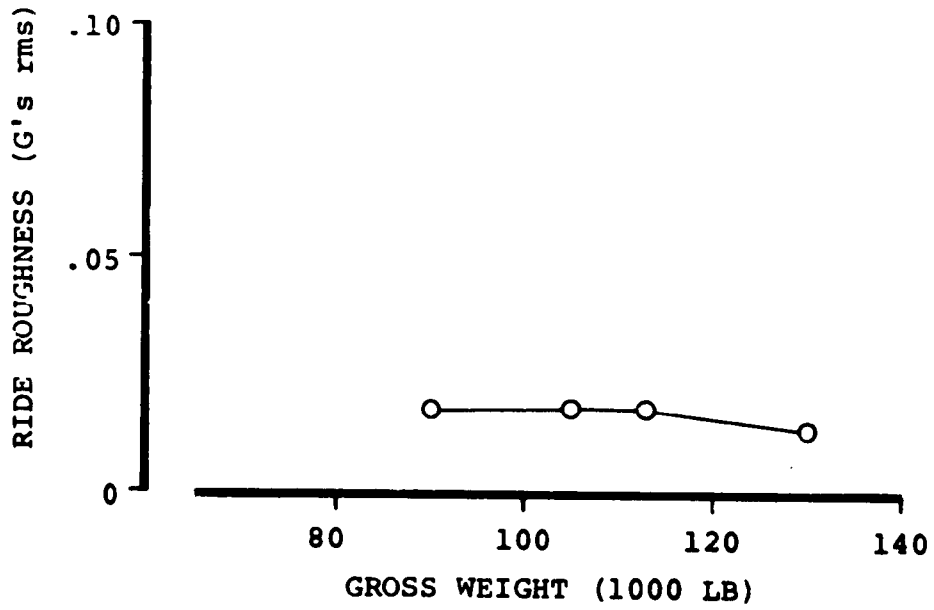


Figure 5-27. Effect of High-Density Car Gross Weight on Forward Car Centerline Vertical Ride Roughness at 55 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

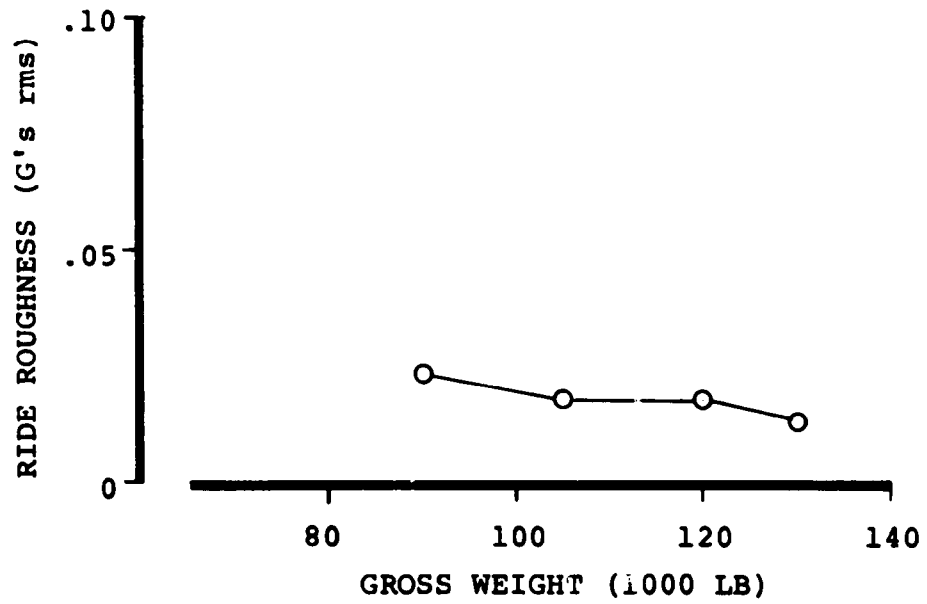


Figure 5-28. Effect of High-Density Car Gross Weight on Mid-Car Centerline Vertical Ride Roughness at 55 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

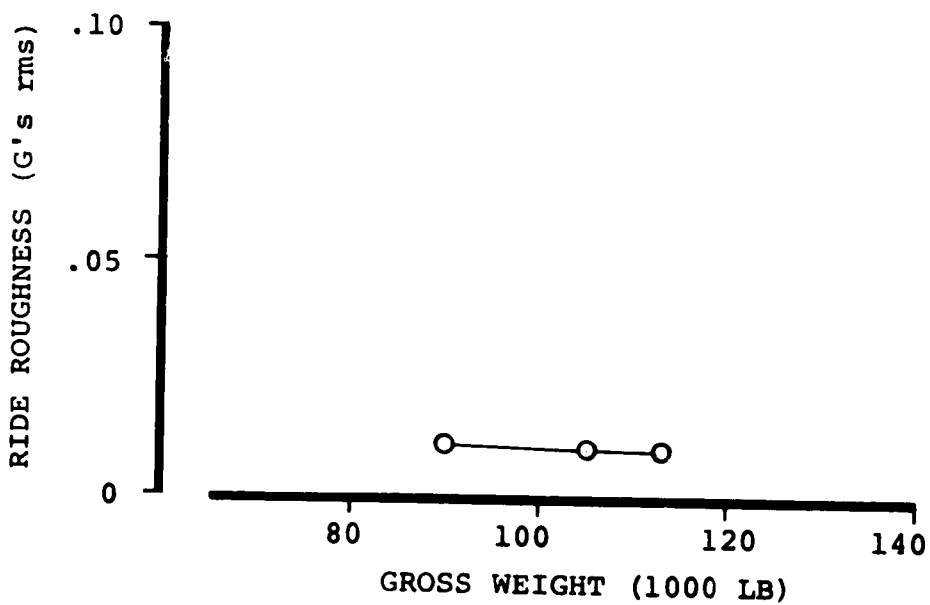


Figure 5-29. Effect of High-Density Car Gross Weight on Aft Car Centerline Lateral Ride Roughness at 80 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

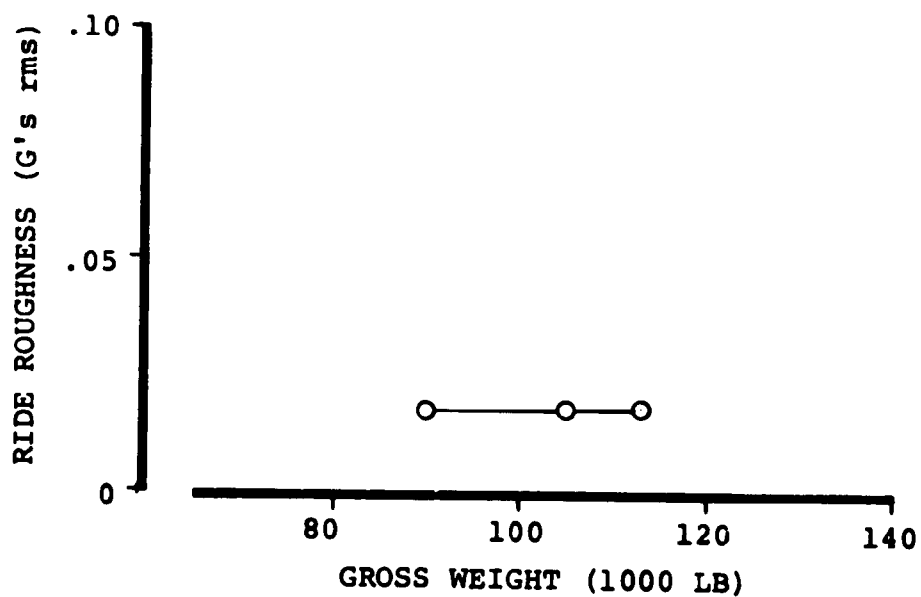


Figure 5-30. Effect of High-Density Car Gross Weight on Forward Car Centerline Vertical Ride Roughness at 80 MPH Speed

NOTES

- 1) RESILIENT WHEELS
- 2) TRACK SECTION I

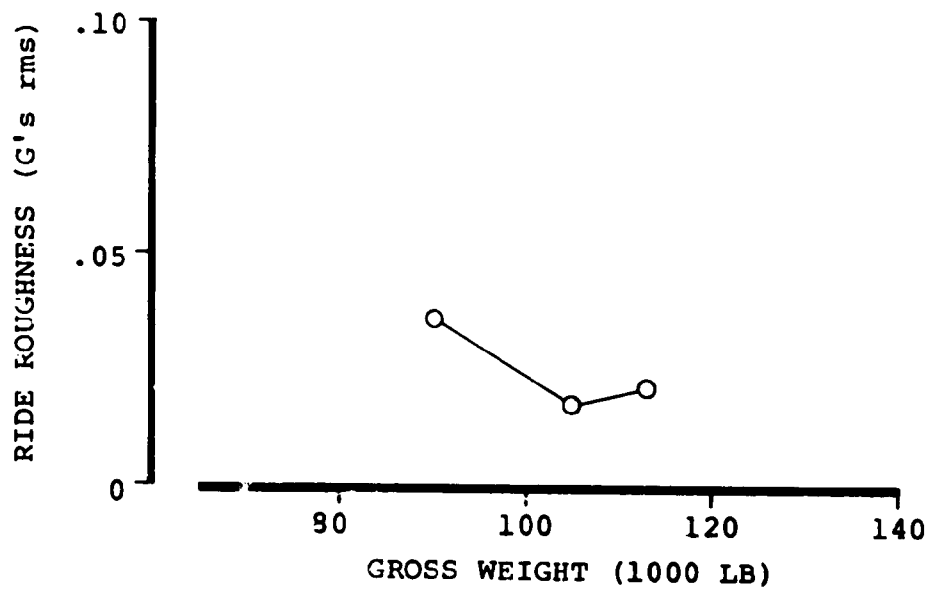


Figure 5-31. Effect of High-Density Car Gross Weight on Mid-Car Centerline Vertical Ride Roughness at 80 MPH Speed

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

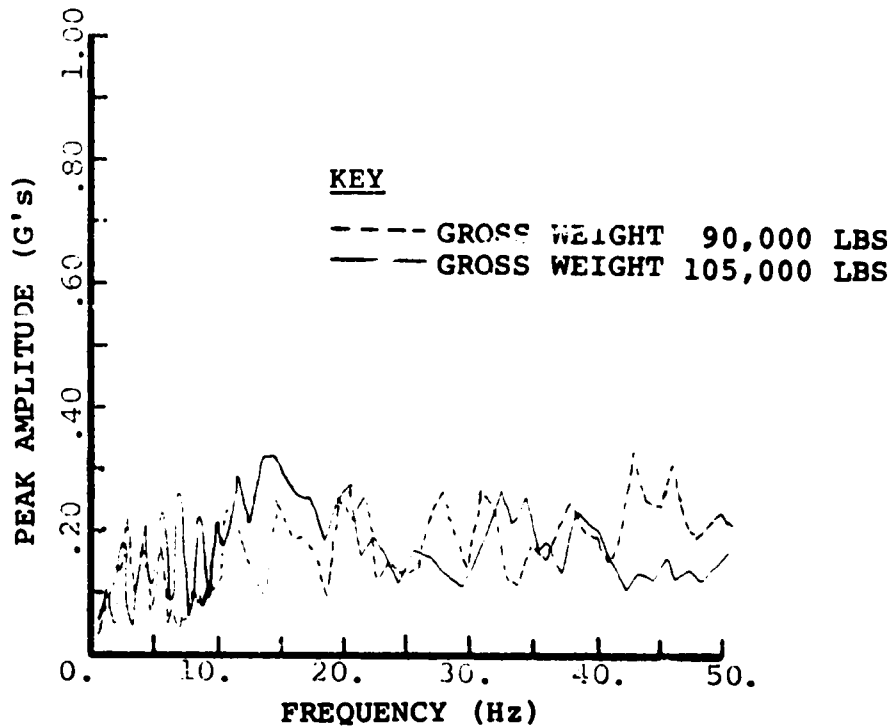


Figure 5-32. Effect of Gross Weight on High-Density Car No. 1 Axle Lateral Acceleration at 35 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

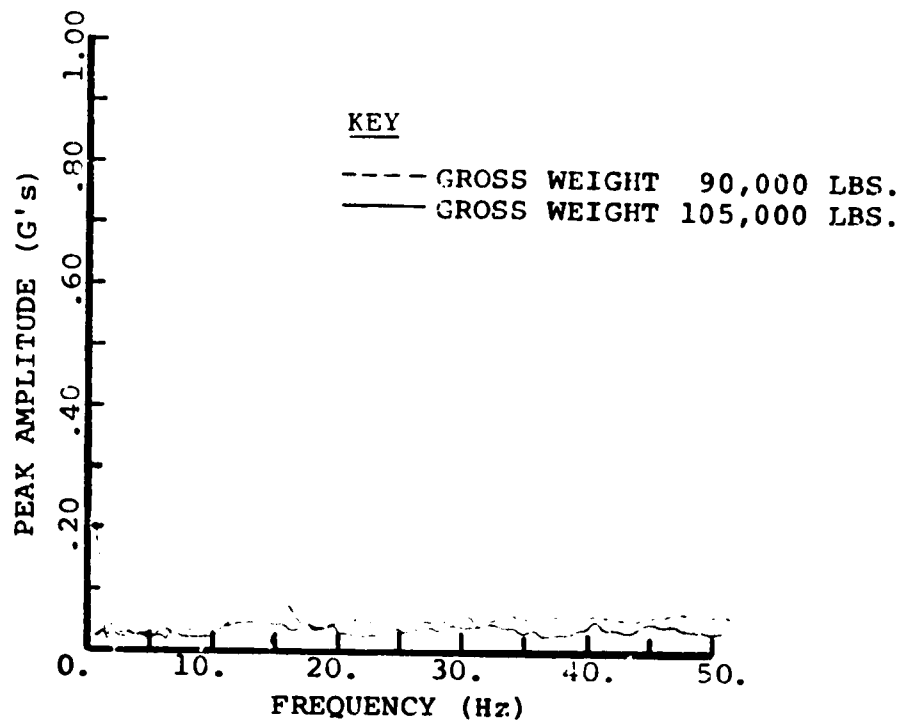


Figure 5-33. Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 35 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

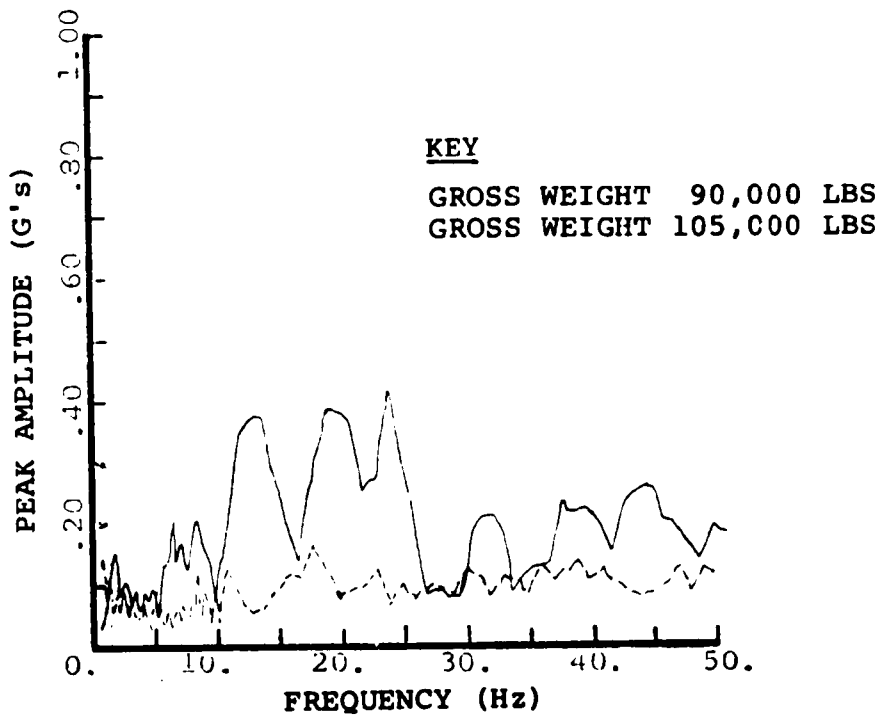


Figure 5-34. Effect of Gross Weight on High-Density Car No. 1 Axle Lateral Acceleration at 45 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

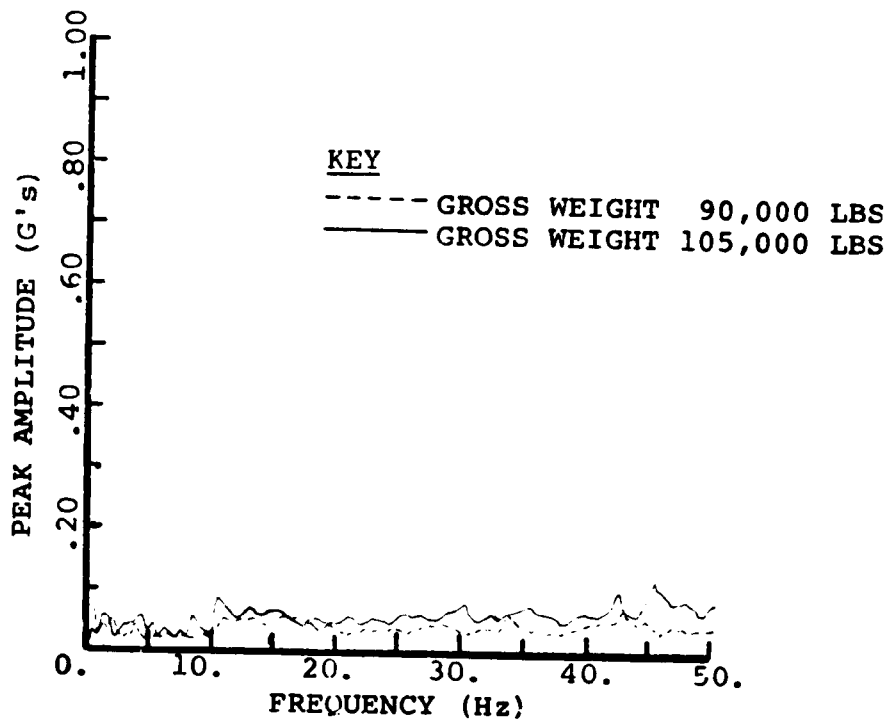


Figure 5-35. Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 45 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

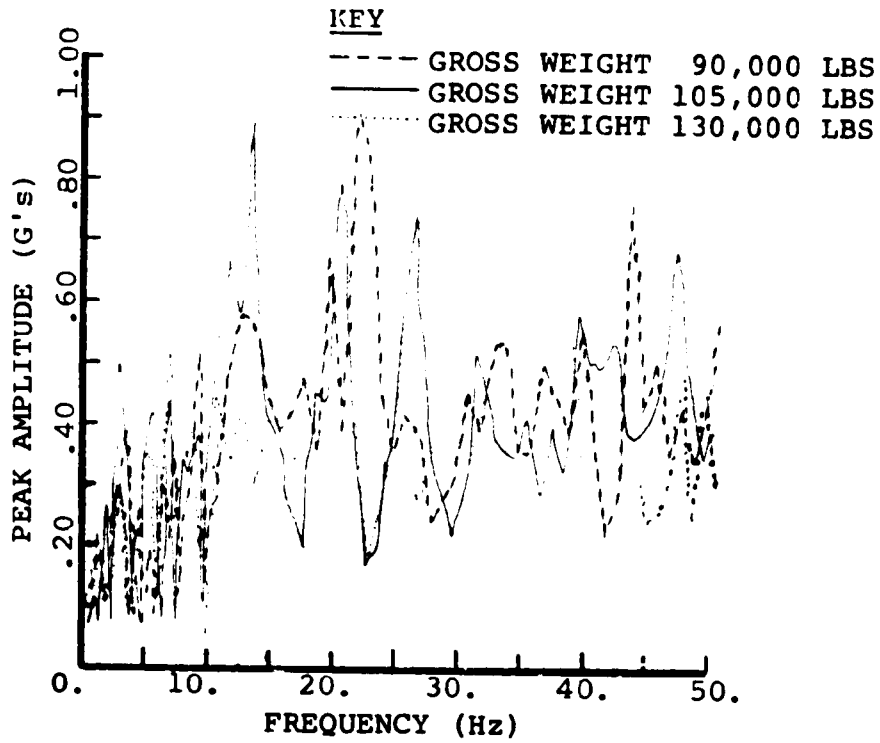


Figure 5-36. Effect of Gross Weight on High-Density Car No. 1 Axle Lateral Acceleration at 55 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

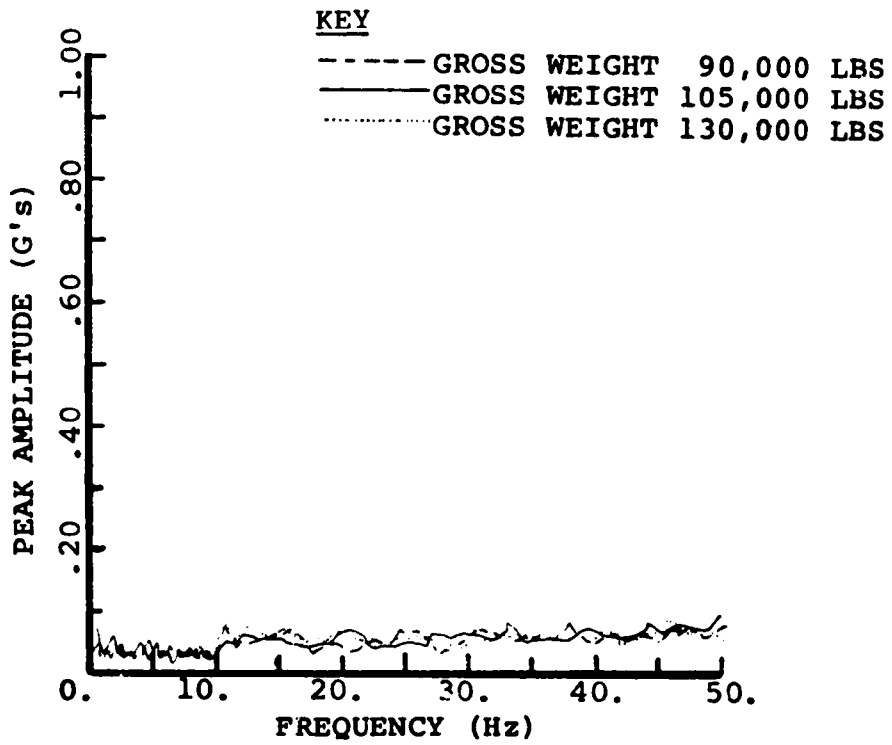


Figure 5-37. Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 55 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

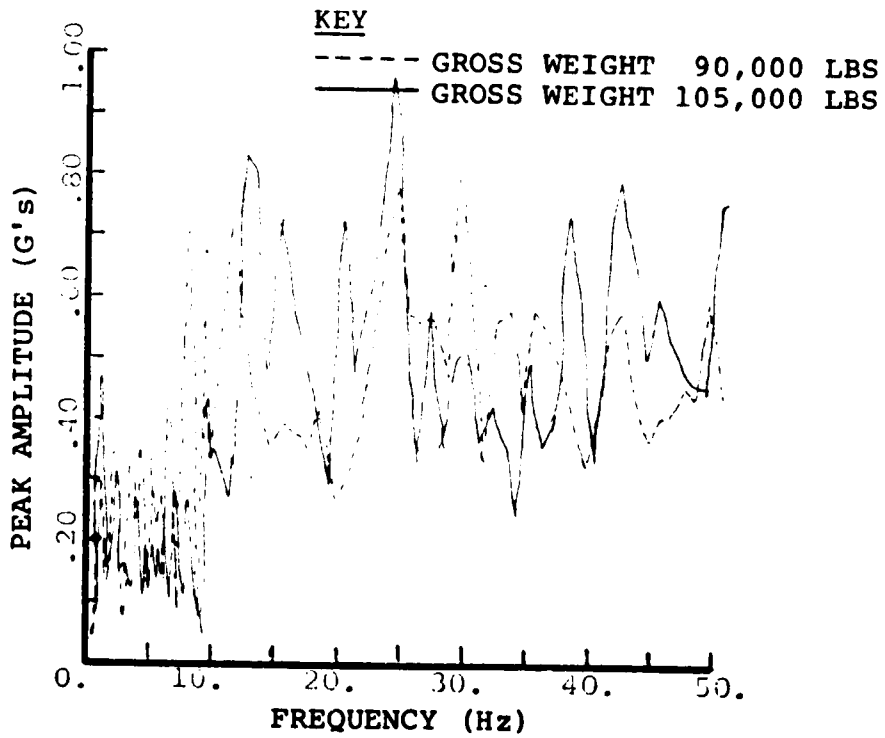


Figure 5-38. Effect of Gross Weight on High-Density Car No. 1 Axle Vertical Acceleration at 80 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) TRACK SECTION I

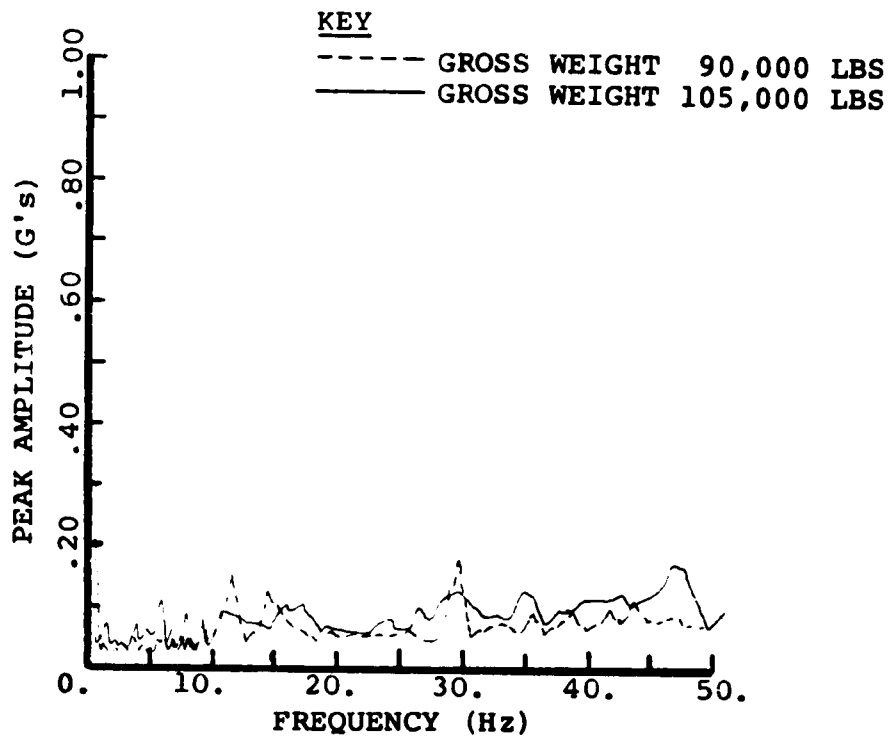


Figure 5-39. Effect of Gross Weight on High-Density Car Axle Vertical Acceleration at 80 MPH Speed.

NOTES

- 1) ○ HIGH-DENSITY CAR
- 2) △ TWO-CAR TRAIN
- 3) RESILIENT WHEELS
- 4) 105,000-LB. GROSS WEIGHT
- 5) TRACK SECTION I

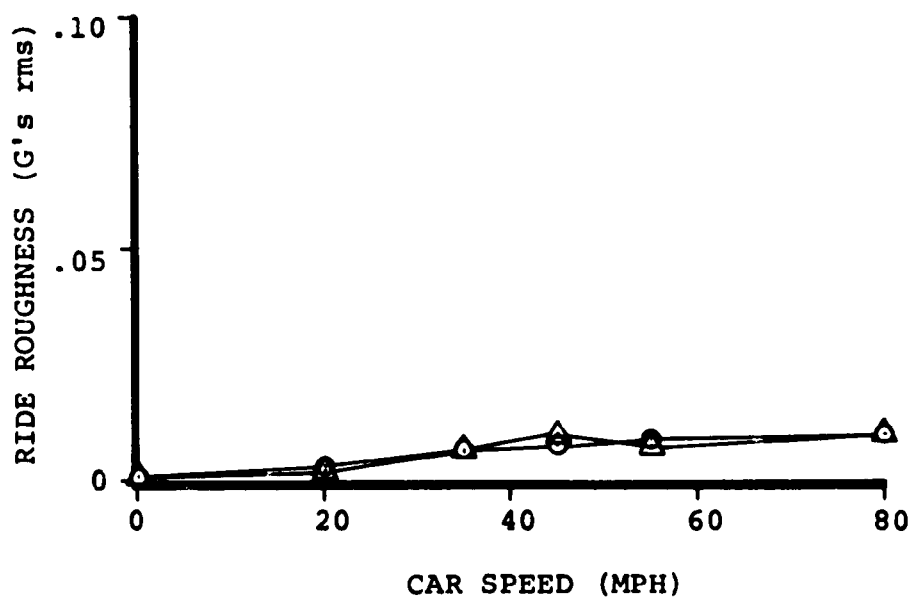


Figure 5-40. Effect of Train Consist on Aft Car Centerline Lateral Ride Roughness

NOTES

- 1) ○ HIGH-DENSITY CAR
- 2) △ TWO-CAR TRAIN
- 3) RESILIENT WHEELS
- 4) 105,000-LB. GROSS WEIGHT
- 5) TRACK SECTION I

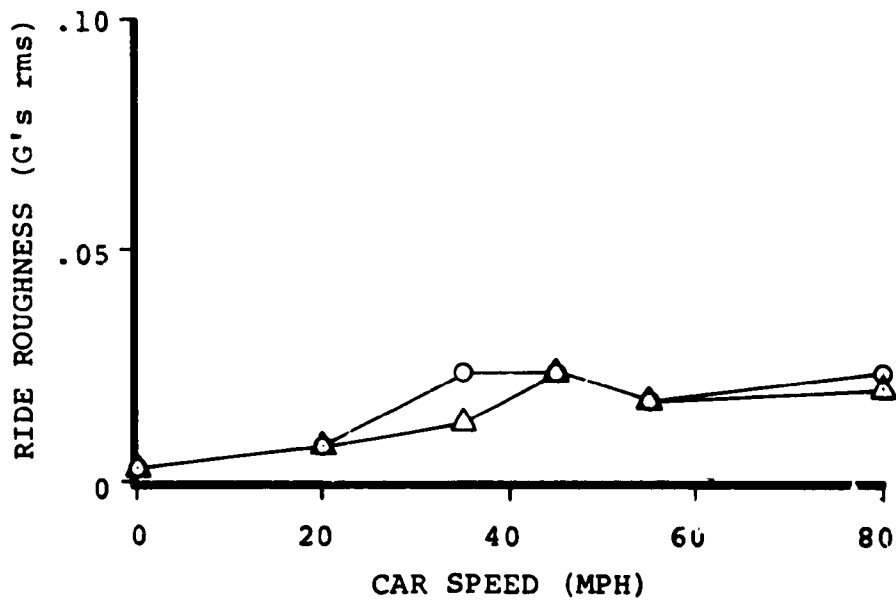


Figure 5-41. Effect of Train Consist on Forward Car Centerline Vertical Ride Roughness

NOTES

- 1) \circ HIGH-DENSITY CAR
- 2) \triangle TWO-CAR TRAIN
- 3) RESILIENT WHEELS
- 4) 105,000-LB. GROSS WEIGHT
- 5) TRACK SECTION I

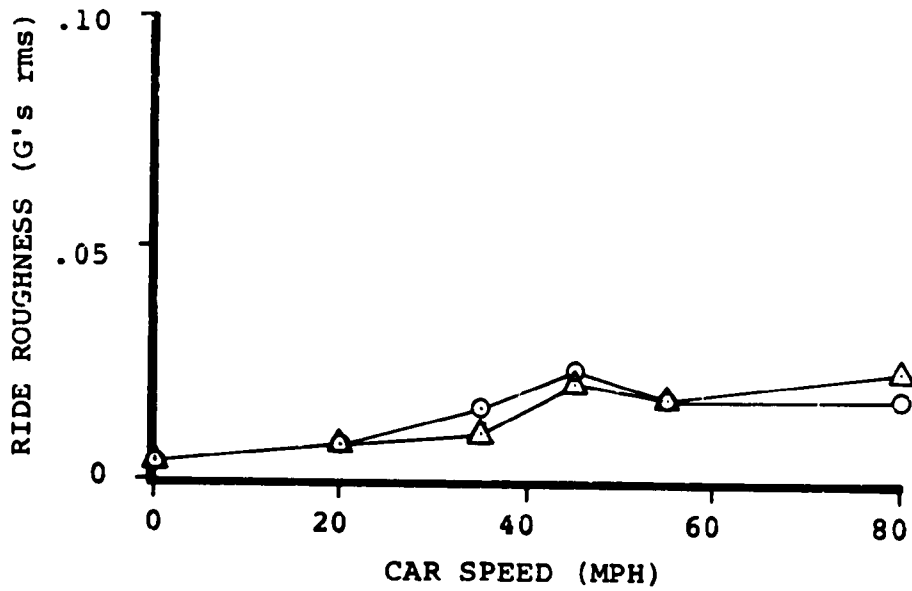


Figure 5-42. Effect of Train Consist on Mid-Car Centerline Vertical Ride Roughness

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

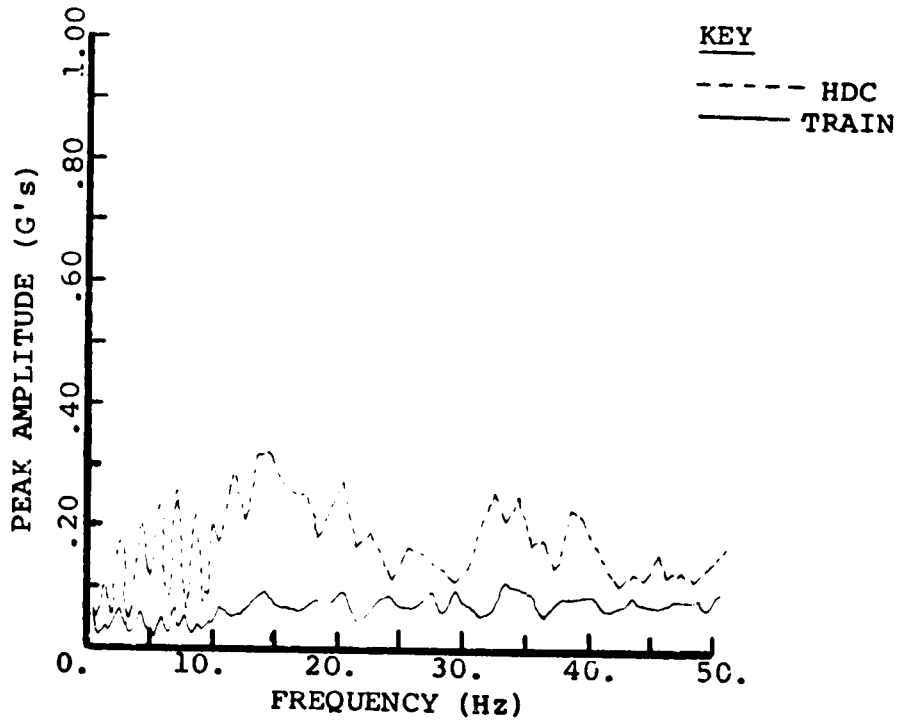


Figure 5-43. Effect of Train Consist on No. 1 Axle Lateral Acceleration at 35 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

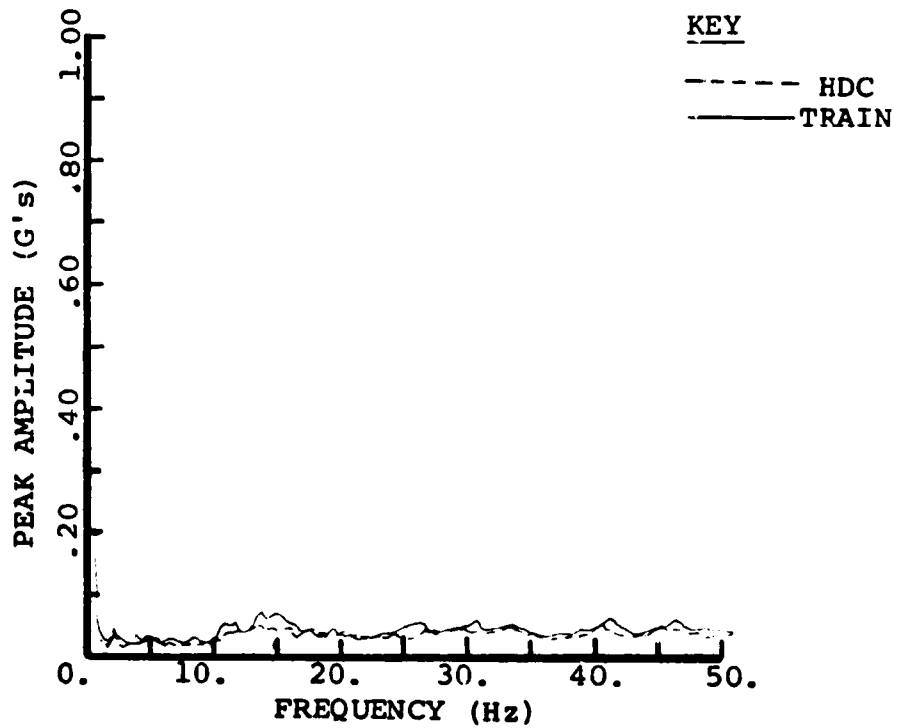


Figure 5-44. Effect of Train Consist on No. 1 Axle Vertical Acceleration at 35 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

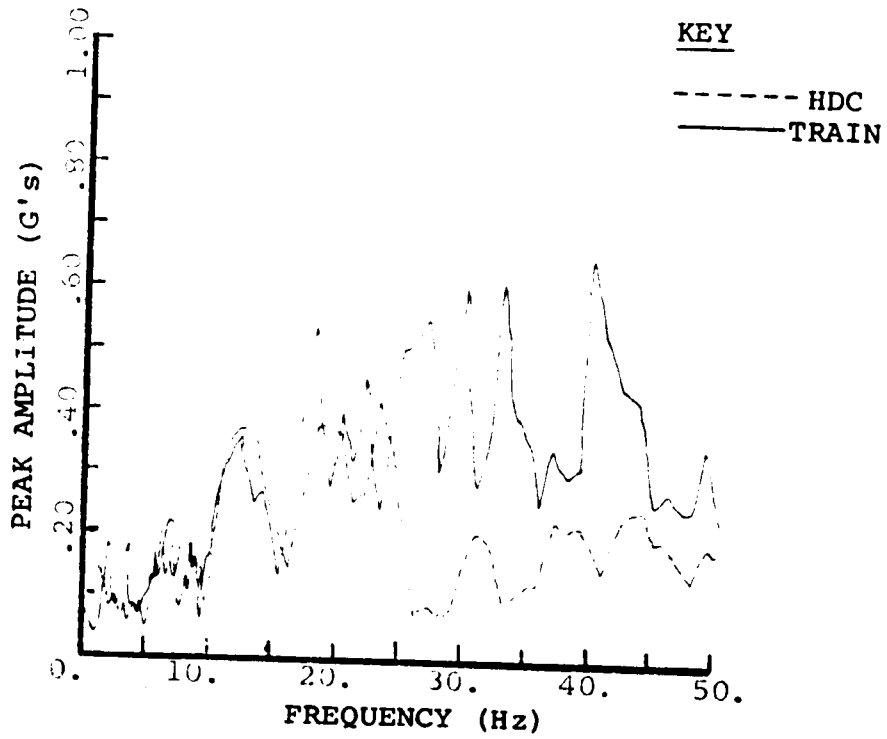


Figure 5-45. Effect of Train Consist on No. 1 Axle Lateral Acceleration at 45 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

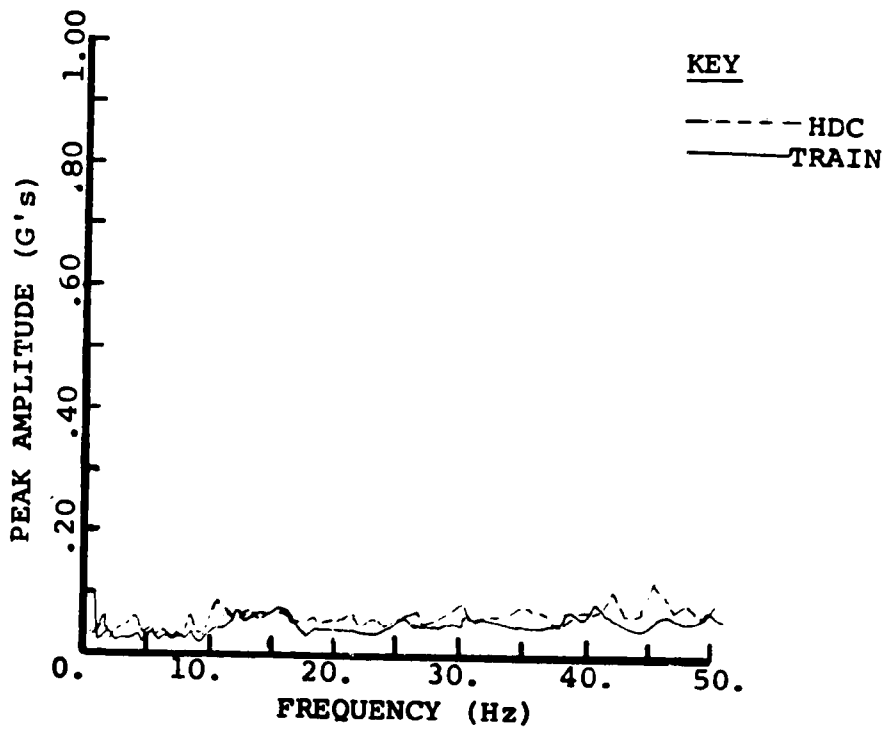


Figure 5-46. Effect of Train Consist on No. 1 Axle Vertical Acceleration at 45 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

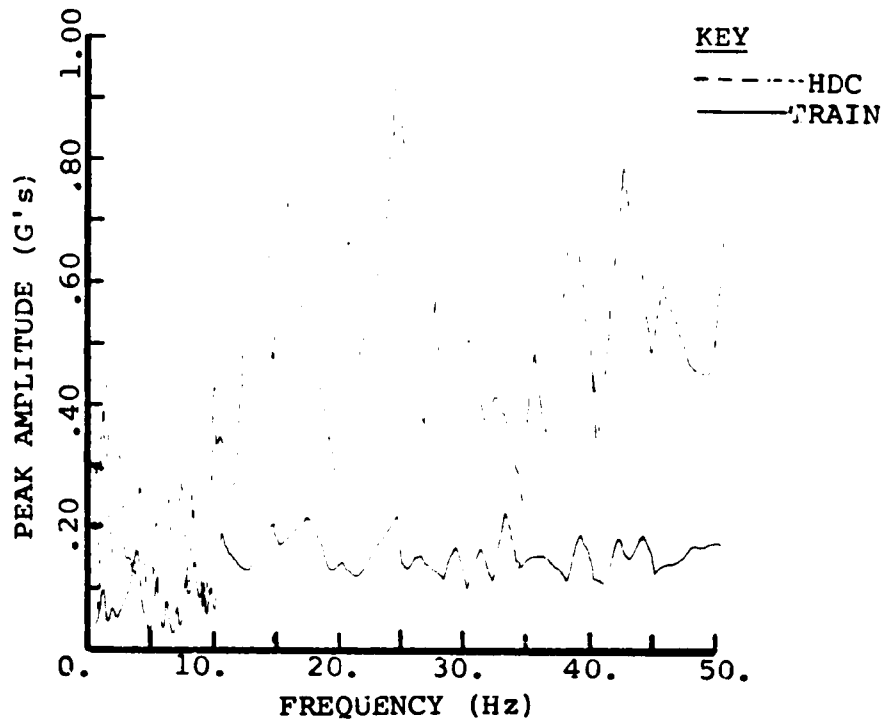


Figure 5-47. Effect of Train Consist on No. 1 Axle Lateral Acceleration at 80 MPH Speed.

NOTES

- 1) FRONT TRUCK,
RH JOURNAL BOX
- 2) RESILIENT WHEELS
- 3) 105,000-LB GROSS WEIGHT
- 4) TRACK SECTION I

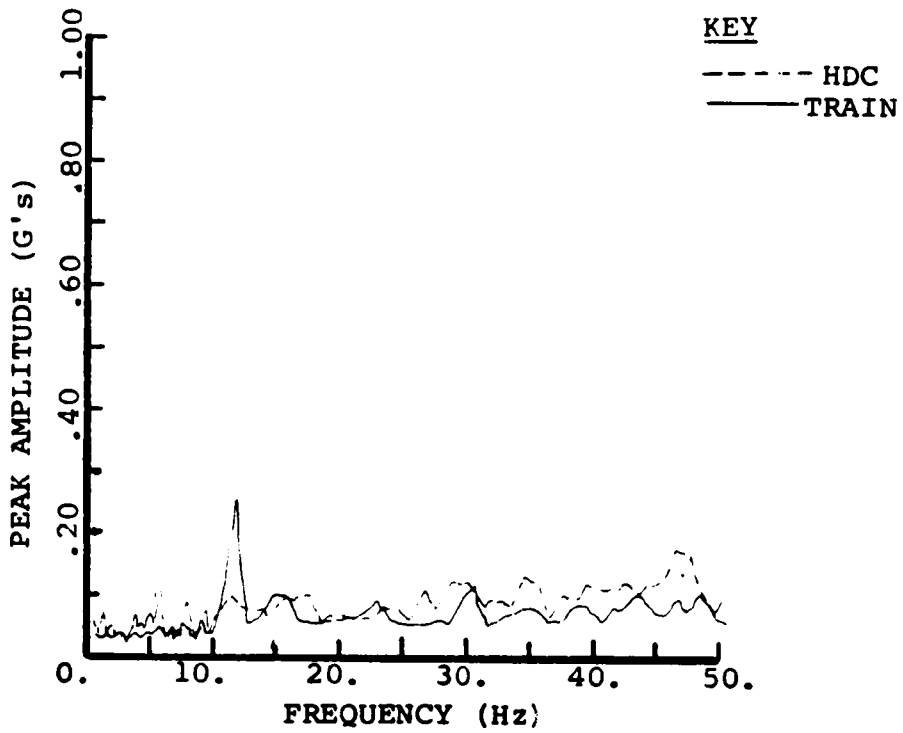


Figure 5-48. Effect of Train Consist on No. 1 Axle Vertical Acccleration at 80 MPH Speed.

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB GROSS WEIGHT
- 3) TRACK SECTION I

KEY

- = 20 MPH
- = 35 MPH
- ◇ = 45 MPH
- △ = 55 MPH
- △ = 80 MPH

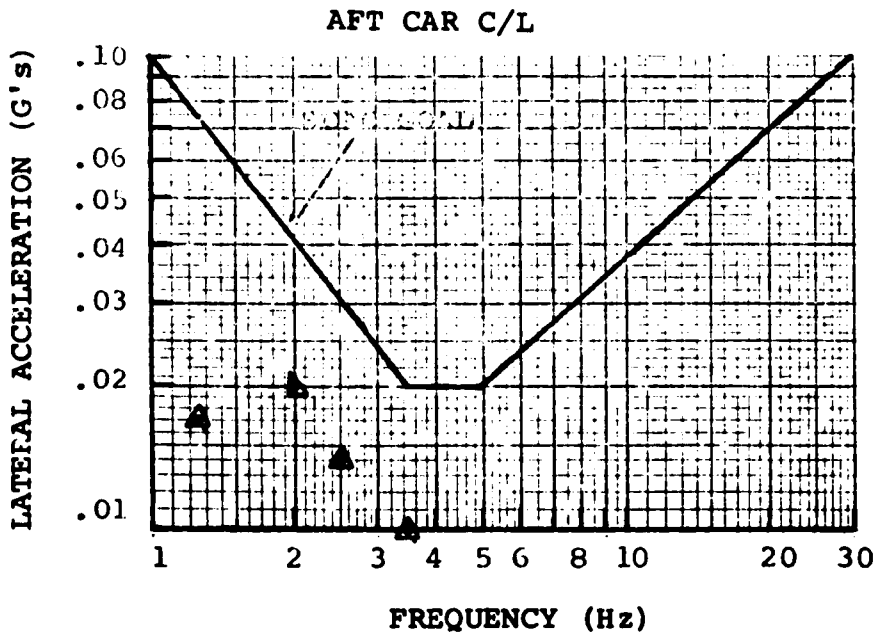
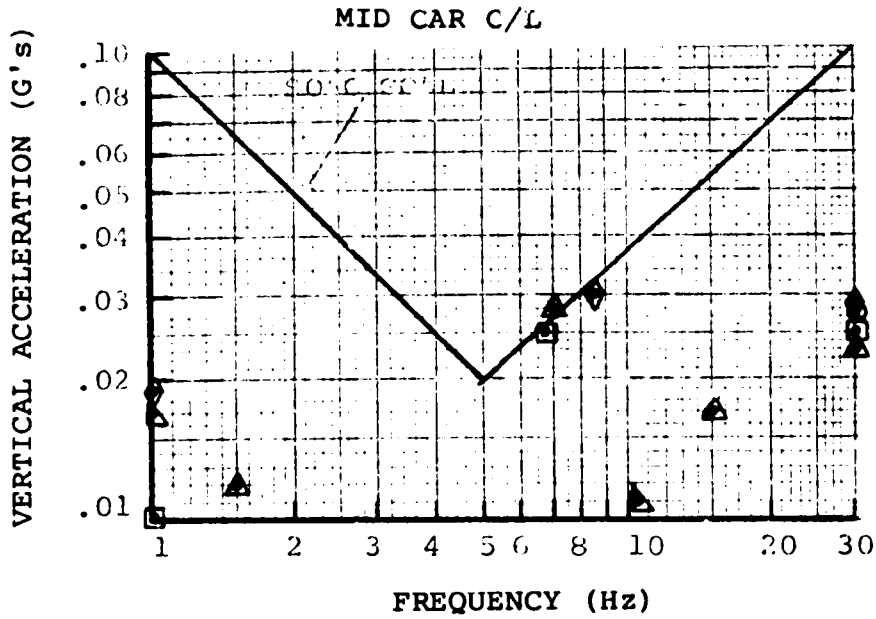


Figure 5-49. Comparison of High-Density Car Ride Quality Vs. Goals.

NOTES

- 1) RESILIENT WHEELS
- 2) 105,000-LB GROSS WEIGHT
- 3) TRACK SECTION I

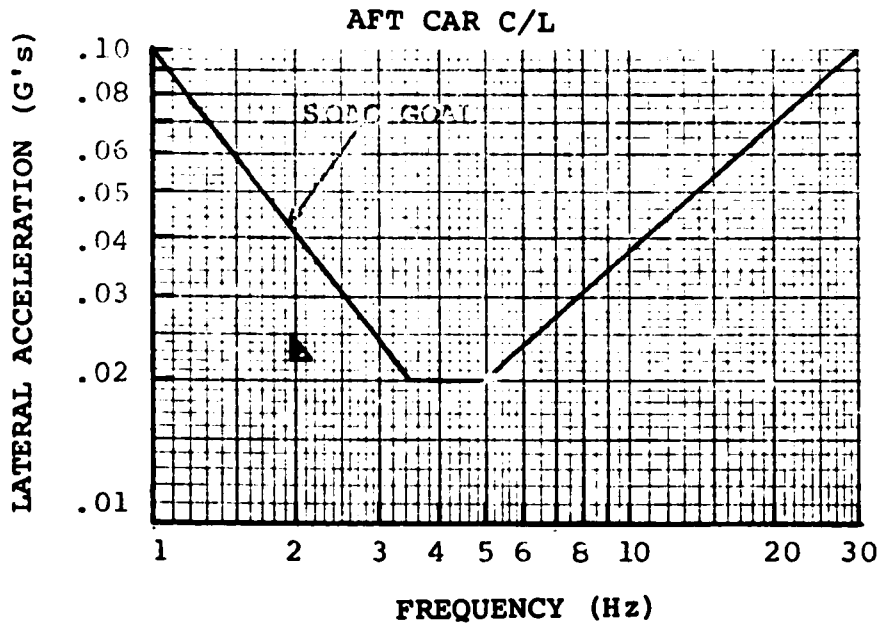
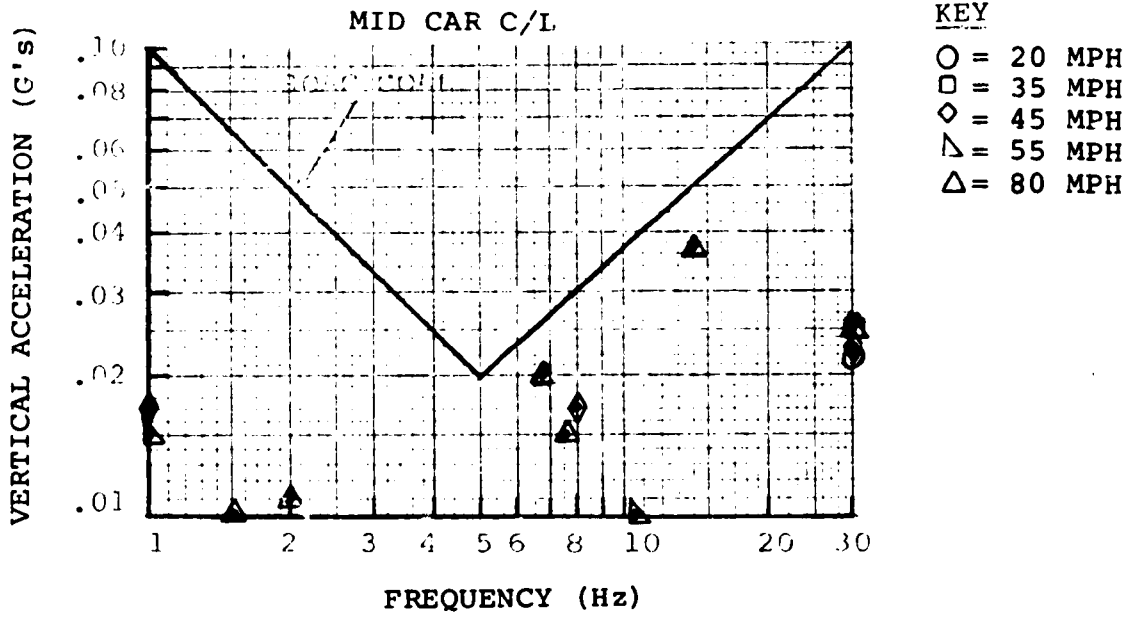


Figure 5-50. Comparison of Two-Car Train Ride Quality Vs. Goals.

Appendix A

RIDE QUALITY POWER SPECTRAL DENSITY
AND PEAK AMPLITUDE MACHINE PLOTS

Table A-1 is an index to the power spectral density and peak amplitude machine plots contained in this appendix.

TABLE A-1. INDEX TO RIDE QUALITY TEST POWER SPECTRAL DENSITY AND PEAK AMPLITUDE MACHINE PLOTS

Figure No.	Pickup Location	Train Consist	Car Weight (1000 LB)	Track Section	Speed (MPH)
A-1	Fwd Axle R/H JB Front Trk Lat.	HDC	90	I	20
A-2	Fwd Axle R/H JB Front Trk Vert.	HDC	90	I	20
A-3	Mid Car R/H Vertical	HDC	90	I	20
A-4	Aft Car C/L Lateral	HDC	90	I	20
A-5	Fwd Car C/L Longitudinal	HDC	90	I	20
A-6	Fwd Car C/L Vertical	HDC	90	I	20
A-7	Mid Car C/L Vertical	HDC	90	I	20
A-8	Aft Car C/L Vertical	HDC	90	I	20
A-9	Fwd Axle R/H JB Front Trk Lat.	HDC	90	I	35
A-10	Fwd Axle R/H JB Front Trk Vert.	HDC	90	I	35
A-11	Mid Car R/H Vertical	HDC	90	I	35
A-12	Aft Car C/L Lateral	HDC	90	I	35
A-13	Fwd Car C/L Longitudinal	HDC	90	I	35
A-14	Fwd Car C/L Vertical	HDC	90	I	35
A-15	Mid Car C/L Vertical	HDC	90	I	35
A-16	Aft Car C/L Vertical	HDC	90	I	35
A-17	Fwd Axle R/H JB Front Trk Lat.	HDC	90	I	45
A-18	Fwd Axle R/H JB Front Trk Vert.	HDC	90	I	45
A-19	Mid Car R/H Vertical	HDC	90	I	45
A-20	Aft Car C/L Lateral	HDC	90	I	45
A-21	Fwd Car C/L Longitudinal	HDC	90	I	45
A-22	Fwd Car C/L Vertical	HDC	90	I	45
A-23	Mid Car C/L Vertical	HDC	90	I	45
A-24	Aft Car C/L Vertical	HDC	90	I	45
A-25	Fwd Axle R/H JB Front Trk Lat.	HDC	90	I	55
A-26	Fwd Axle R/H JB Front Trk Vert.	HDC	90	I	55
A-27	Mid Car R/H Vertical	HDC	90	I	55
A-28	Aft Car C/L Lateral	HDC	90	I	55
A-29	Fwd Car C/L Longitudinal	HDC	90	I	55
A-30	Fwd Car C/L Vertical	HDC	90	I	55
A-31	Mid Car C/L Vertical	HDC	90	I	55
A-32	Aft Car C/L Vertical	HDC	90	I	55

TABLE A-1. Continued

Figure No.	Pickup Location	Train Consist	Car Weight (1000 LB)	Track Section	Speed (MPH)
A-33	Fwd Axle R/H JB Front Trk Lat.	HDC	90	I	80
A-34	Fwd Axle R/H JB Front Trk Vert.	HDC	90	I	80
A-35	Mid Car R/H Vertical	HDC	90	I	80
A-36	Aft Car C/L Lateral	HDC	90	I	80
A-37	Fwd Car C/L Longitudinal	HDC	90	I	80
A-38	Fwd Car C/L Vertical	HDC	90	I	90
A-39	Mid Car C/L Vertical	HDC	90	I	80
A-40	Aft Car C/L Vertical	HDC	90	I	80
A-41	Fwd Axle R/H JB Front Trk Lat.	HDC	105	I	20
A-42	Fwd Axle R/H JB Front Trk Vert.	HDC	105	I	20
A-43	Mid Car R/H Vertical	HDC	105	I	20
A-44	Aft Car C/L Lateral	HDC	105	I	20
A-45	Fwd Car C/L Longitudinal	HDC	105	I	20
A-46	Fwd Car C/L Vertical	HDC	105	I	20
A-47	Mid Car C/L Vertical	HDC	105	I	20
A-48	Aft Car C/L Vertical	HDC	105	I	20
A-49	Fwd Axle R/H JB Front Trk Lat.	HDC	105	I	35
A-50	Fwd Axle R/H JB Front Trk Vert.	HDC	105	I	35
A-51	Mid Car R/H Vertical	HDC	105	I	35
A-52	Aft Car C/L Lateral	HDC	105	I	35
A-53	Fwd Car C/L Longitudinal	HDC	105	I	35
A-54	Fwd Car C/L Vertical	HDC	105	I	35
A-55	Mid Car C/L Vertical	HDC	105	I	35
A-56	Aft Car C/L Vertical	HDC	105	I	35
A-57	Fwd Axle R/H JB Front Trk Lat.	HDC	105	I	45
A-58	Fwd Axle R/H JB Front Trk Vert.	HDC	105	I	45
A-59	Mid Car R/H Vertical	HDC	105	I	45
A-60	Aft Car C/L Lateral	HDC	105	I	45
A-61	Fwd Car C/L Longitudinal	HDC	105	I	45
A-62	Fwd Car C/L Vertical	HDC	105	I	45
A-63	Mid Car C/L Vertical	HDC	105	I	45
A-64	Aft Car C/L Vertical	HDC	105	I	45

TABLE A-1. Continued

Figure No.	Pickup Location	Train Consist	Car Weight (1000 LB)	Track Section	Speed (MPH)
A-65	Fwd Axle R/H JB Front Trk Lat.	HDC	105	I	55
A-66	Fwd Axle R/H JB Front Trk Vert.	HDC	105	I	55
A-67	Mid Car R/H Vertical	HDC	105	I	55
A-68	Aft Car C/L Lateral	HDC	105	I	55
A-69	Fwd Car C/L Longitudinal	HDC	105	I	55
A-70	Fwd Car C/L Vertical	HDC	105	I	55
A-71	Mid Car C/L Vertical	HDC	105	I	55
A-72	Aft Car C/L Vertical	HDC	105	I	55
A-73	Fwd Axle R/H JB Front Trk Lat.	HDC	105	I	80
A-74	Fwd Axle R/H JB Front Trk Vert.	HDC	105	I	80
A-75	Mid Car R/H Vertical Trk Vert.	HDC	105	I	80
A-76	Aft Car C/L Lateral	HDC	105	I	80
A-77	Fwd Car C/L Longitudinal	HDC	105	I	80
A-78	Fwd Car C/L Vertical	HDC	105	I	80
A-79	Mid Car C/L Vertical	HDC	105	I	80
A-80	Aft Car C/L Vertical	HDC	105	I	80
A-81	Fwd Car C/L Vertical	HDC	105	I	35
A-82	Mid Car C/L Vertical	HDC	105	I	35
A-83	Aft Car C/L Vertical	HDC	105	I	35
A-84	Fwd Car C/L Vertical	HDC	105	I	80
A-85	Mid Car C/L Vertical	HDC	105	I	80
A-36	Aft Car C/L Vertical	HDC	105	I	80
A-87	Fwd Car C/L Vertical	HDC	105	II	35
A-88	Mid Car C/L Vertical	HDC	105	II	35
A-89	Aft Car C/L Vertical	HDC	105	II	35
A-90	Fwd Car C/L Vertical	HDC	105	II	80
A-91	Mid Car C/L Vertical	HDC	105	II	80
A-92	Aft Car C/L Vertical	HDC	105	II	80

TABLE A-1. Continued

Figure No.	Pickup Location	Train Consist	Car Weight (1000 LB)	Track Section	Speed (MPH)
A-93	Fwd Car C/L Vertical	HDC	105	III	35
A-94	Mid Car C/L Vertical	HDC	105	III	35
A-95	Aft Car C/L Vertical	HDC	105	III	35
A-96	Fwd Car C/L Vertical	HDC	105	III	80
A-97	Mid Car C/L Vertical	HDC	105	III	80
A-98	Aft Car C/L Vertical	HDC	105	III	80
A-99	Fwd Car C/L Vertical	HDC	105	IV	35
A-100	Mid Car C/L Vertical	HDC	105	IV	35
A-101	Aft Car C/L Vertical	HDC	105	IV	35
A-102	Fwd Car C/L Vertical	HDC	105	IV	80
A-103	Mid Car C/L Vertical	HDC	105	IV	80
A-104	Aft Car C/L Vertical	HDC	105	IV	80
A-105	Fwd Car C/L Vertical	HDC	105	V	35
A-106	Mid Car C/L Vertical	HDC	105	V	35
A-107	Aft Car C/L Vertical	HDC	105	V	35
A-108	Fwd Car C/L Vertical	HDC	105	V	80
A-109	Mid Car C/L Vertical	HDC	105	V	80
A-110	Aft Car C/L Vertical	HDC	105	V	80
A-111	Fwd Car C/L Vertical	HDC	105	VI	35
A-112	Mid Car C/L Vertical	HDC	105	VI	35
A-113	Aft Car C/L Vertical	HDC	105	VI	35
A-114	Fwd Car C/L Vertical	HDC	105	VI	80
A-115	Mid Car C/L Vertical	HDC	105	VI	80
A-116	Aft Car C/L Vertical	HDC	105	VI	80
A-117	Fwd Car C/L Vertical	HDC	105	North Gap & Switch	80
A-118	Mid Car C/L Vertical	HDC	105	North Gap & Switch	80
A-119	Aft Car C/L Vertical	HDC	105	North Gap & Switch	80

TABLE A-1. Continued

Figure No.	Pickup Location	Train Cor.sist	Car Weight (1000 LB)	Track Section	Speed (MPH)
A-120	Fwd Axle R/H JB Front Trk Lat.	HDC	130	I	55
A-121	Fwd Axle R/H JB Front Trk Vert.	HDC	130	I	55
A-122	Mid Car R/H Vertical	HDC	130	I	55
A-123	Aft Car C/L Lateral	HDC	130	I	55
A-124	Fwd Car C/L Longitudinal	HDC	130	I	55
A-125	Fwd Car C/L Vertical	HDC	130	I	55
A-126	Mid Car C/L Vertical	HDC	130	I	55
A-127	Aft Car C/L Vertical	HDC	130	I	55
A-128	Fwd Axle R/H JB Front Trk Lat.	Train	105	I	20
A-129	Fwd Axle R/H JB Front Trk Vert.	Train	105	I	20
A-130	Mid Car R/H Vertical	Train	105	I	20
A-131	Aft Car C/L Lateral	Train	105	I	20
A-132	Fwd Car C/L Longitudinal	Train	105	I	20
A-133	Fwd Car C/L Vertical	Train	105	I	20
A-134	Mid Car C/L Vertical	Train	105	I	20
A-135	Aft Car C/L Vertical	Train	105	I	20
A-136	Fwd Axle R/H JB Front Trk Lat.	Train	105	I	35
A-137	Fwd Axle R/H JB Front Trk Vert.	Train	105	I	35
A-138	Mid Car R/H Vertical	Train	105	I	35
A-139	Aft Car C/L Lateral	Train	105	I	35
A-140	Fwd Car C/L Longitudinal	Train	105	I	35
A-141	Fwd Car C/L Vertical	Train	105	I	35
A-142	Mid Car C/L Vertical	Train	105	I	35
A-143	Aft Car C/L Vertical	Train	105	I	35
A-144	Fwd Axle R/H JB Front Trk Lat.	Train	105	I	45
A-145	Fwd Axle R/H JB Front Trk Vert.	Train	105	I	45
A-146	Mid Car R/H Vertical	Train	105	I	45
A-147	Aft Car C/L Lateral	Train	105	I	45
A-148	Fwd Car C/L Longitudinal	Train	105	I	45
A-149	Fwd Car C/L Vertical	Train	105	I	45
A-150	Mid Car C/L Vertical	Train	105	I	45
A-151	Aft Car C/L Vertical	Train	105	I	45

TABLE A-1. Continued

Figure No.	Pickup Location	Train Consist	Car Weight (1000 LB)	Track Section	Speed (MPH)
A-152	Fwd Axle R/H JB Front Trk Lat.	Train	105	I	55
A-153	Fwd Axle R/H JB Front Trk Vert.	Train	105	I	55
A-154	Mid Car R/H Vertical	Train	105	I	55
A-155	Aft Car C/L Lateral	Train	105	I	55
A-156	Fwd Car C/L Longitudinal	Train	105	I	55
A-157	Fwd Car C/L Vertical	Train	105	I	55
A-158	Mid Car C/L Vertical	Train	105	I	55
A-159	Aft Car C/L Vertical	Train	105	I	55
A-160	Fwd Axle R/H JB Front Trk Lat.	Train	105	I	80
A-161	Fwd Axle R/H JB Front Trk Vert.	Train	105	I	80
A-162	Mid Car R/H Vertical	Train	105	I	80
A-163	Aft Car C/L Lateral	Train	105	I	80
A-164	Fwd Car C/L Longitudinal	Train	105	I	80
A-165	Fwd Car C/L Vertical	Train	105	I	80
A-166	Mid Car C/L Vertical	Train	105	I	80
A-167	Aft Car C/L Vertical	Train	105	I	80

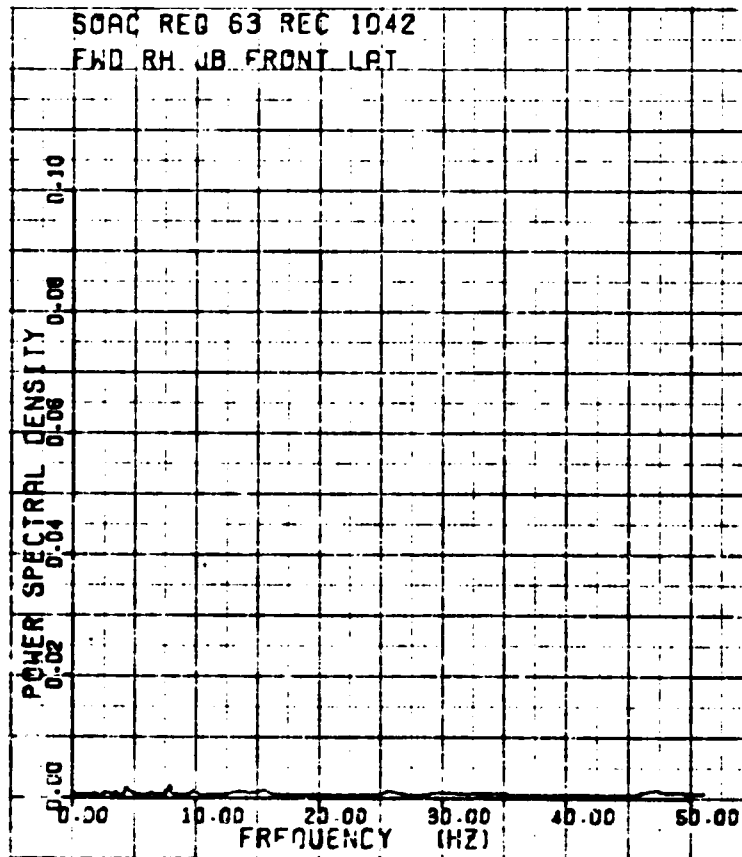
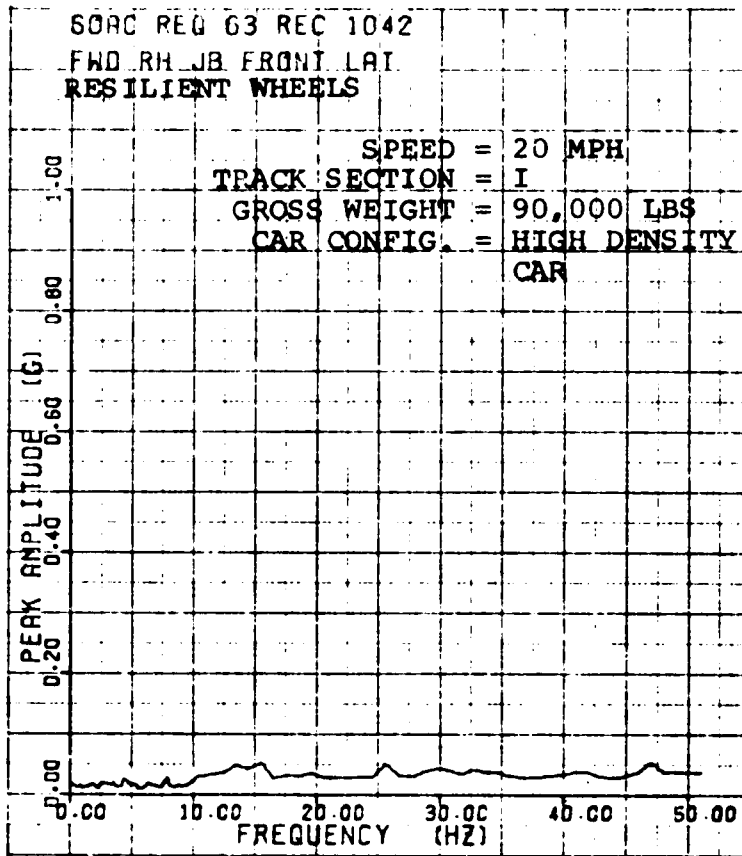


Figure A-1

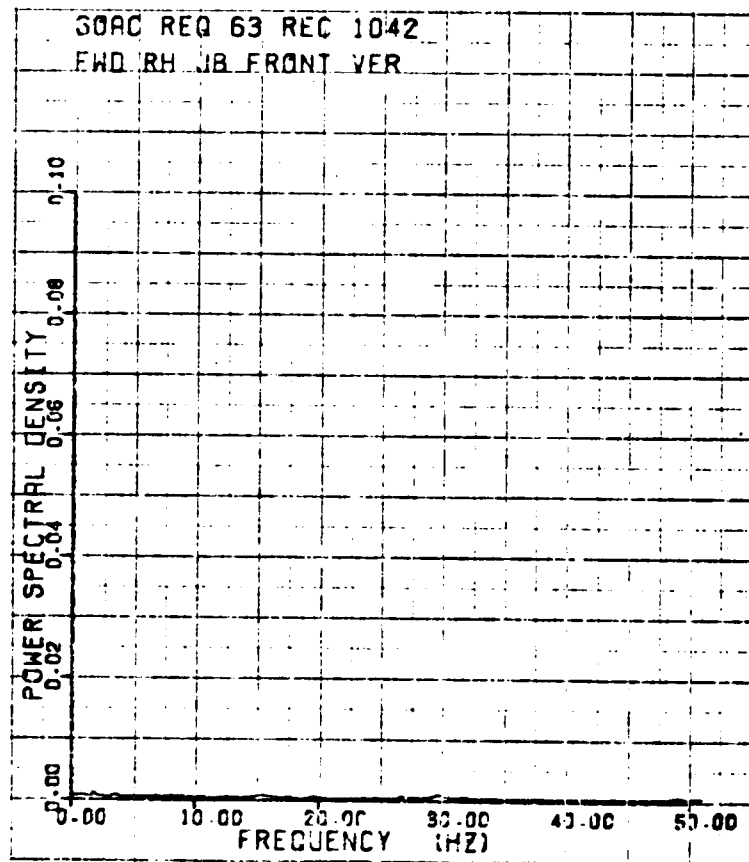
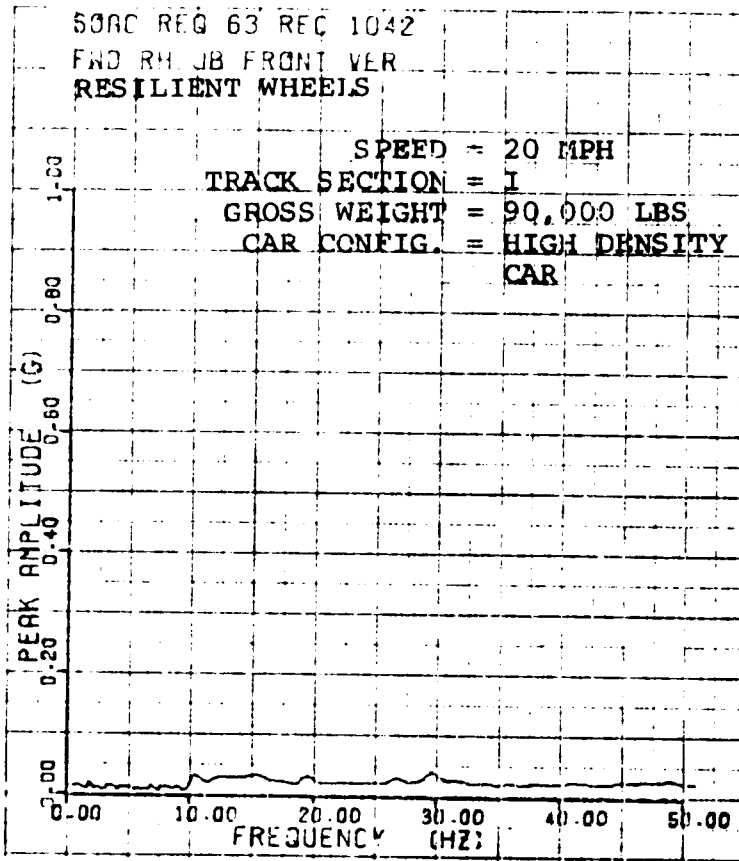
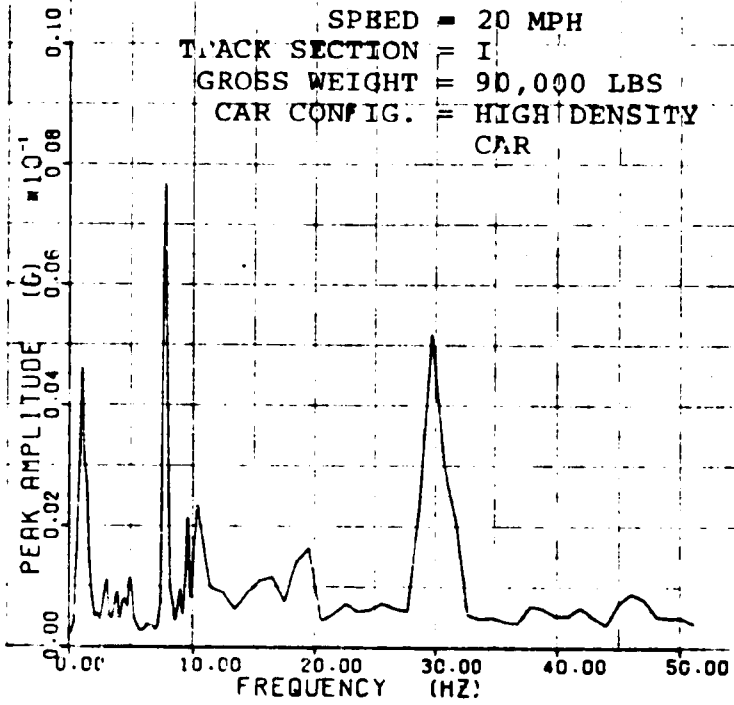


Figure A-2

SOAC REQ 64 REC 1042

MID R/H VER

RESILIENT WHEELS



SOAC REQ 64 REC 1042

MID R/H VER

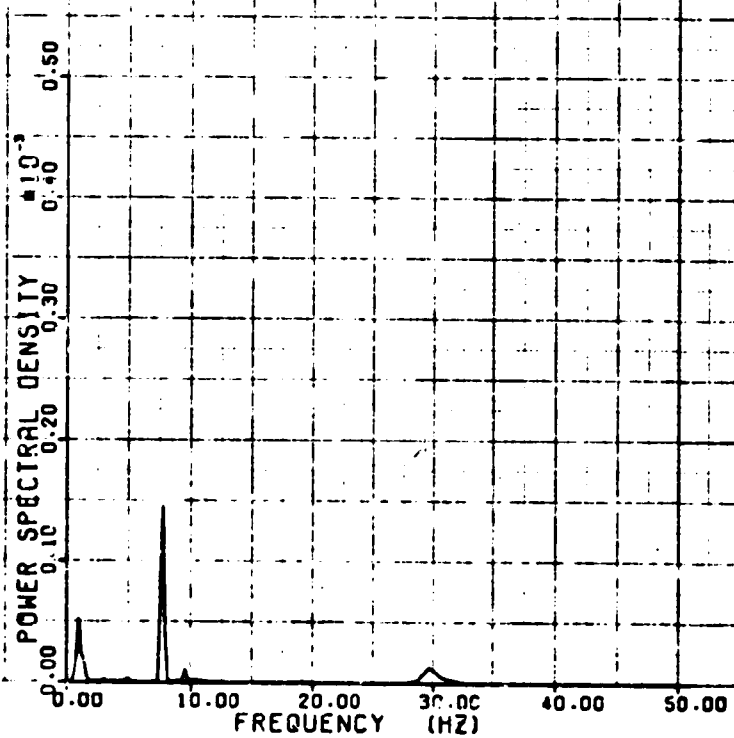
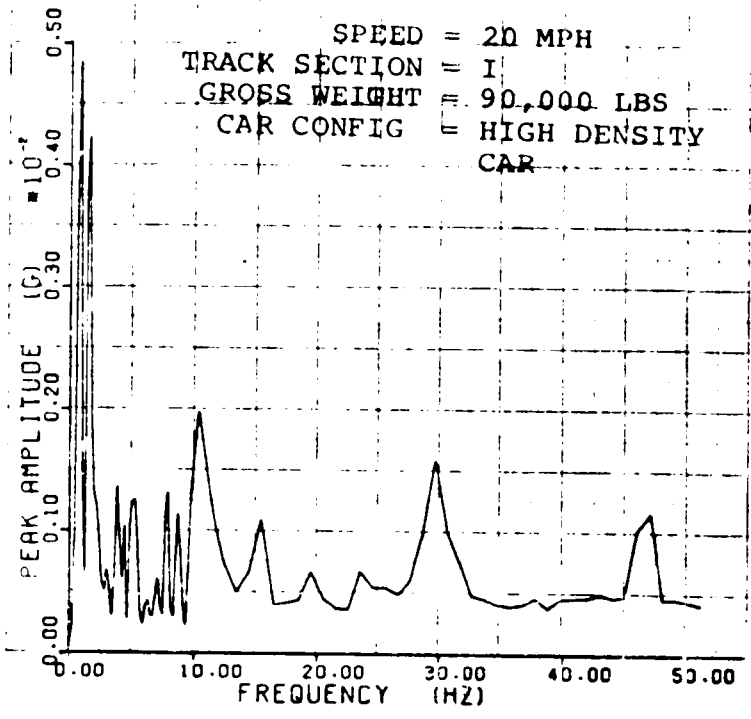


Figure A-3

SOAC REQ 64 REC 1042

AFT C/L LAT

RESILIENT WHEELS



SOAC REQ 64 REC 1042

AFT C/L LAT

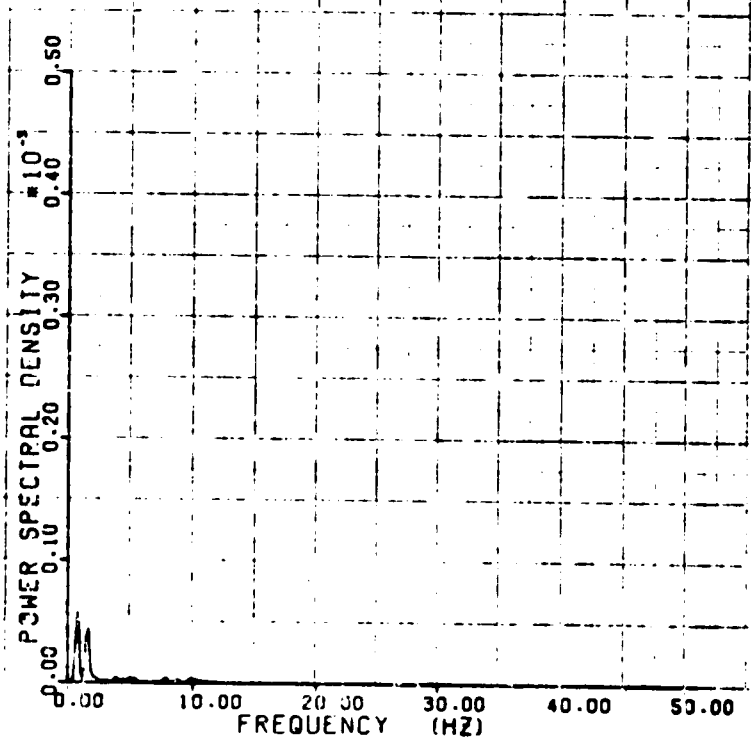


Figure A-4

SOAC REQ 64 REC 1042

FWD C/L LONG

RESILIENT WHEELS

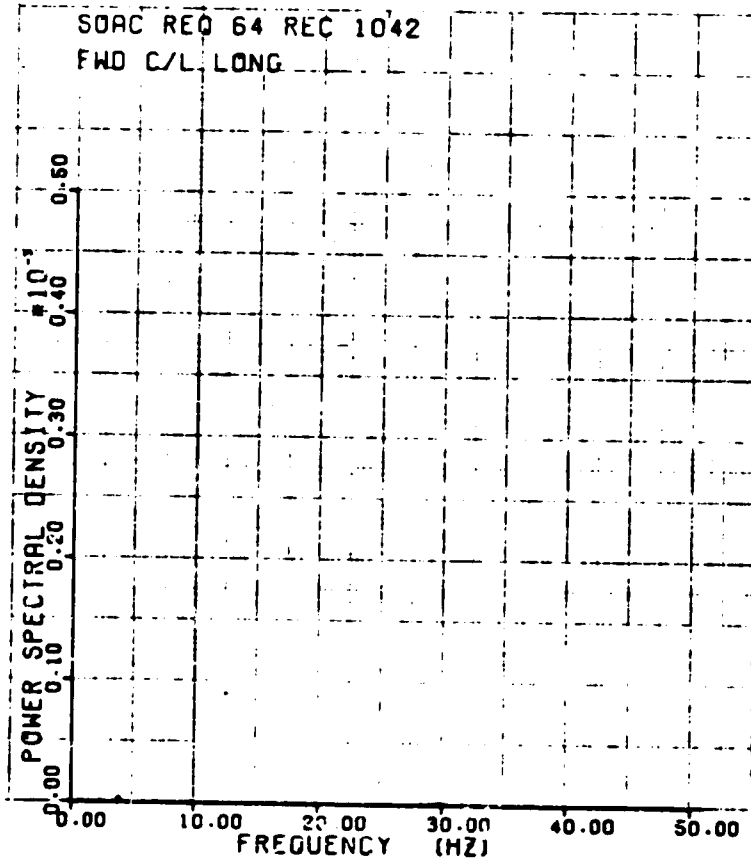
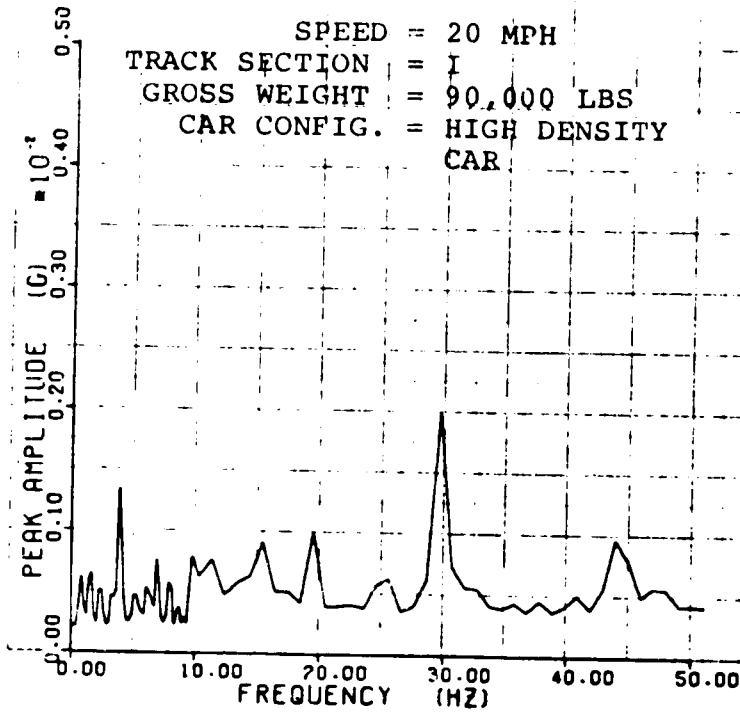
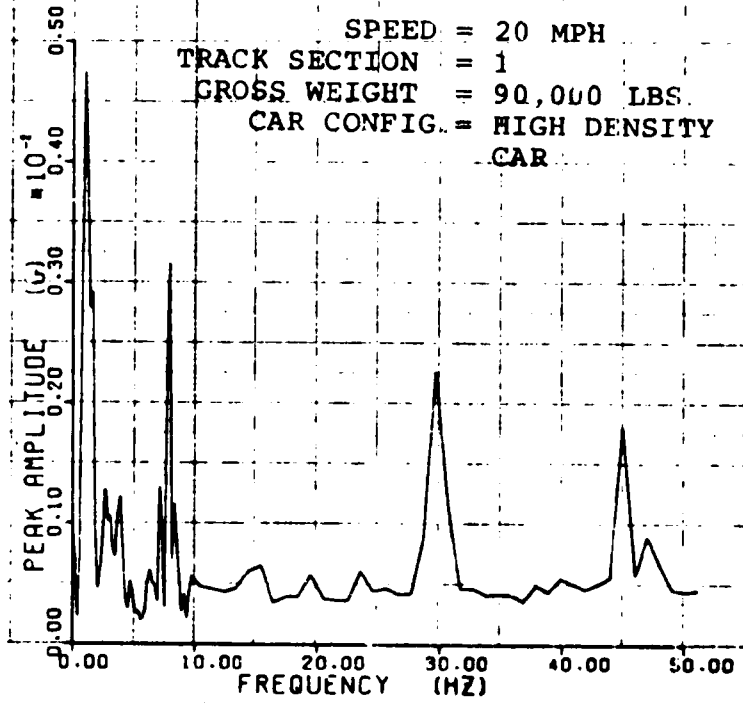


Figure A-5

SOARC REQ 64 REC 1042

FWD C/L VER

RESILIENT WHEELS



SOARC REQ 64 REC 1042

FWD C/L VER

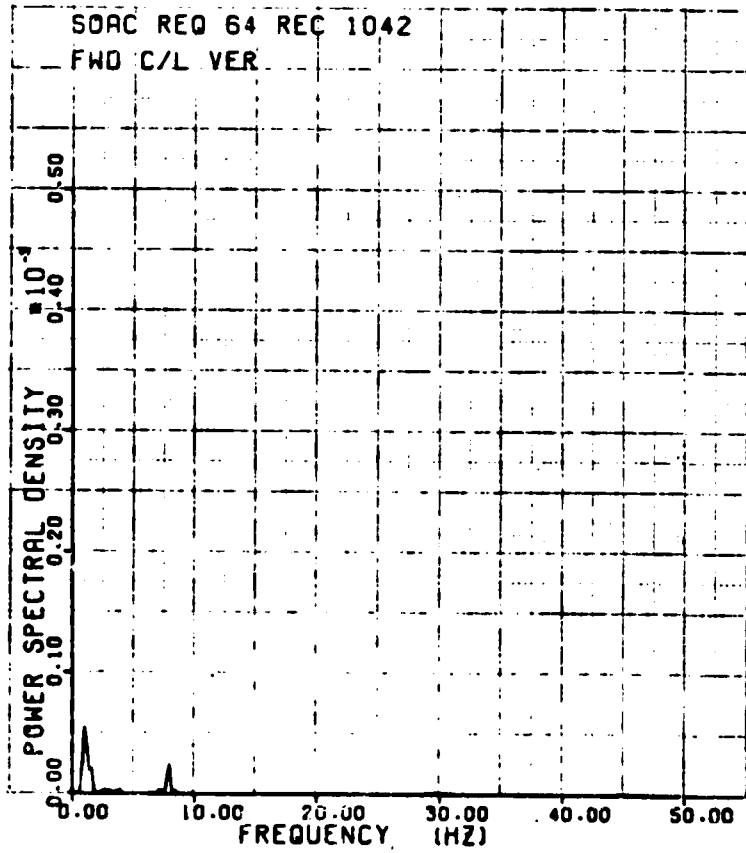
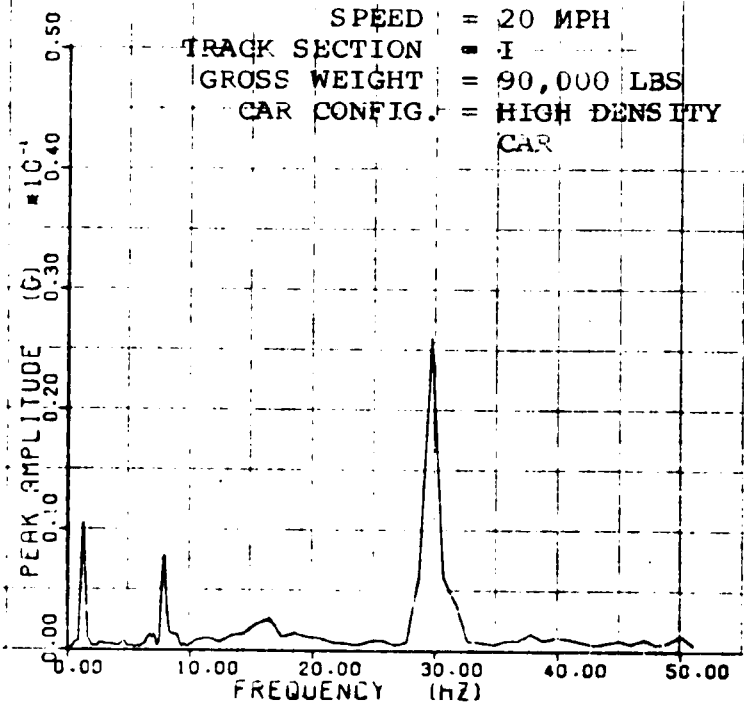


Figure A-6

SOAC REQ 64 REC 1042

MID C/L VER

RESILIENT WHEELS



SOAC REQ 64 REC 1042

MID C/L VER

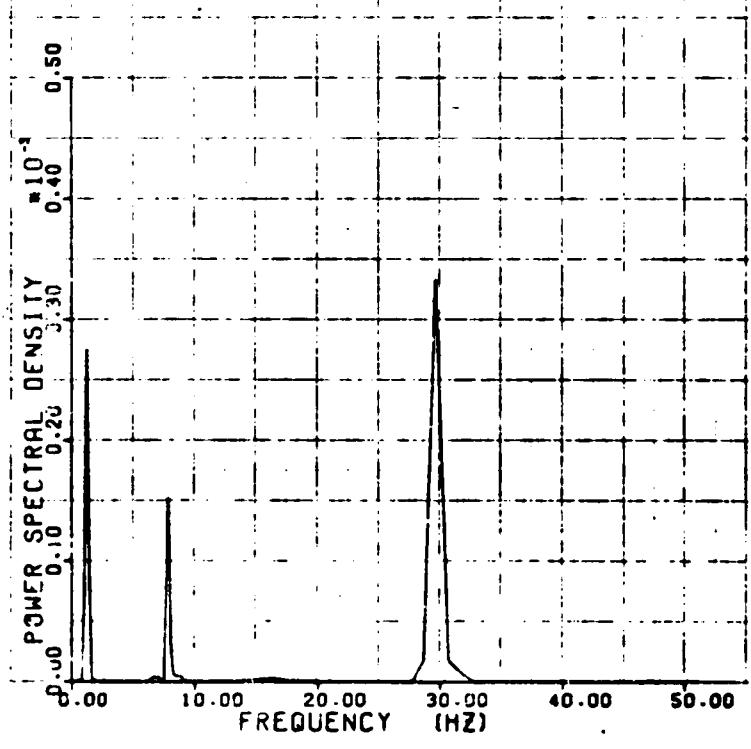


Figure A-7

SOAC REQ 64 REC 1042
AFT C/L VER
RESILIENT WHEELS

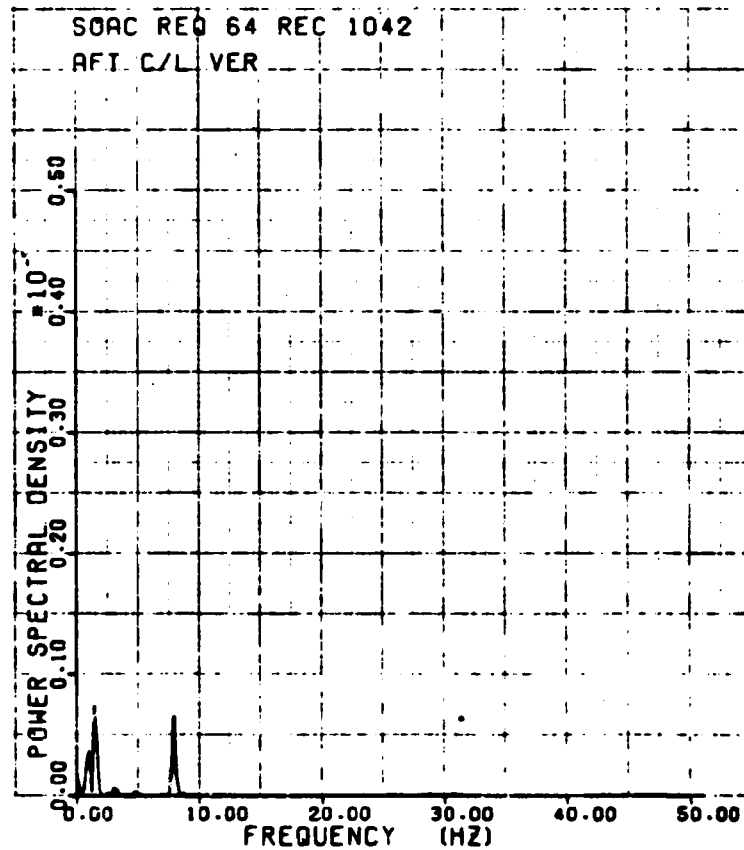
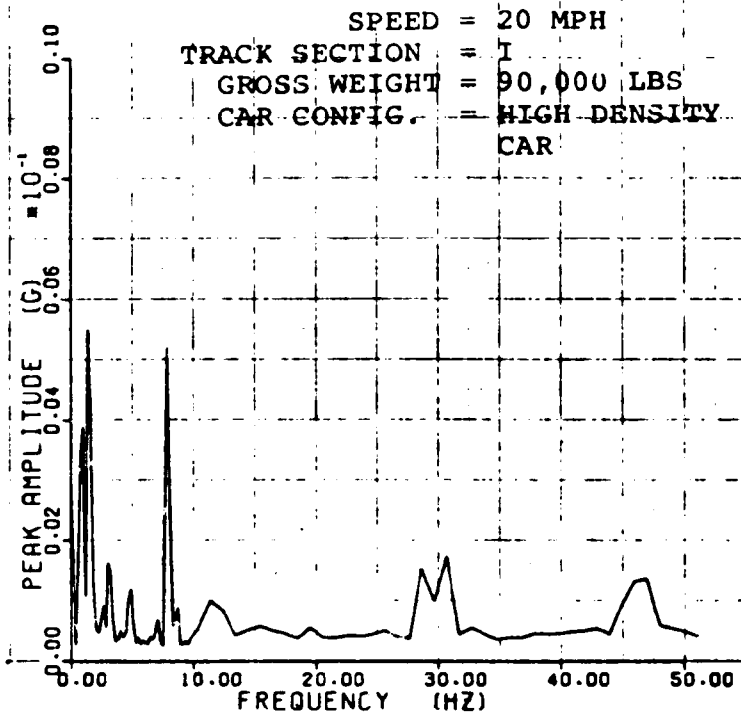
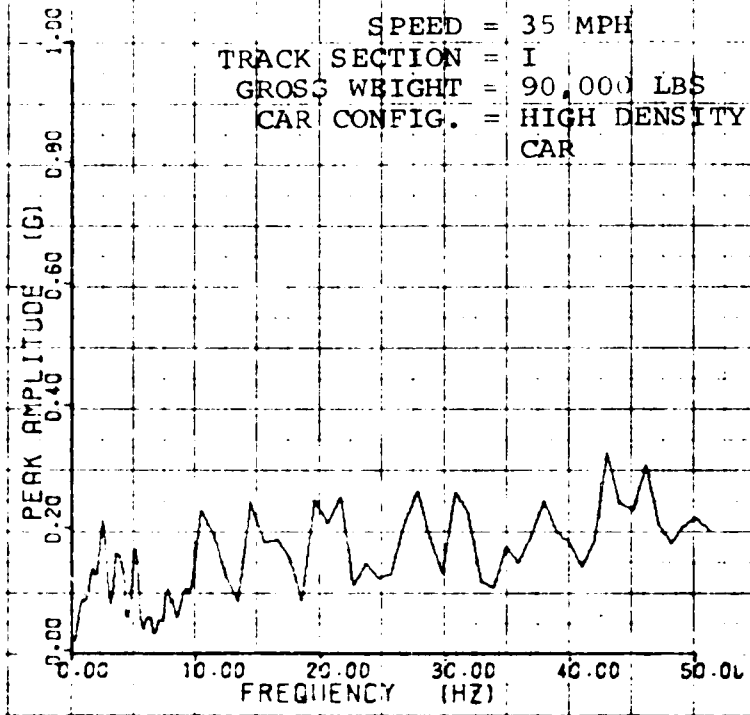


Figure A-8

SCAC REQ 63 REC 1107

FWD RH JB FRONT LAI

RESILIENT WHEELS



SCAC REQ 63 REC 1107

FWD RH JB FRONT LAI

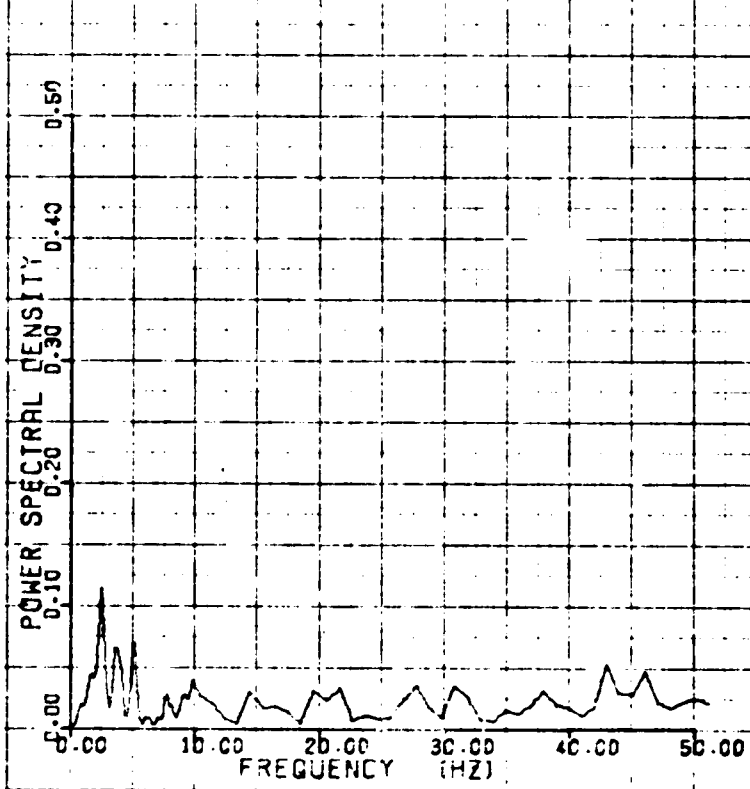


Figure A-9

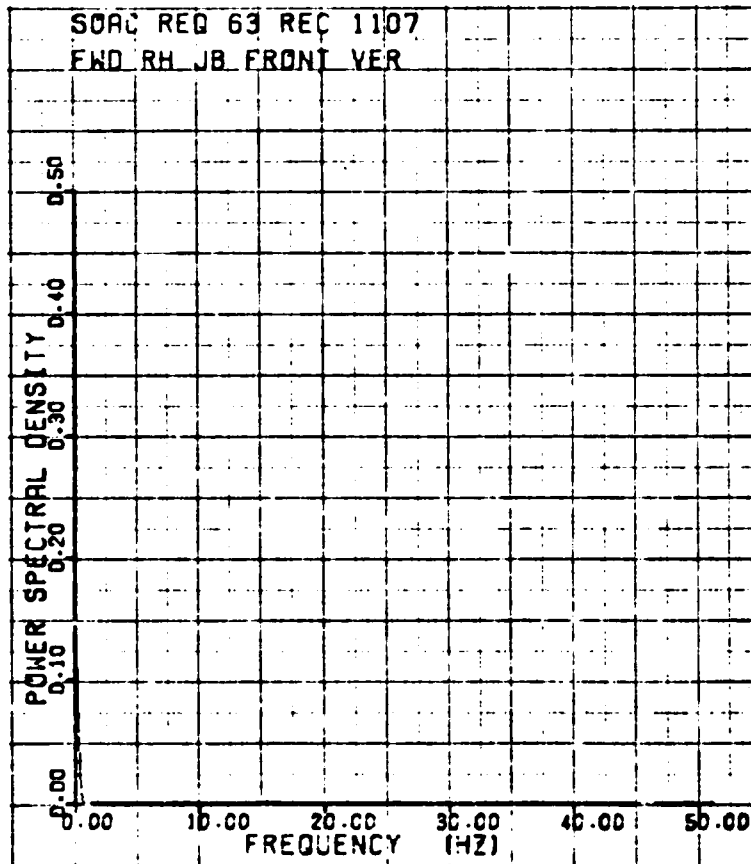
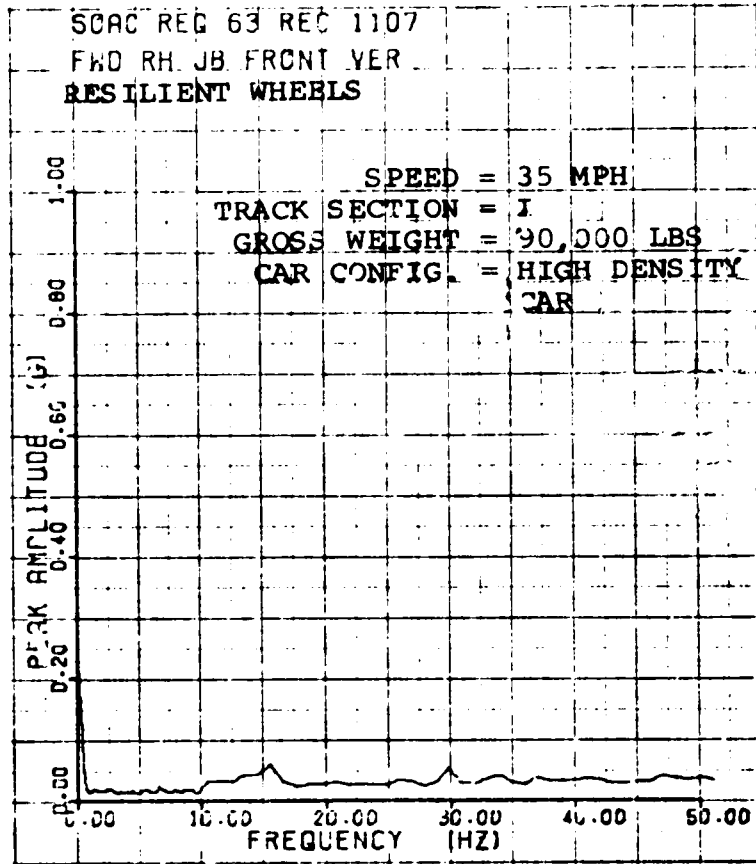


Figure A-10

SOAC REQ 64 REC 1107
MID R/H VER

RESILIENT WHEELS

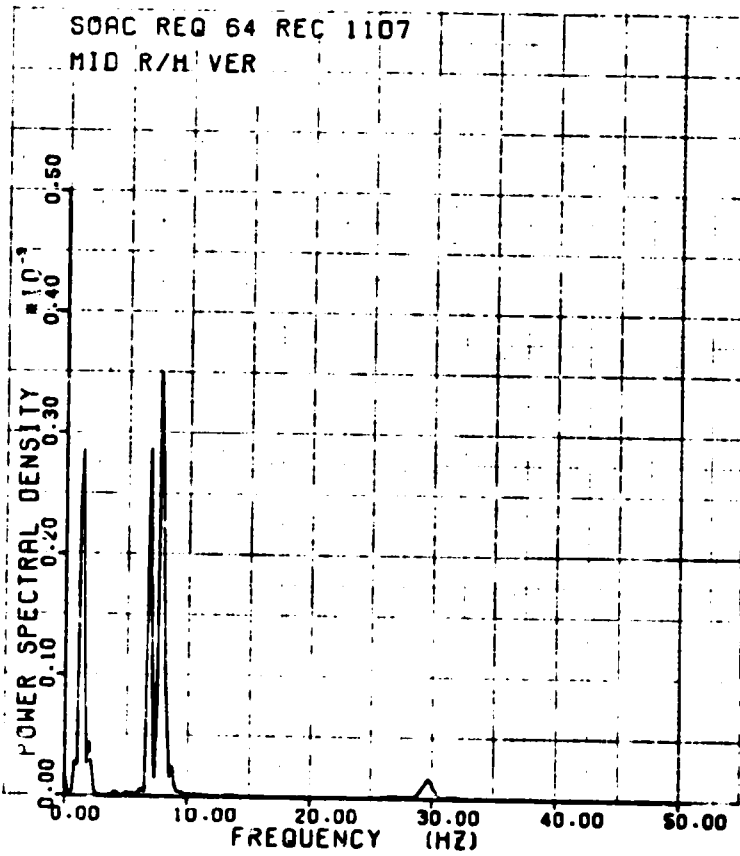
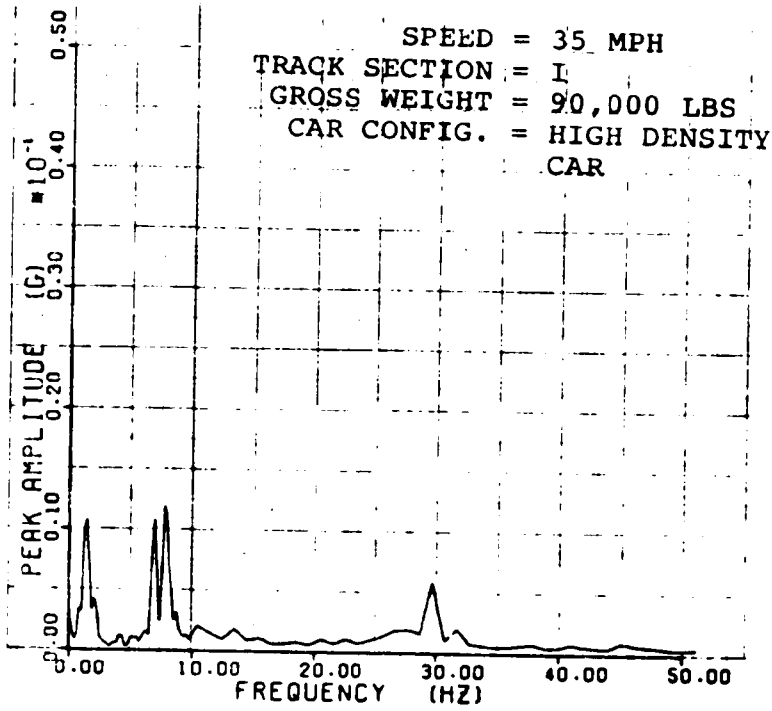
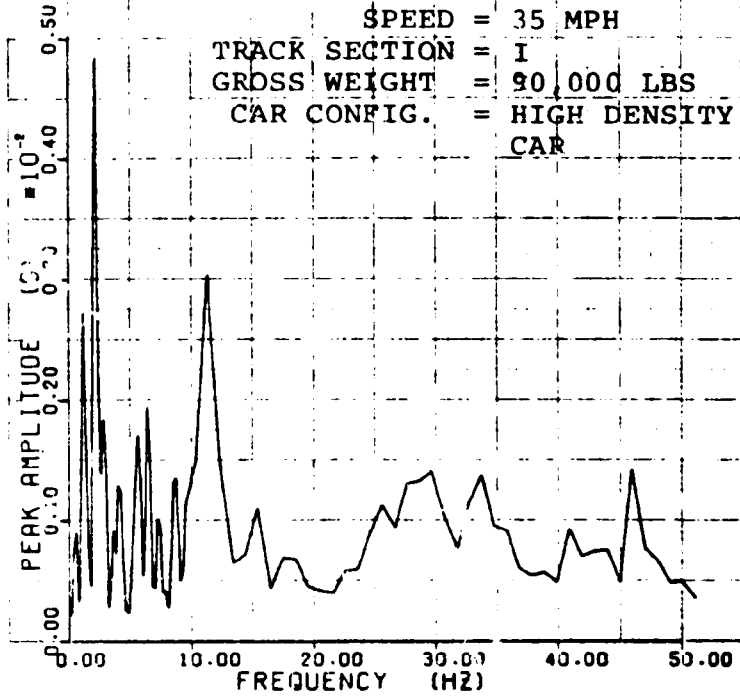


Figure A-11

SOAC REQ 64 REC 1107

AFT C/L LAT

RESILIENT WHEELS



SOAC REQ 64 REC 1107

AFT C/L LAT

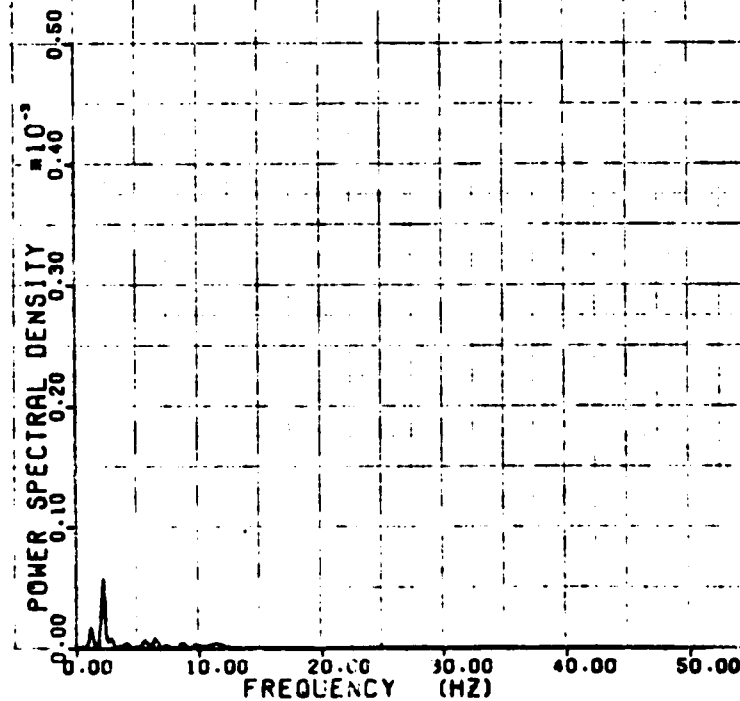


Figure A-12

SOAC REQ 64 REC 1107
FWD C/L LONG
RESILIENT WHEELS

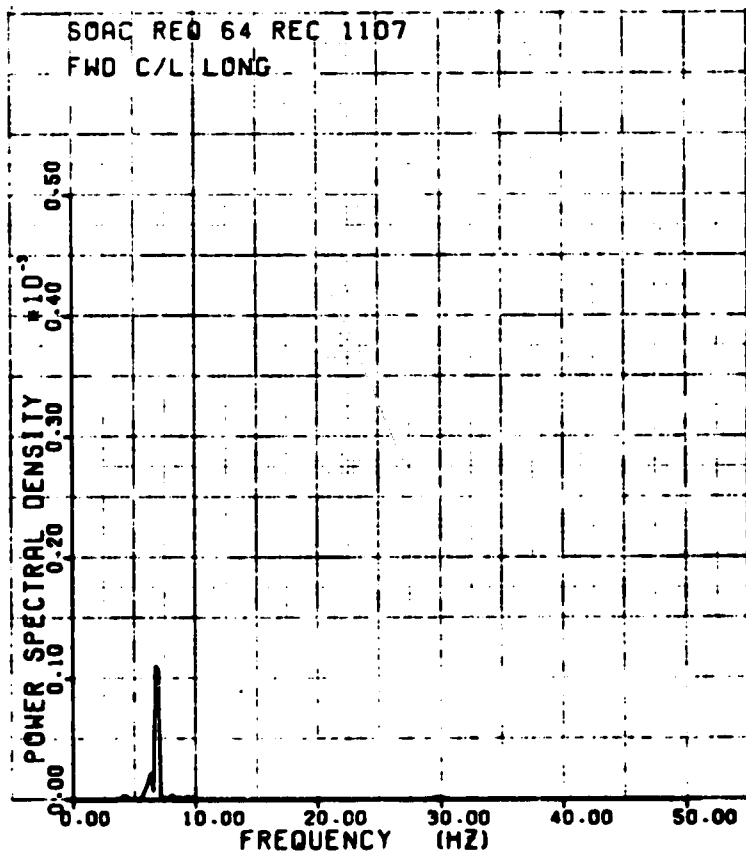
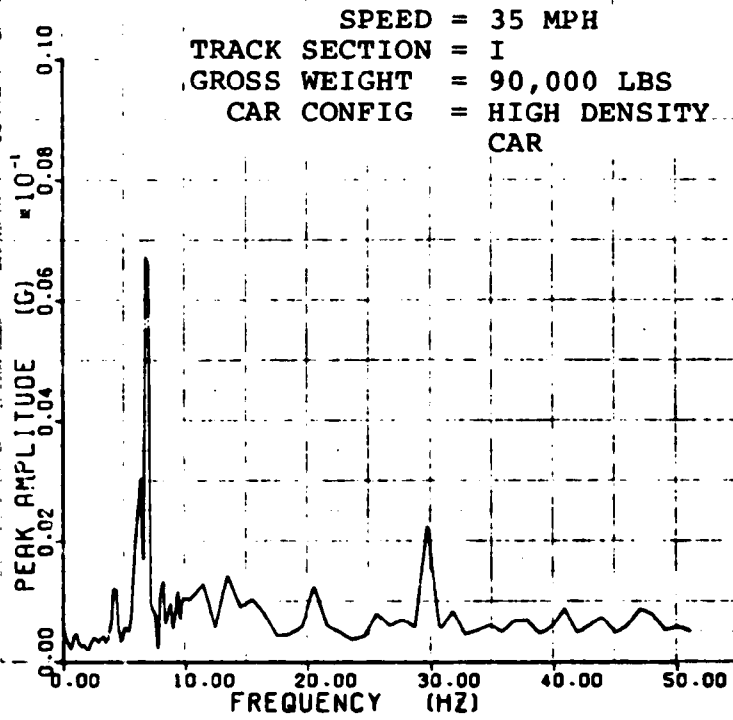


Figure A-13

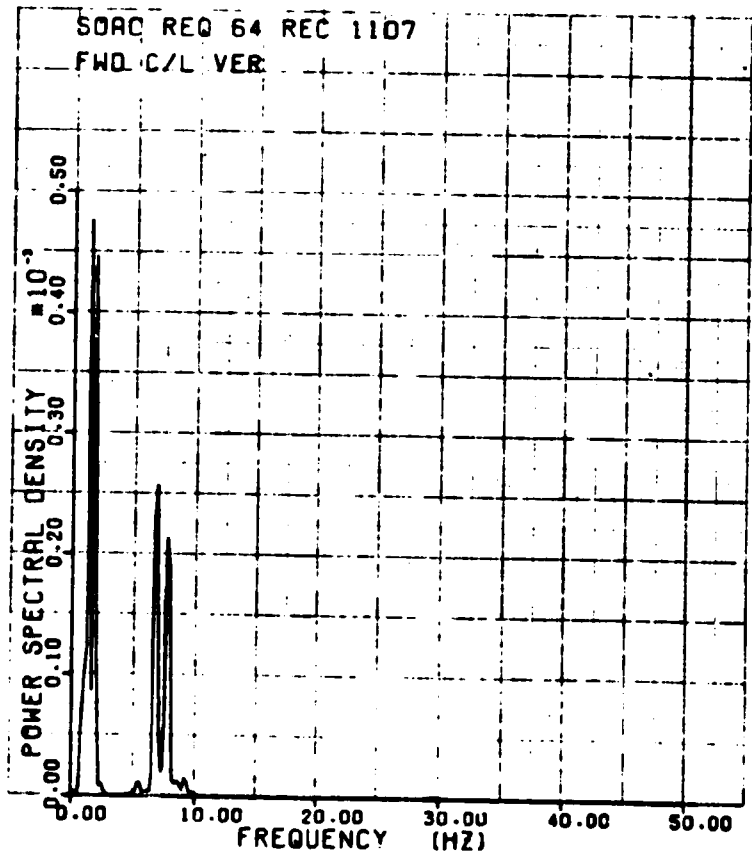
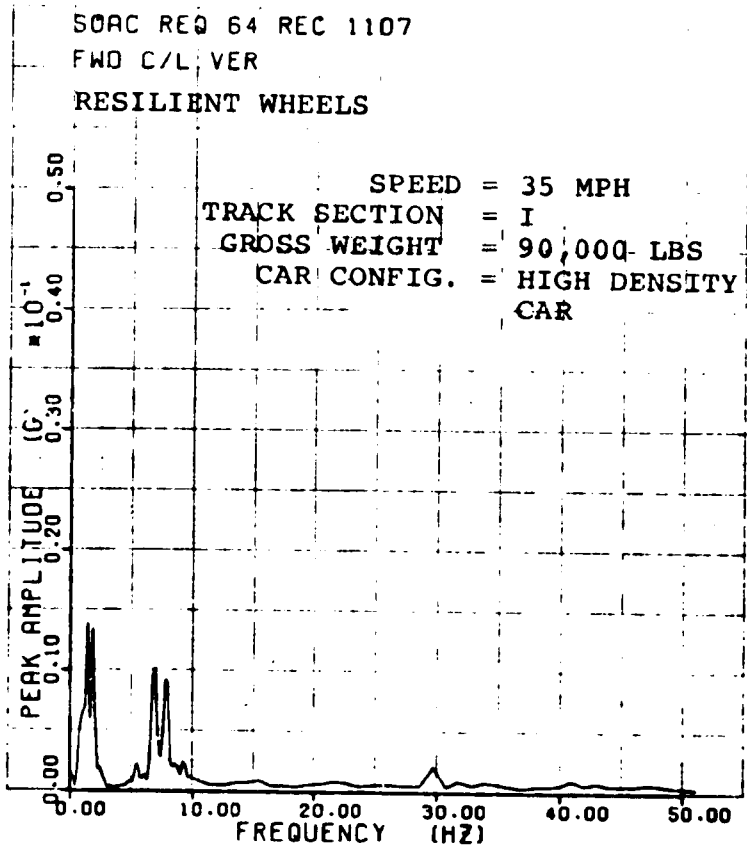


Figure A-14

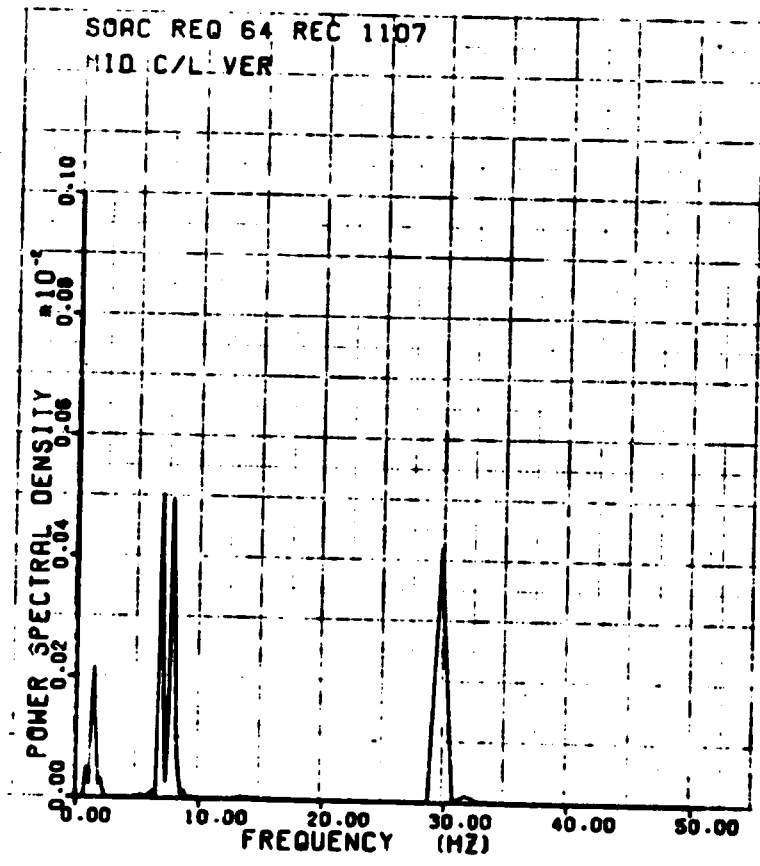
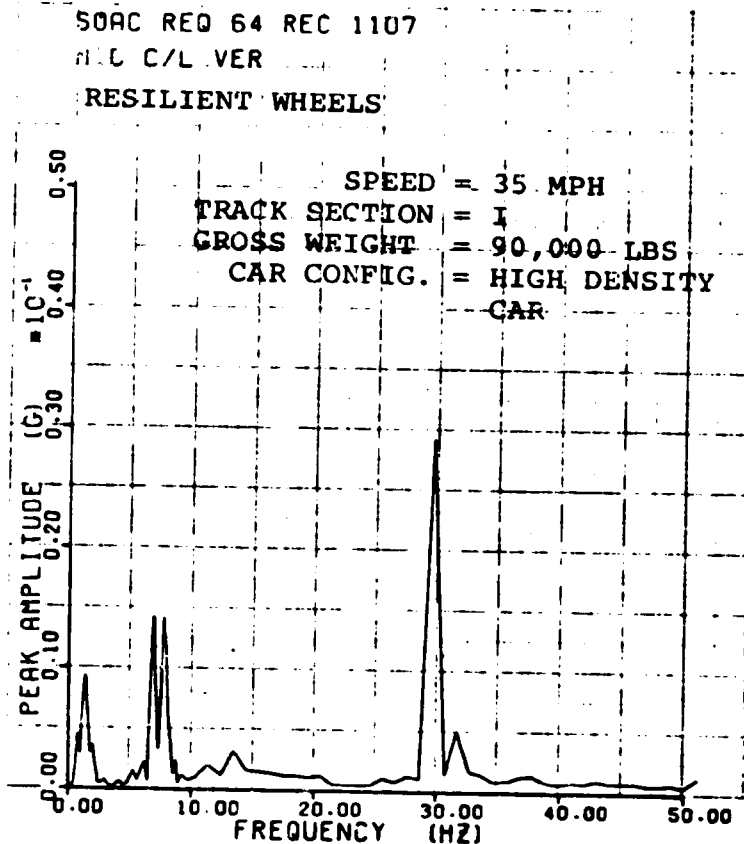


Figure A-15

SOAC REQ 64 REC 1107

AFT C/L VER

RESILIENT WHEELS

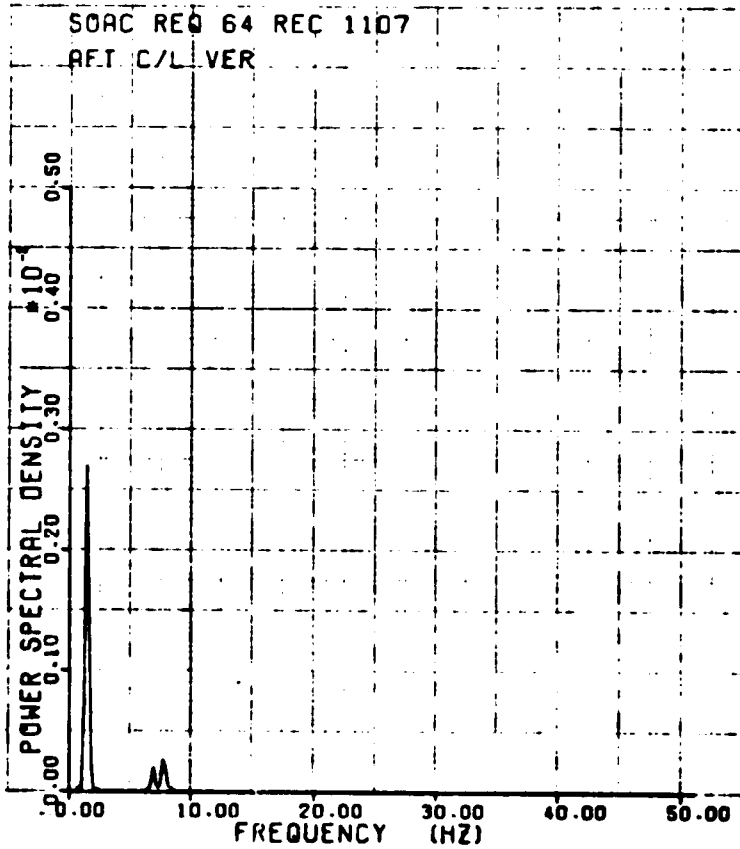
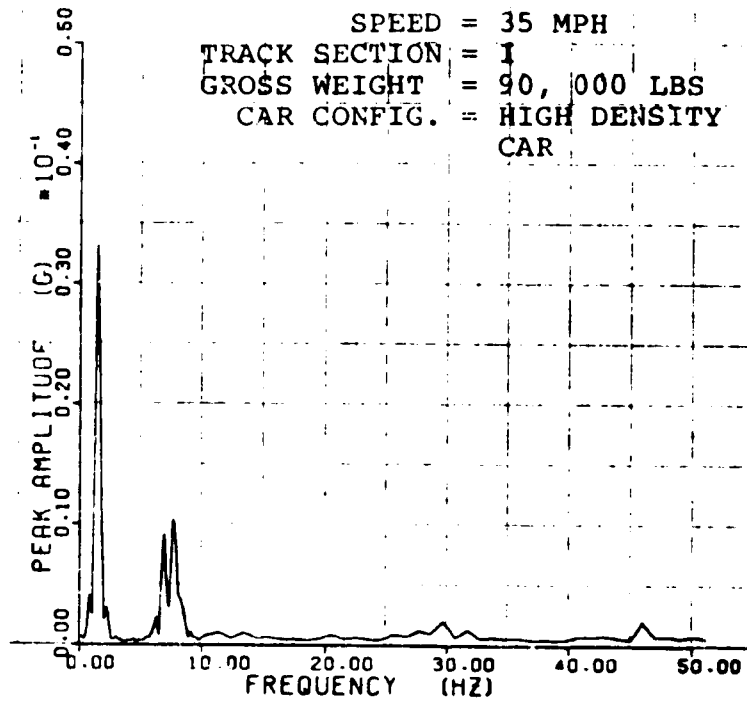


Figure A-16

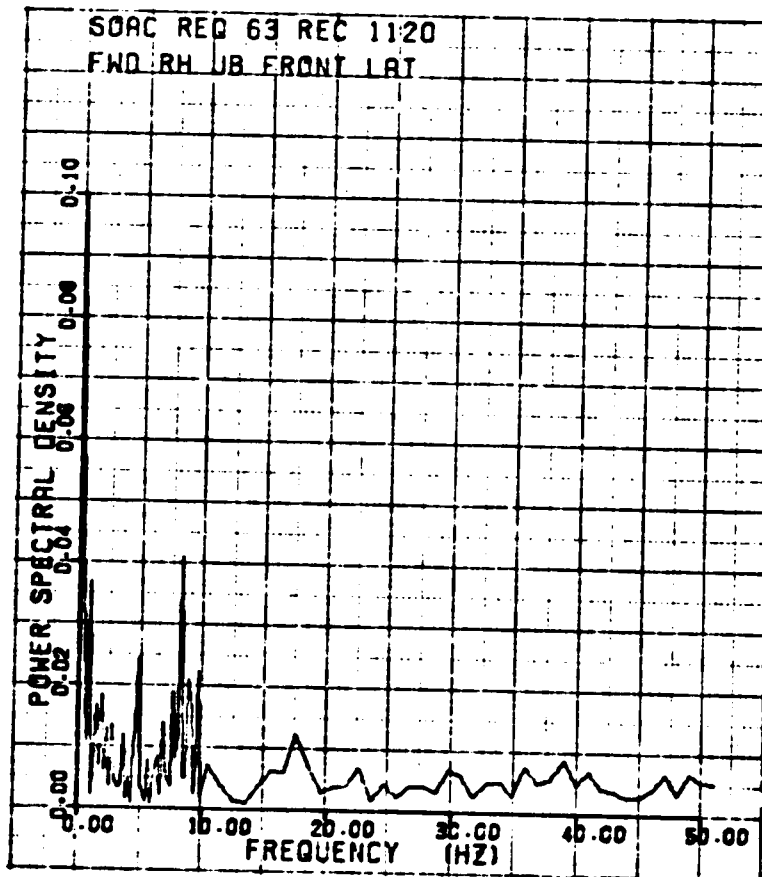
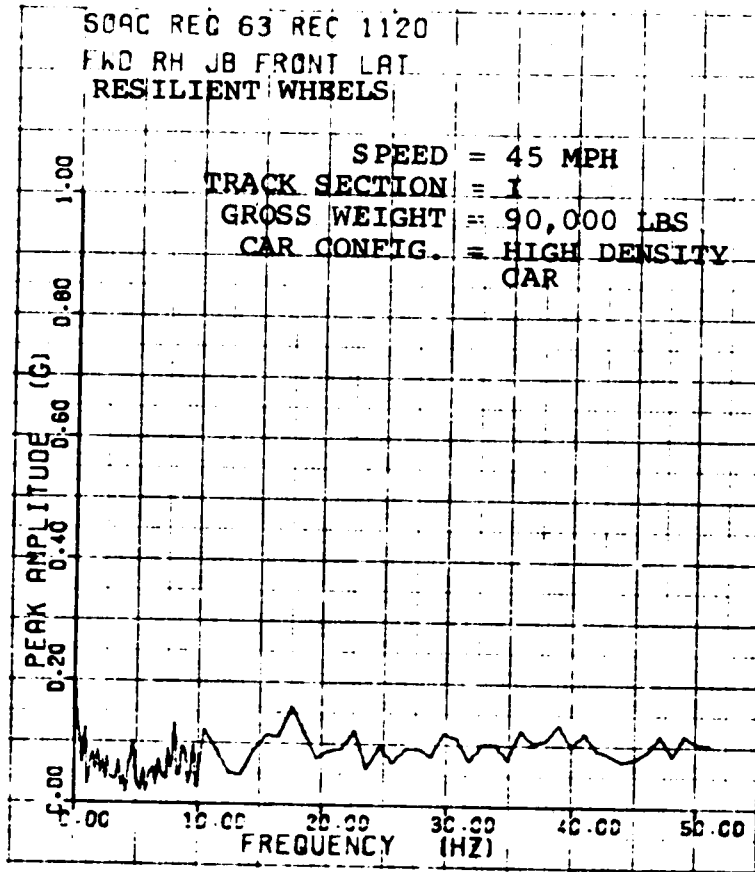


Figure A-17

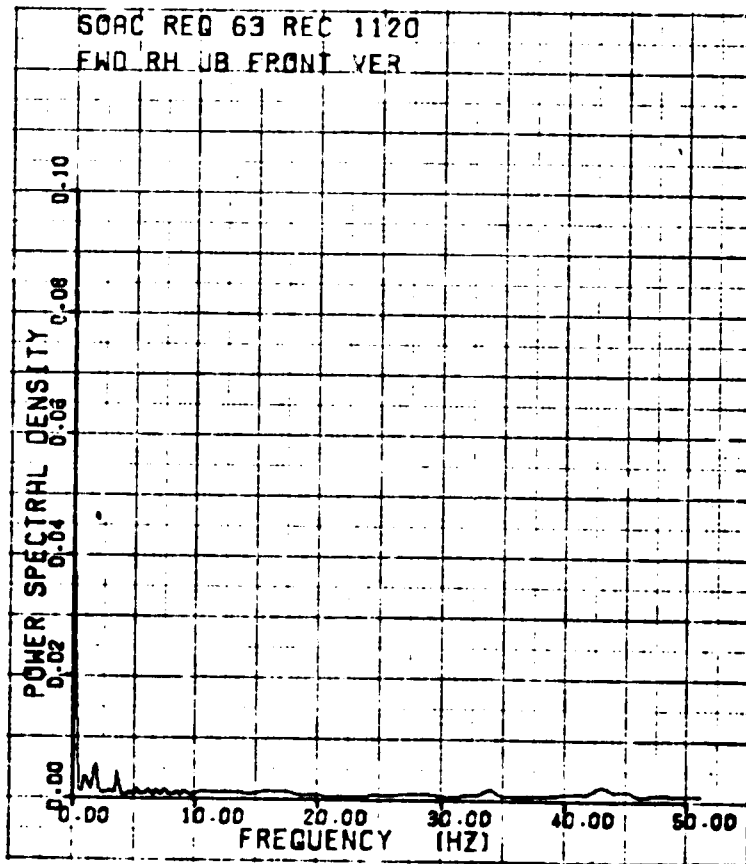
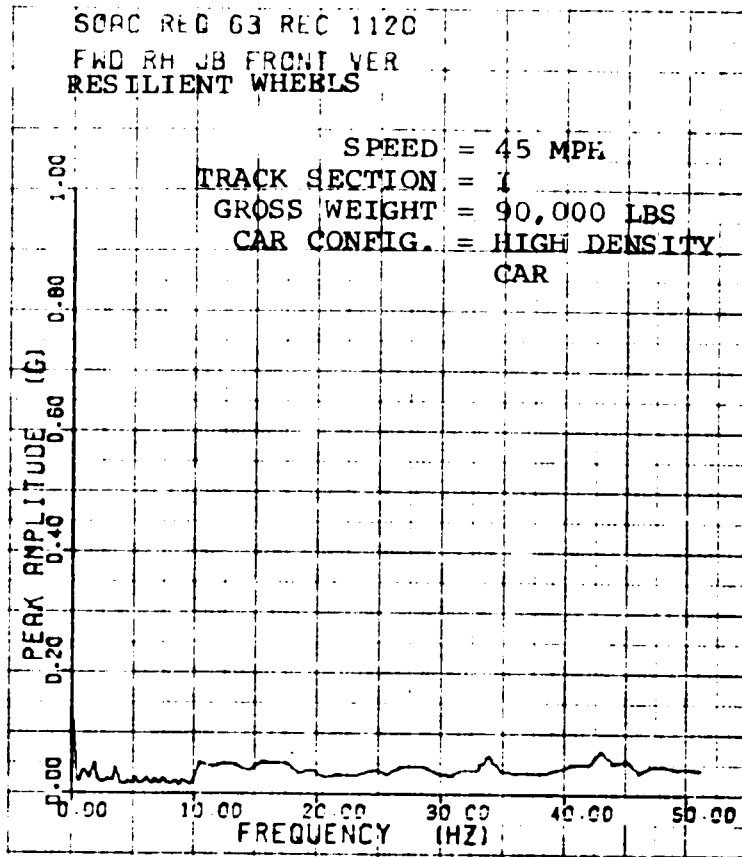


Figure A-18

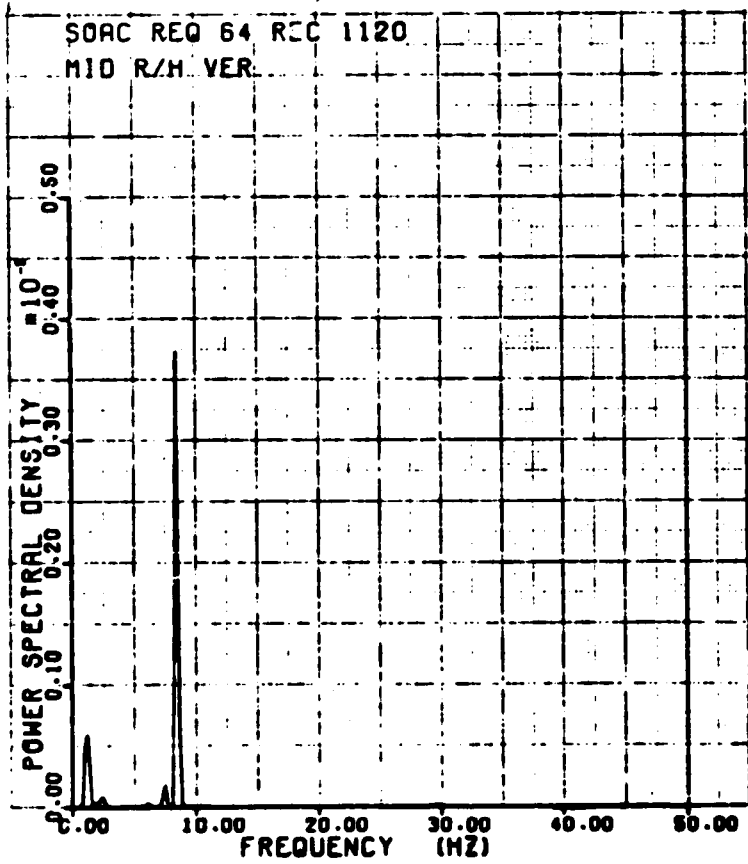
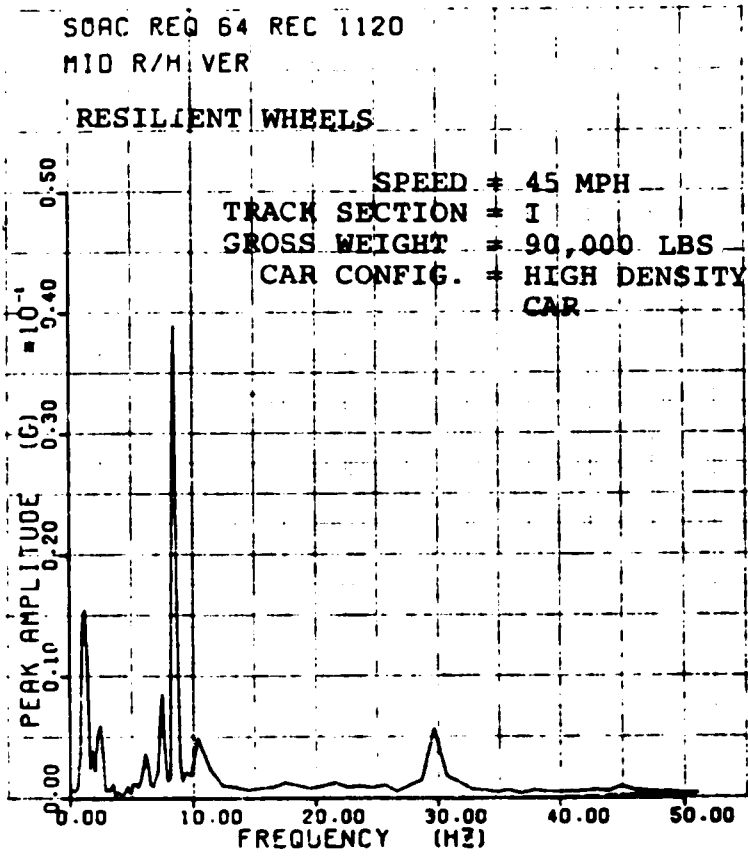
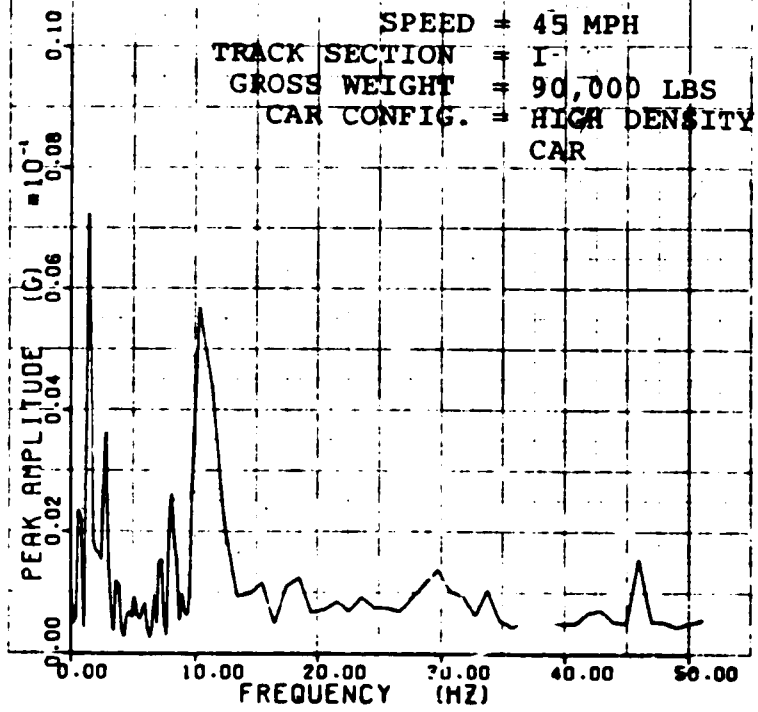


Figure A-19

SOAC REQ 64 REC 1120

AFT C/L LAT

RESILIENT WHEELS



SOAC REQ 64 REC 1120

AFT C/L LAT

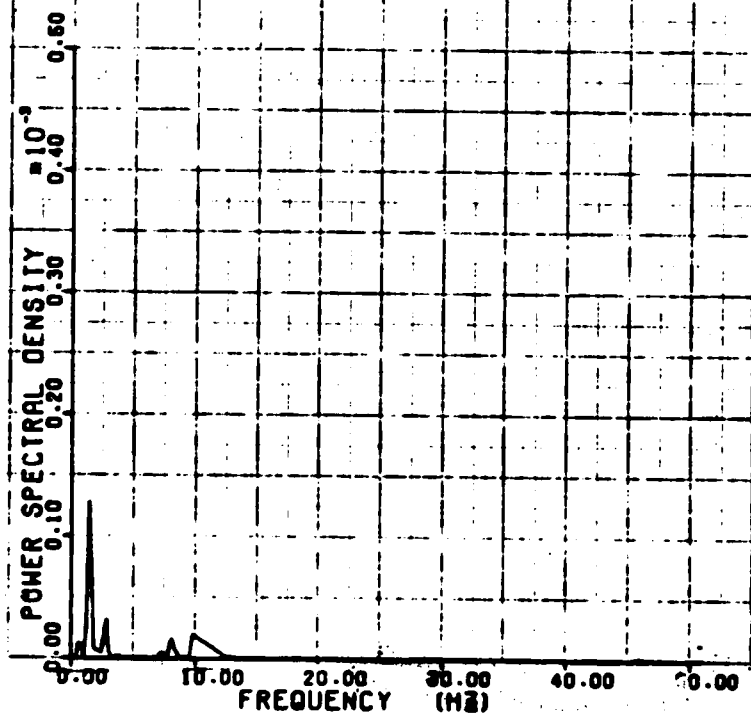


Figure A-20

SOAC REQ 64 REC 1120
FWD C/L LONG

RESILIENT WHEELS

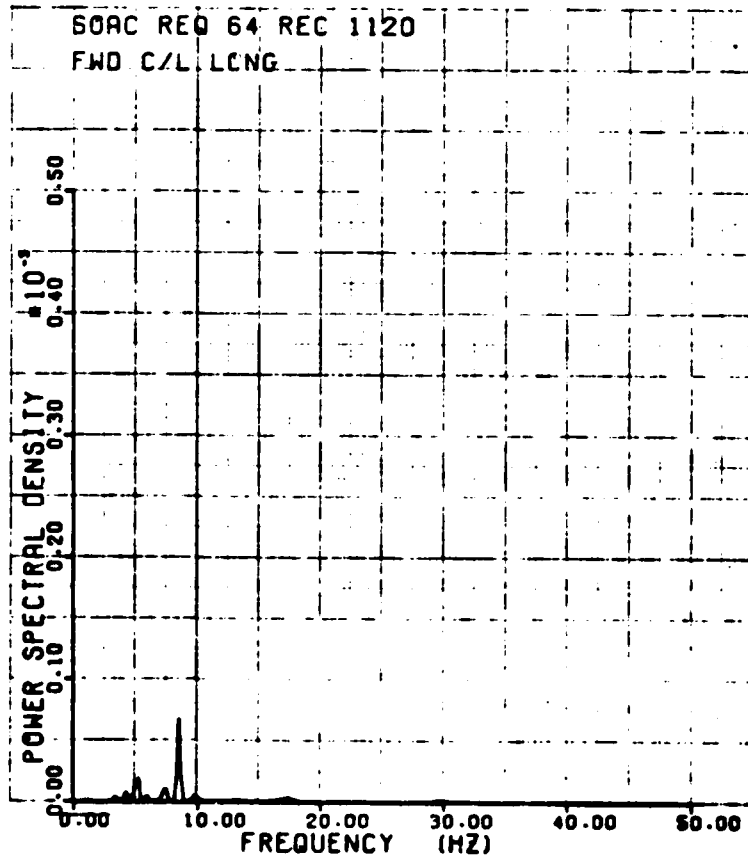
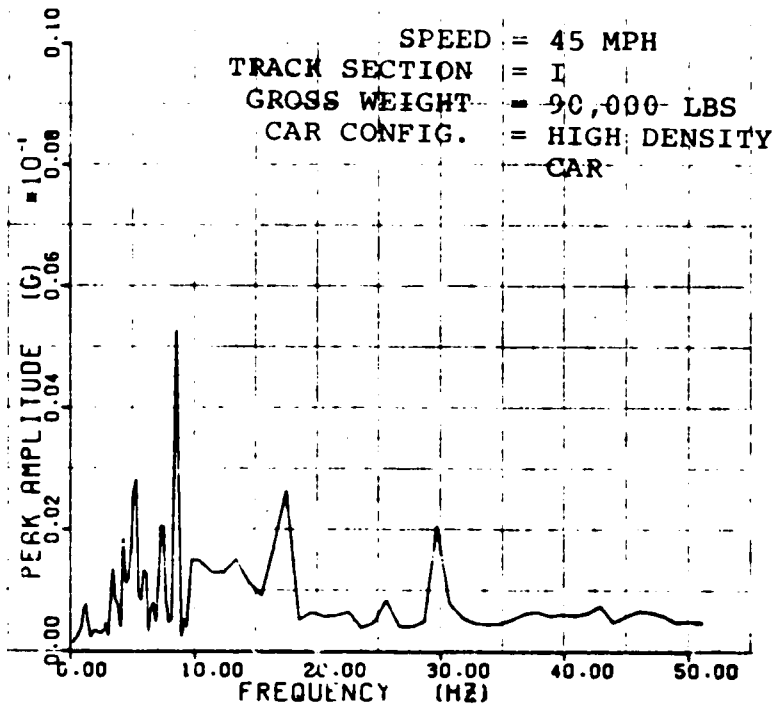


Figure A-21

SOARC REQ 64 REC 1120

FWD C/L VER

RESILIENT WHEELS

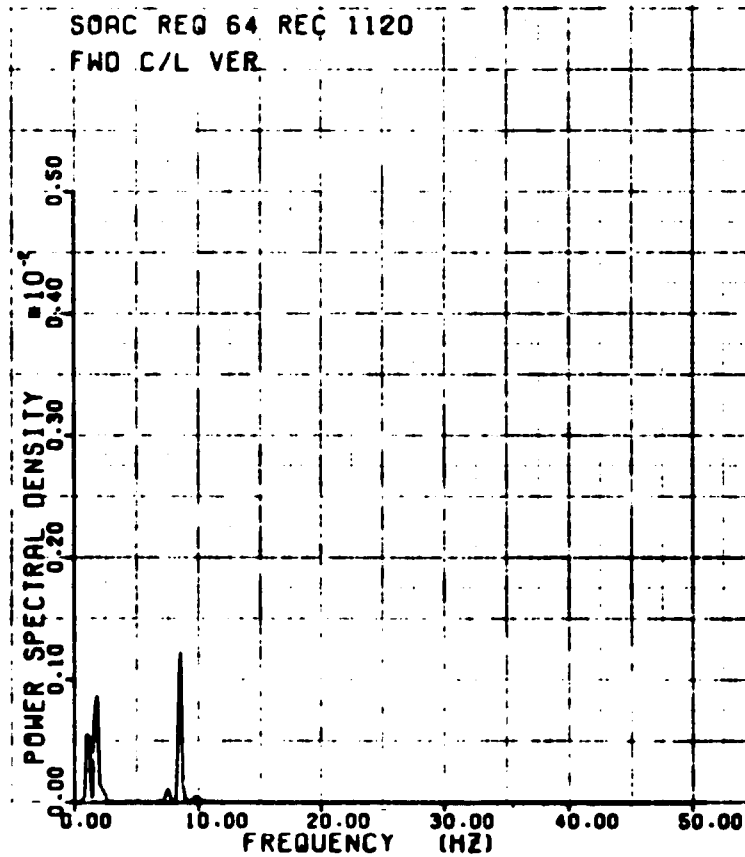
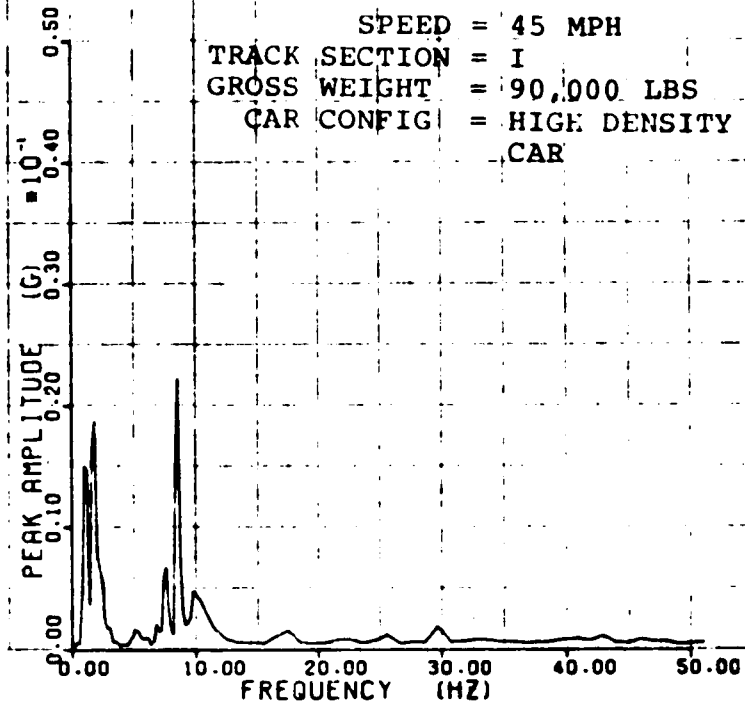
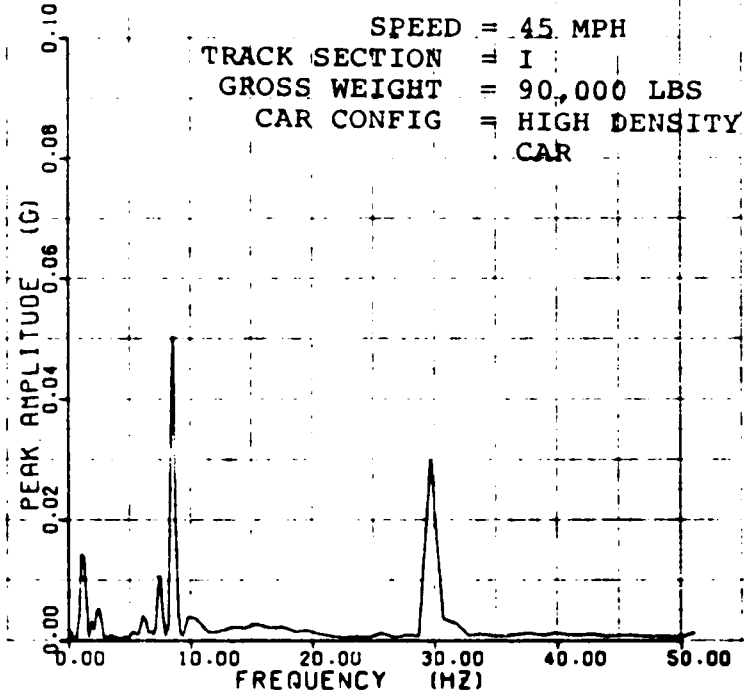


Figure A-22

SCRC REQ 64 REC 1120

MID C/L VER

RESILIENT WHEELS



SCRC REQ 64 REC 1120

MID C/L VER

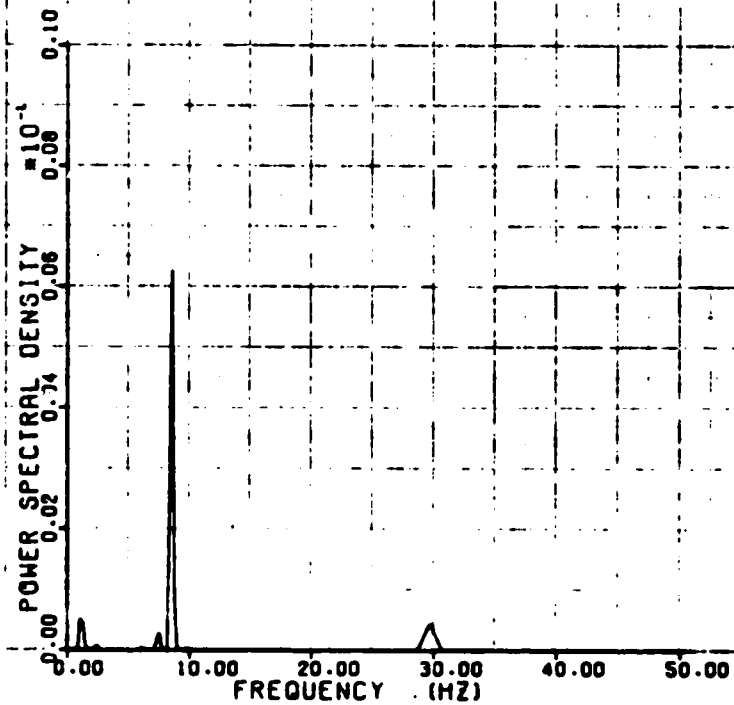


Figure A-23

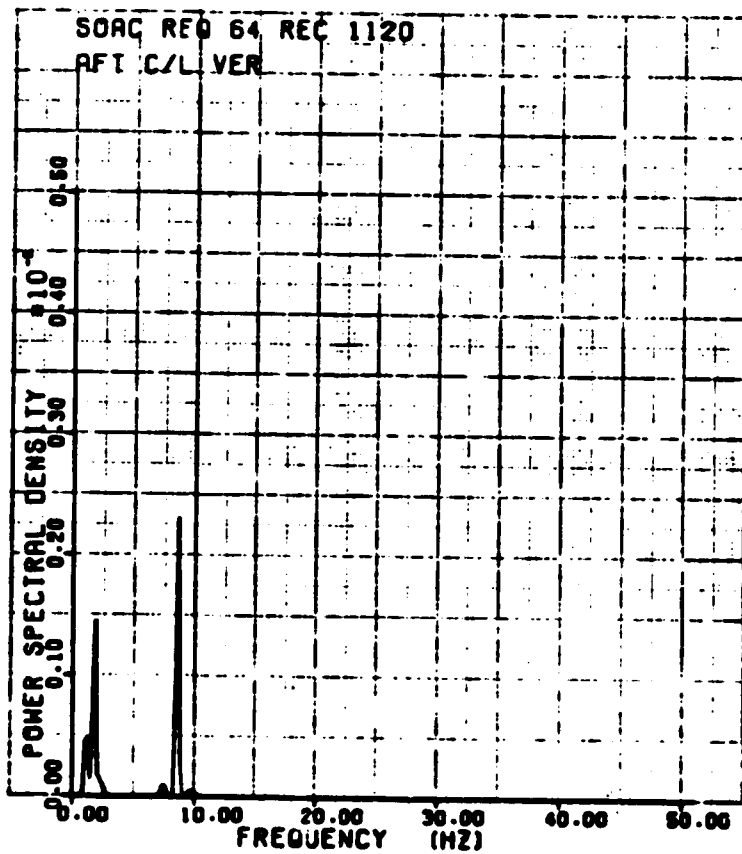
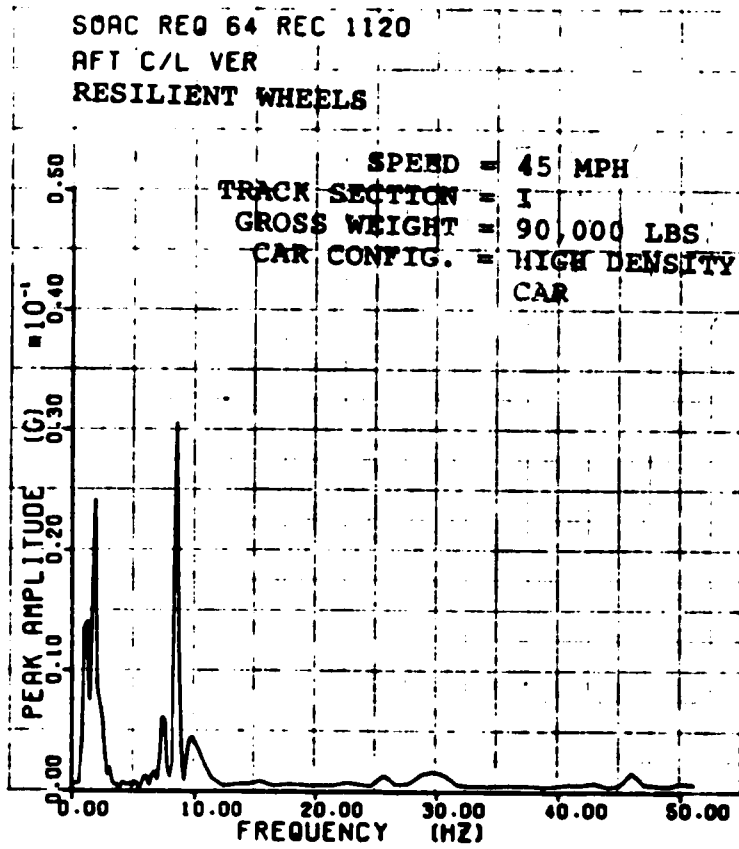


Figure A-24

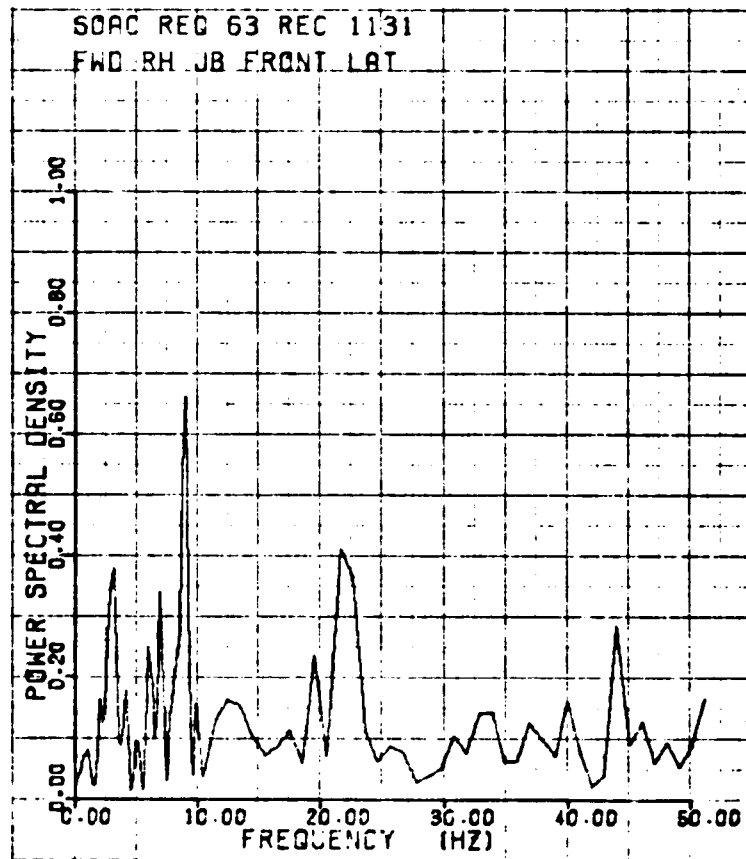
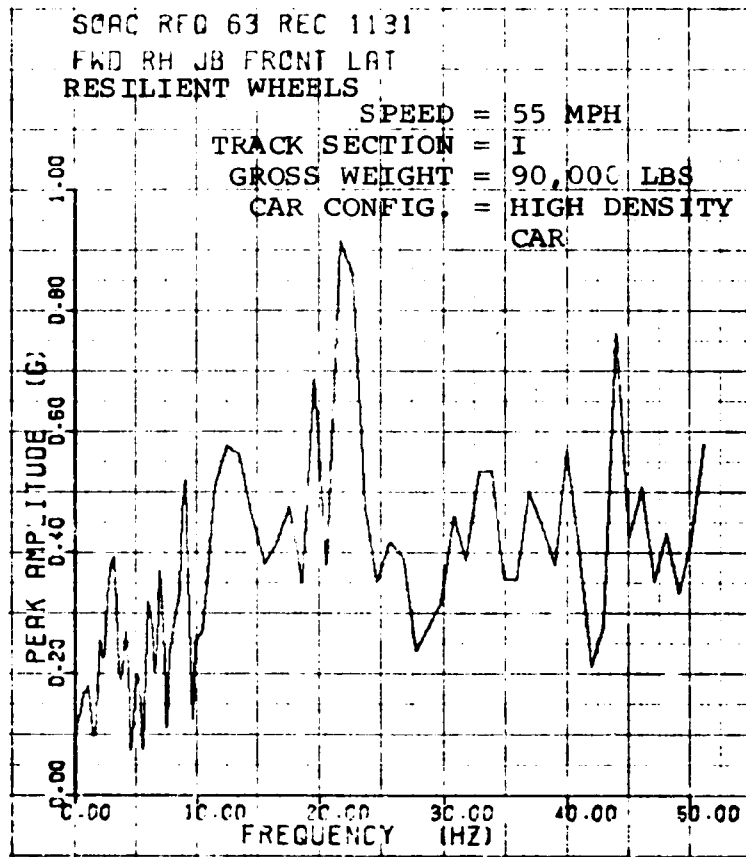


Figure A-25

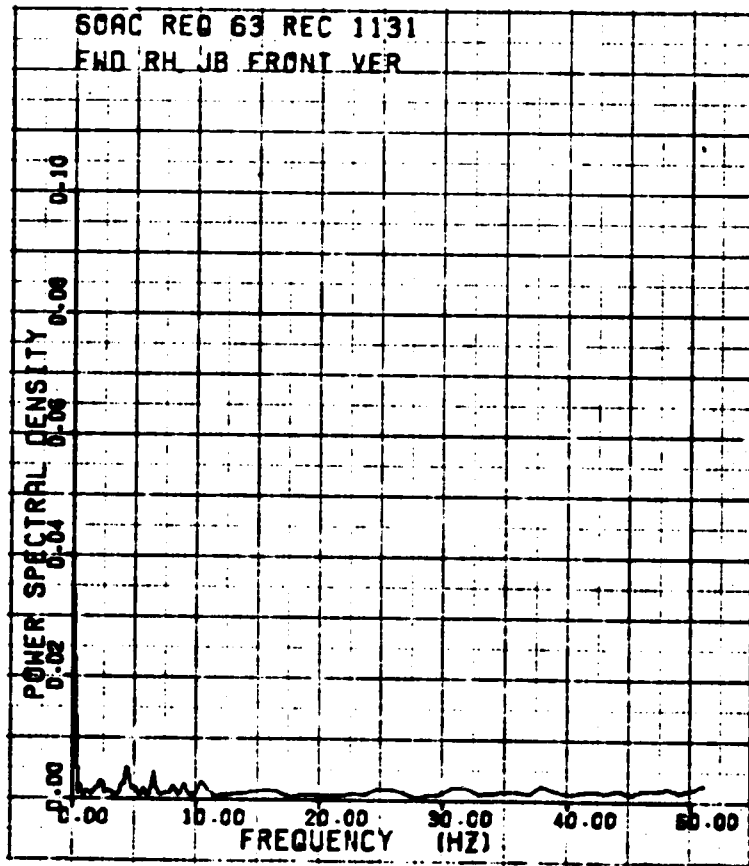
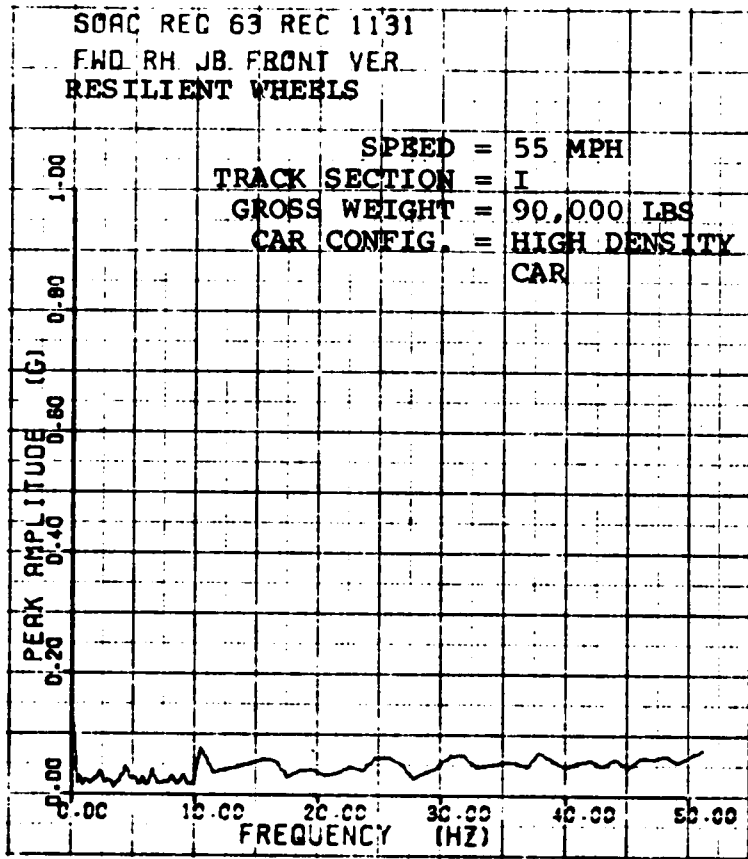


Figure A-26

SOAC REQ 64 REC 1131

MID R/H VER

RESILIENT WHEELS

SPEED = 55 MPH

TRACK SECTION = I

GROSS WEIGHT = 90,000 LBS

CAR CONFIG, = HIGH DENSITY
CAR

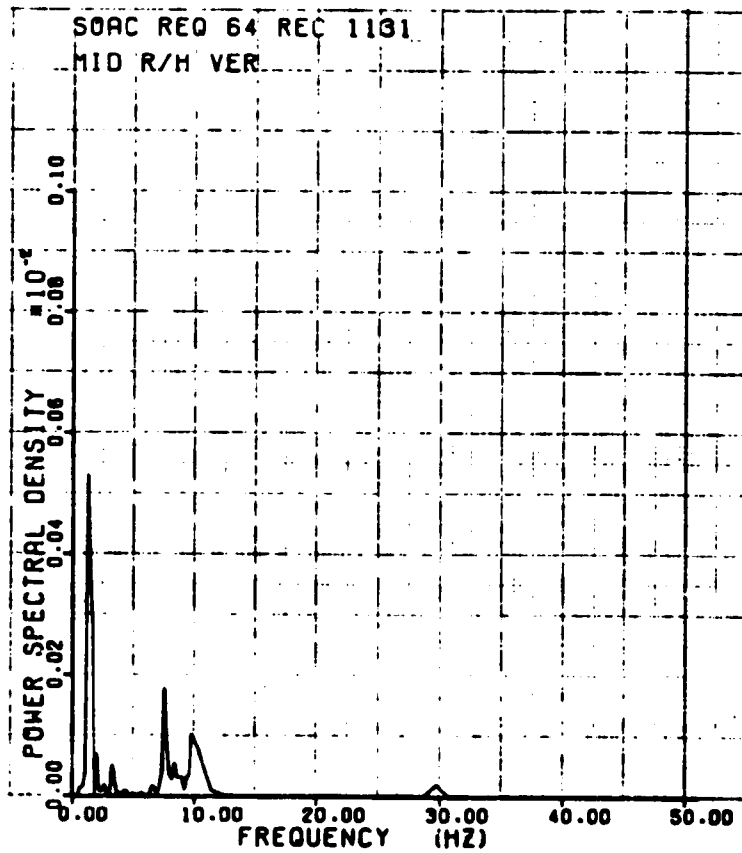
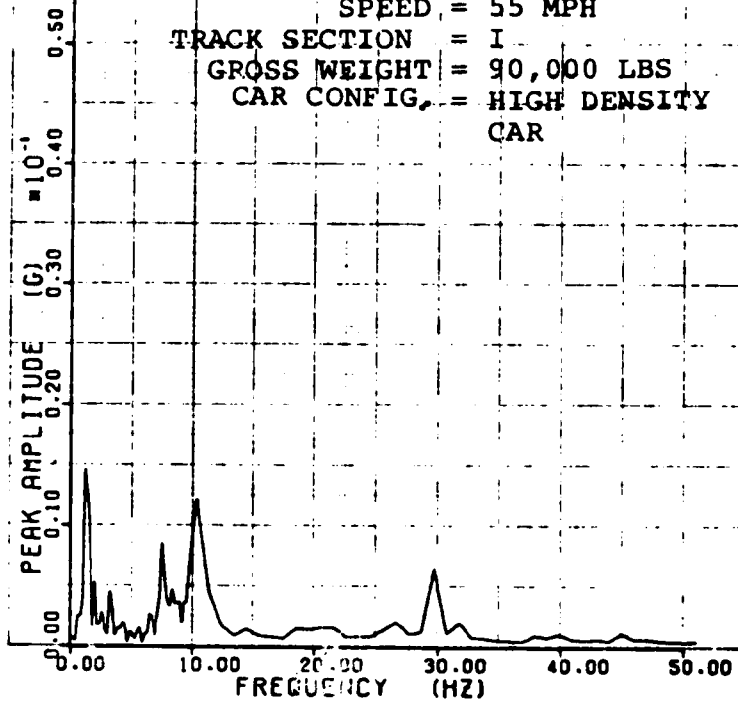
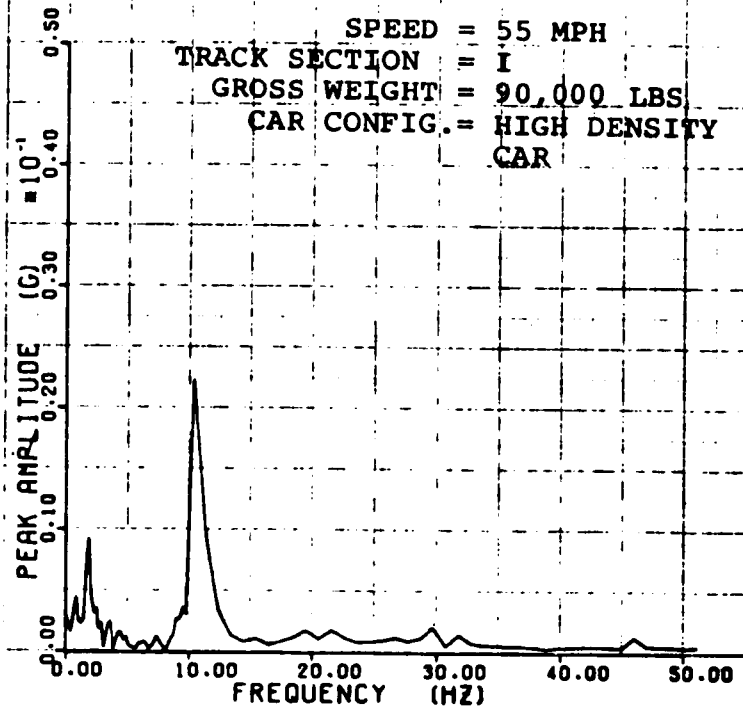


Figure A-27

SOAC REQ 64 REC 1131

AFT C/L LAT

RESILIENT WHEELS



SOAC REQ 64 REC 1131

AFT C/L LAT

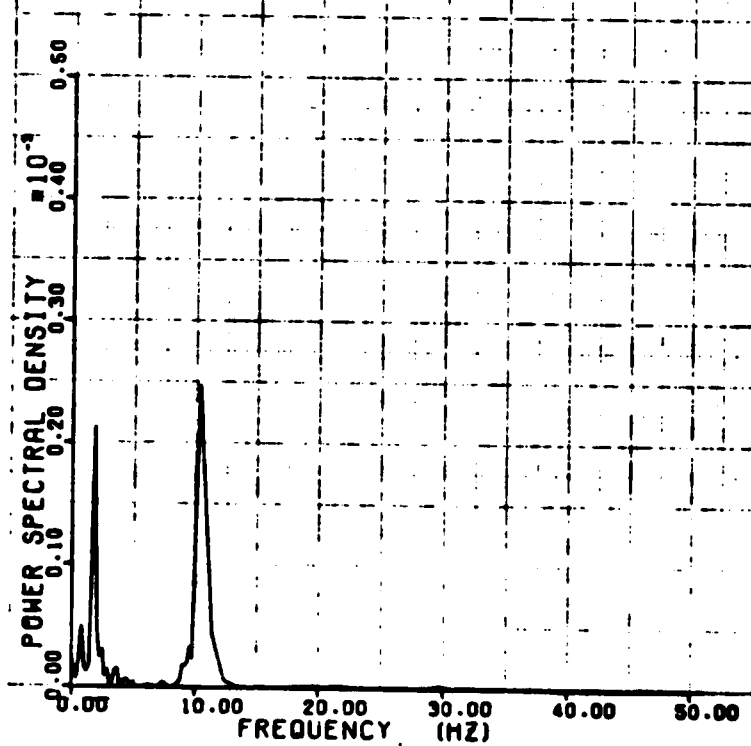


Figure A-28

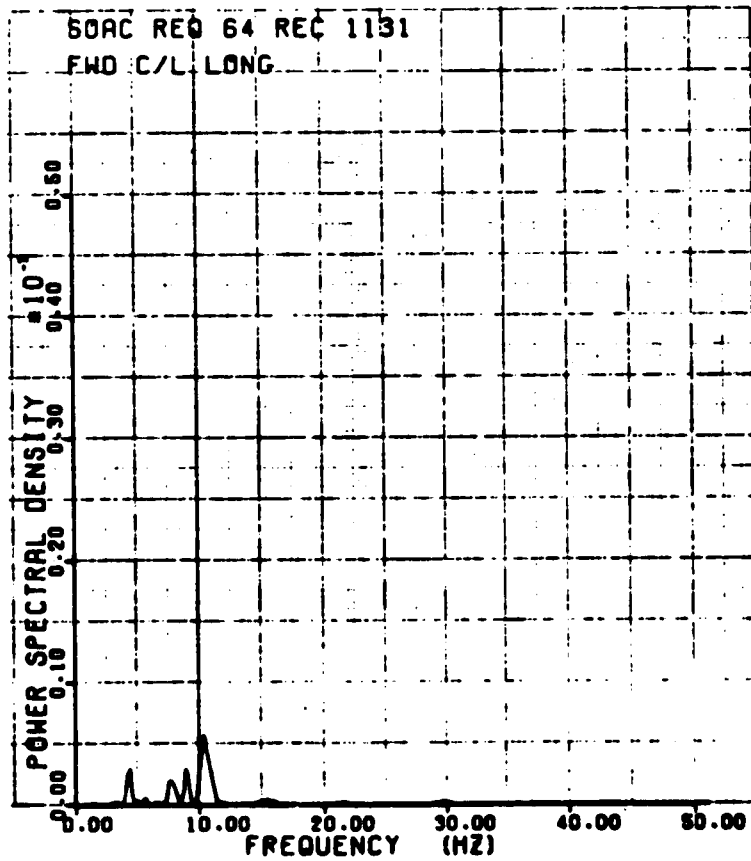
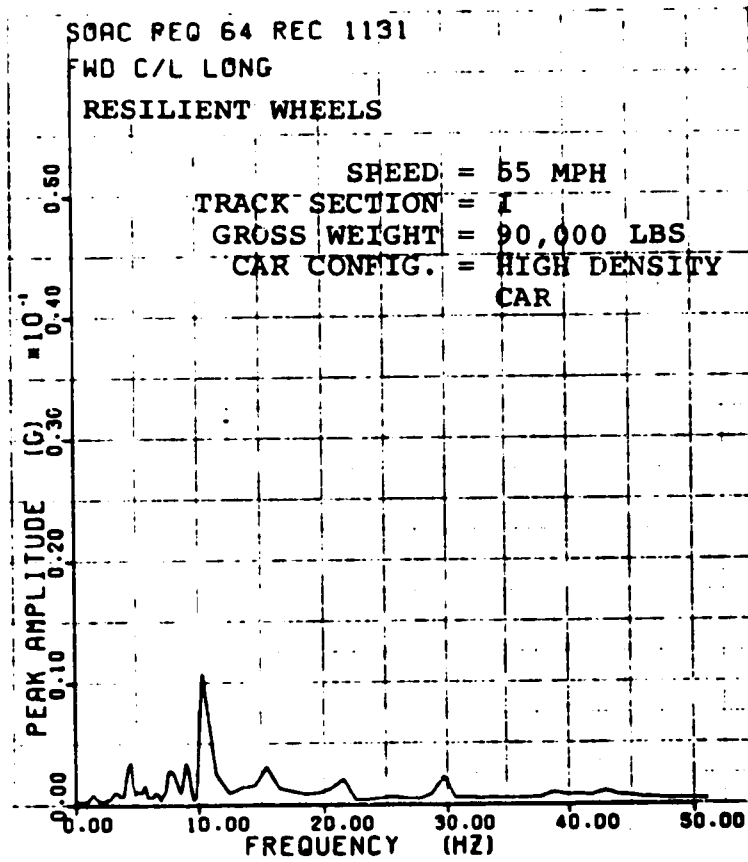


Figure A-29

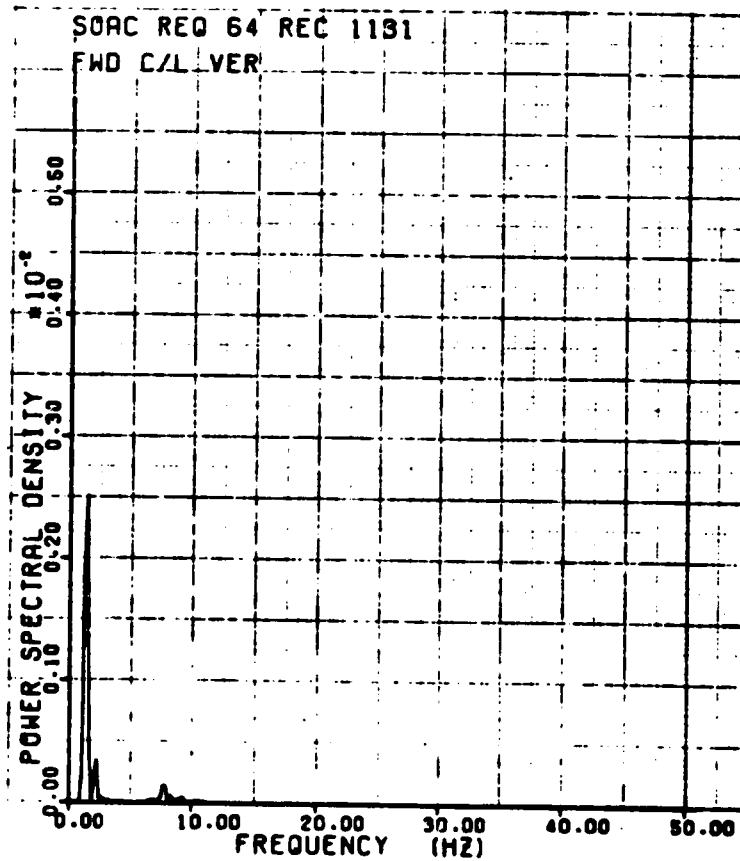
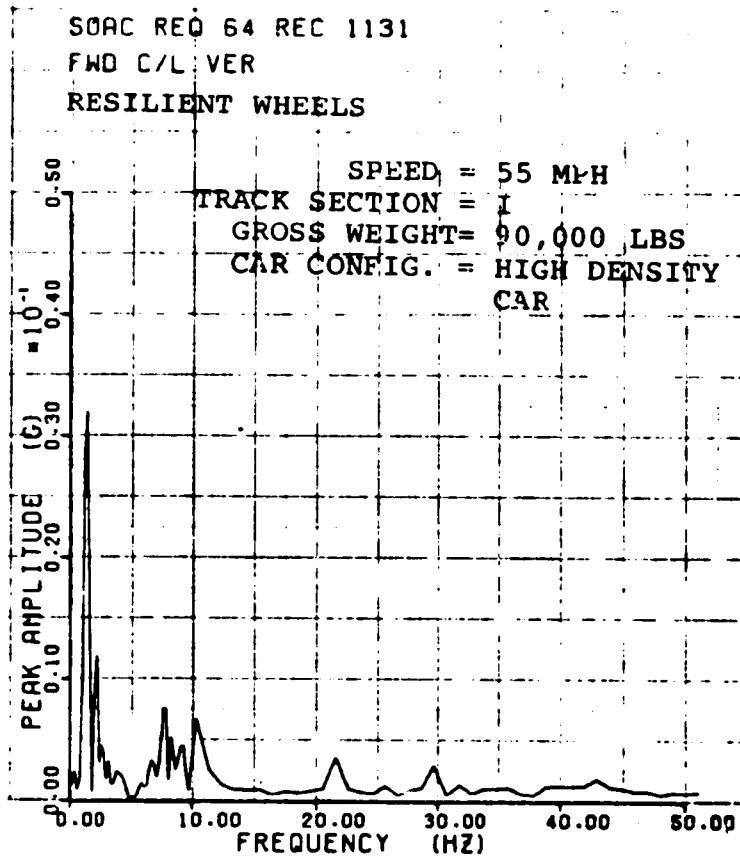
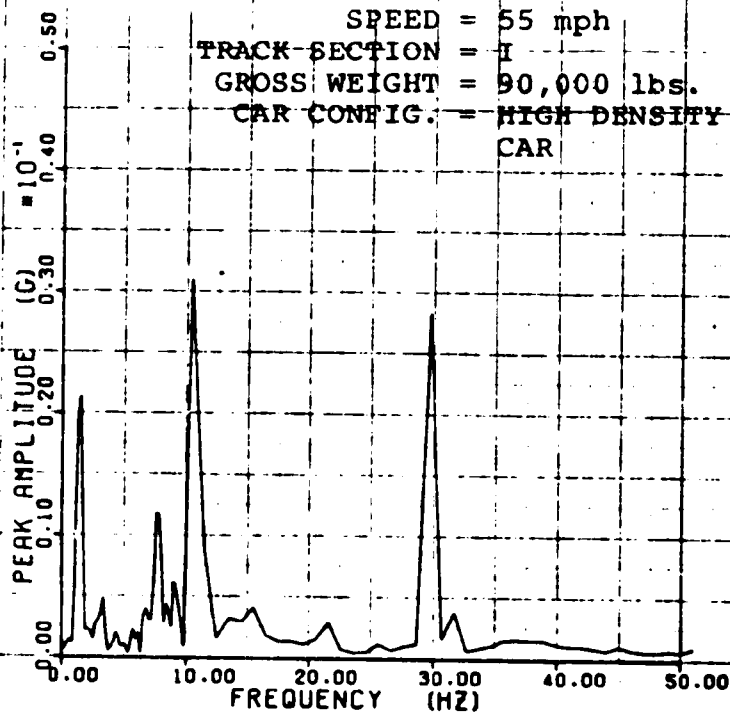


Figure A-30

SOAC REQ 64 REC 1131

MID C/L VER

RESILIENT WHEELS



SOAC REQ 64 REC 1131

MID C/L VER

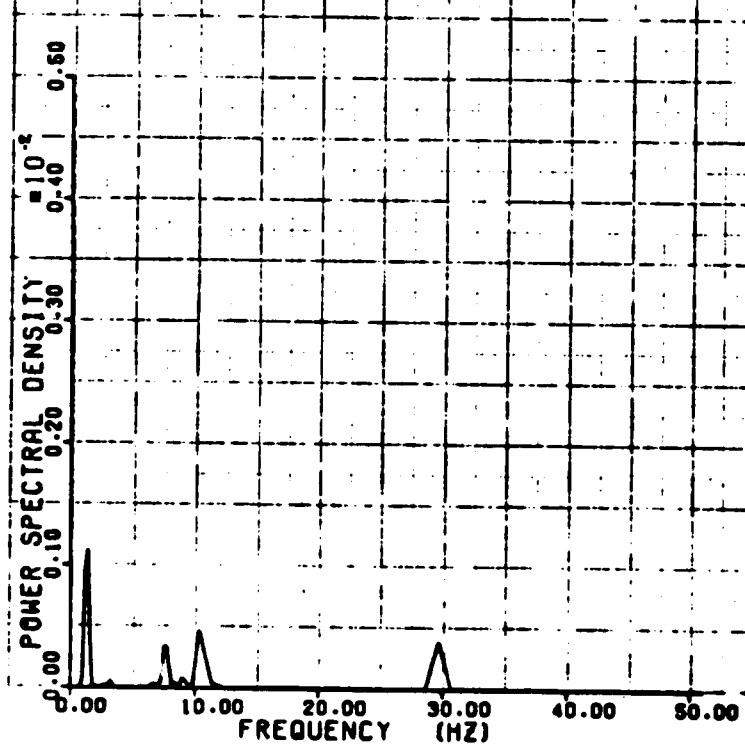


Figure A-31

SOAC REQ 64 REC 1131

AFT C/L VER

RESILIENT WHEELS

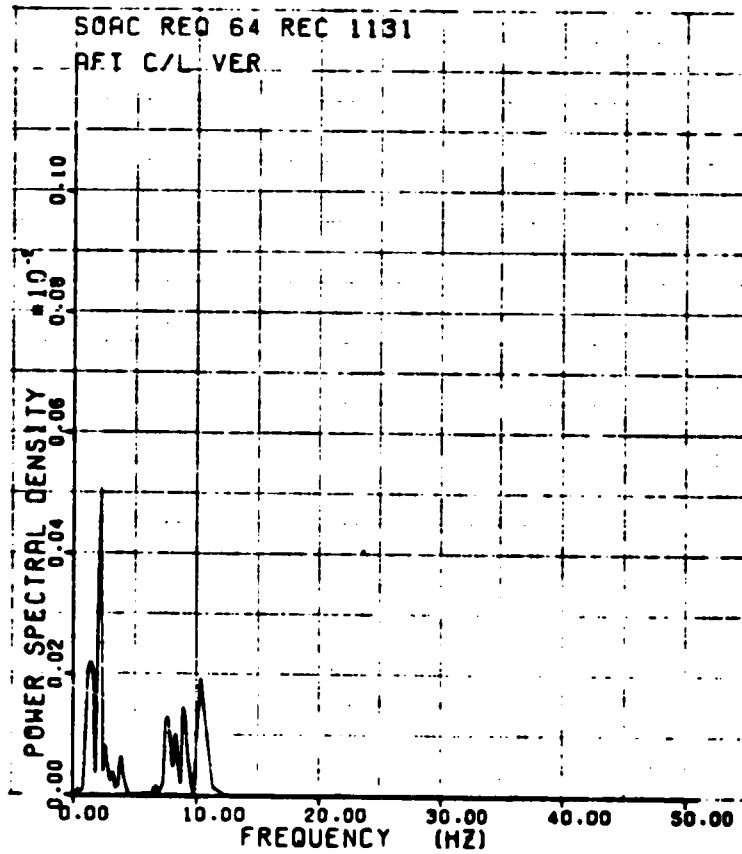
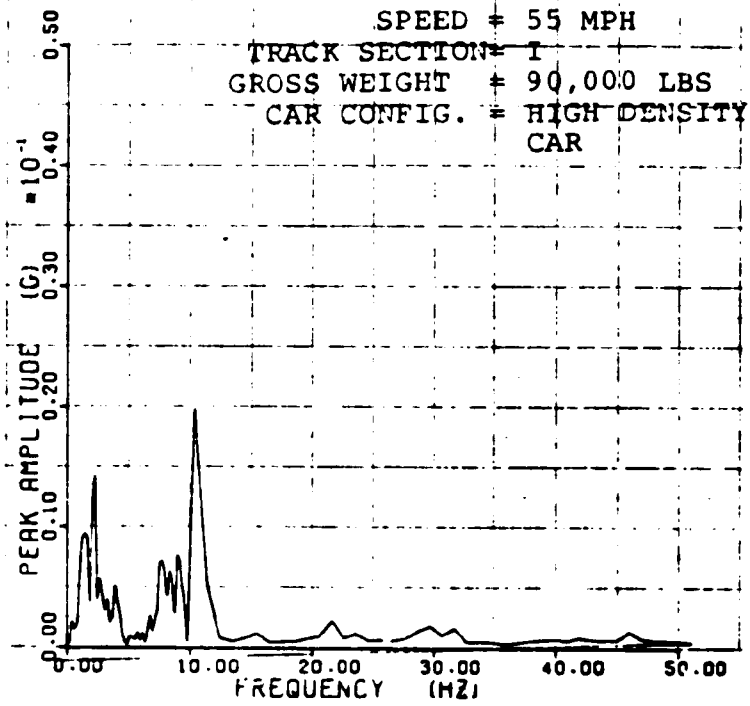


Figure A-32

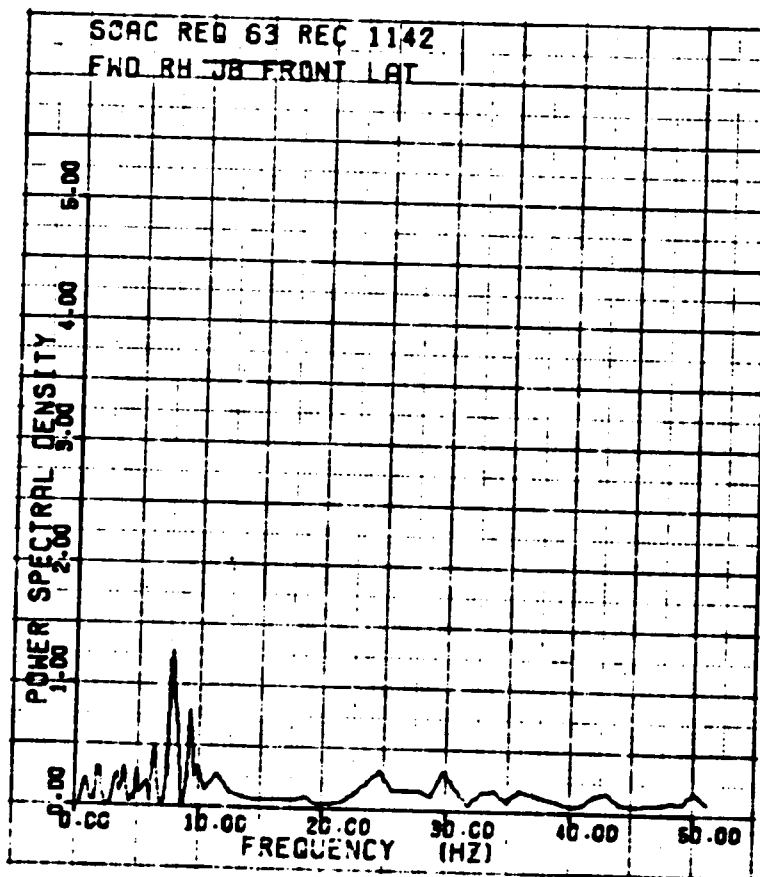
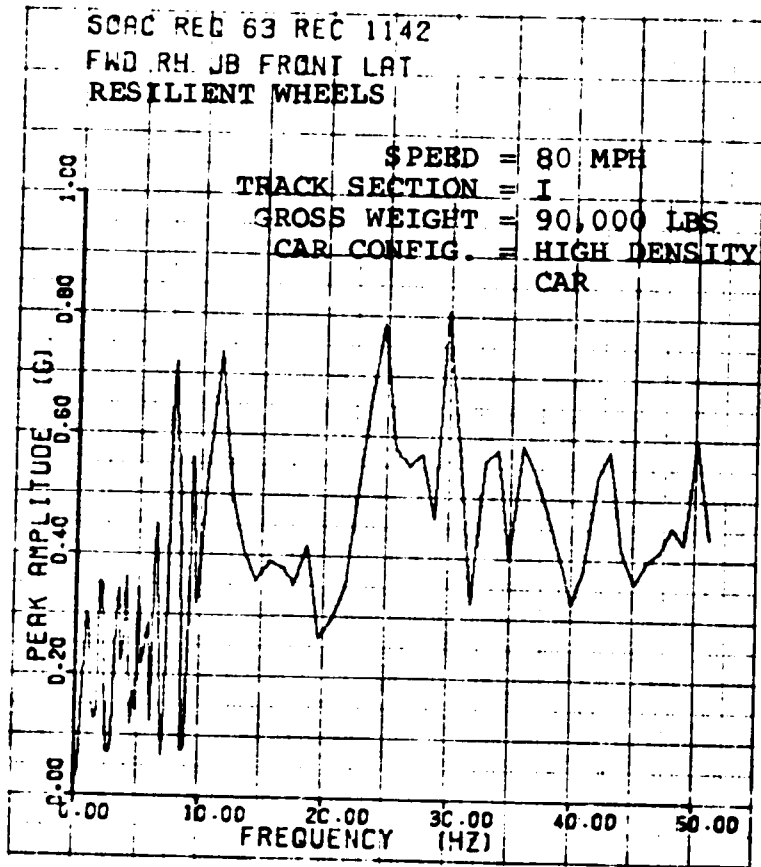


Figure A-33

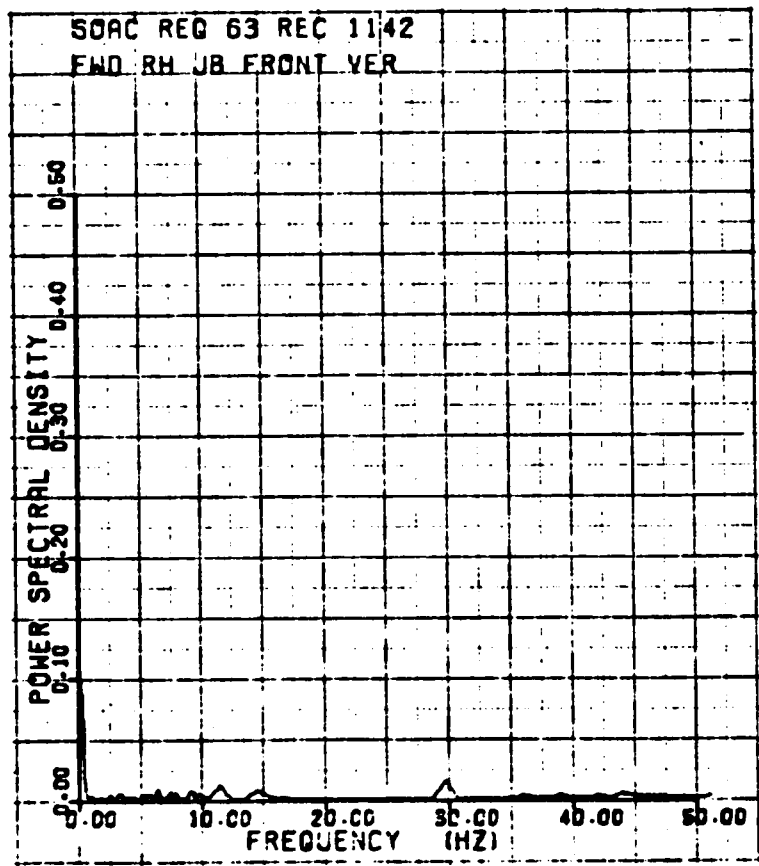
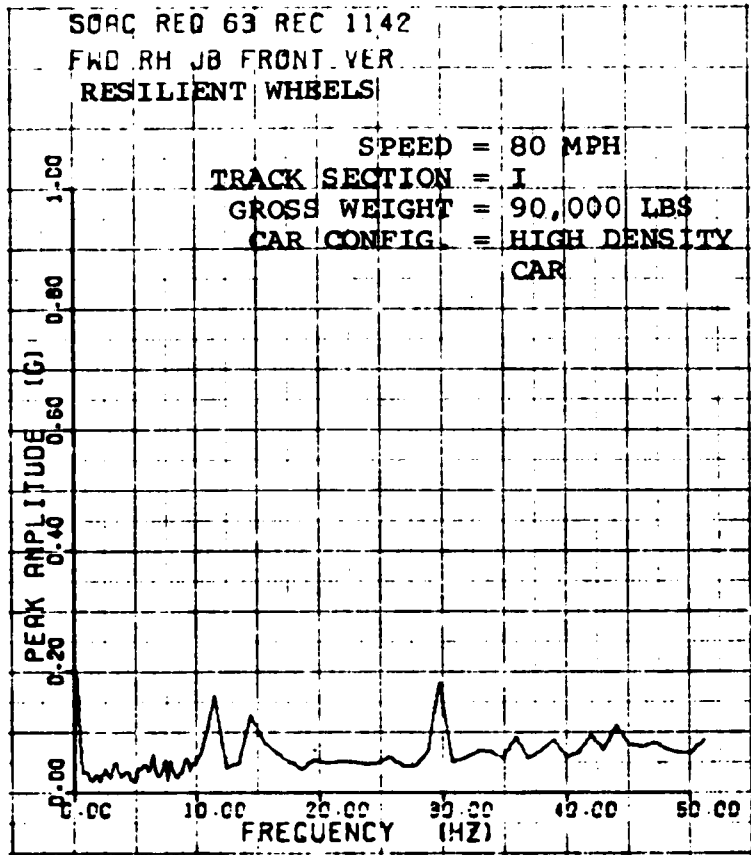


Figure A-34

SOAC REQ 64 REC 1142

MID R/H VER

RESILIENT WHEELS

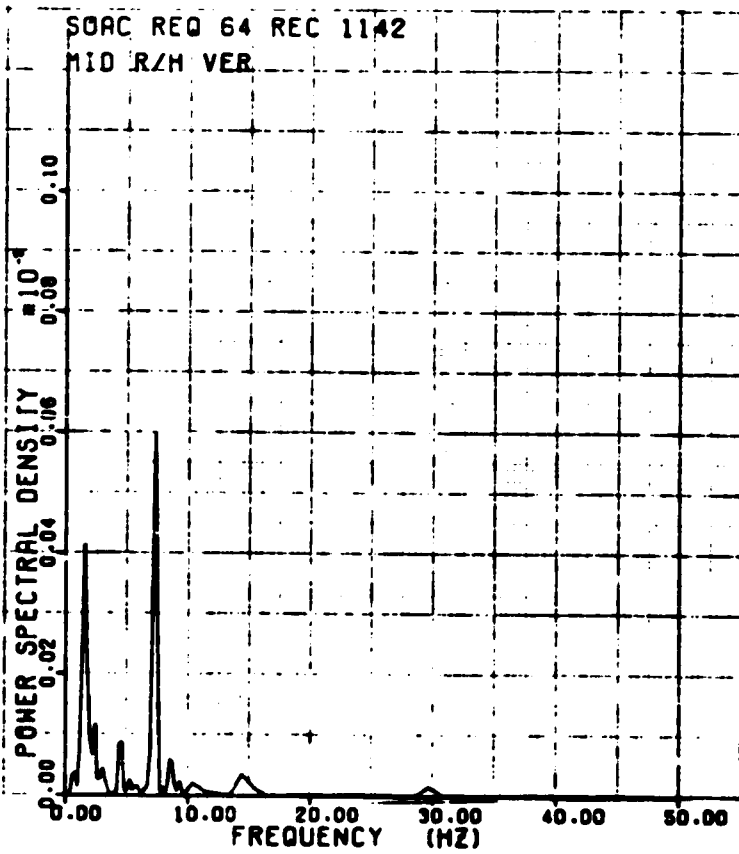
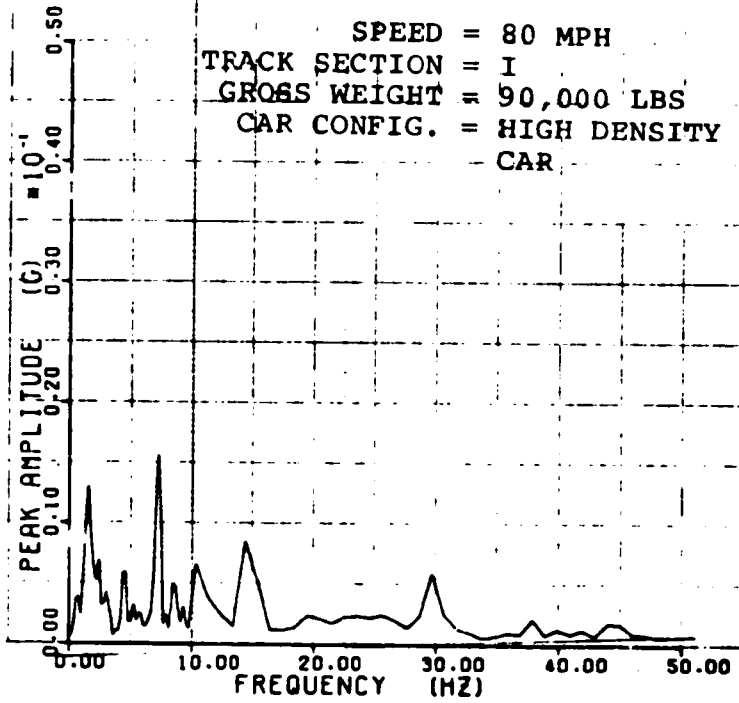


Figure A-35

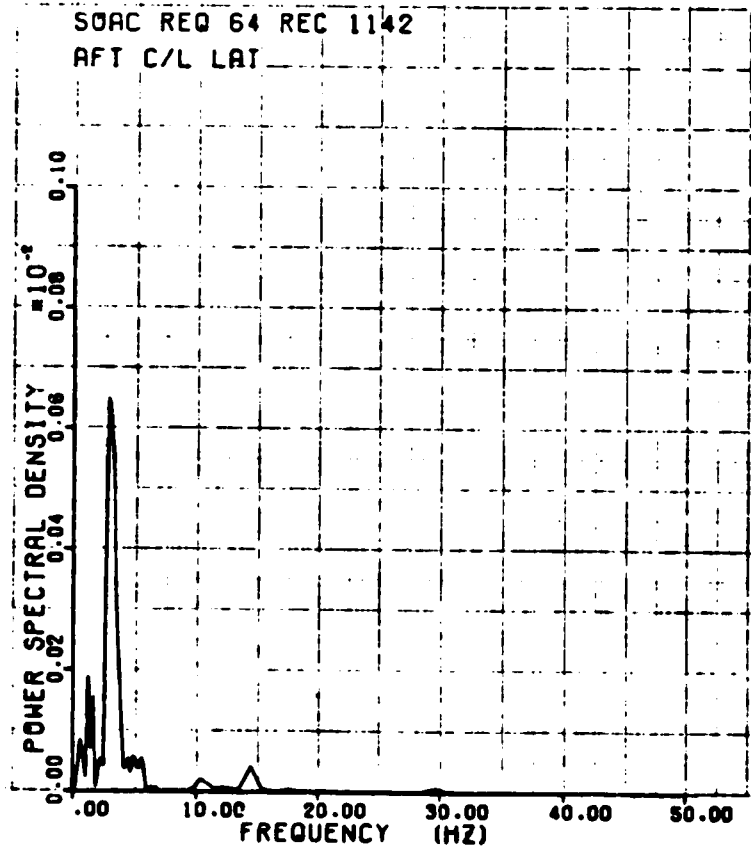
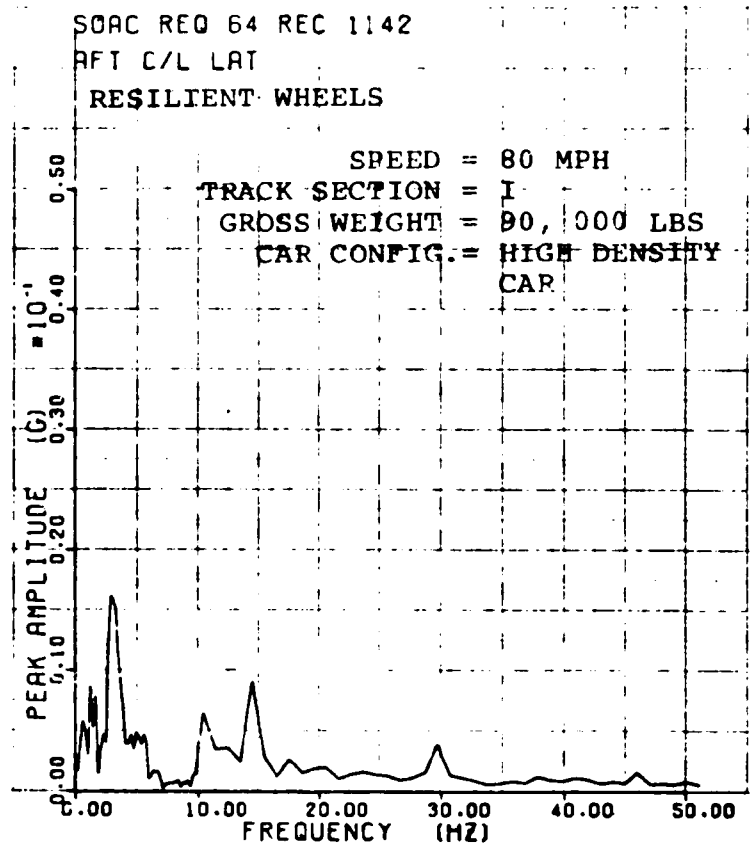


Figure A-36

SOAC REQ 64 REC 1142

FWD C/L LONG

RESILIENT WHEELS

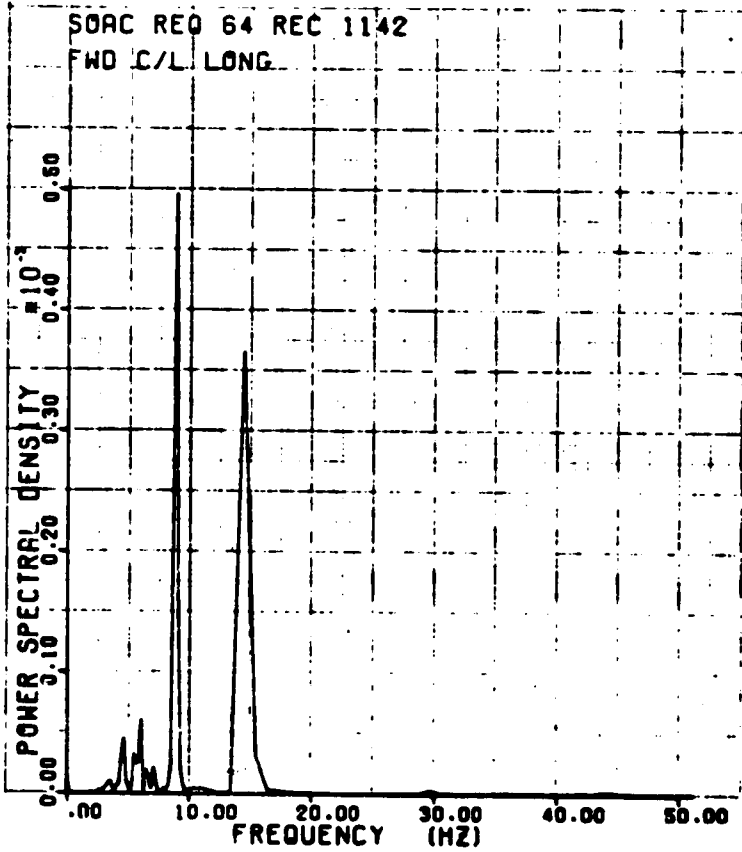
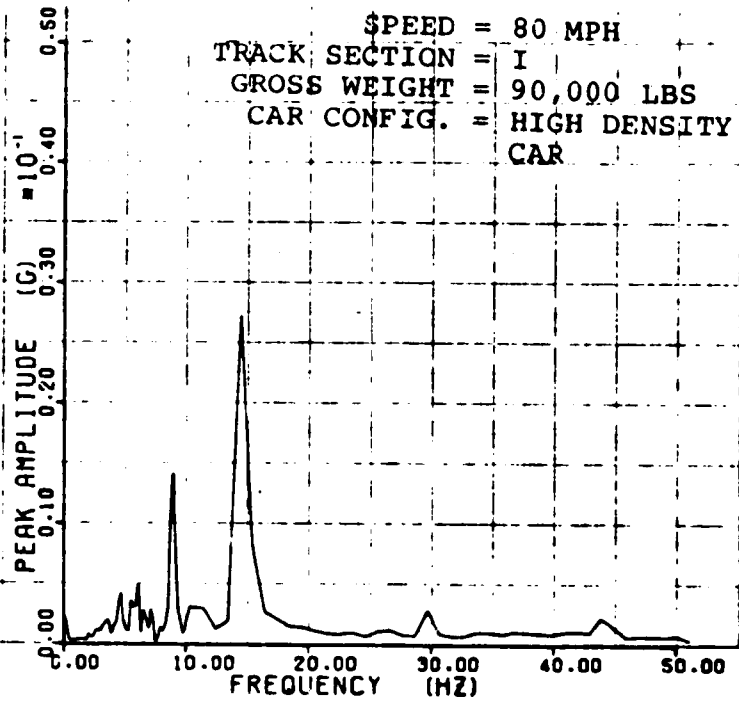


Figure A-37

SOAC REQ 64 REC 1142

FWD C/L VER

RESILIENT WHEELS

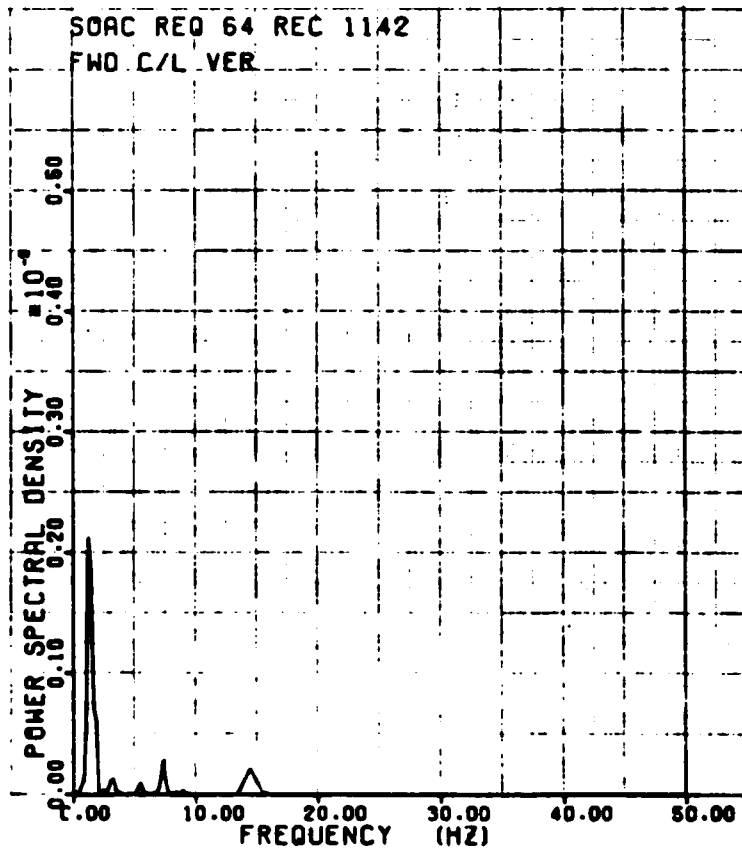
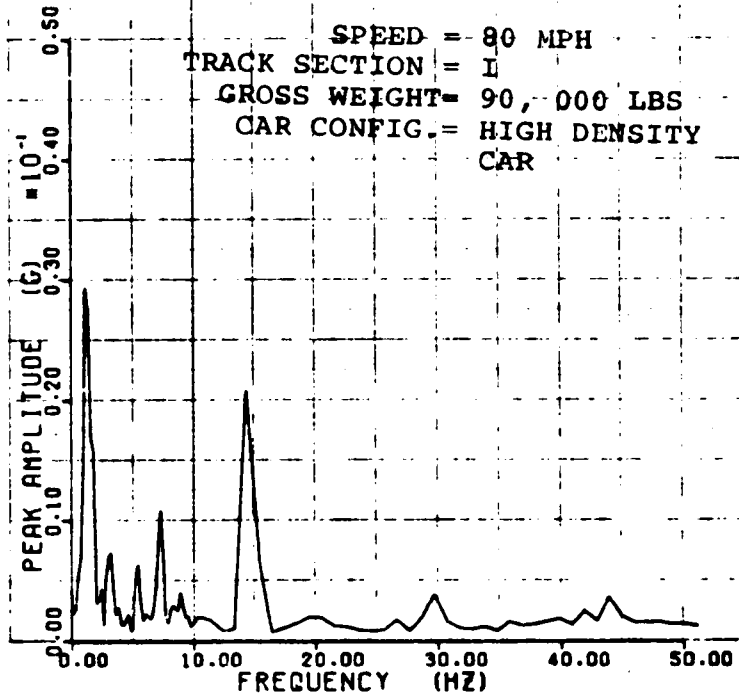


Figure A-38

SOAC REQ 64 REC 1142

MID C/L VER

RESILIENT WHEELS

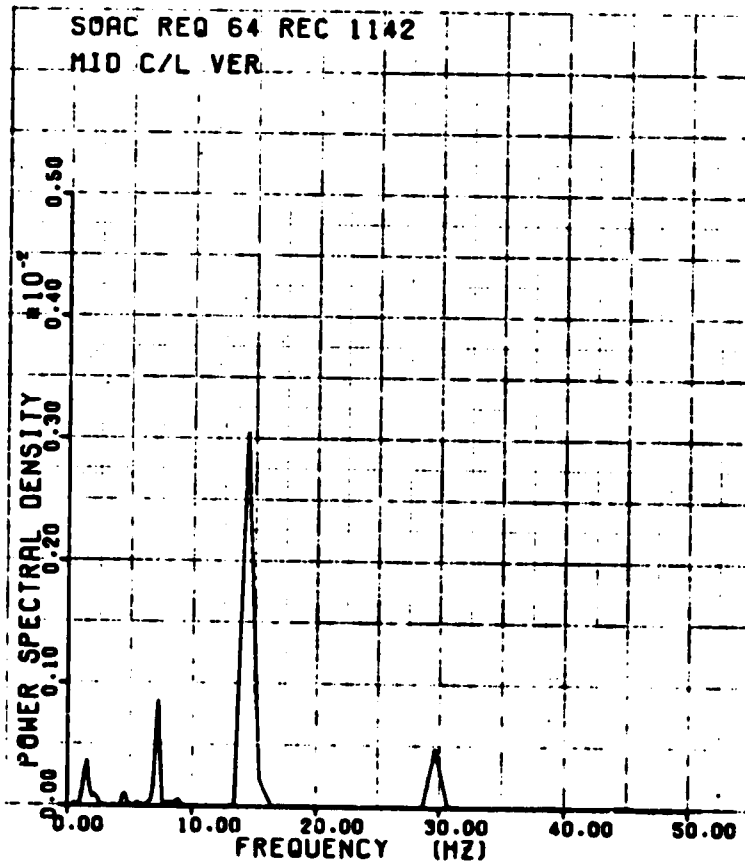
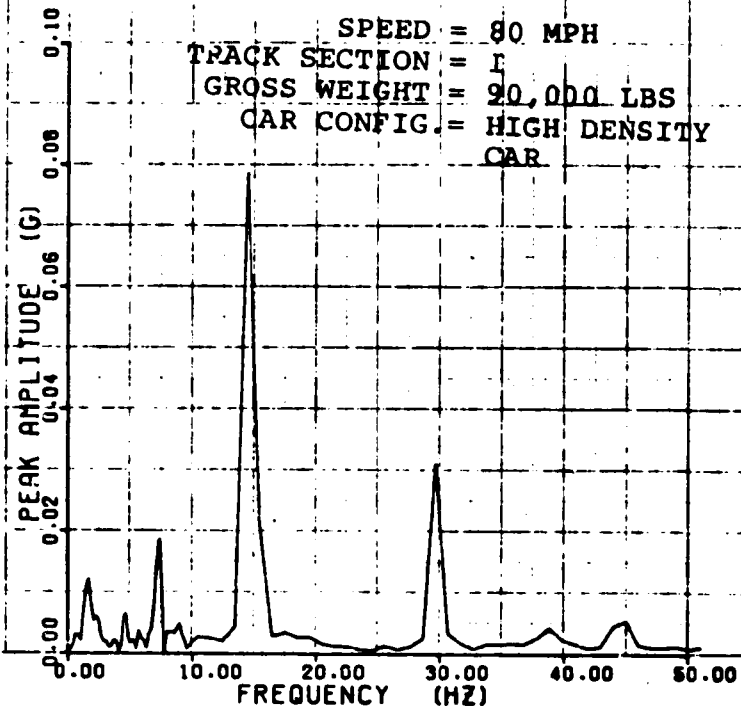
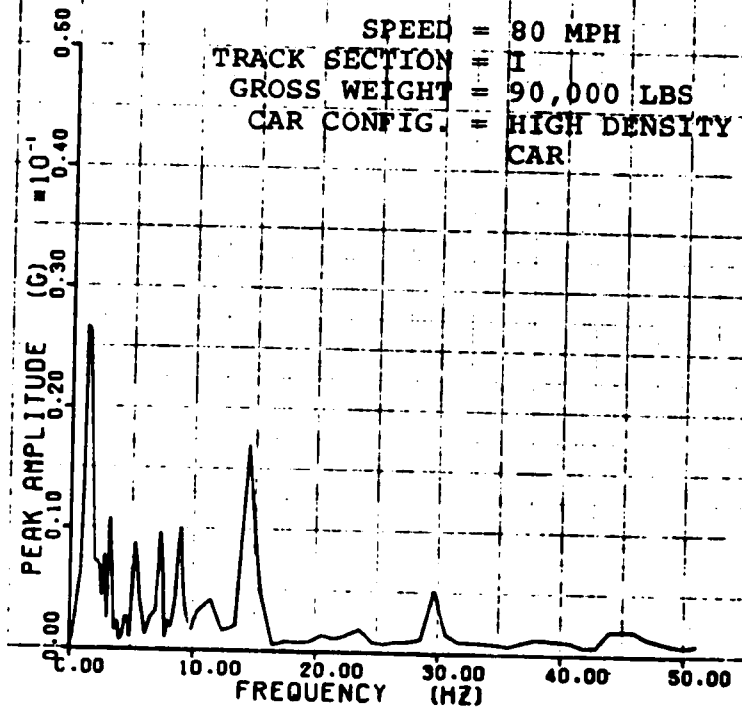


Figure A-39

SOAC REQ 64 REC 1142

AFT C/L VER.

RESILIENT WHEELS



SOAC REQ 64 REC 1142

AFT C/L VER.

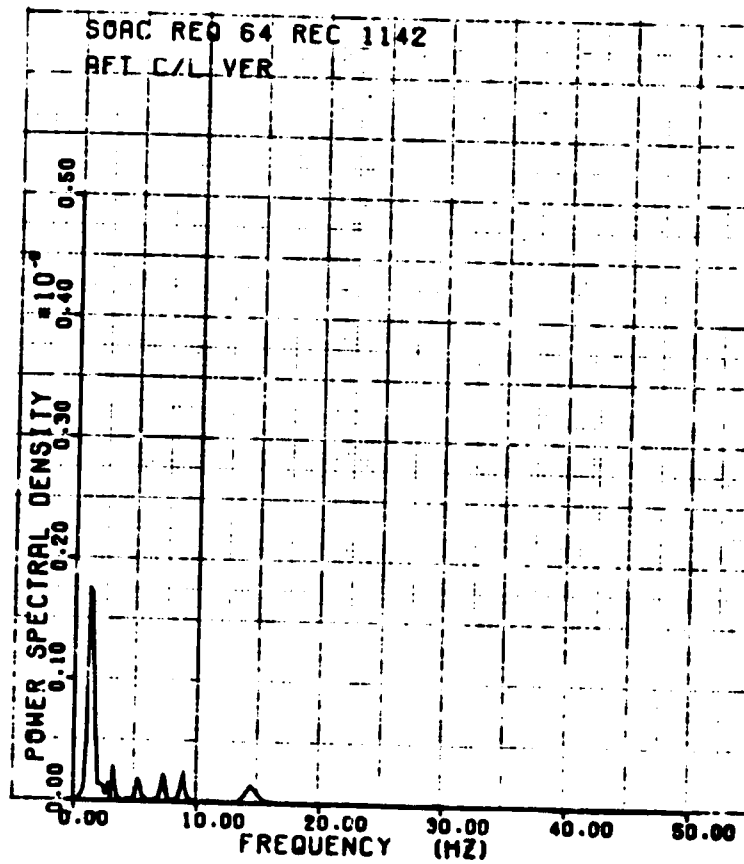


Figure A-40

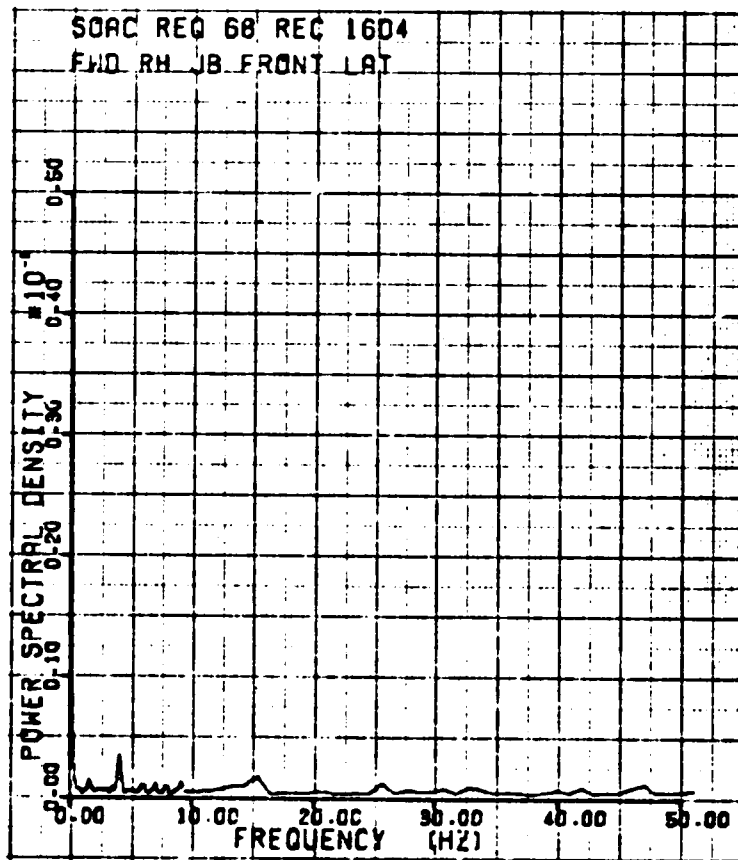
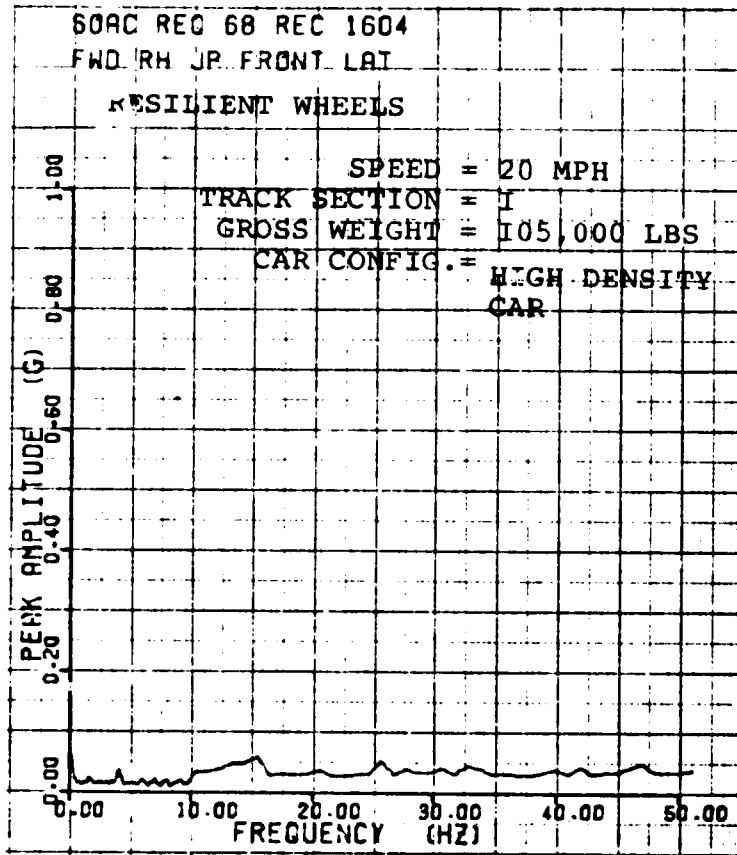


Figure A-41

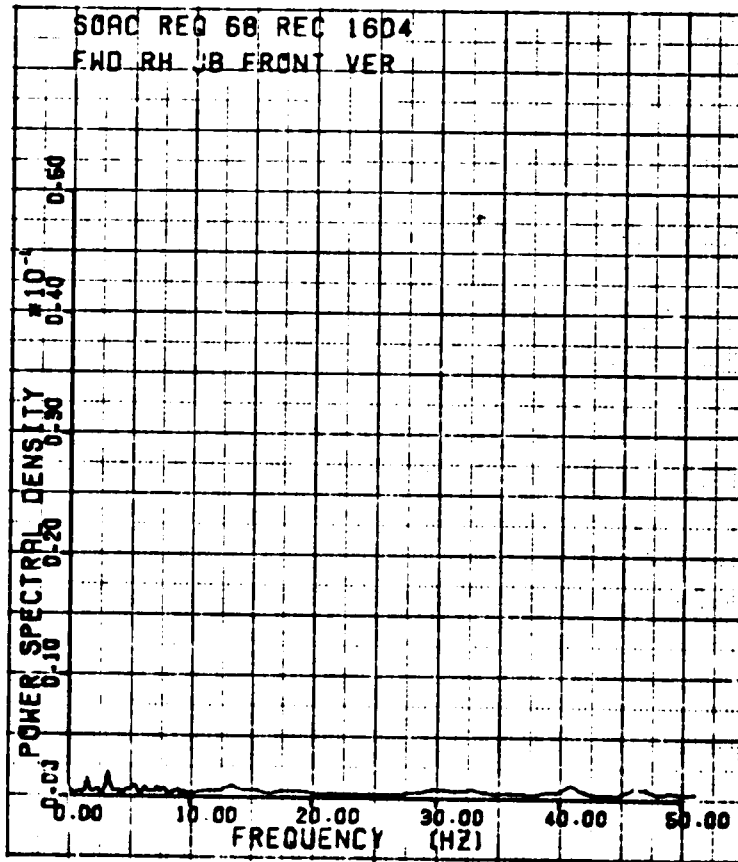
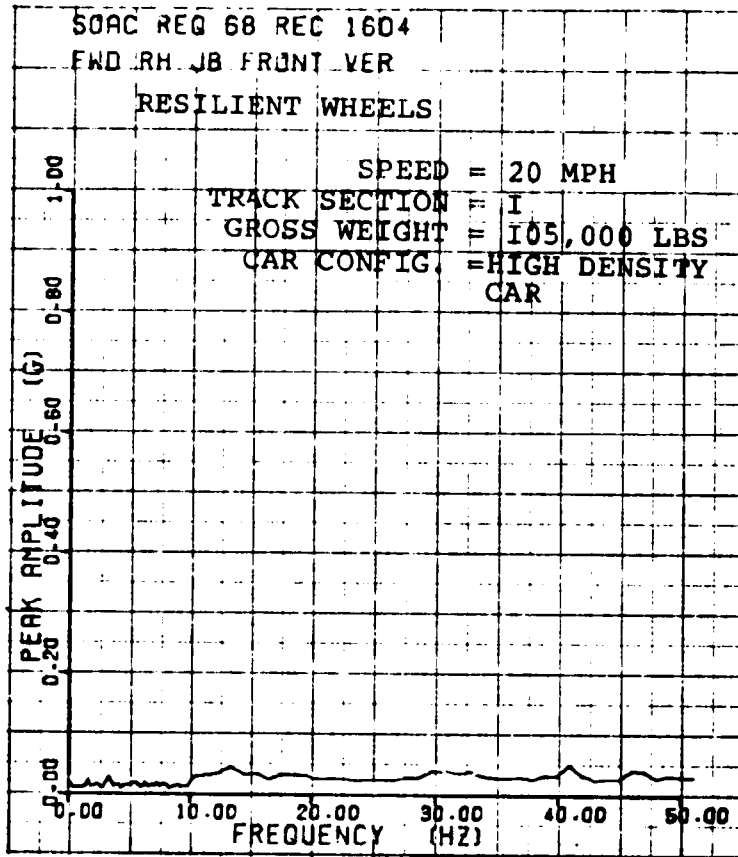
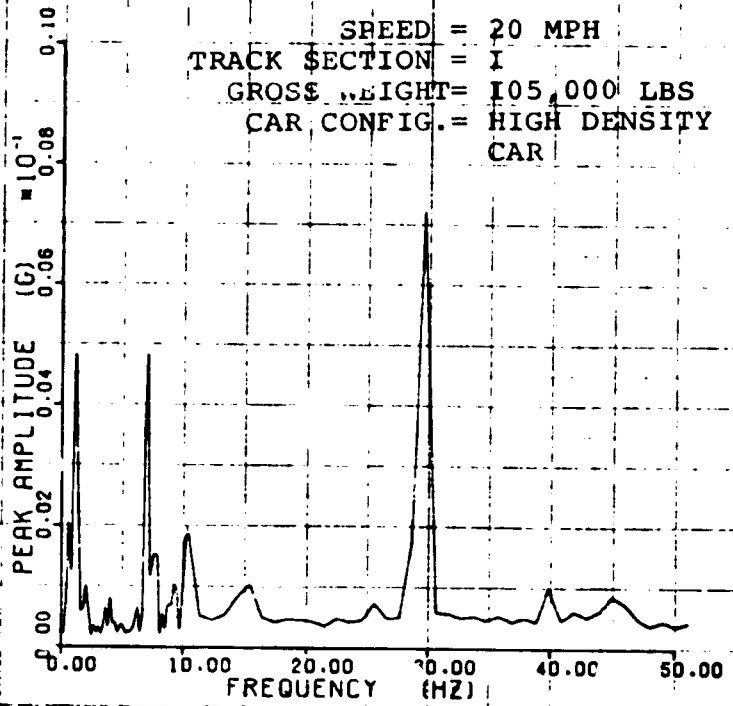


Figure A-42

SOAC REQ 69 REC 1604
MID R/H VER

RESILIENT WHEELS



SOAC REQ 69 REC 1604
MID R/H VER

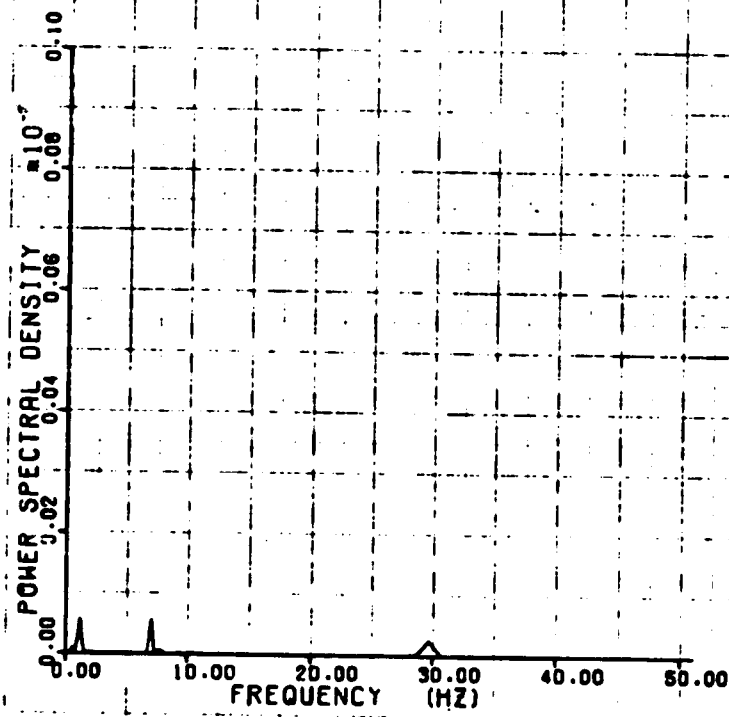


Figure A-43

SOAC REQ 69 REC 1604
AFT C/L LAT

RESILIENT WHEELS

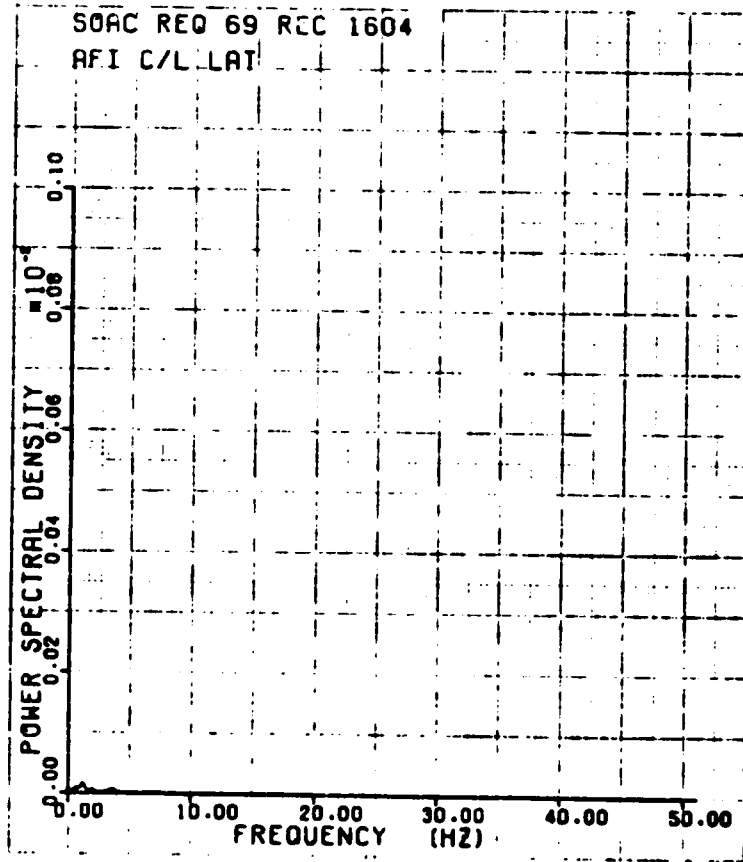
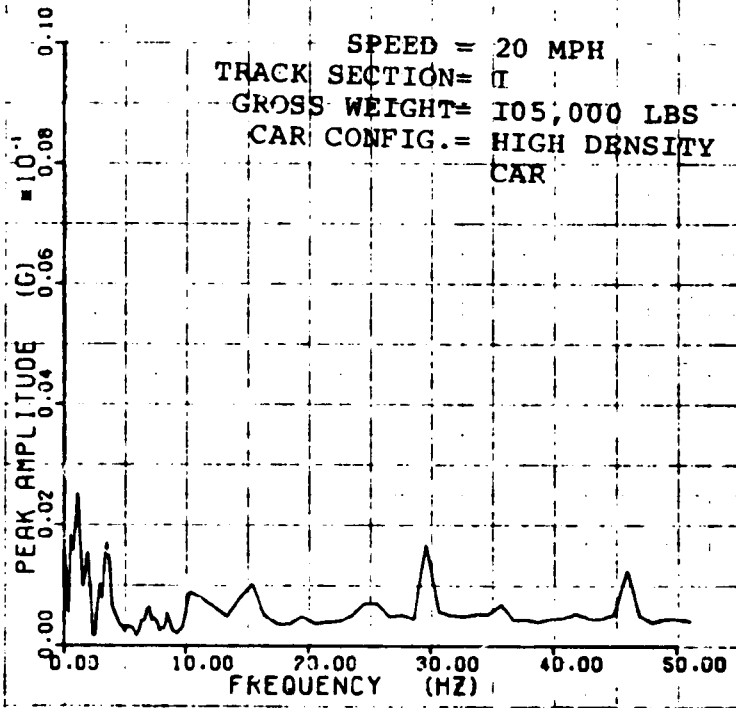


Figure A-44

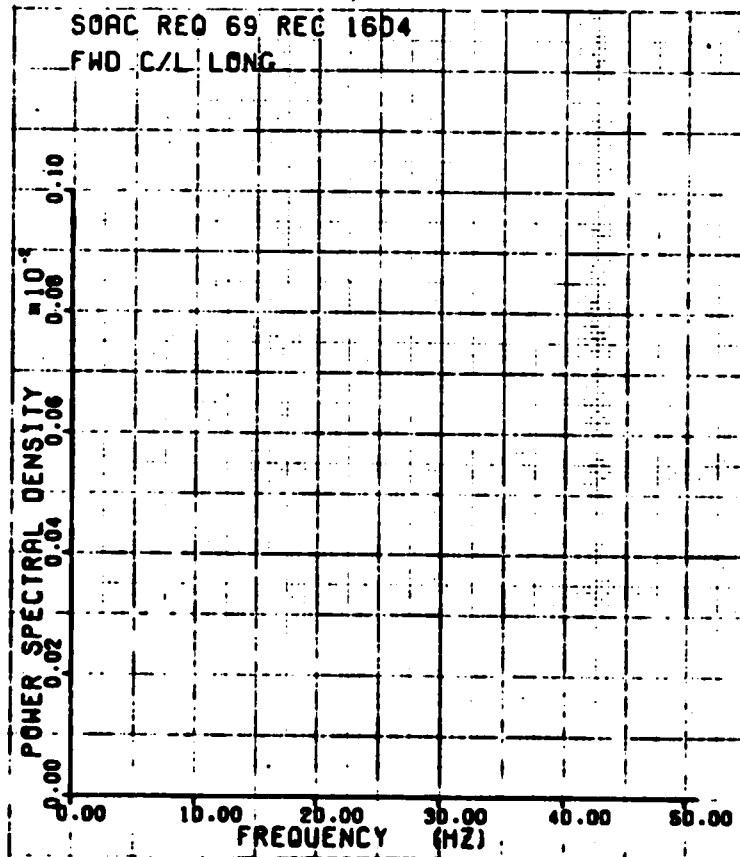
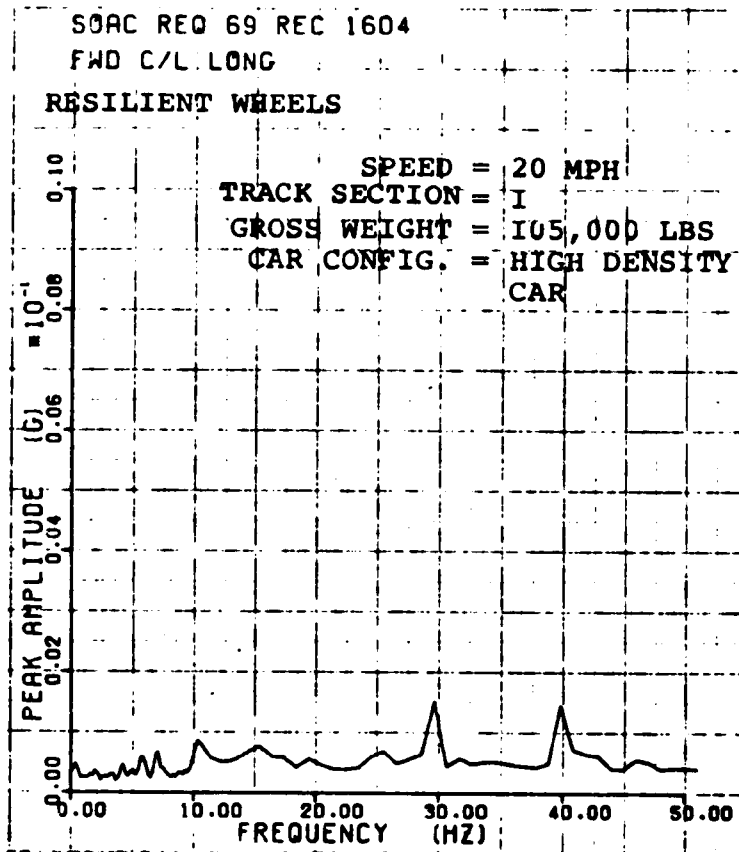
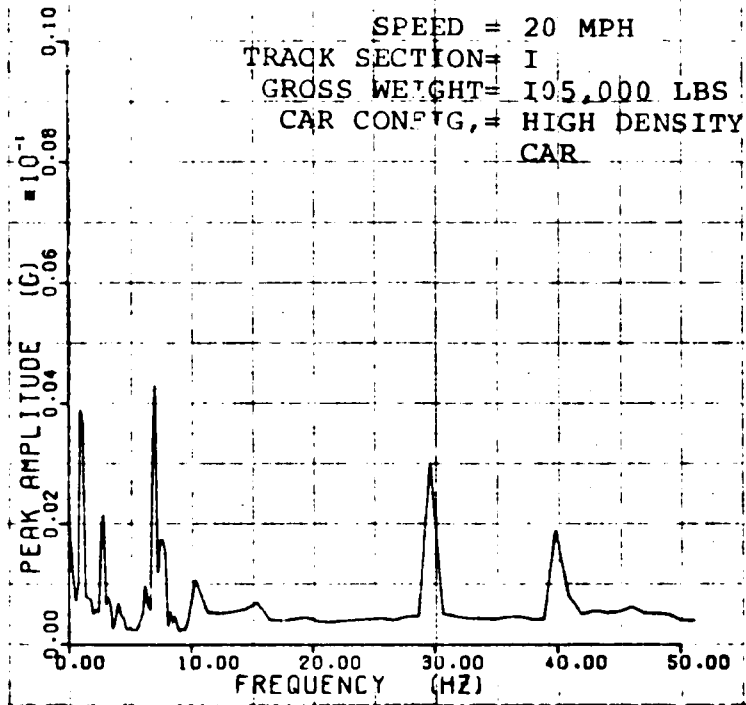


Figure A-45

SOAC REQ 69 REC 1604

FWD C/L VER

RESILIENT WHEELS



SOAC REQ 69 REC 1604

FWD C/L VER

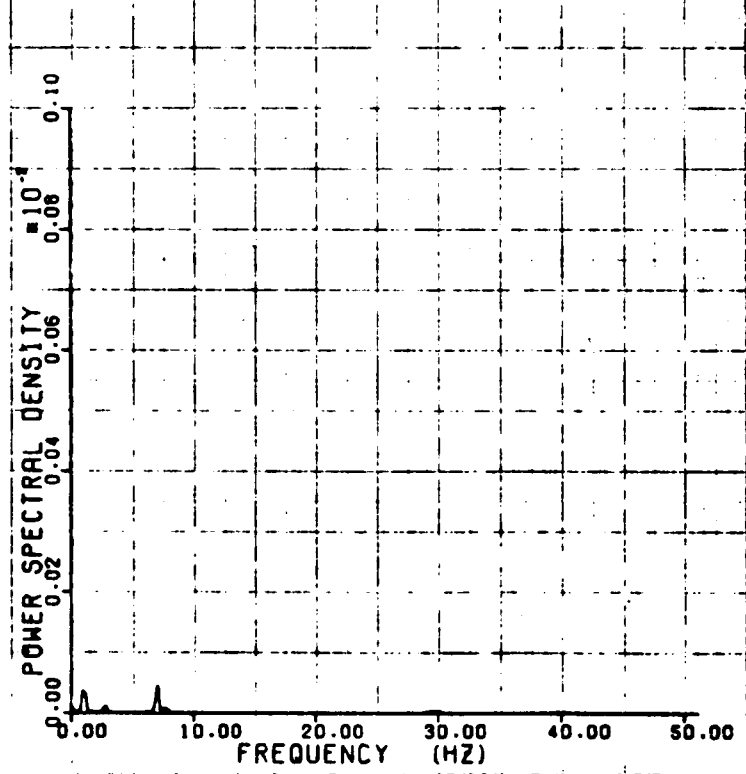
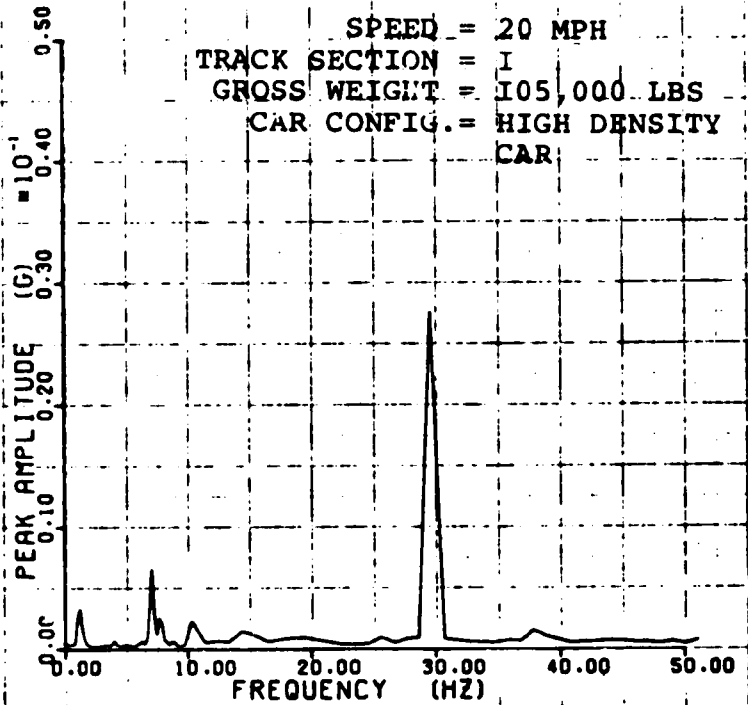


Figure A-46

SOAC REQ 69 REC 1604

MID C/L VER

RESILIENT WHEELS



SOAC REQ 69 REC 1604

MID C/L VER

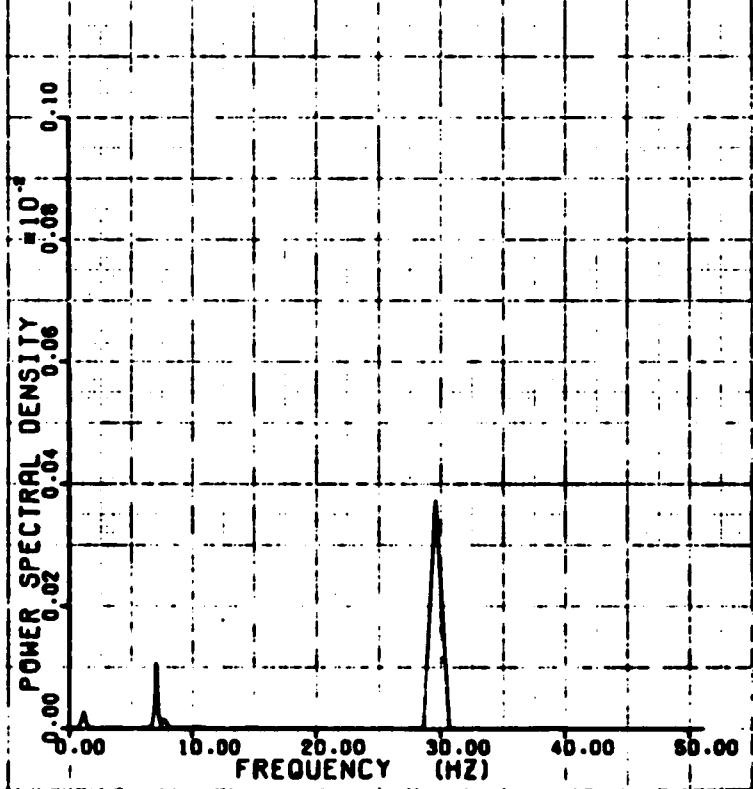
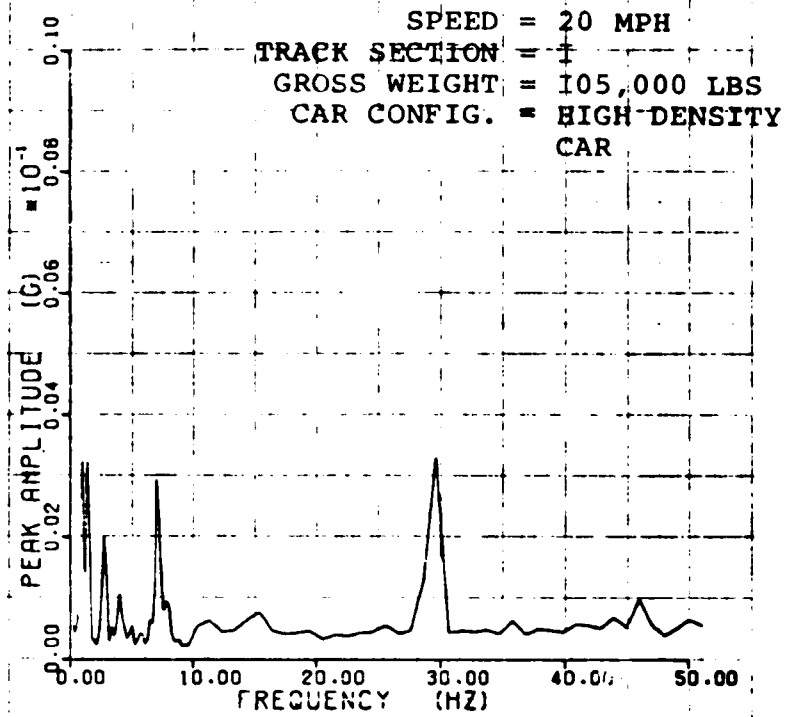


Figure A-47

SOAC REQ 69 REC 1604

AFT C/L VER

RESILIENT WHEELS



SOAC REQ 69 REC 1604

AFT C/L VER

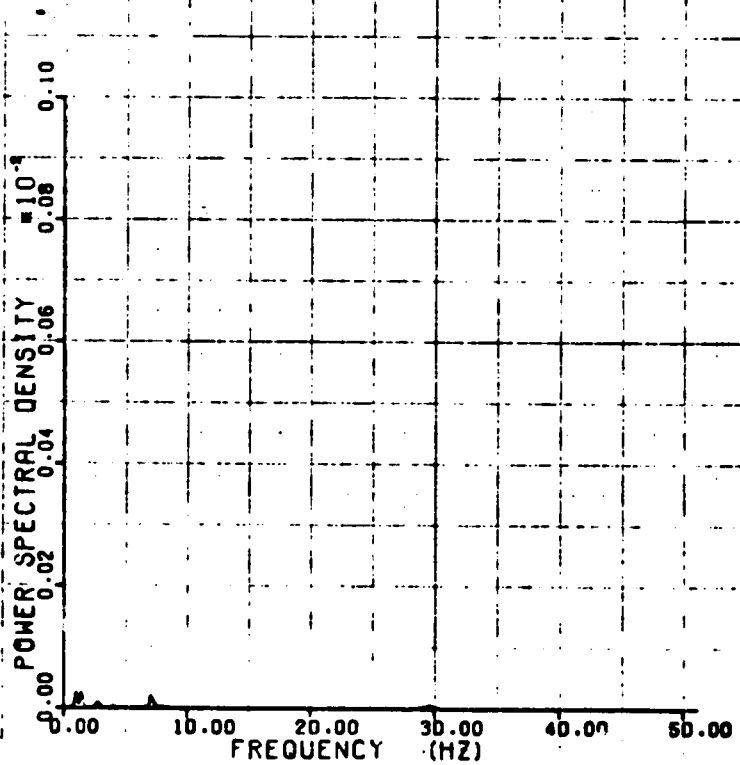


Figure A-48

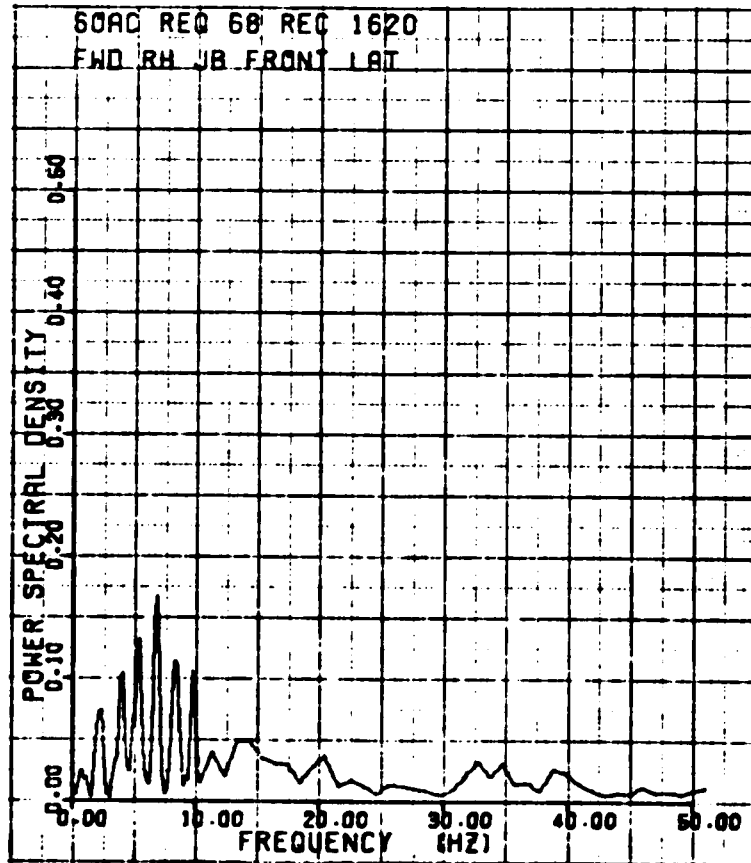
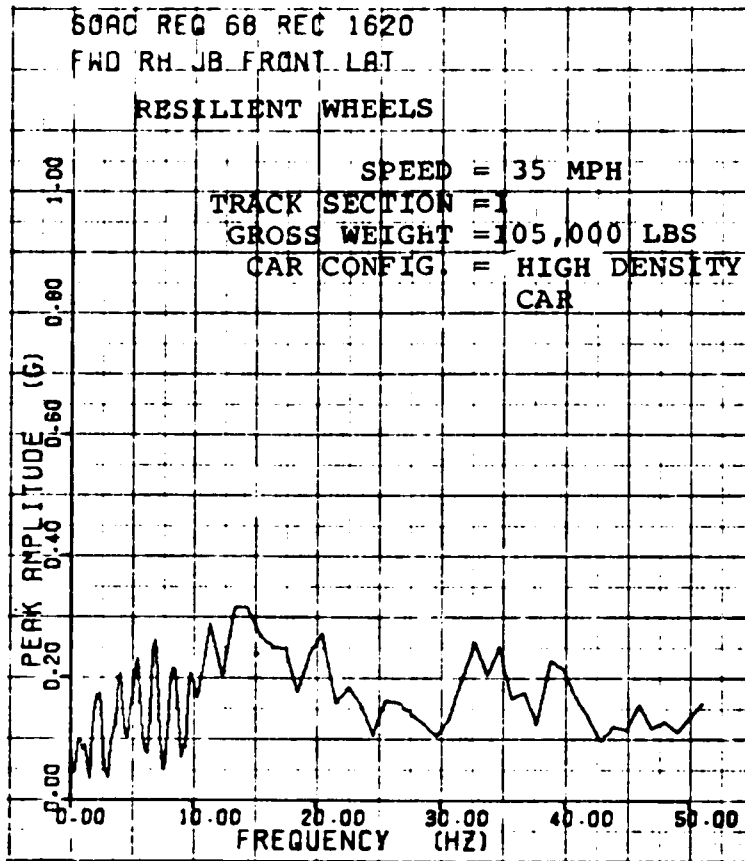


Figure A-49

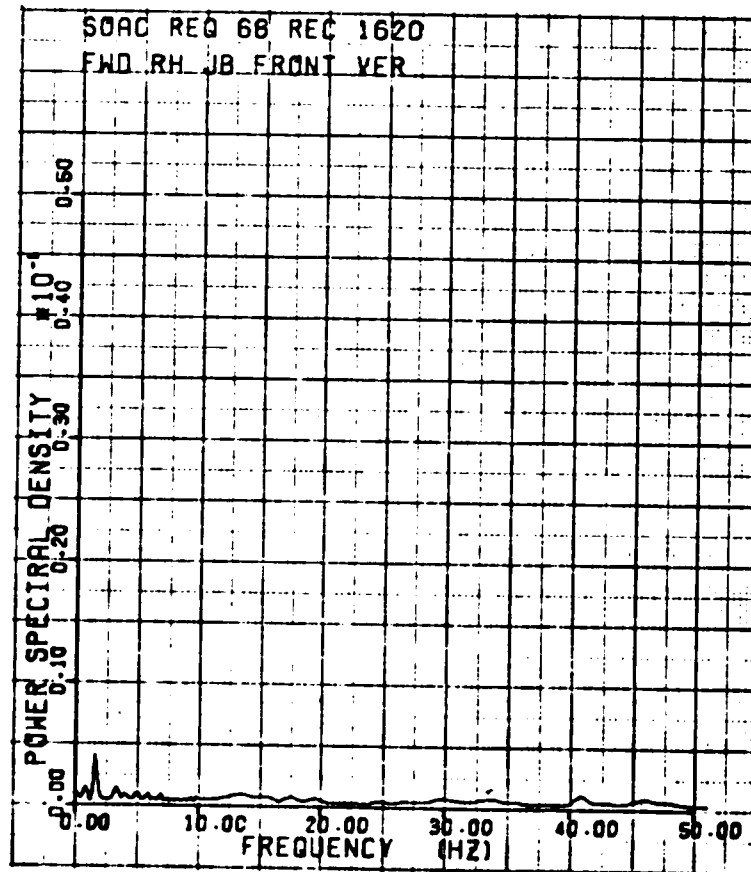
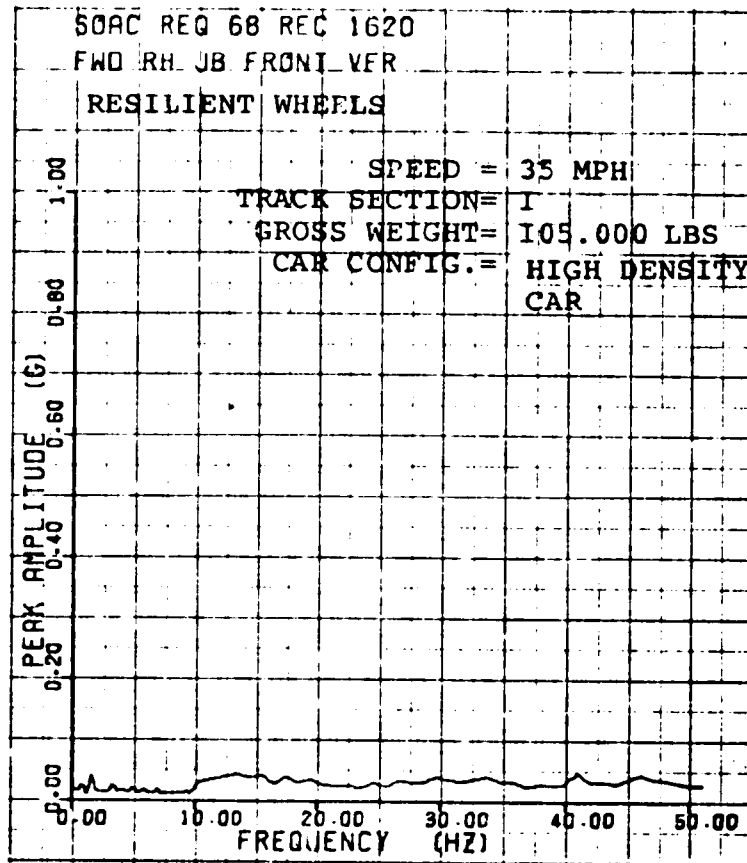


Figure A-50

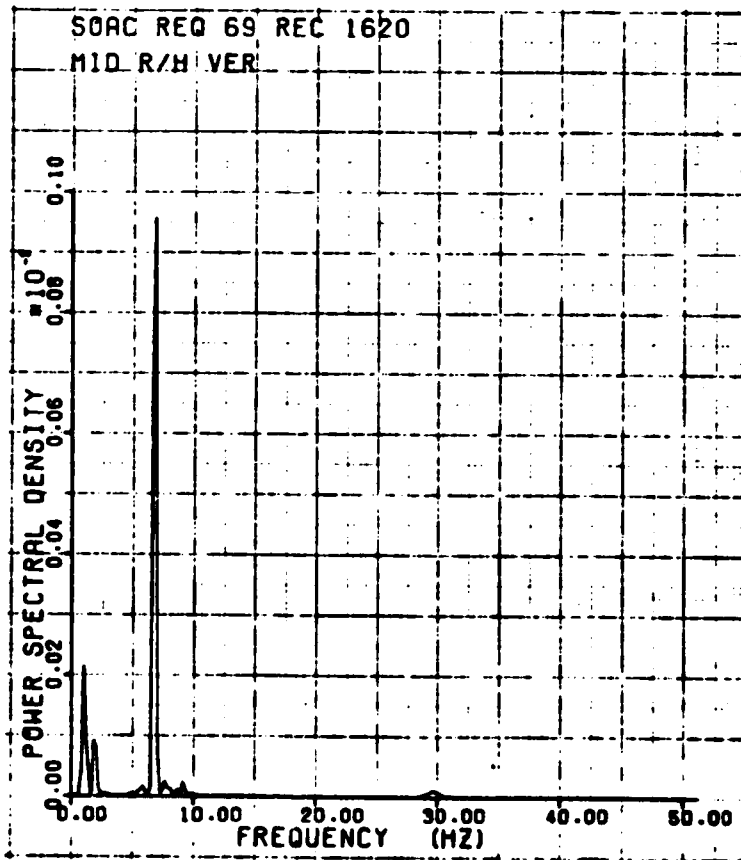
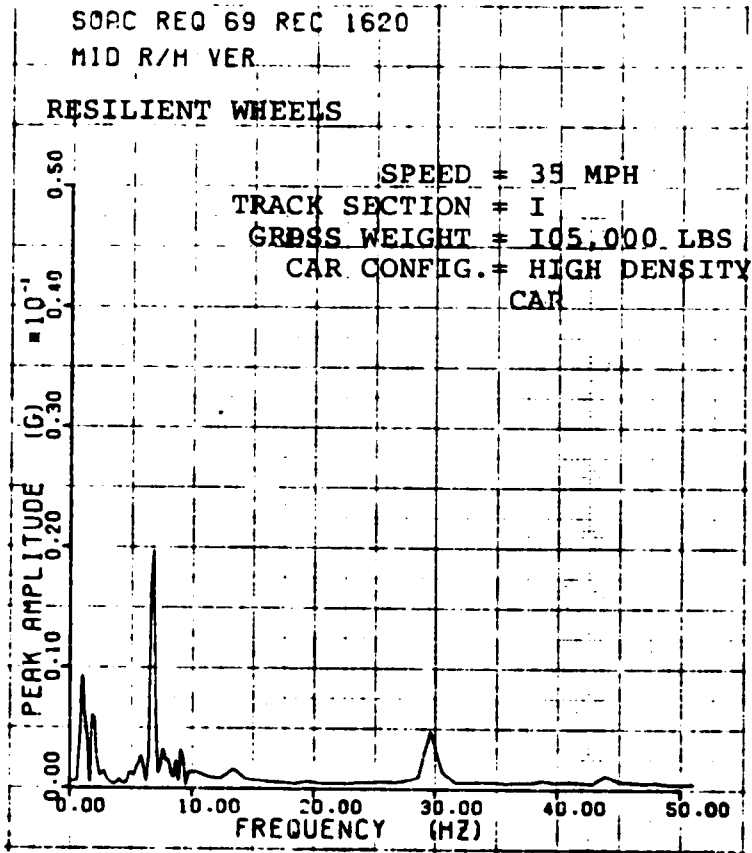


Figure A-51

SOAC REQ 69 REC 1620

AFT C/L LAT

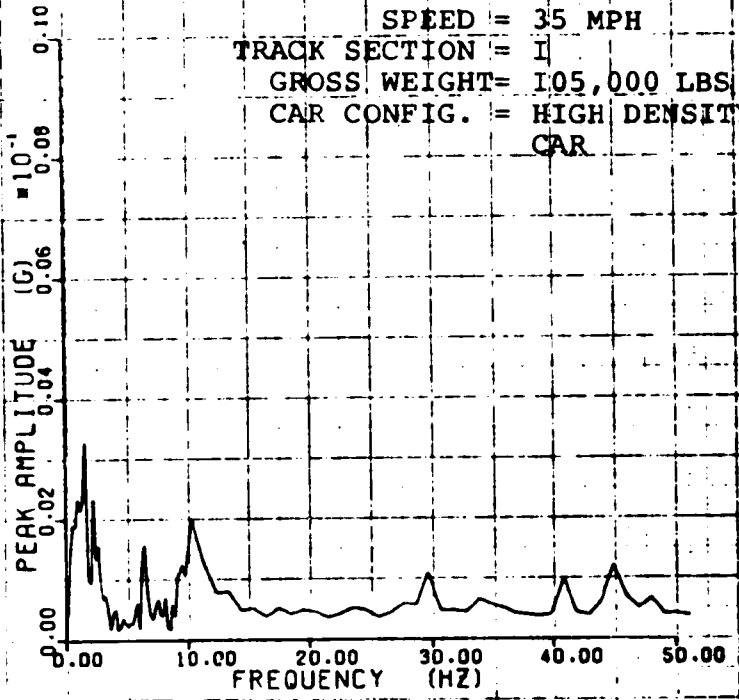
RESILIENT WHEELS

SPEED = 35 MPH

TRACK SECTION = I

GROSS WEIGHT = 105,000 LBS

CAR CONFIG. = HIGH DENSITY
CAR



SOAC REQ 69 REC 1620

AFT C/L LAT

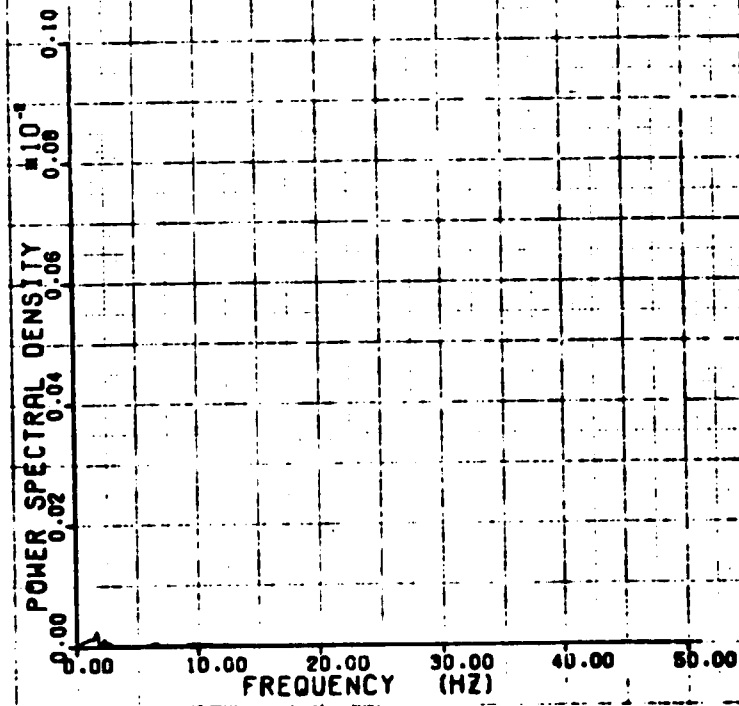


Figure A-52

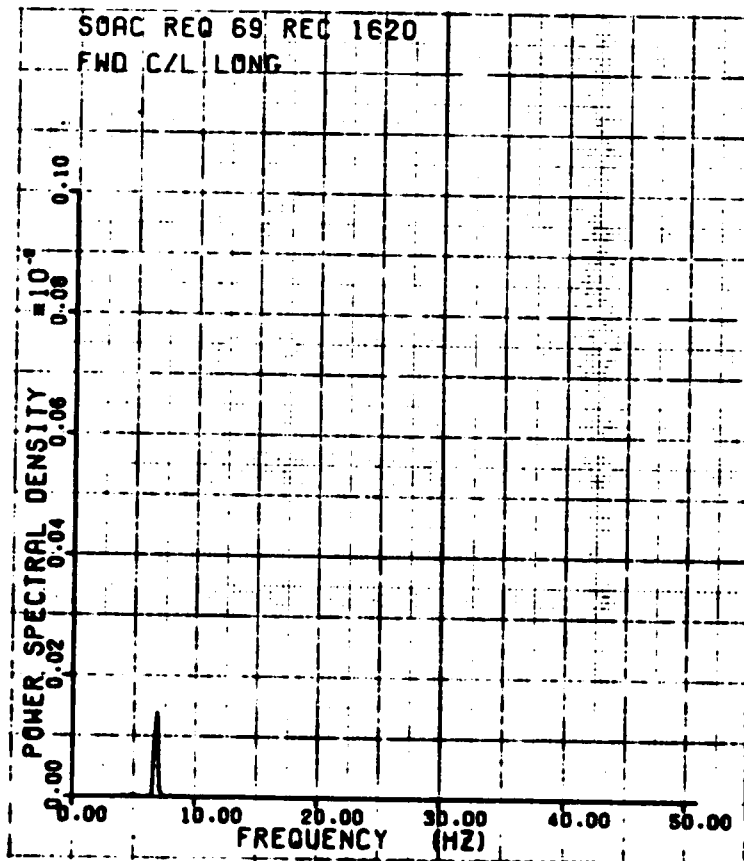
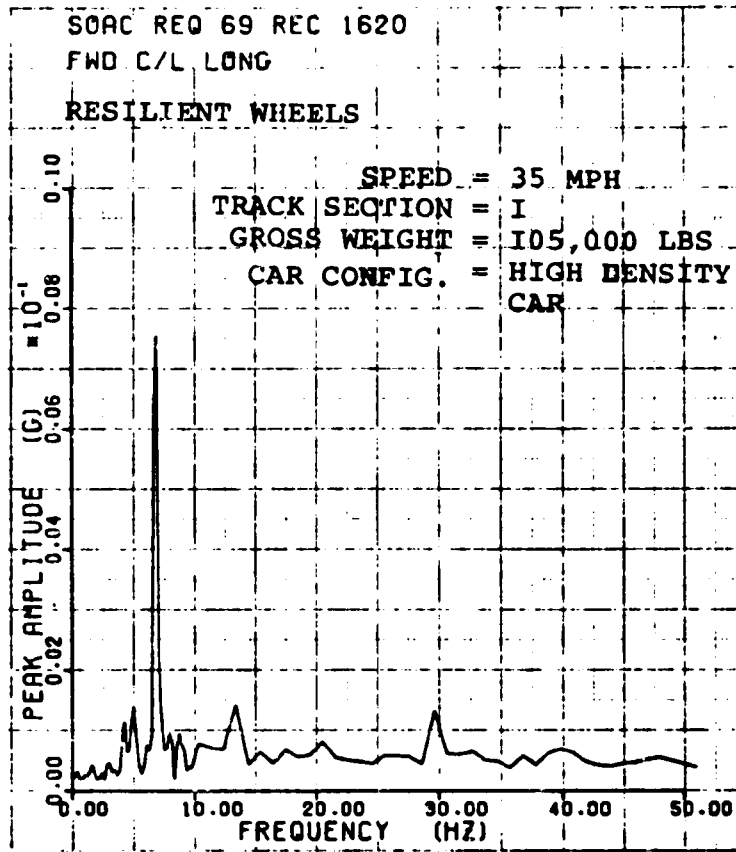


Figure A-53

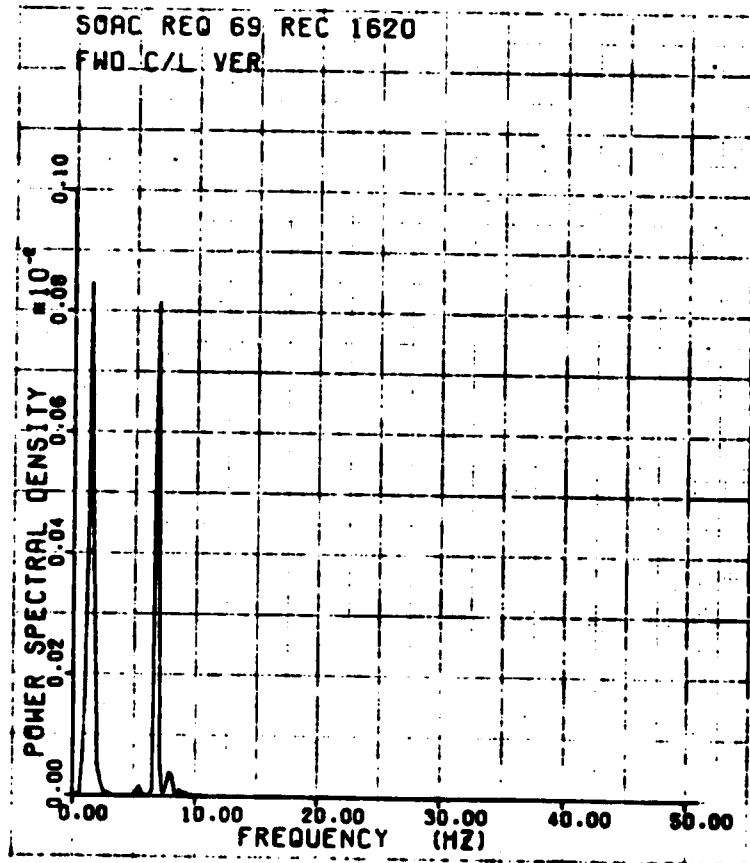
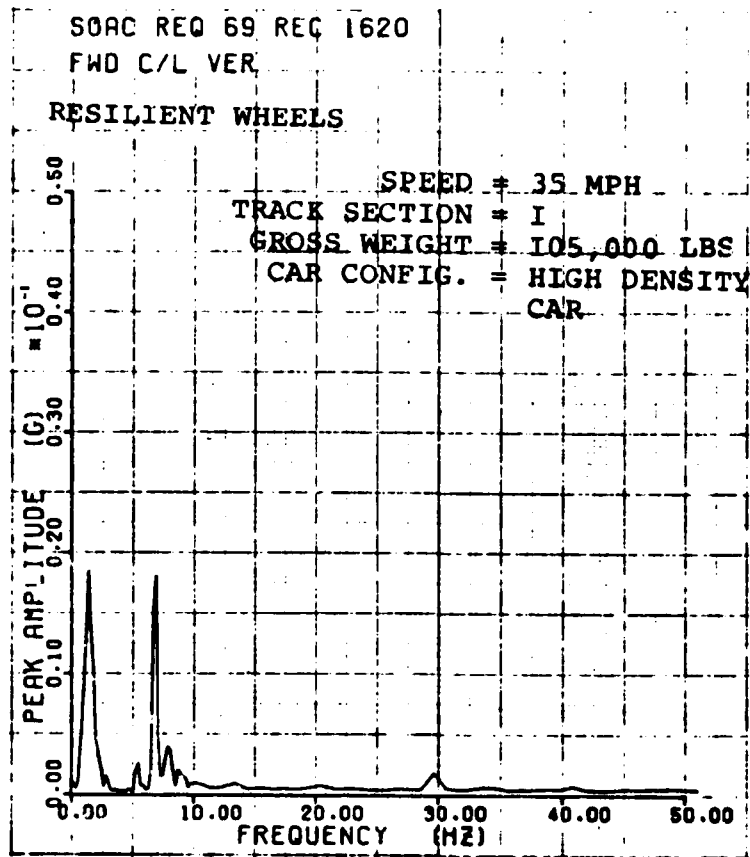


Figure A-54

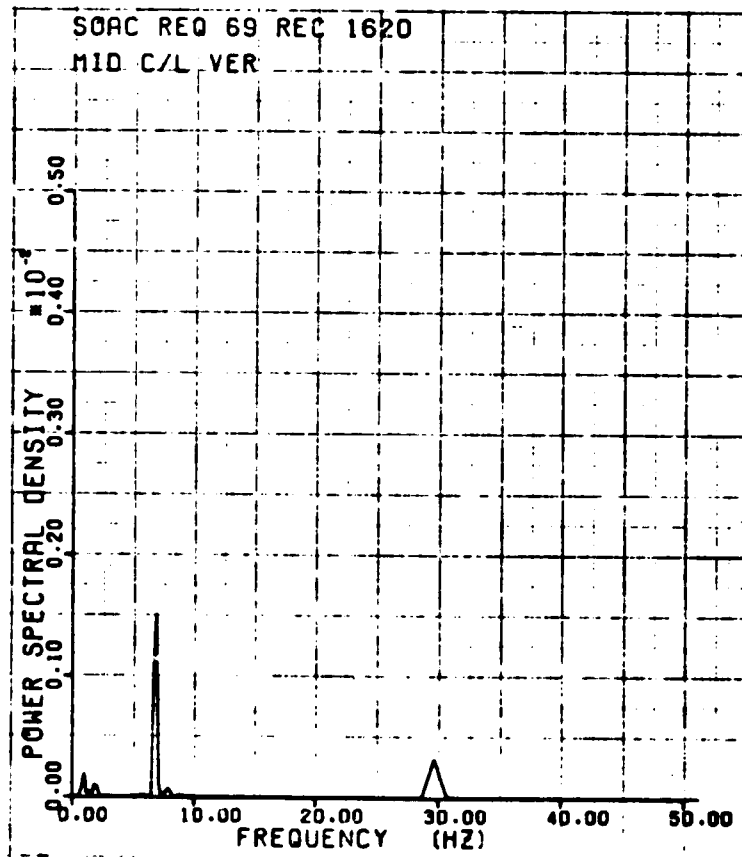
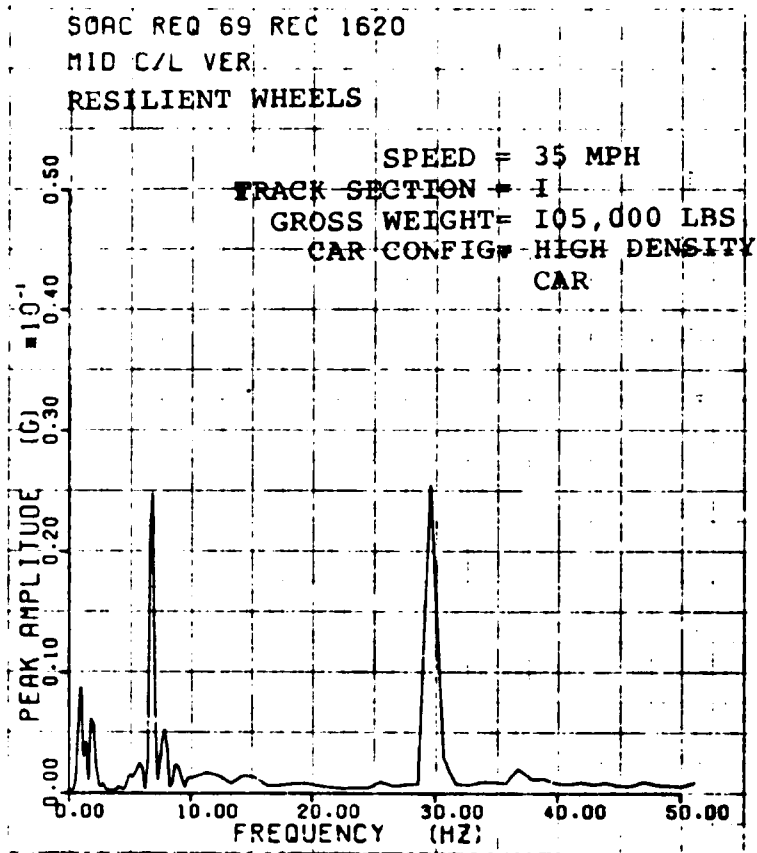


Figure A-55

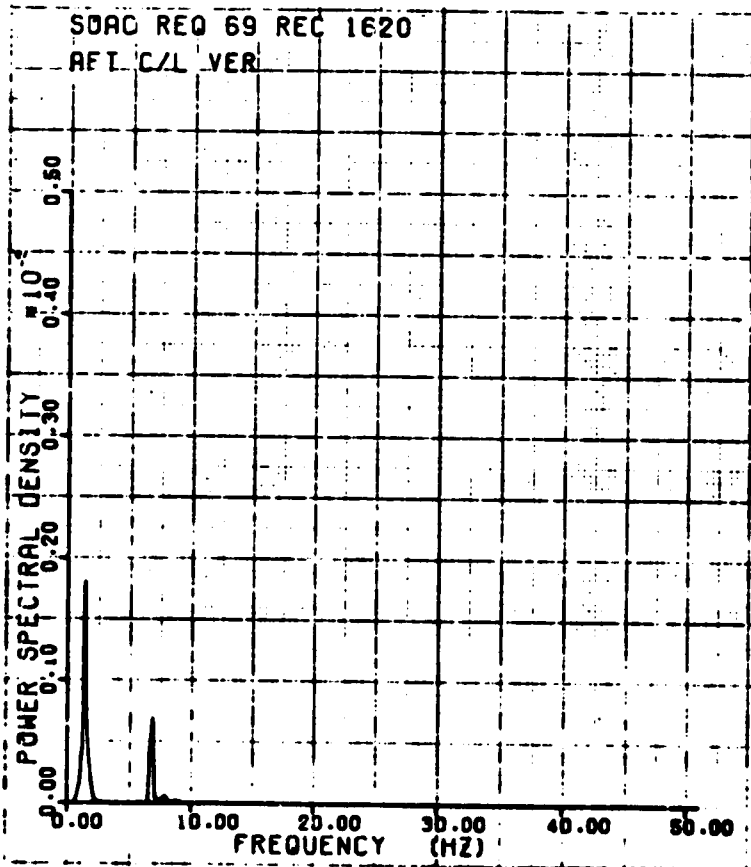
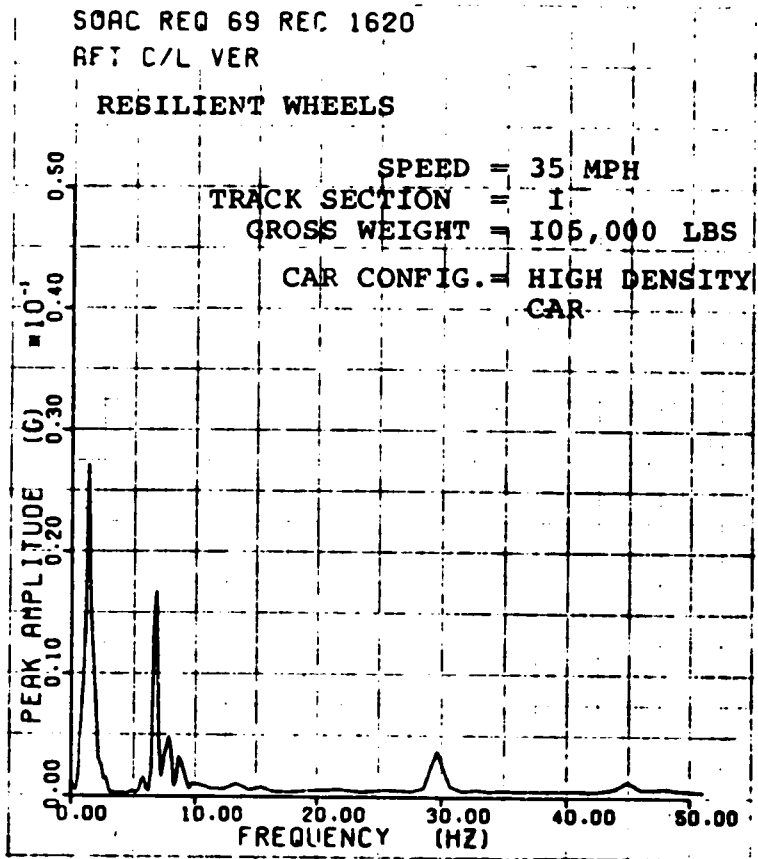


Figure A-56

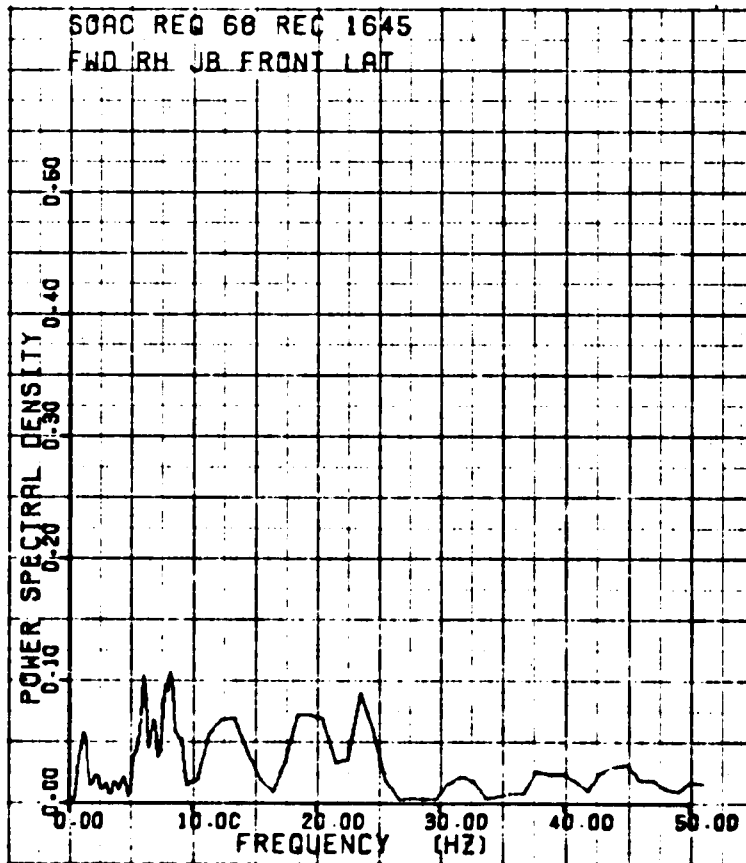
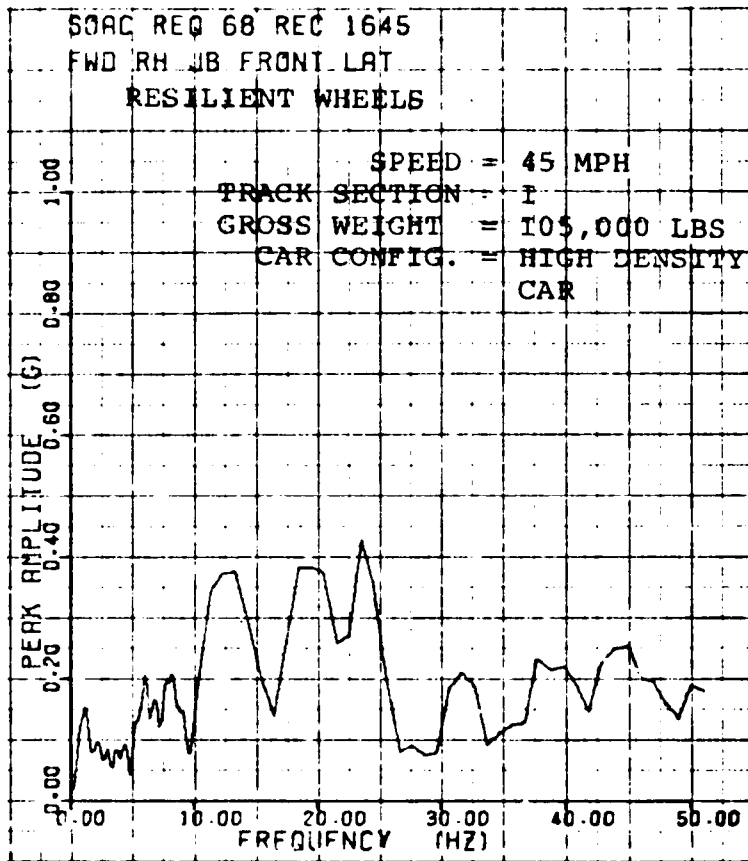


Figure A-57

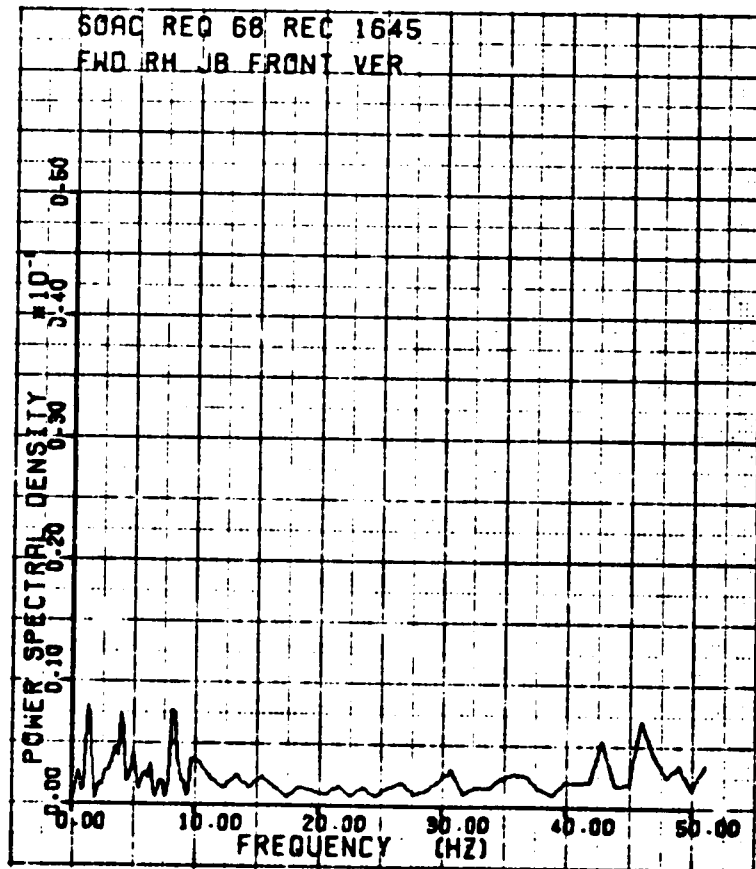
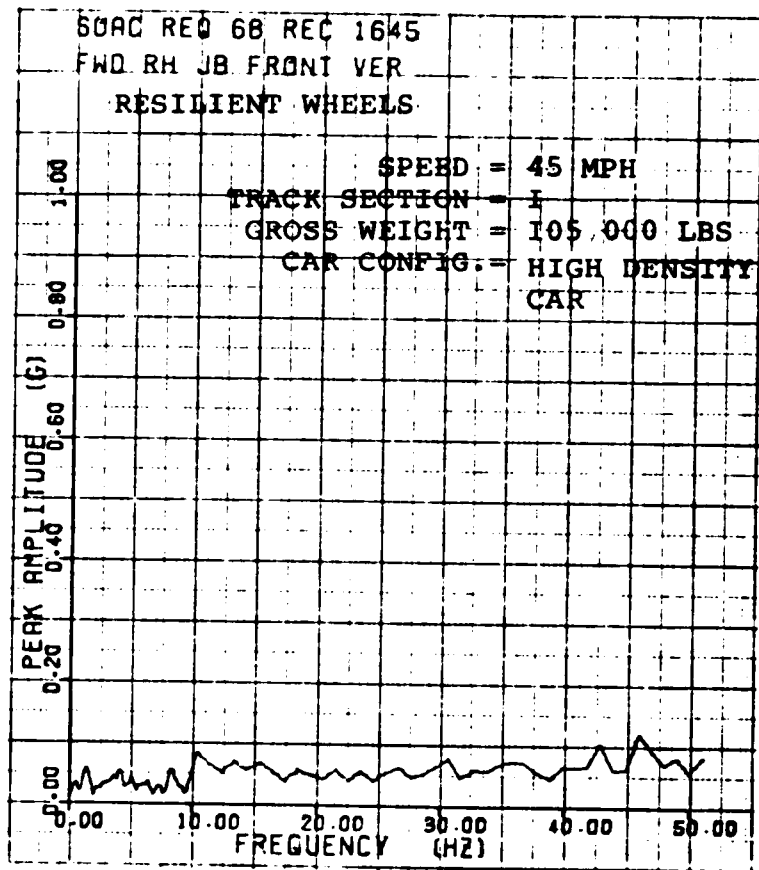


Figure A-58

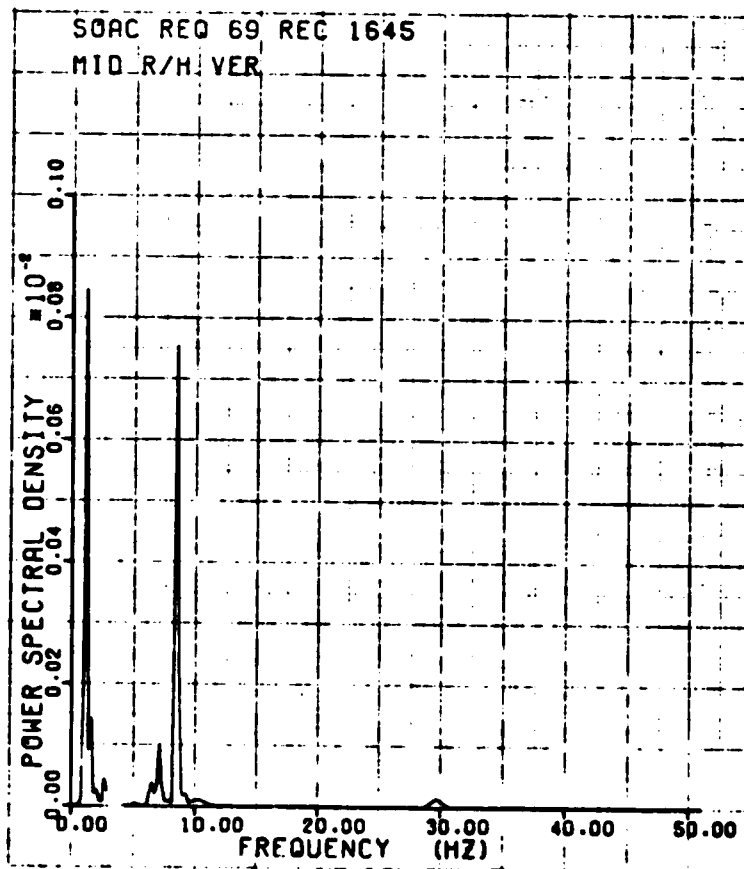
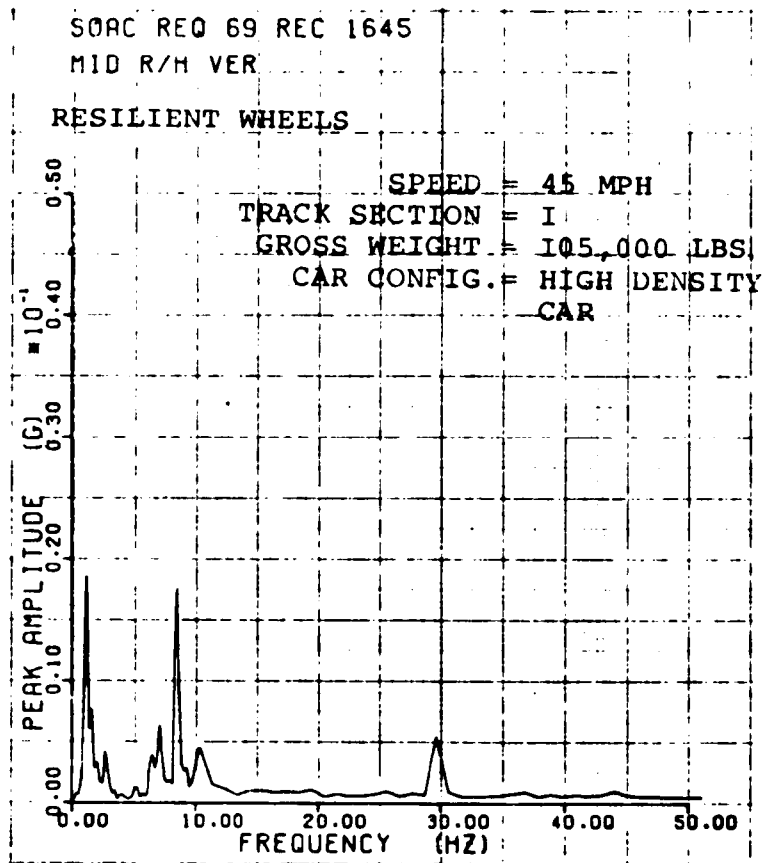


Figure A-59

SOAC REQ 69 REC 1645

AFT C/L LAT

RESILIENT WHEELS

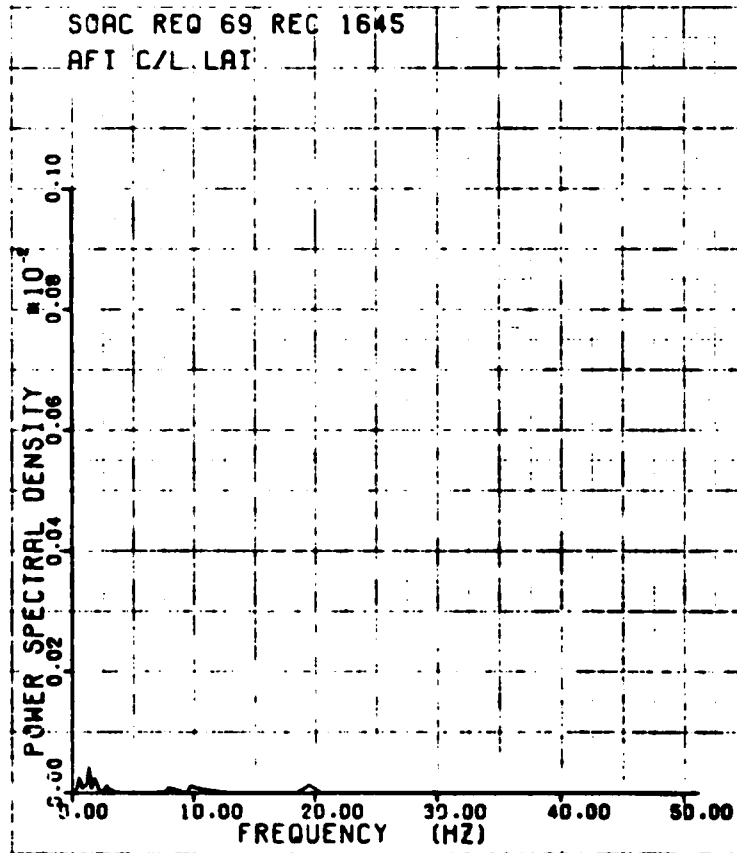
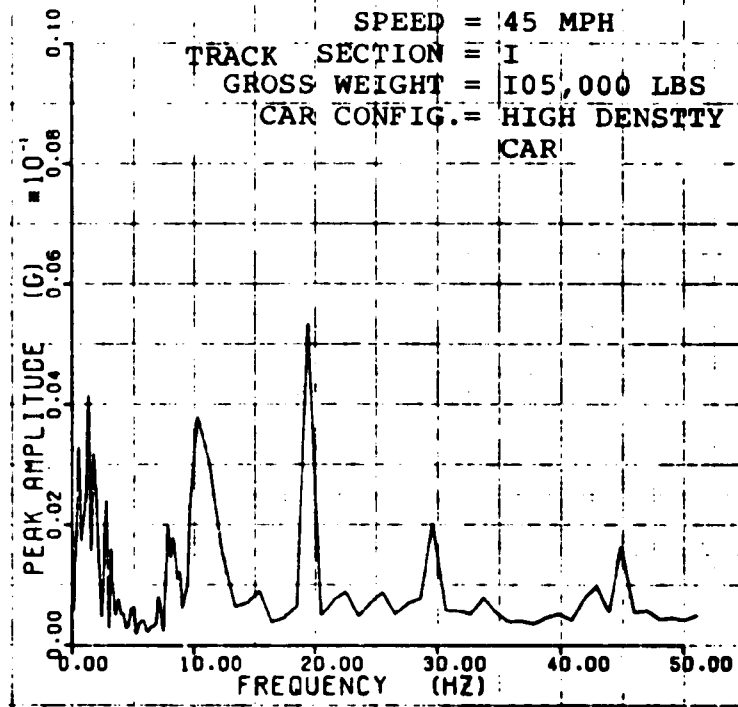
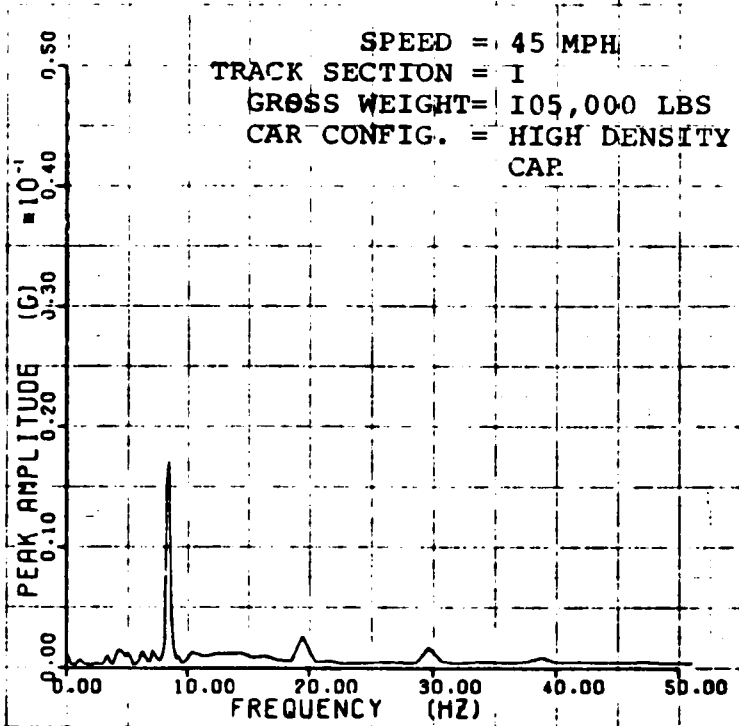


Figure A-60

SOAC REQ 69 REC 1645

FWD C/L LONG

RESILIENT WHEELS



SOAC REQ 69 REC 1645

FWD C/L LONG

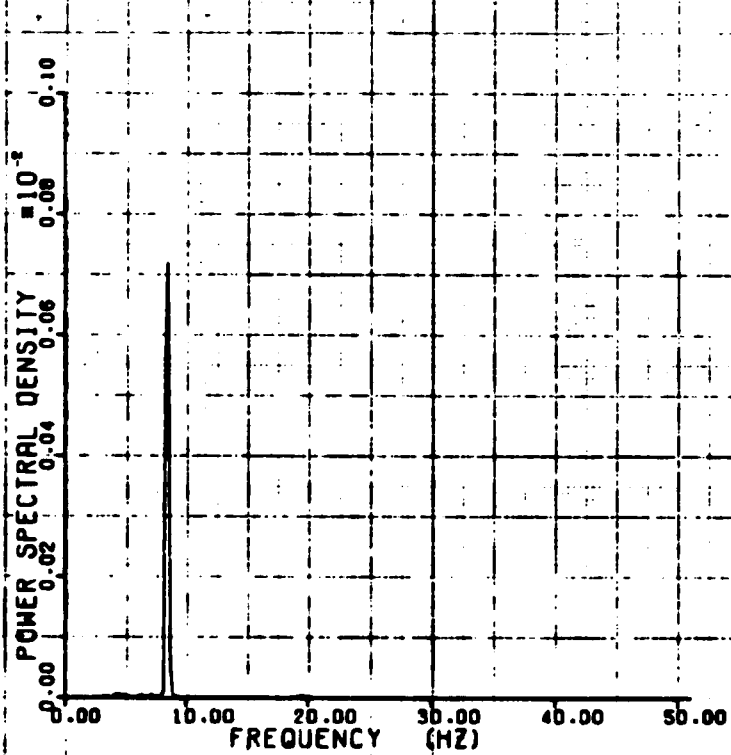


Figure A-61

SOAC REQ 69 REC 1645

FWD C/L VER

RESILIENT WHEELS

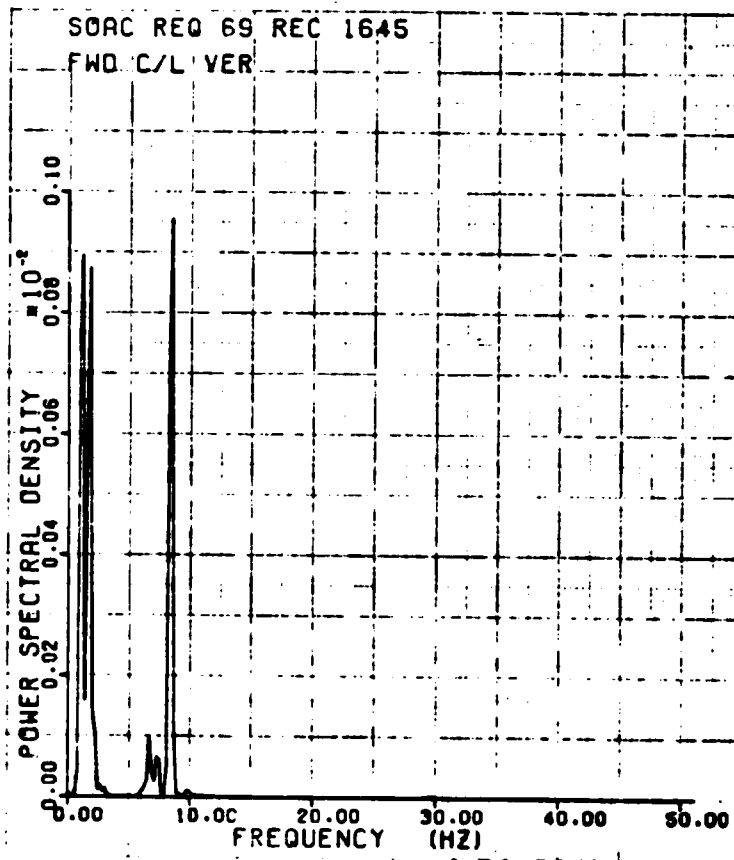
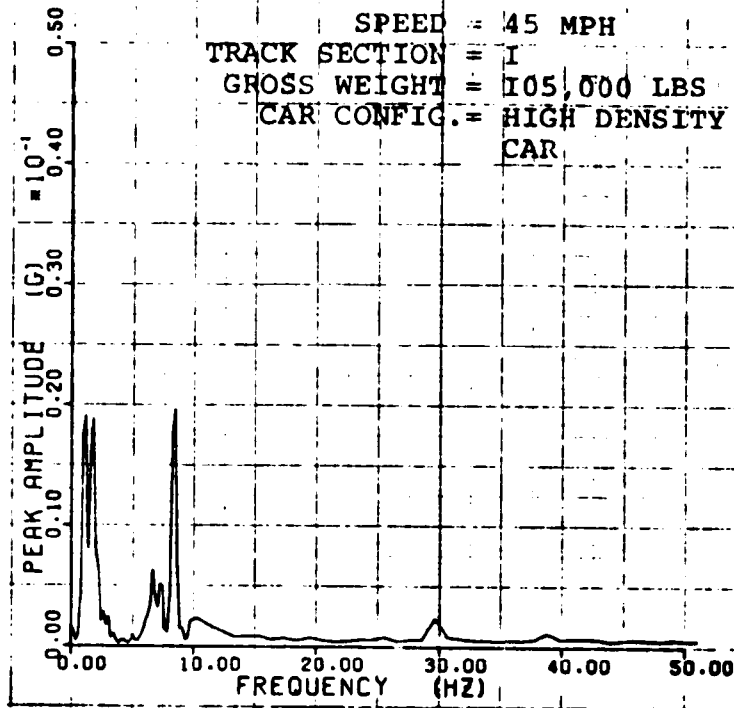
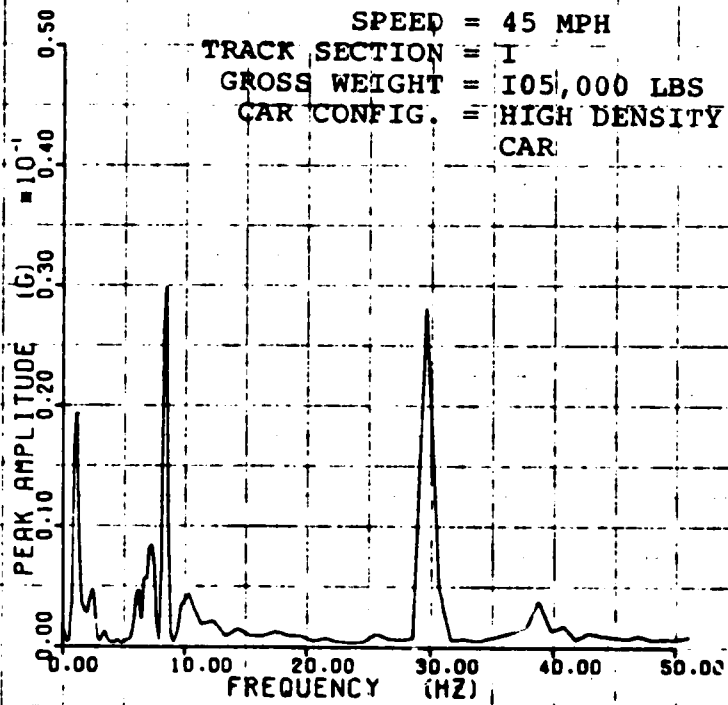


Figure A-62

SOAC REQ 69 REC 1645

MID C/L VER

RESILIENT WHEELS



SOAC REQ 69 REC 1645

MID C/L VER

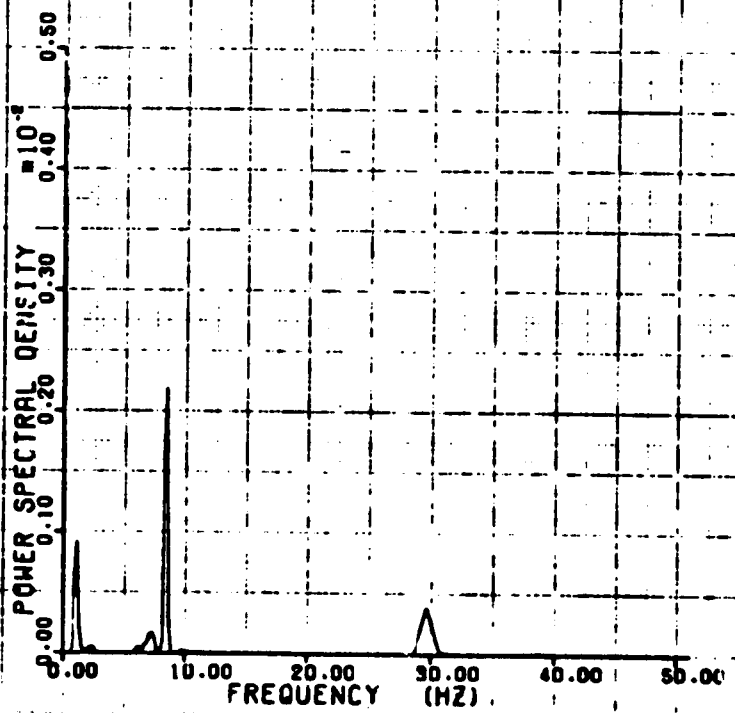


Figure A-63

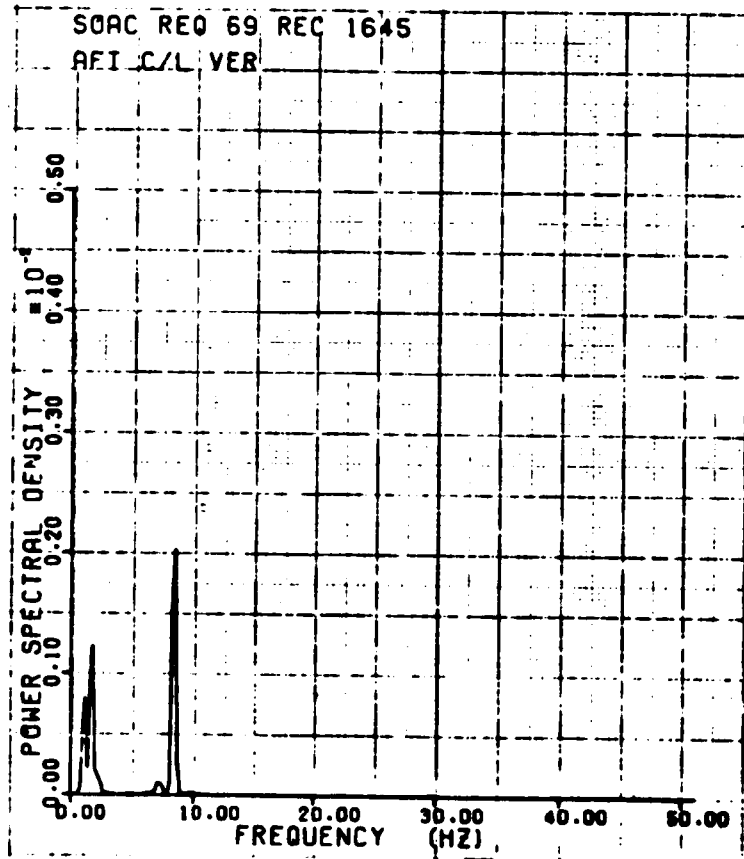
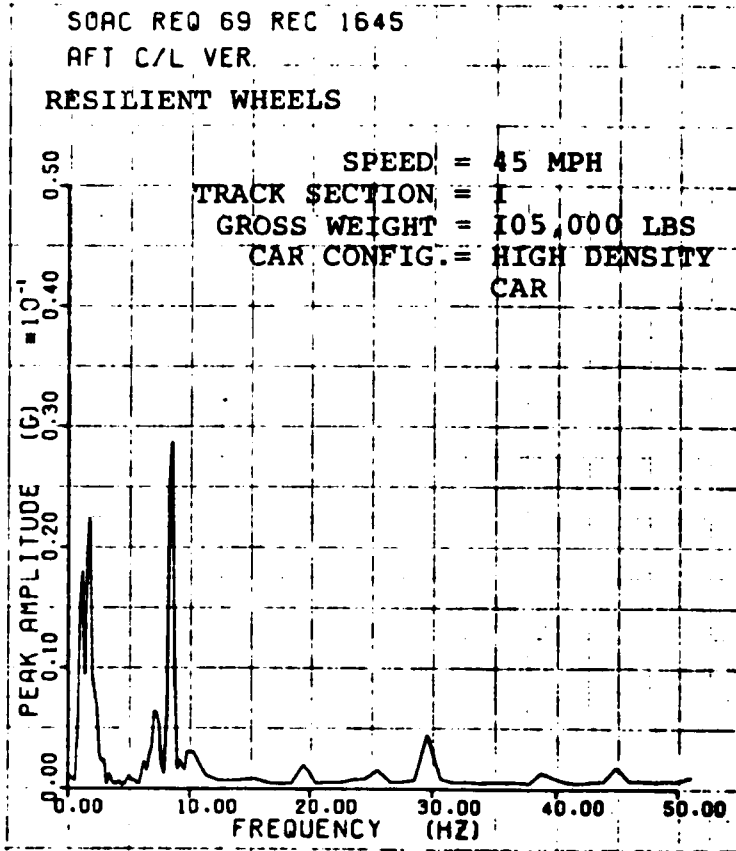


Figure A-64

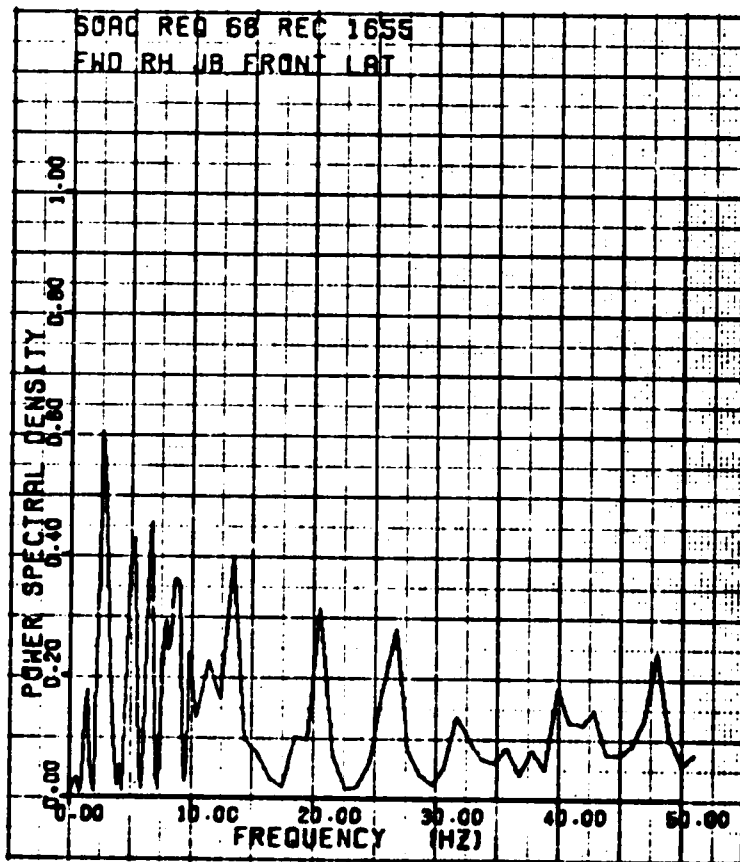
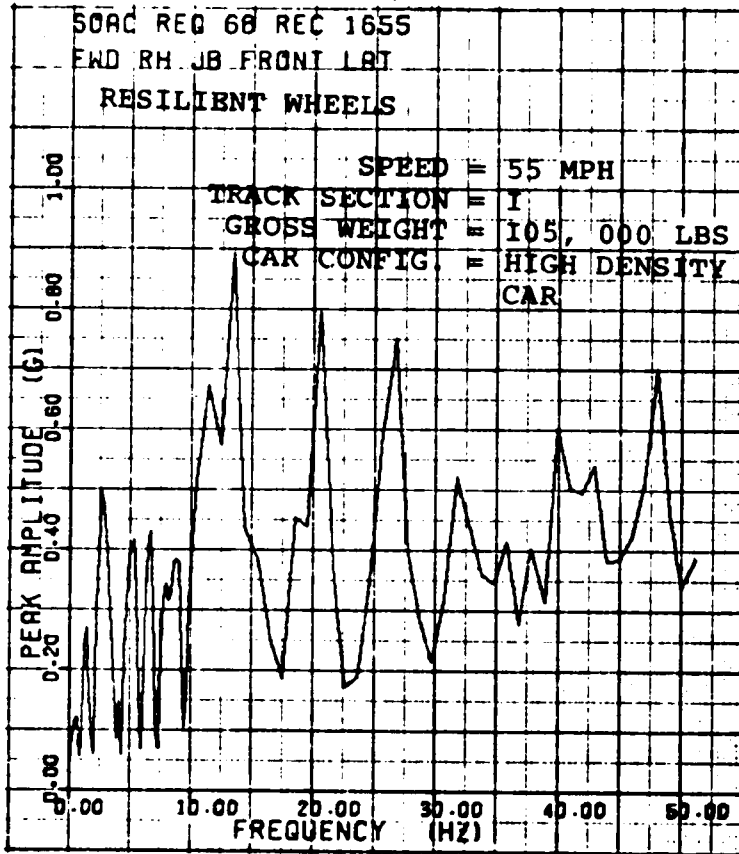


Figure A-65

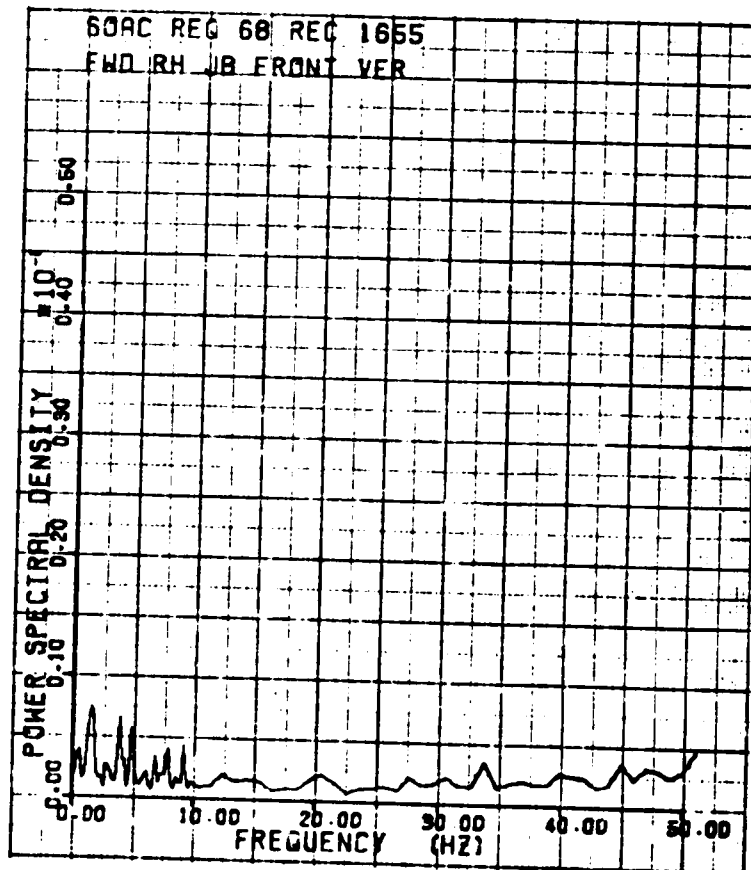
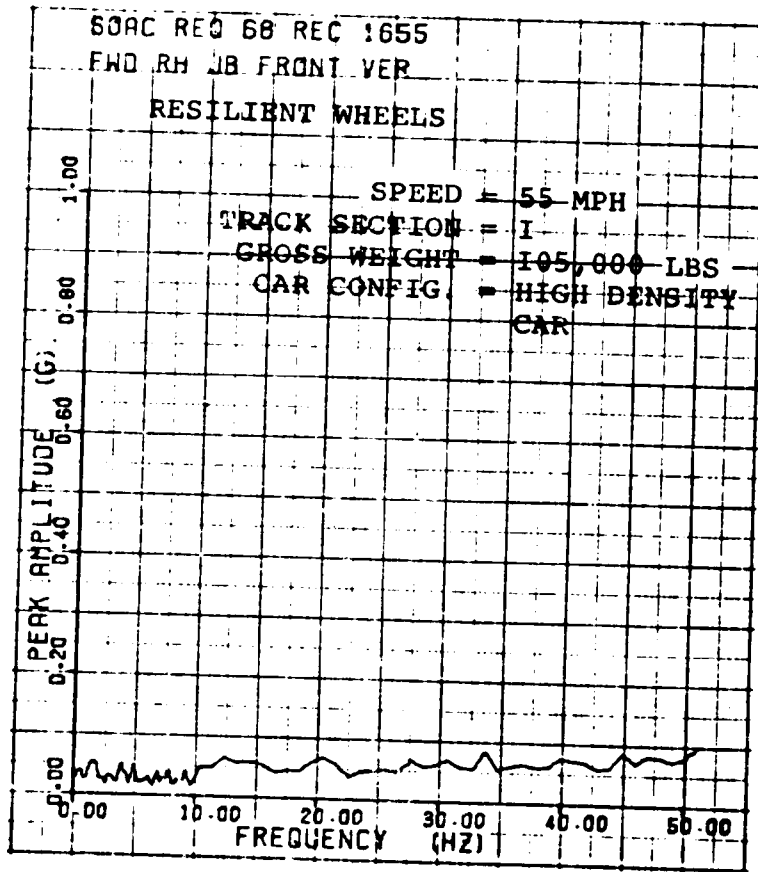


Figure A-66

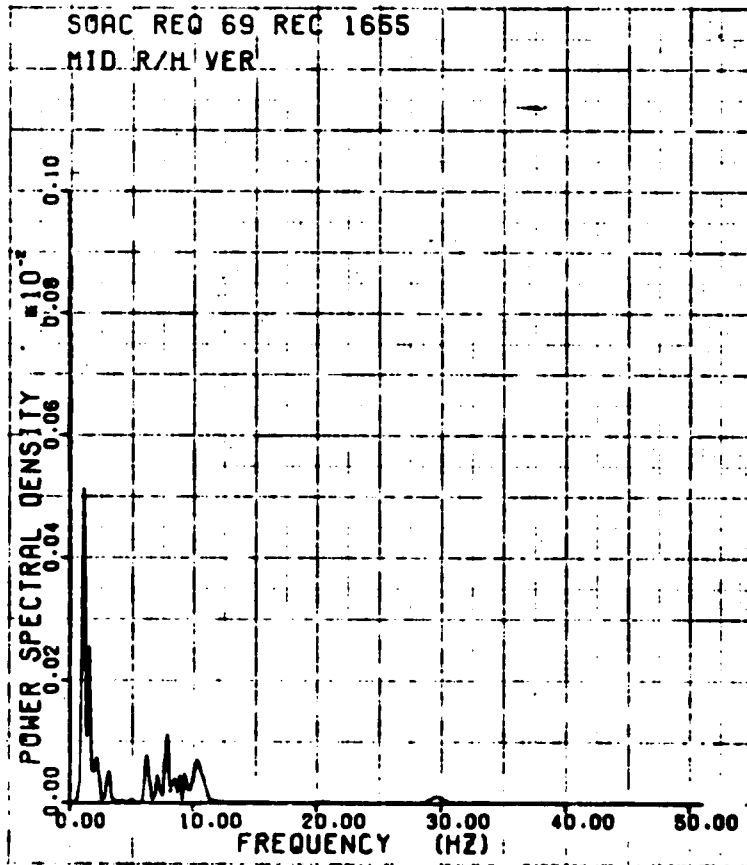
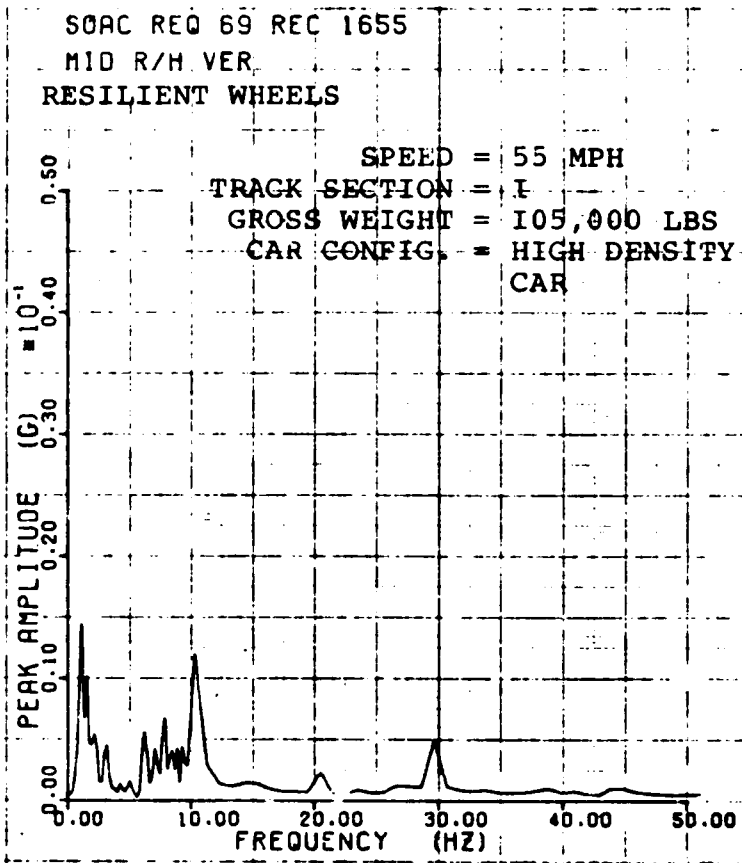
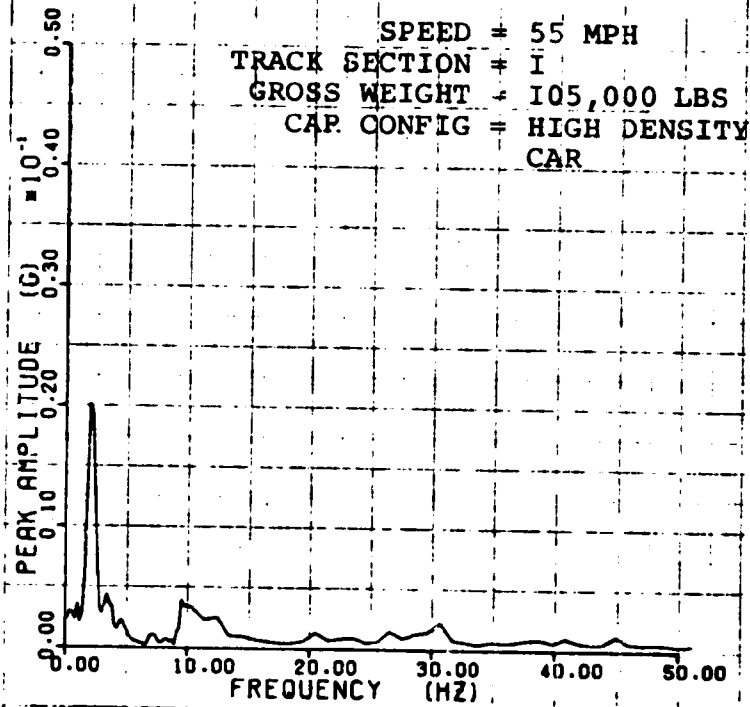


Figure A-67

SOAC REQ 69 REC 1655

AFT C/L LAT

RESILIENT WHEELS



SOAC REQ 69 REC 1655

AFT C/L LAT

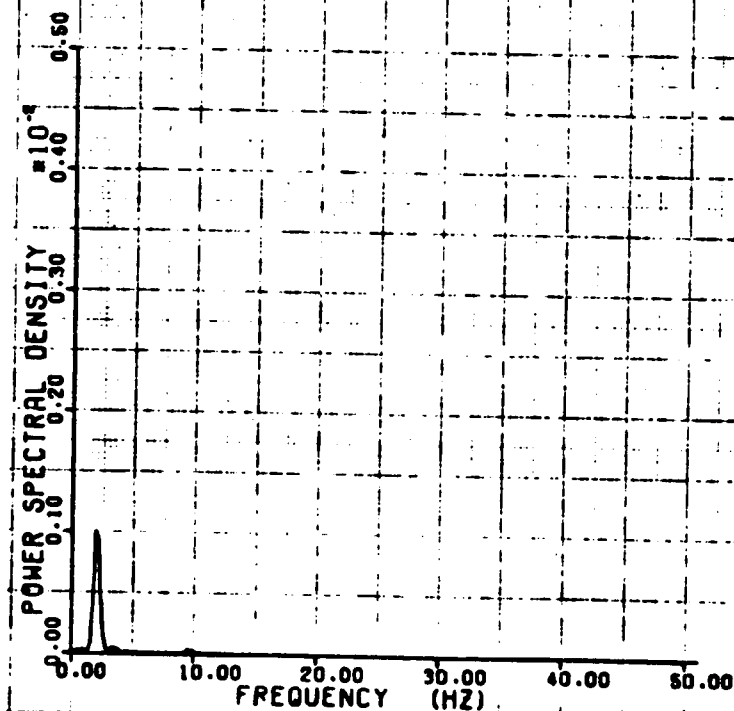
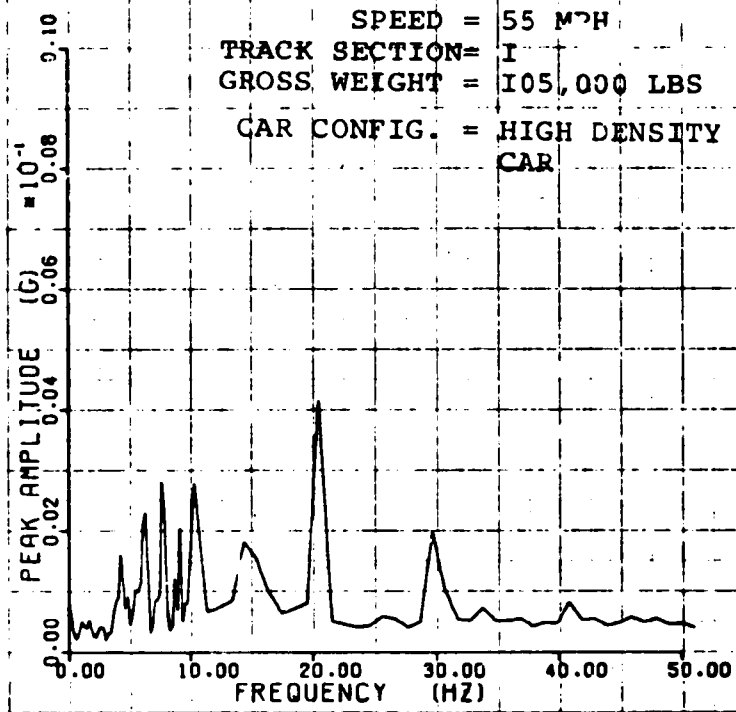


Figure A-68

SOAC REQ 69 REC 1655

FWD C/L LONG

RESILIENT WHEELS



SOAC REQ 69 REC 1655

FWD C/L LONG

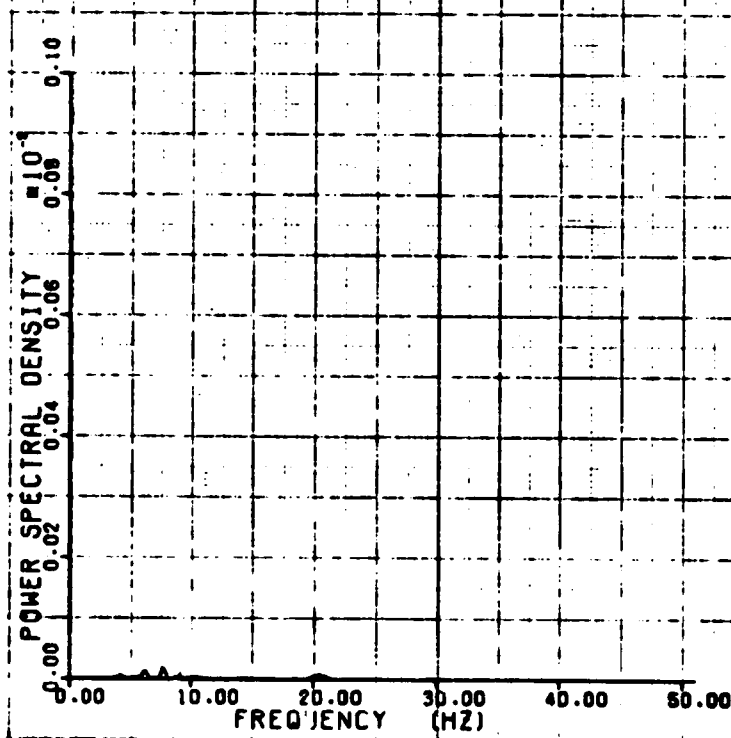
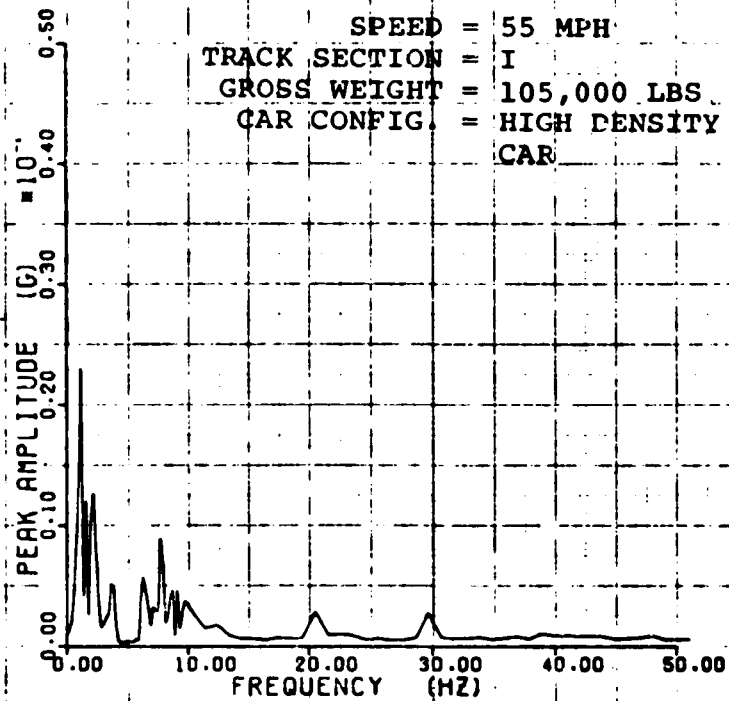


Figure A-69

SOAC REQ 69 REC 1655

FWD C/L VER.

RESILIENT WHEELS



SOAC REQ 69 REC 1655

FWD C/L VER.

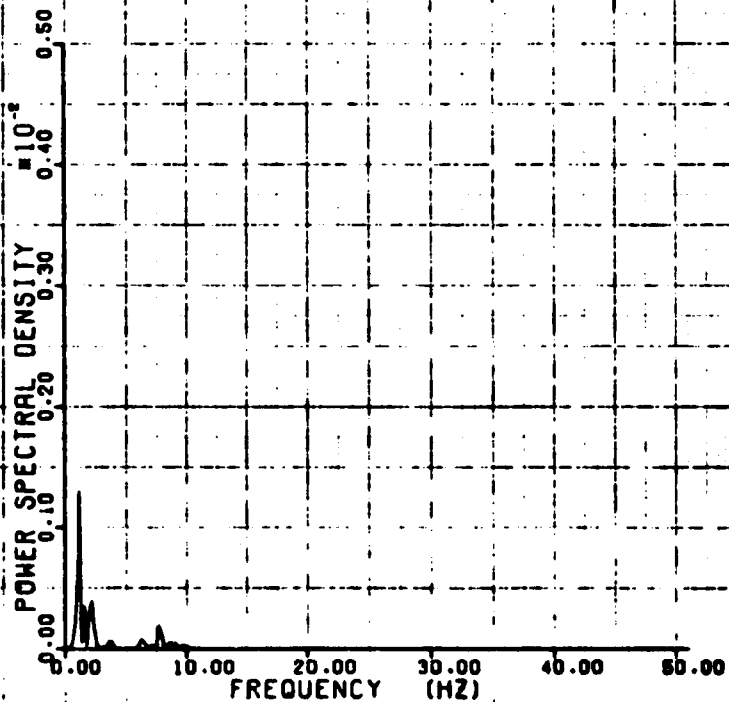


Figure A-70

SOAC REQ 69 REC 1655

MID C/L VER

RESILIENT WHEELS

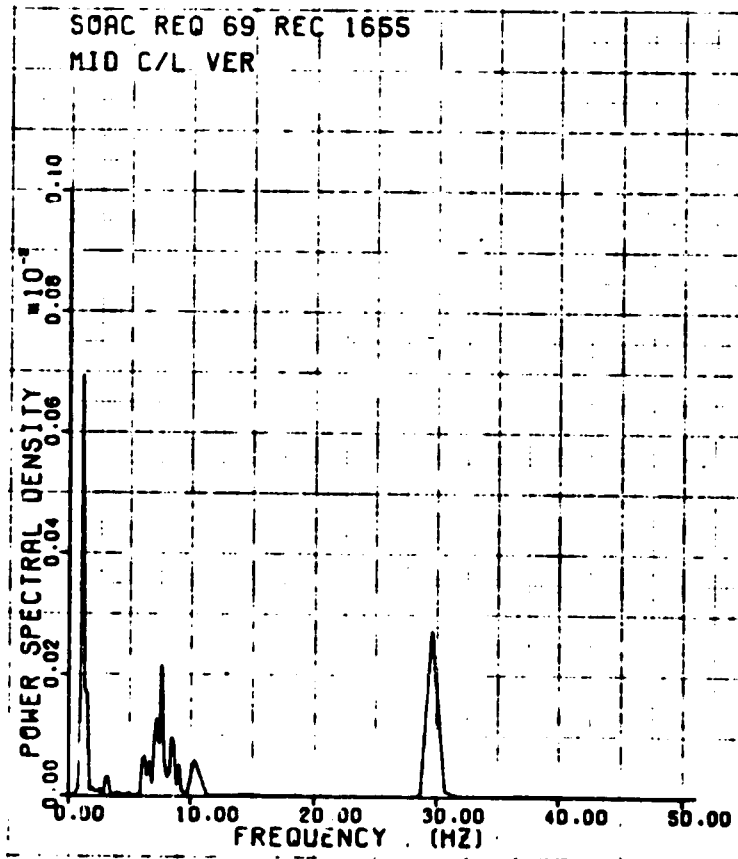
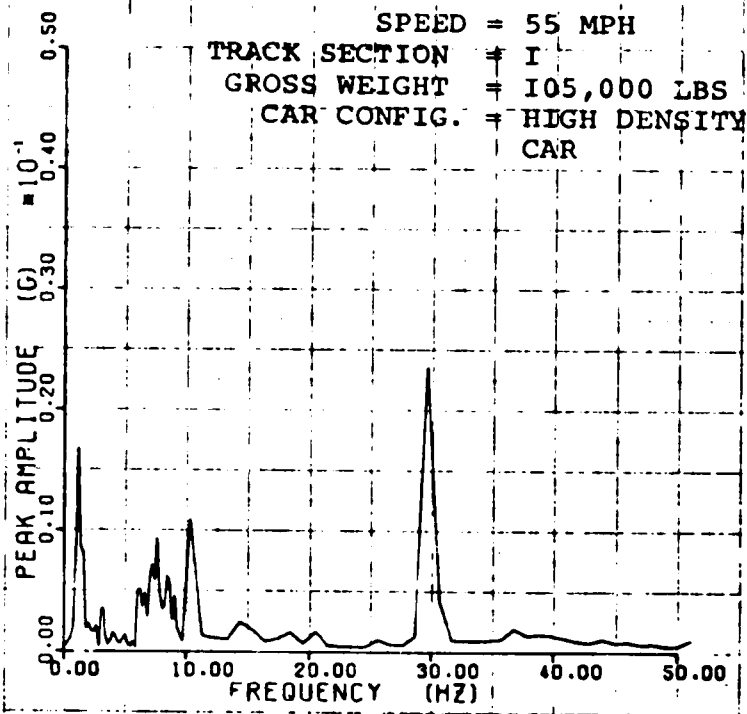
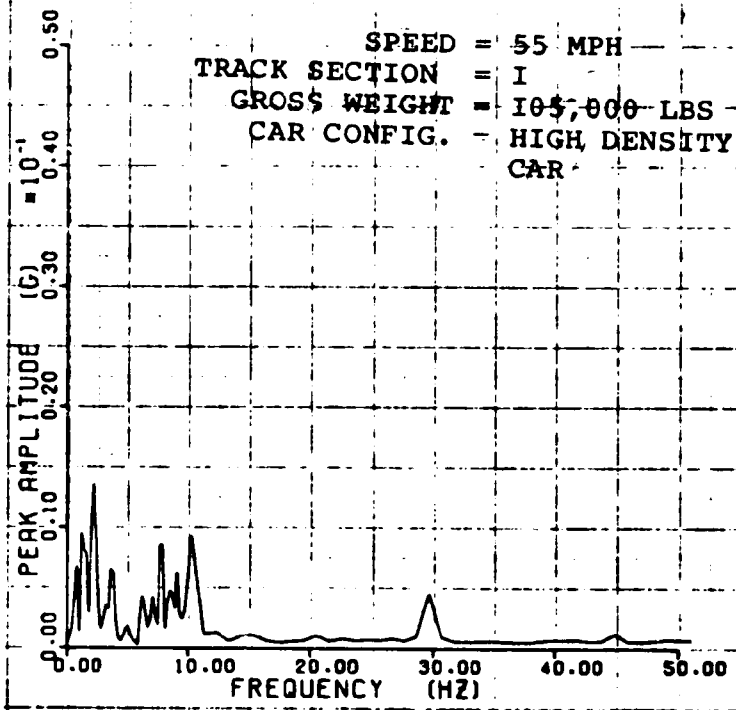


Figure A-71

SOAC REQ 69 REC 1655

AFT C/L VER

RESILIENT WHEELS



SOAC REQ 69 REC 1655

AFT C/L VER

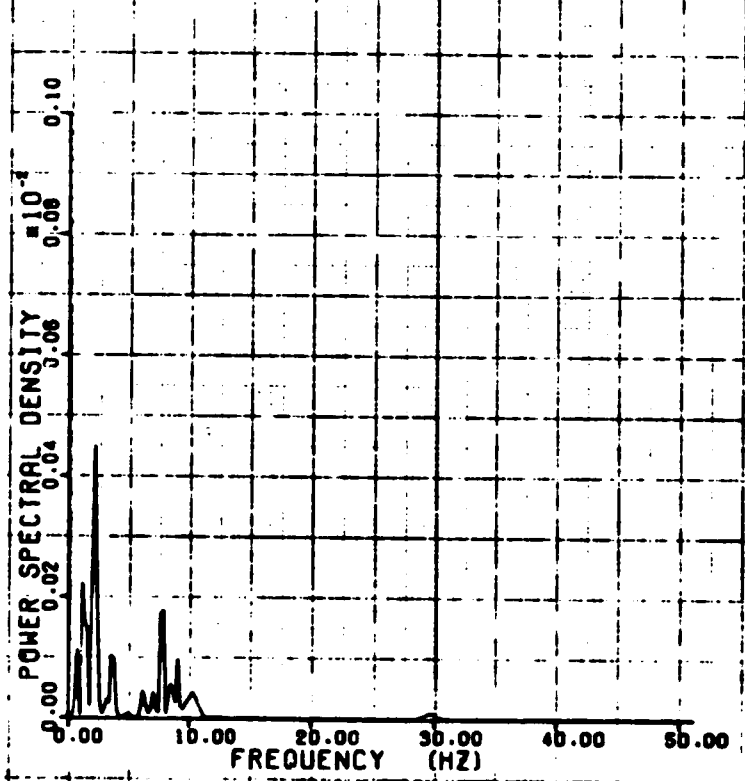


Figure A-72

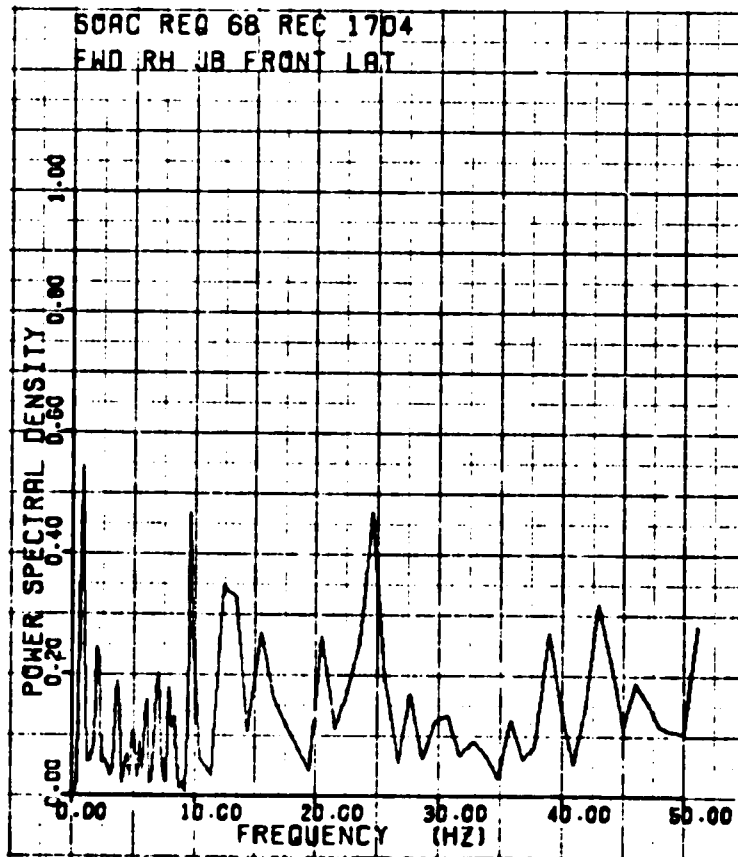
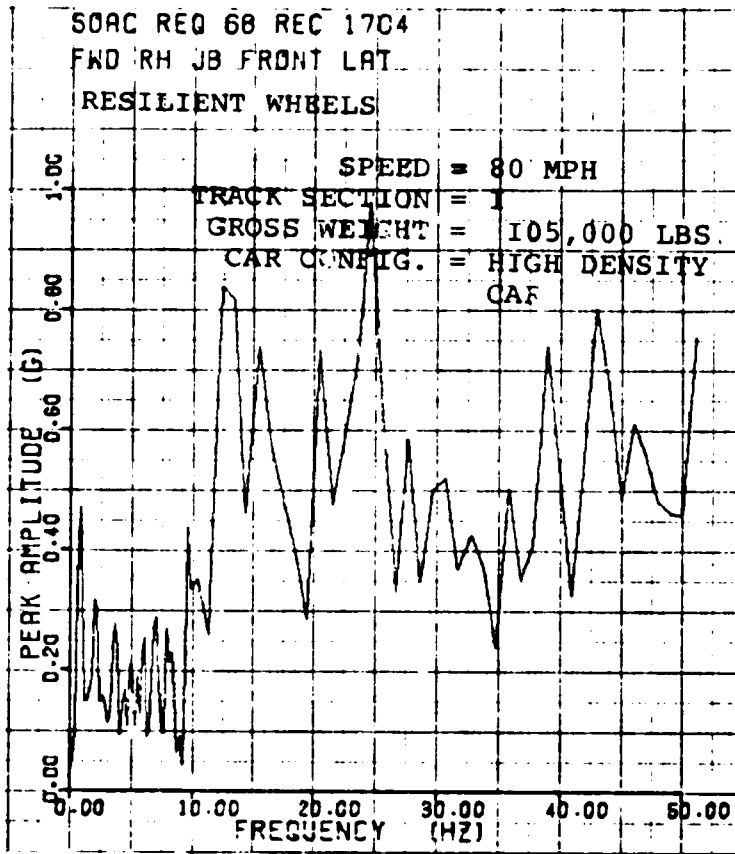


Figure A-73

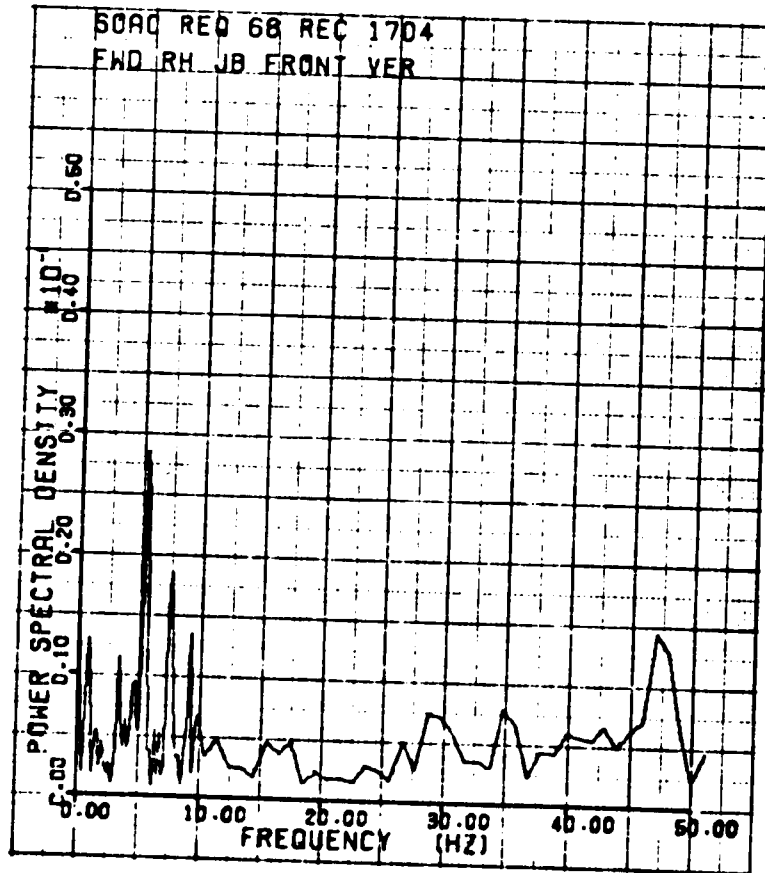
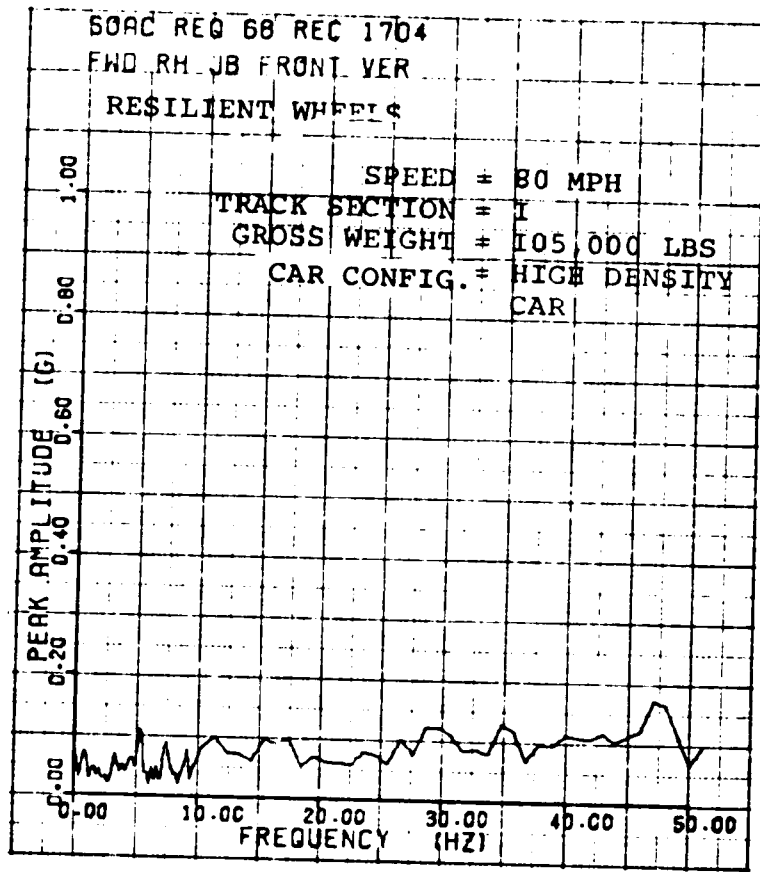


Figure A-74

SOAC REQ 69 REC 1704
MID R/H VER
RESILIENT WHEELS

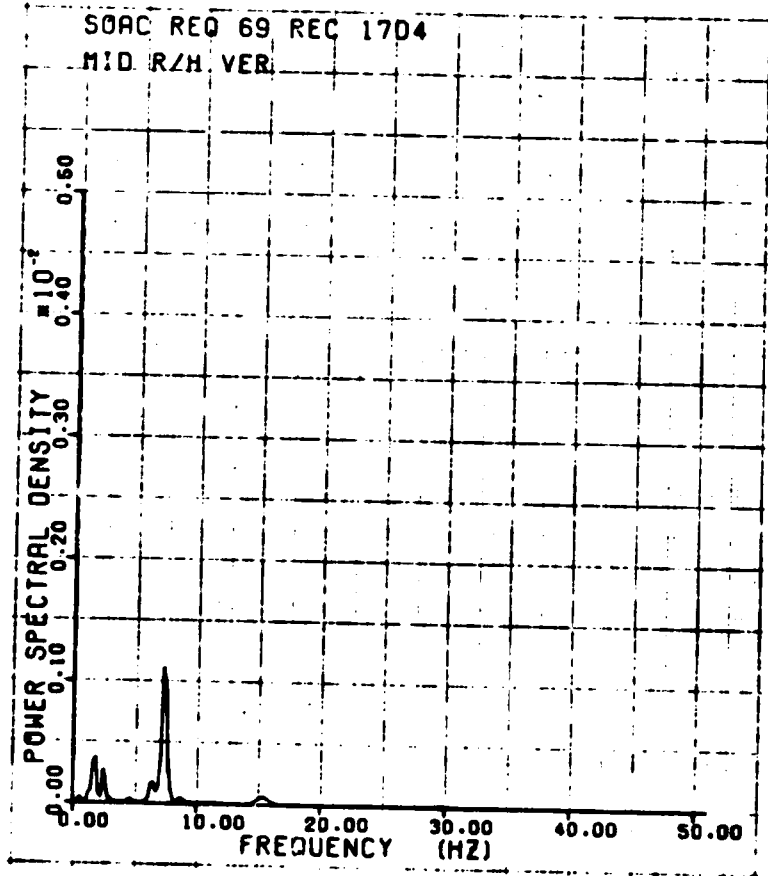
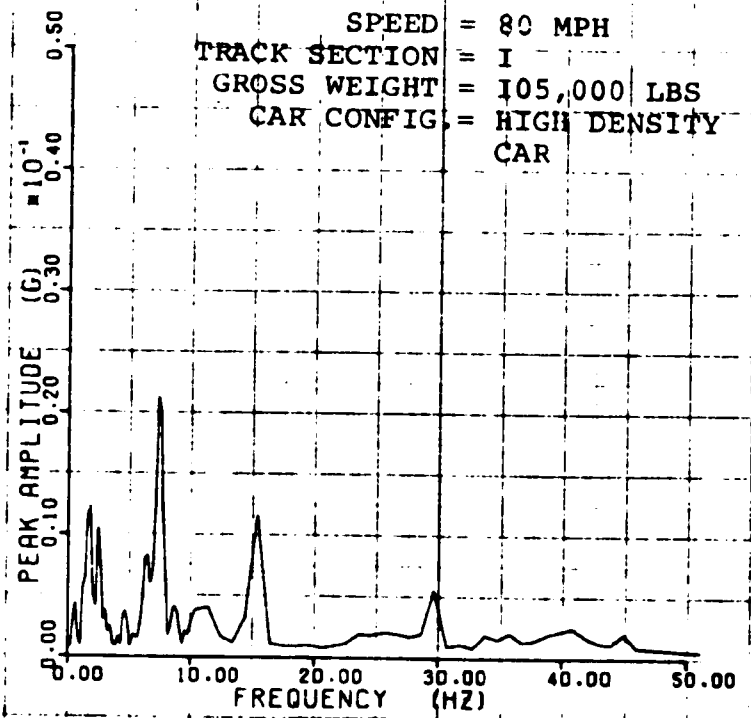


Figure A-75

SOAC REQ 69 REC 1704

AFT C/L LAT

RESILIENT WHEELS

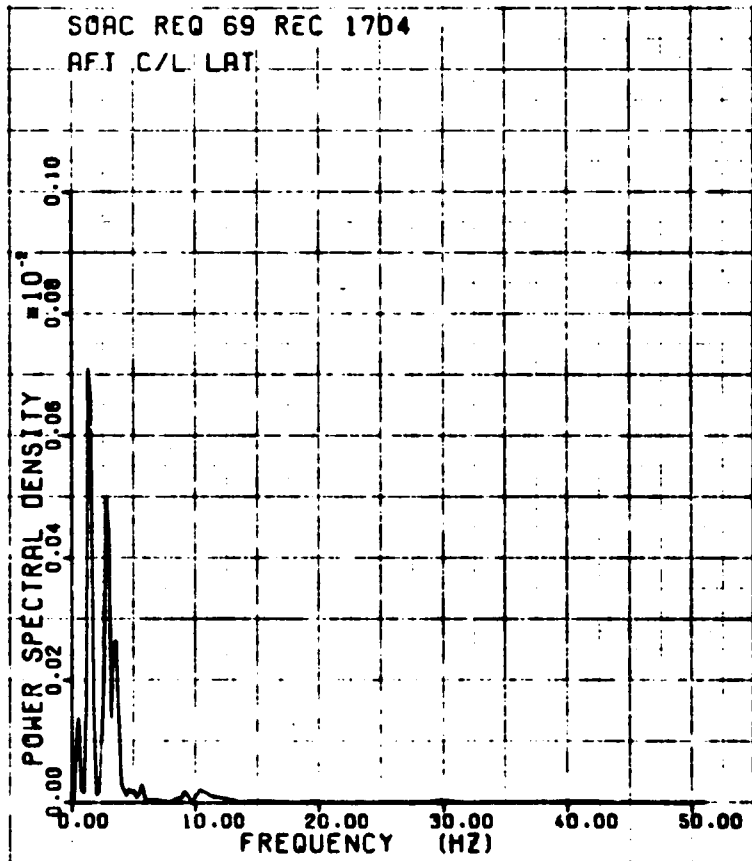
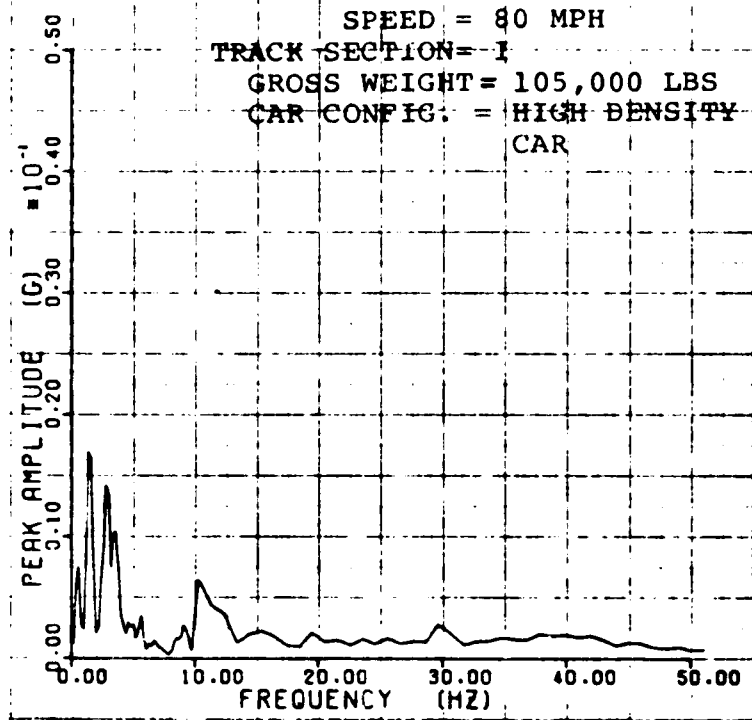


Figure A-76

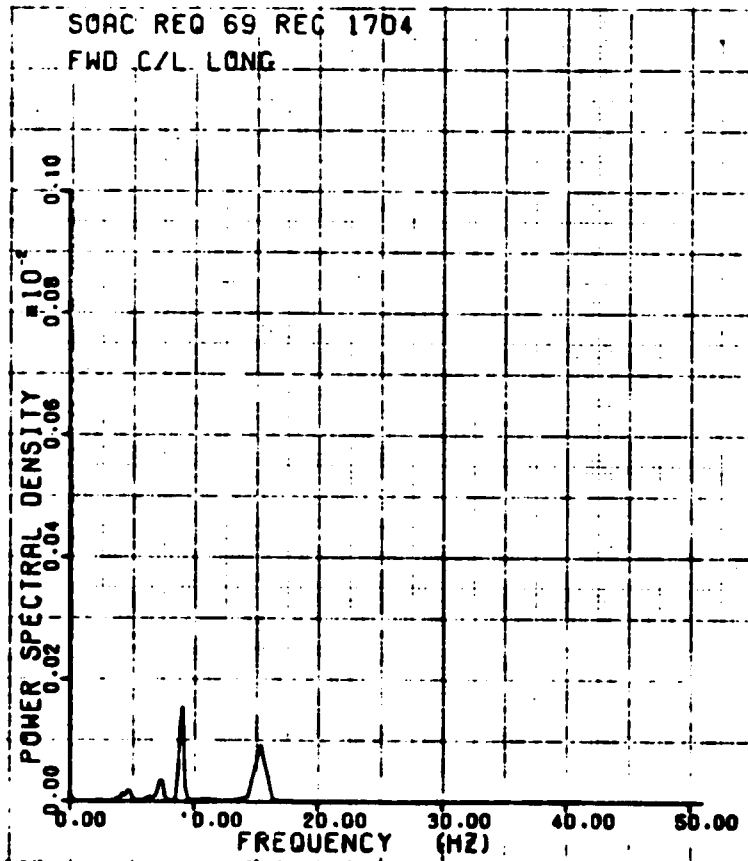
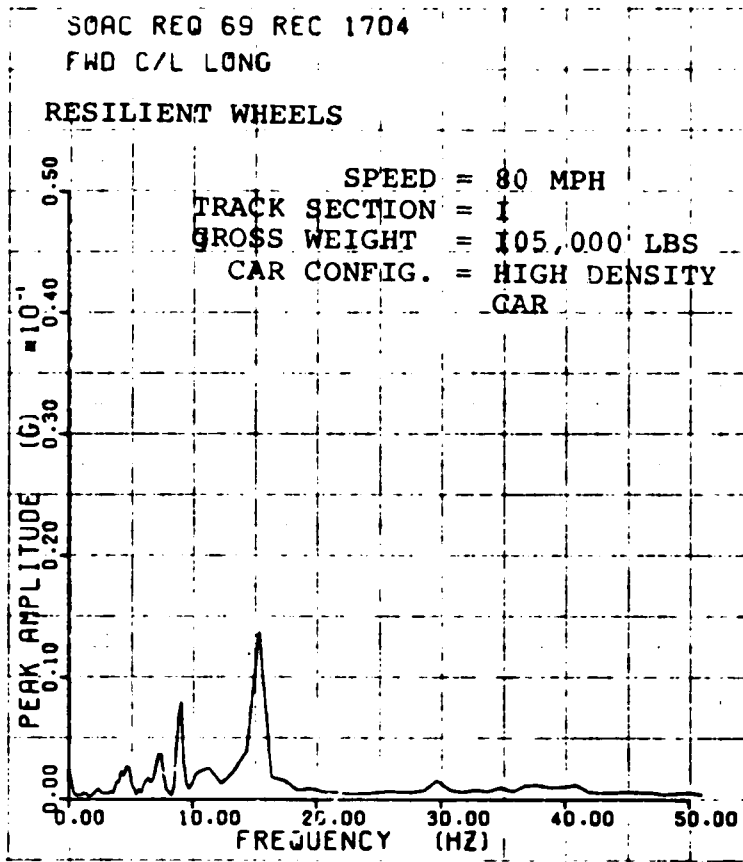
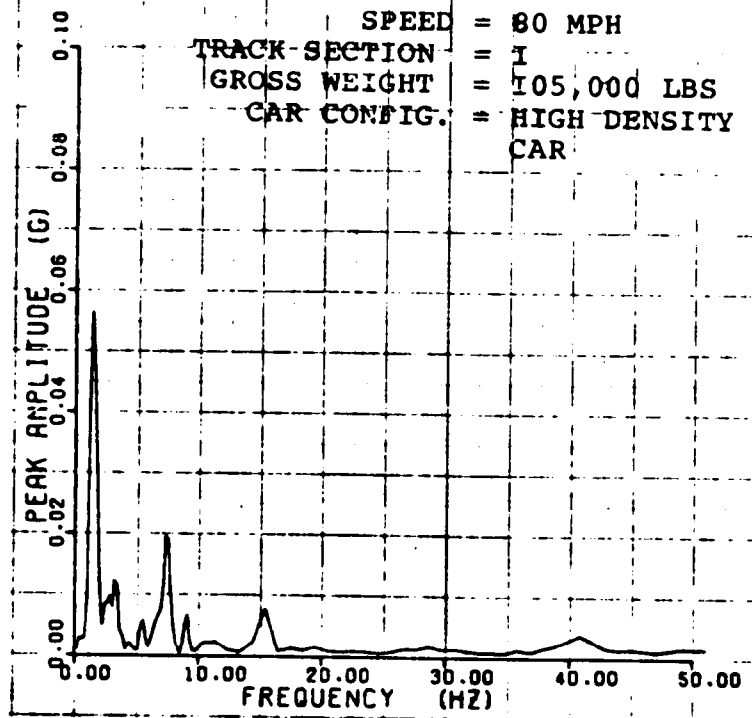


Figure A-77

SOARC REQ 69 REC 1704

FWD C/L VER

RESILIENT WHEELS



SOARC REQ 69 REC 1704

FWD C/L VER

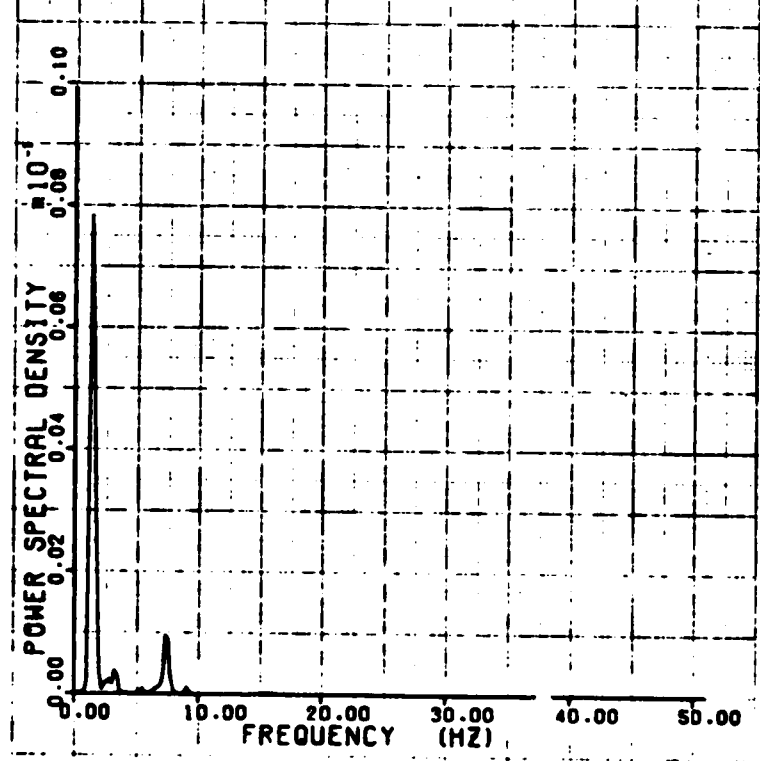


Figure A-78

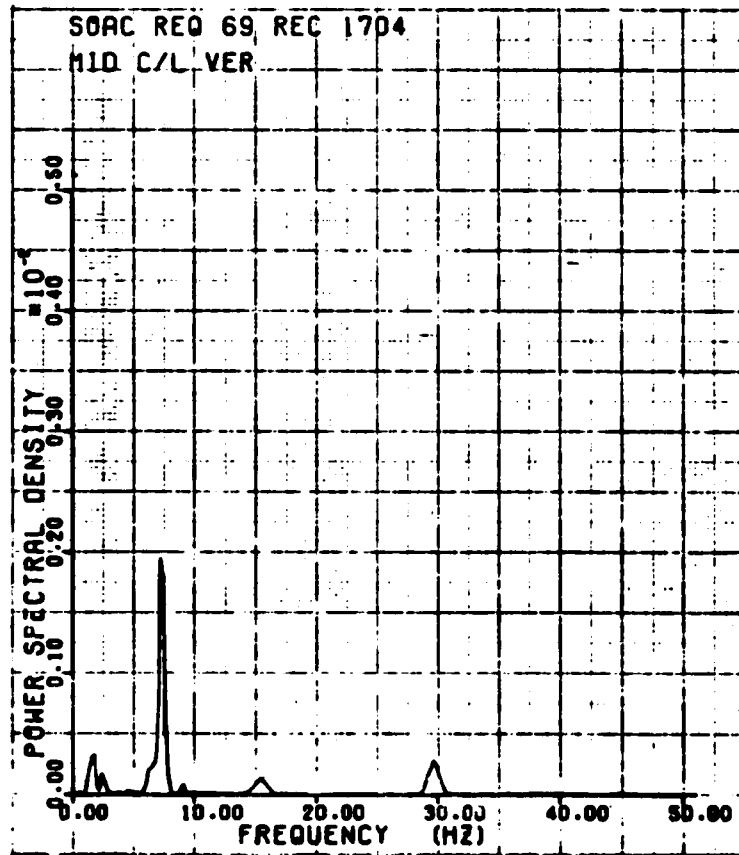
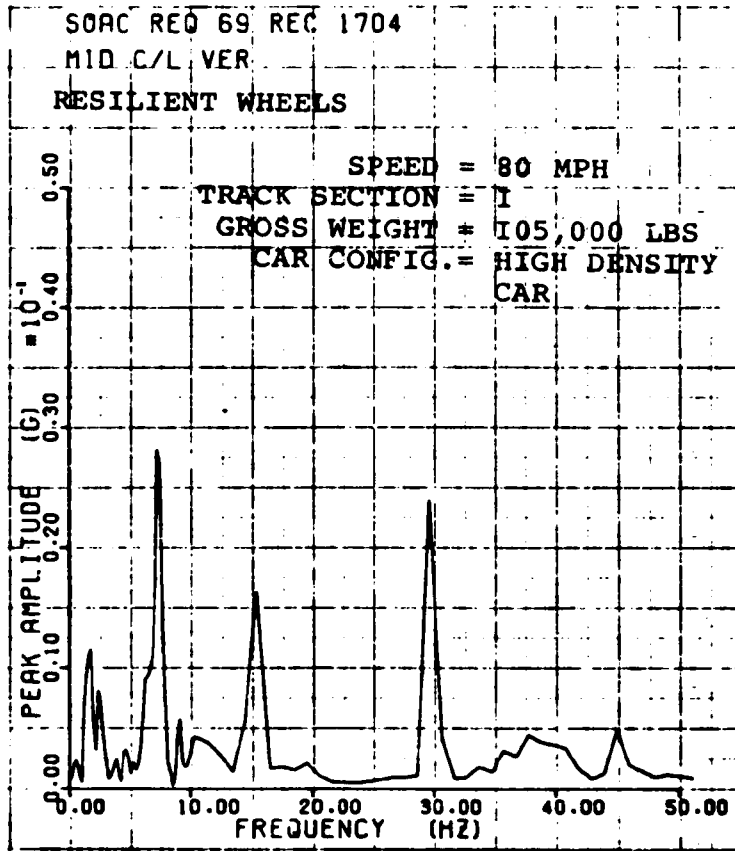
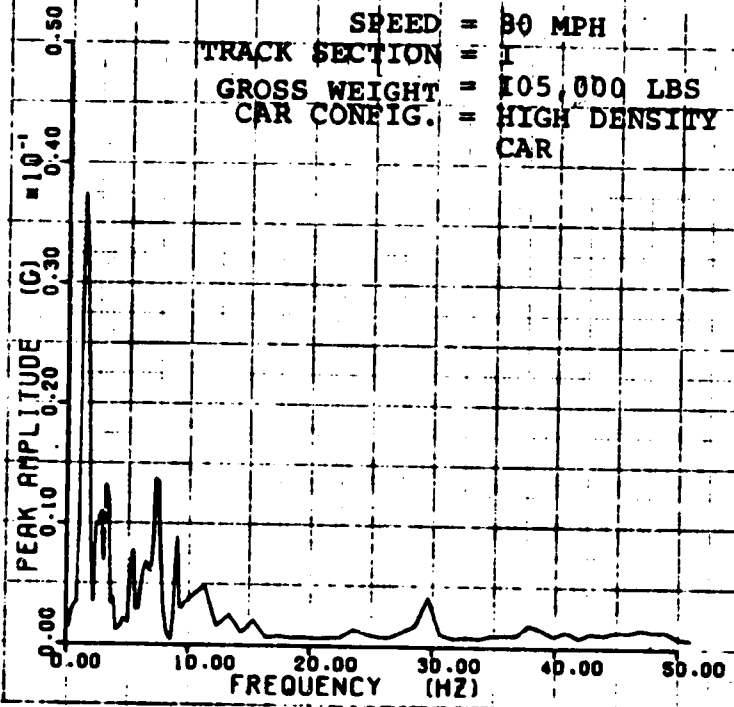


Figure A-79

SOAC REQ 69 REC 1704

9FT C/L VER

RESILIENT WHEELS



SOAC REQ 69 REC 1704

9FT C/L VER

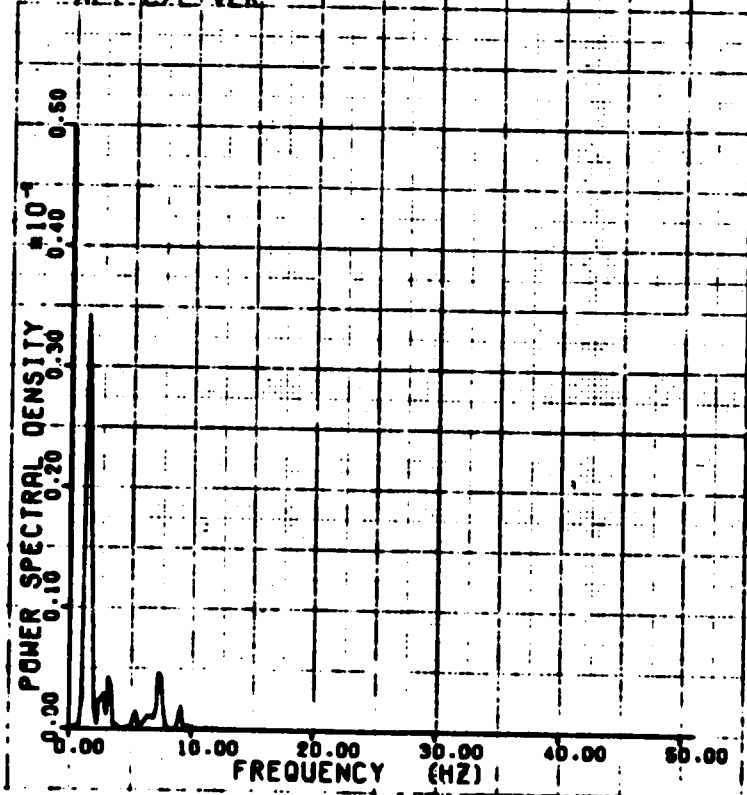
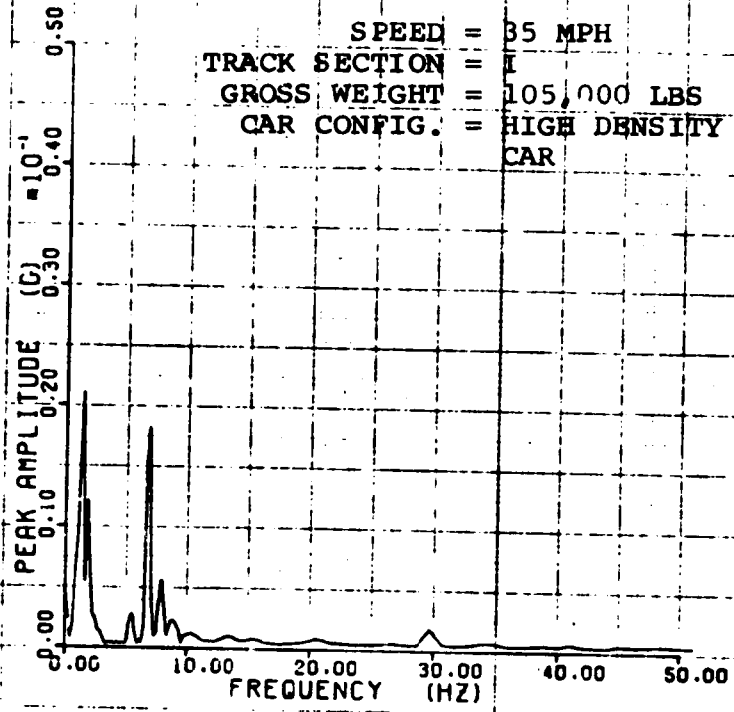


Figure A-80

SOAC REQ 77 REC 1620
FWD C/L VERT
RESILIENT WHEELS



SOAC REQ 77 REC 1620
FWD C/L VERT

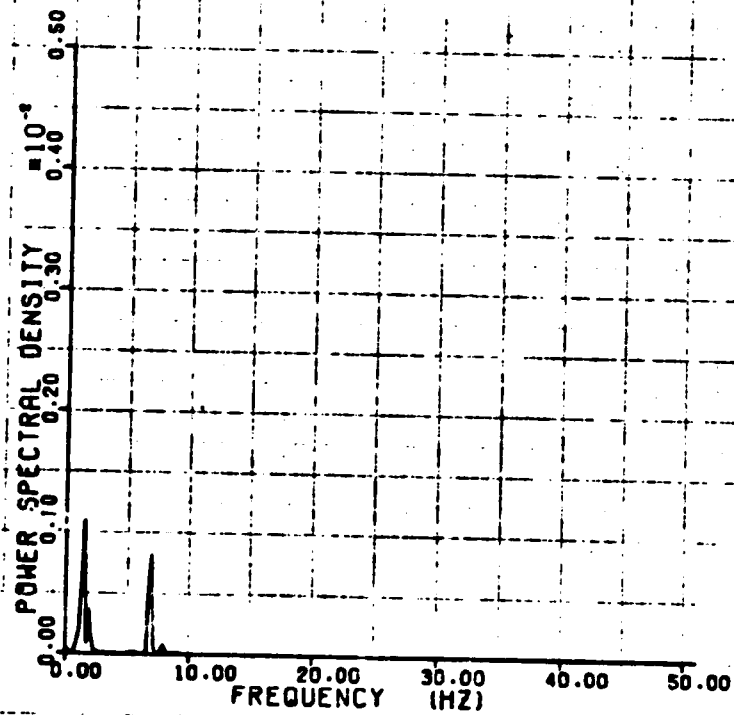


Figure A-81

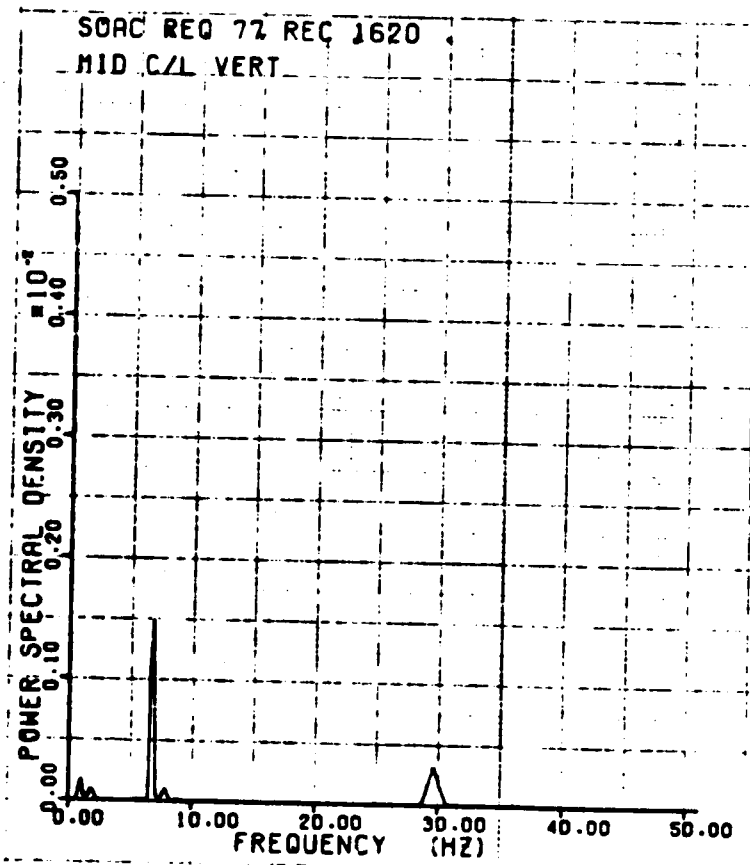
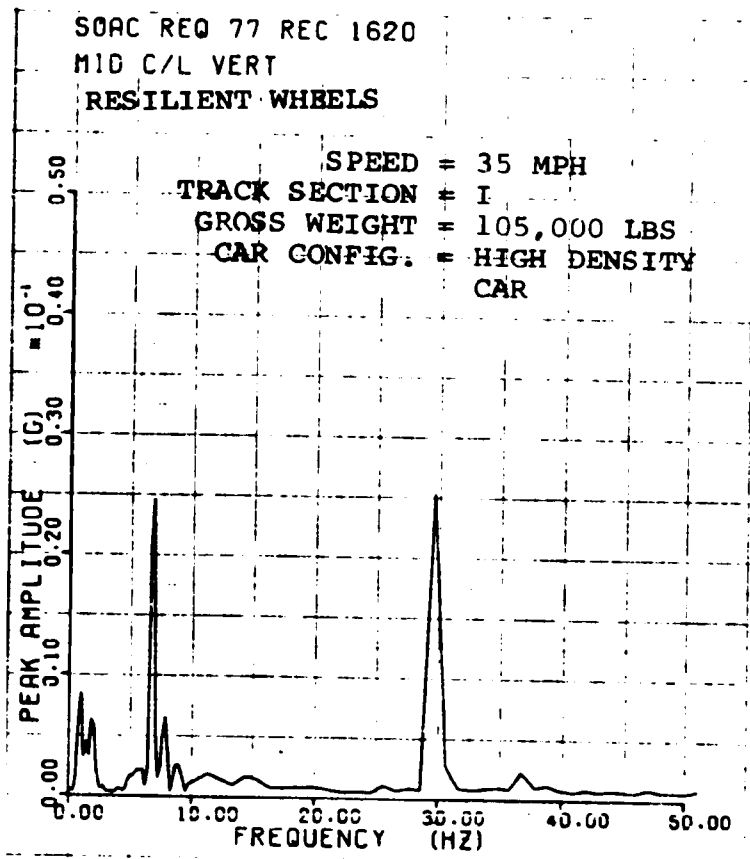


Figure A-82

SOAC REQ 77 REC 1620
AFT C/L VERT
RESILIENT WHEELS

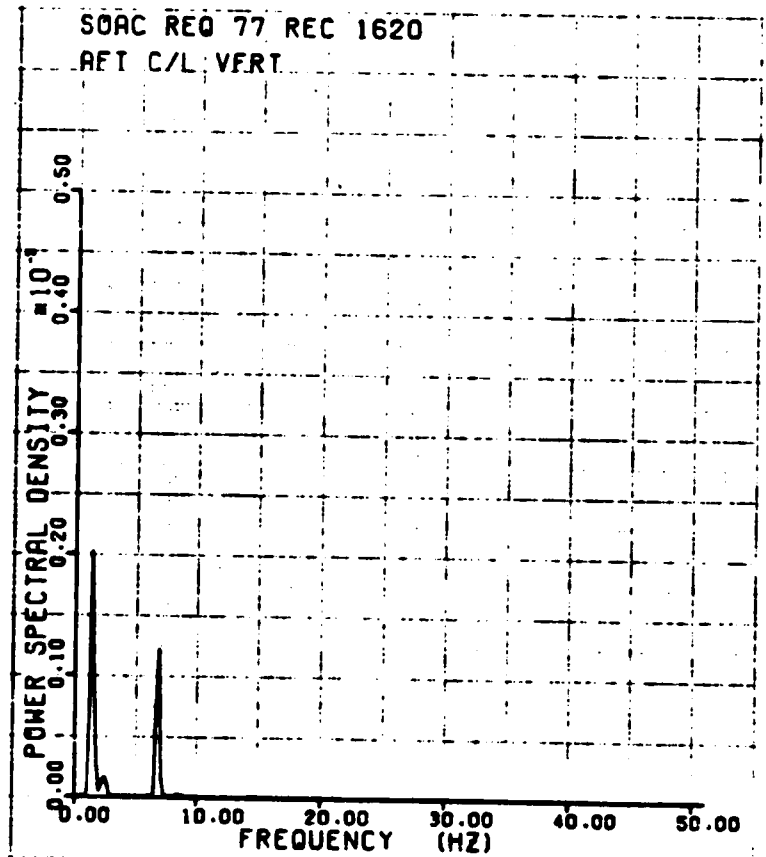
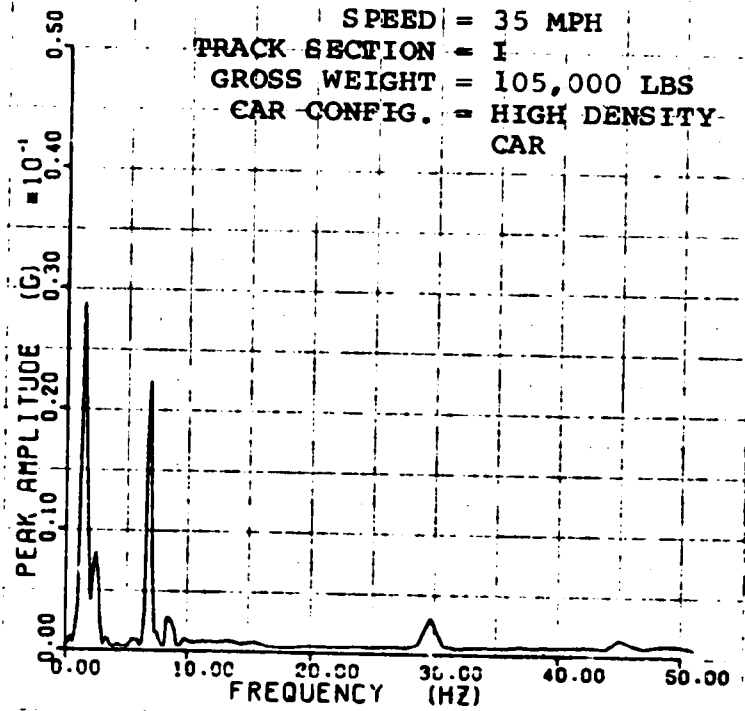
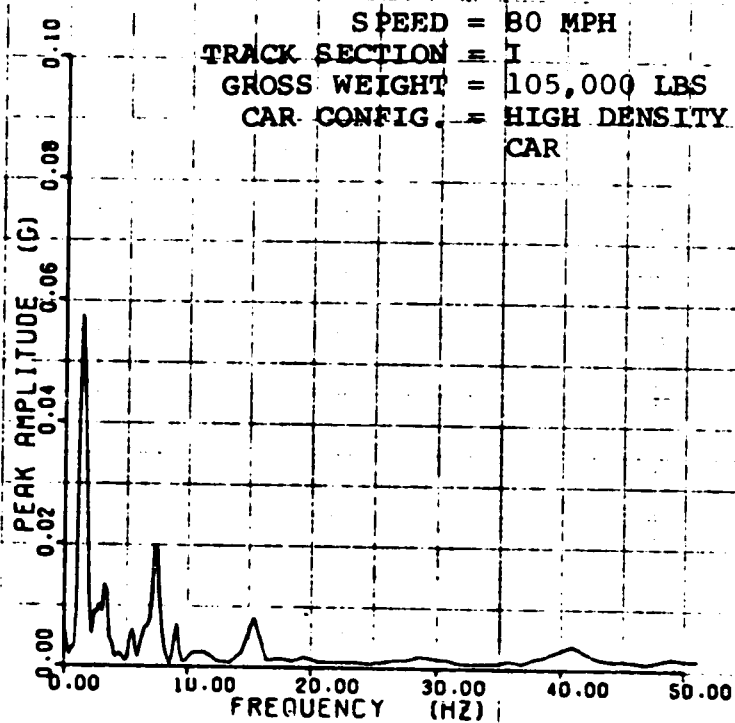


Figure A-83

SOARC REQ 77 REC 1704

FWD C/L VERT

RESILIENT WHEELS



SOARC REQ 77 REC 1704

FWD C/L VERT

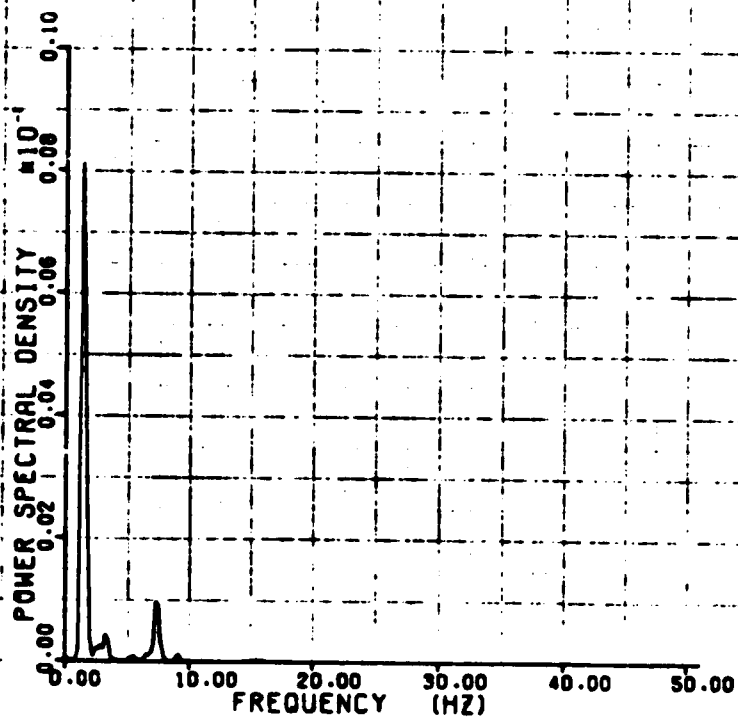
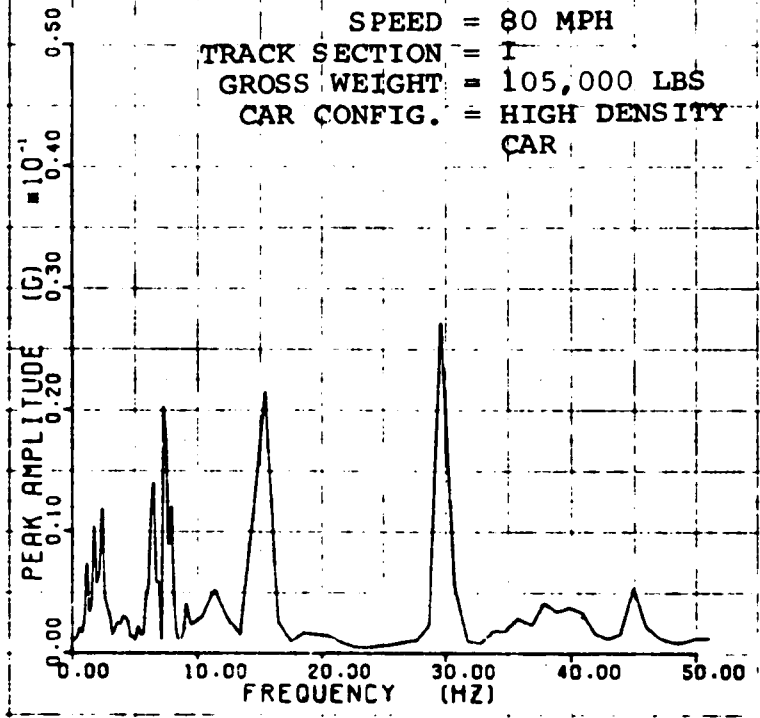


Figure A-84

SOAC REQ 77 REC 1704

MID C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1704

MID C/L VERT

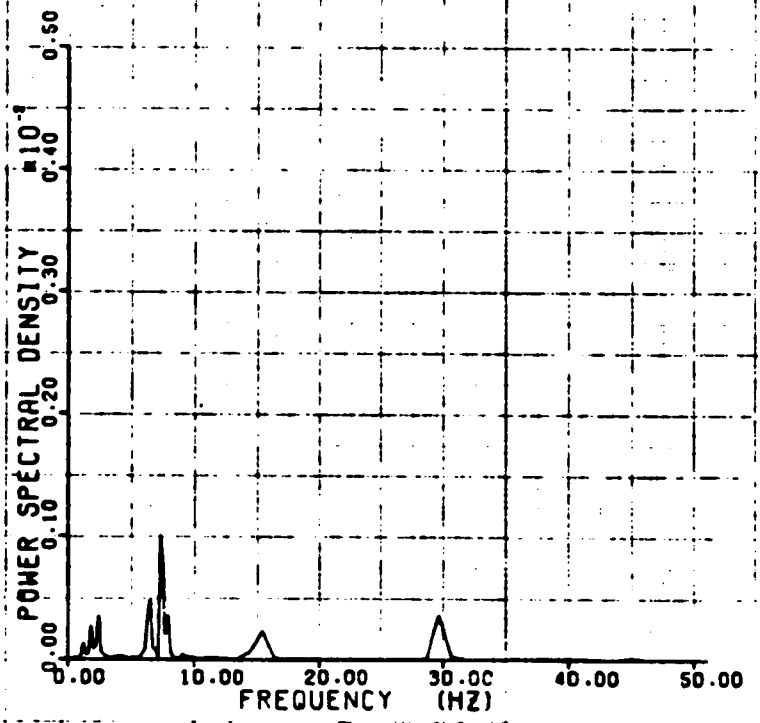
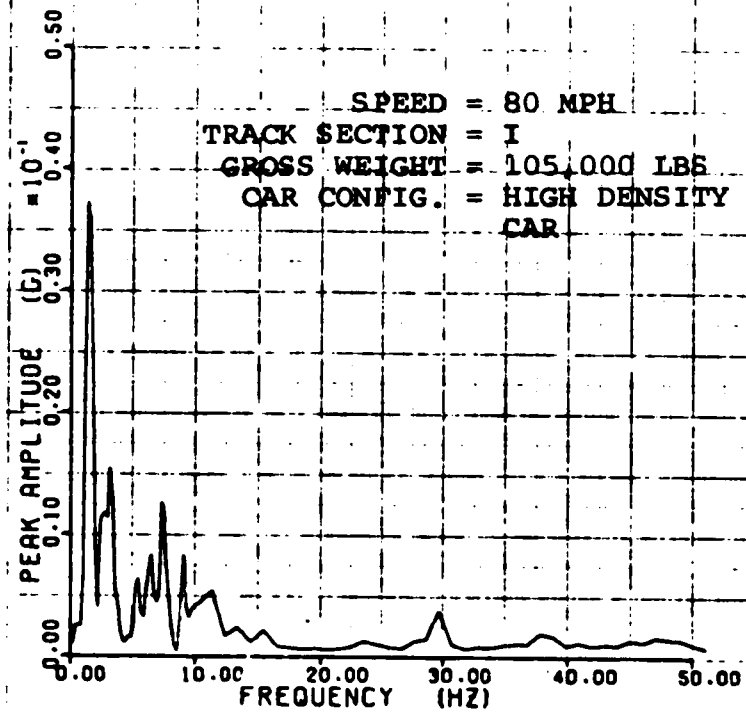


Figure A-85

SOAC REQ 77 REC 1704

AFT C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1704

AFT C/L VERT

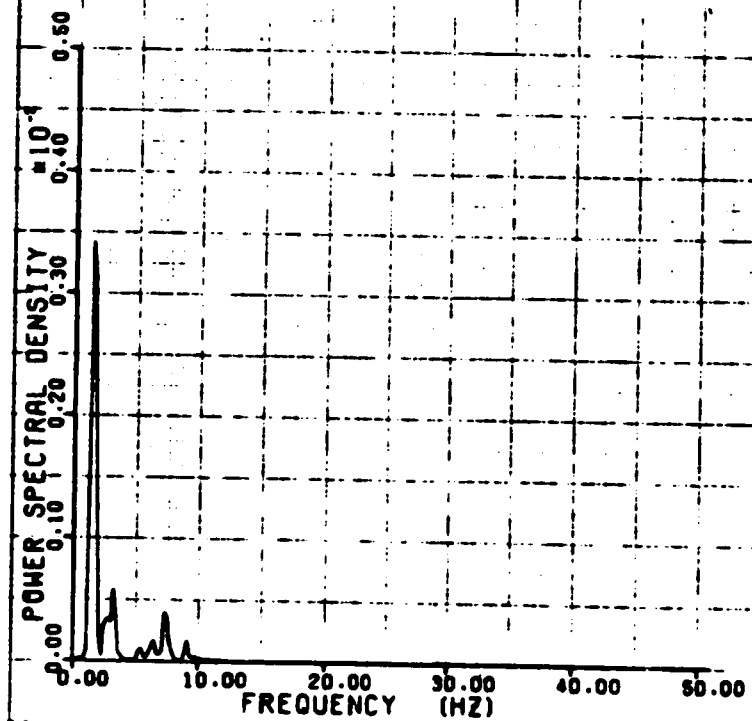
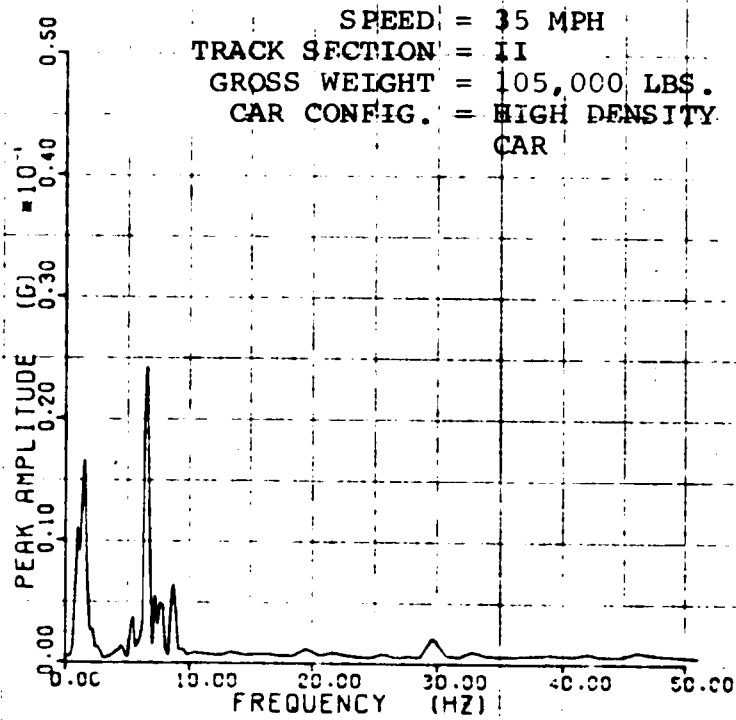


Figure A-86

SOAC REQ 77 REC 1623

FWD C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1623

FWD C/L VERT

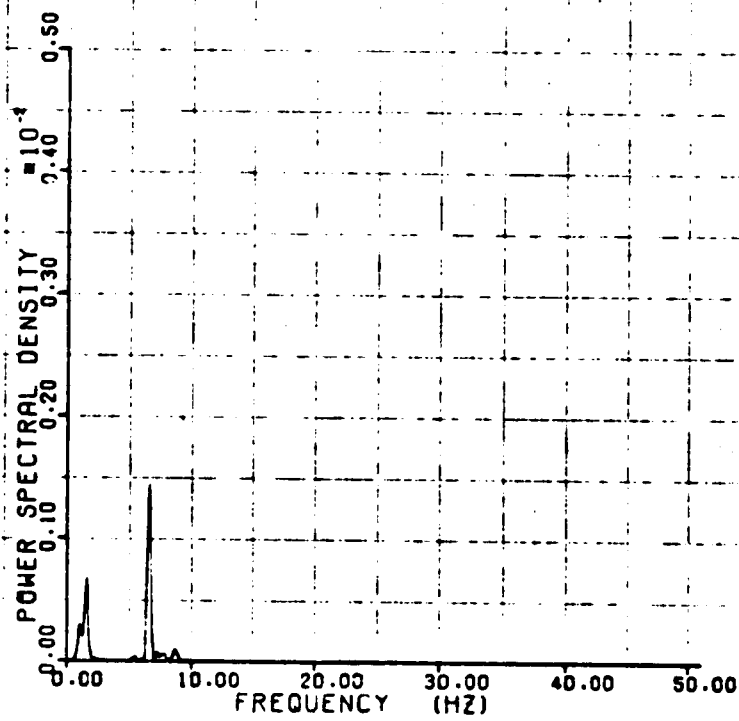
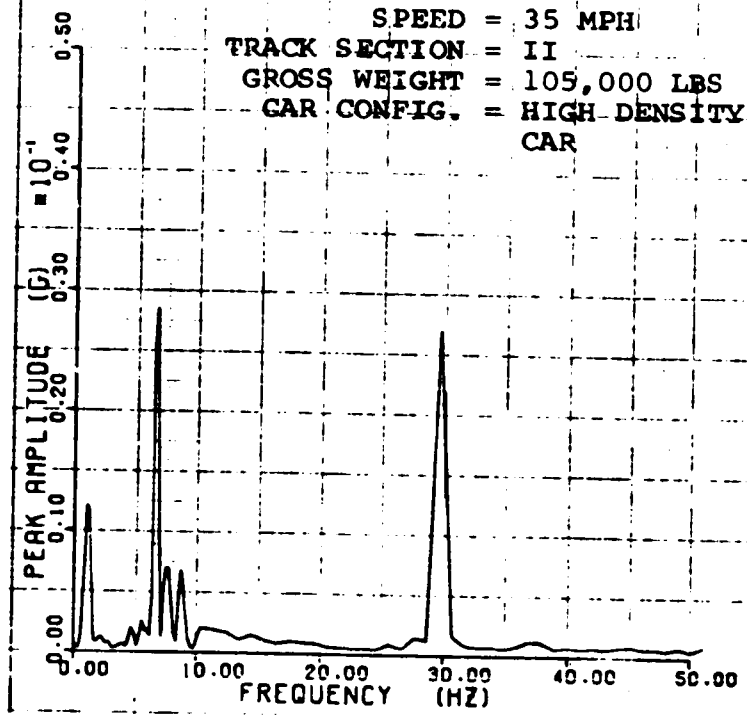


Figure A-87

SOAC REQ 77 REC 1623

MID C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1623

MID C/L VERT

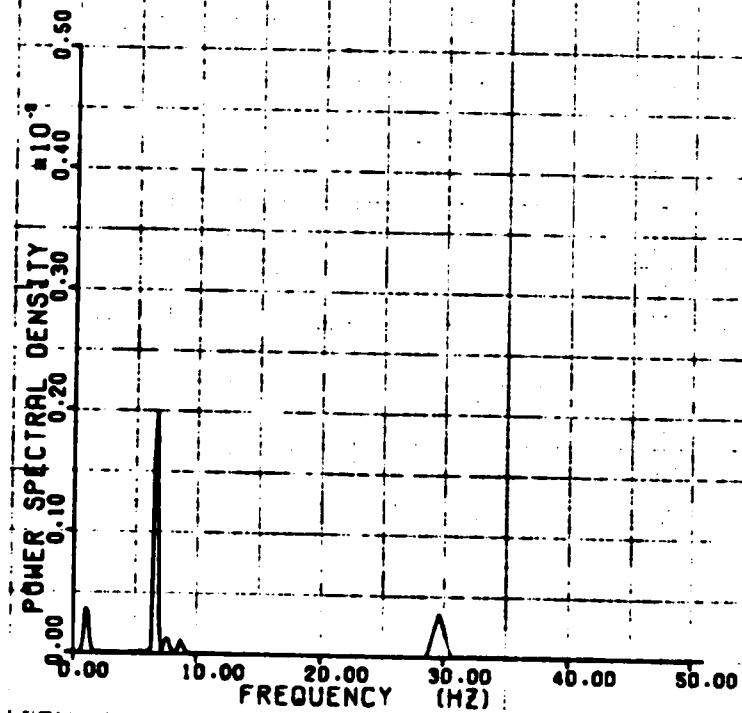
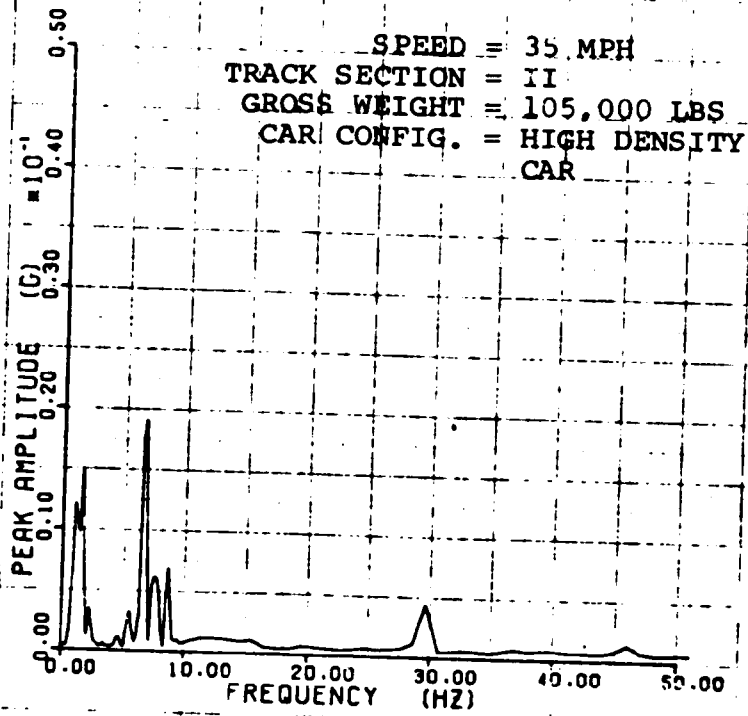


Figure A-88

SOAC REQ 77 REC 1623

RFT C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1623

RFI C/L VERT

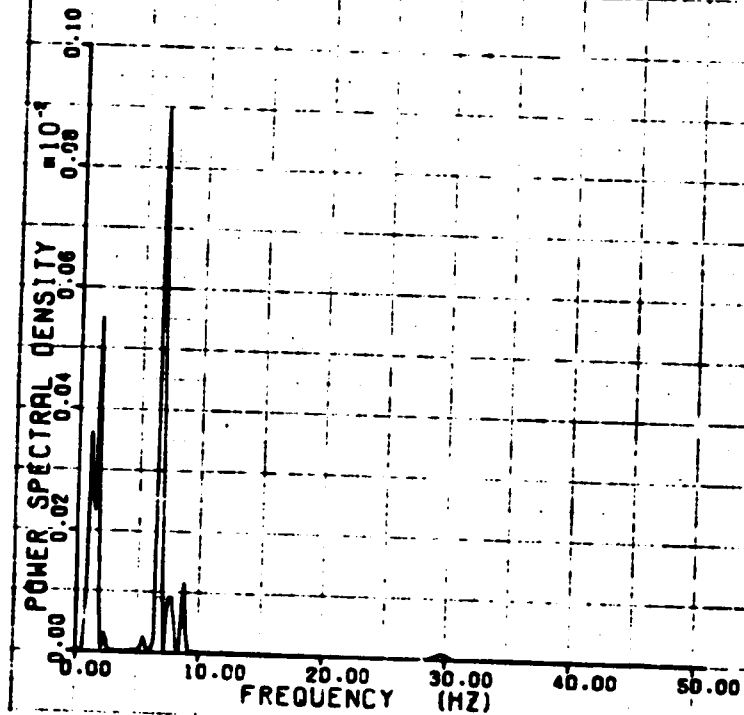
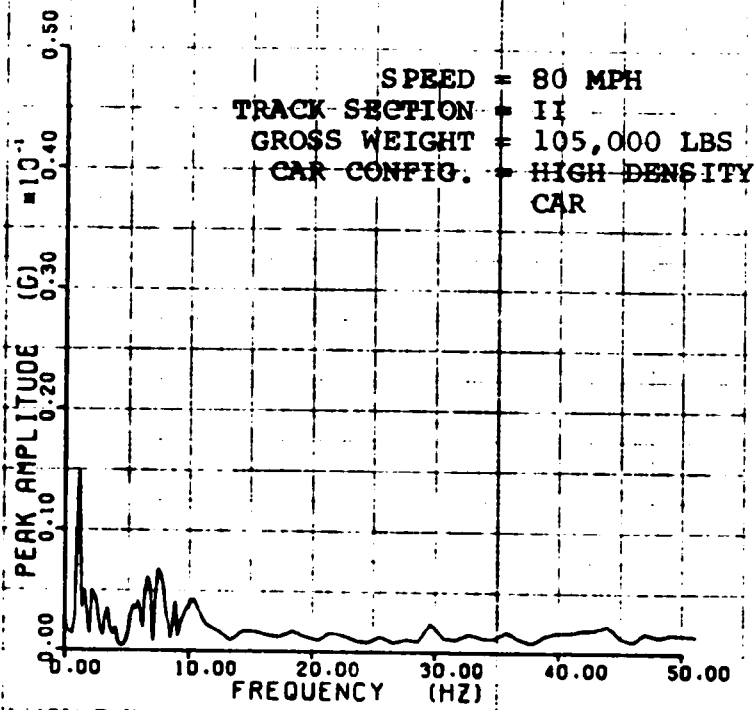


Figure A-89

SOAC REQ 77 REC 1705

FWD C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1705

FWD C/L VERT

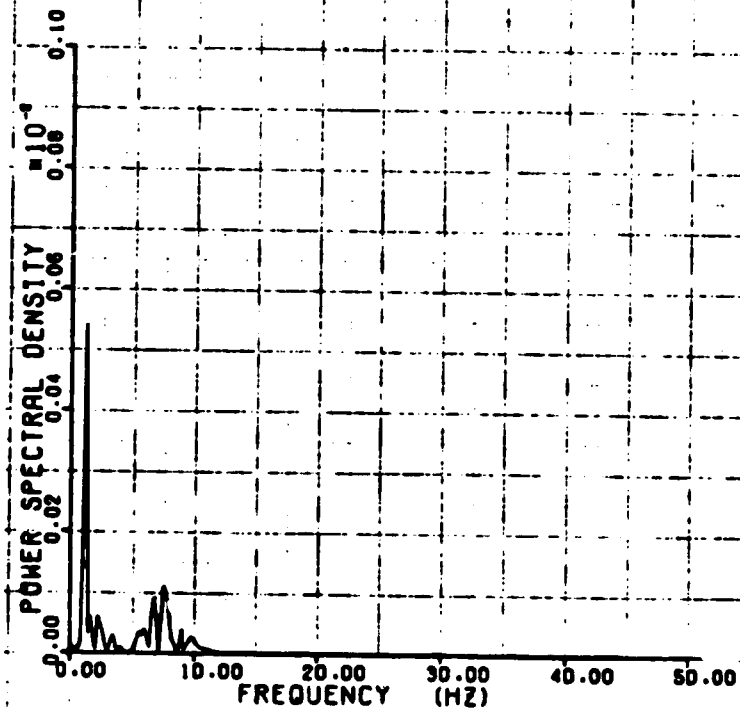


Figure A-90

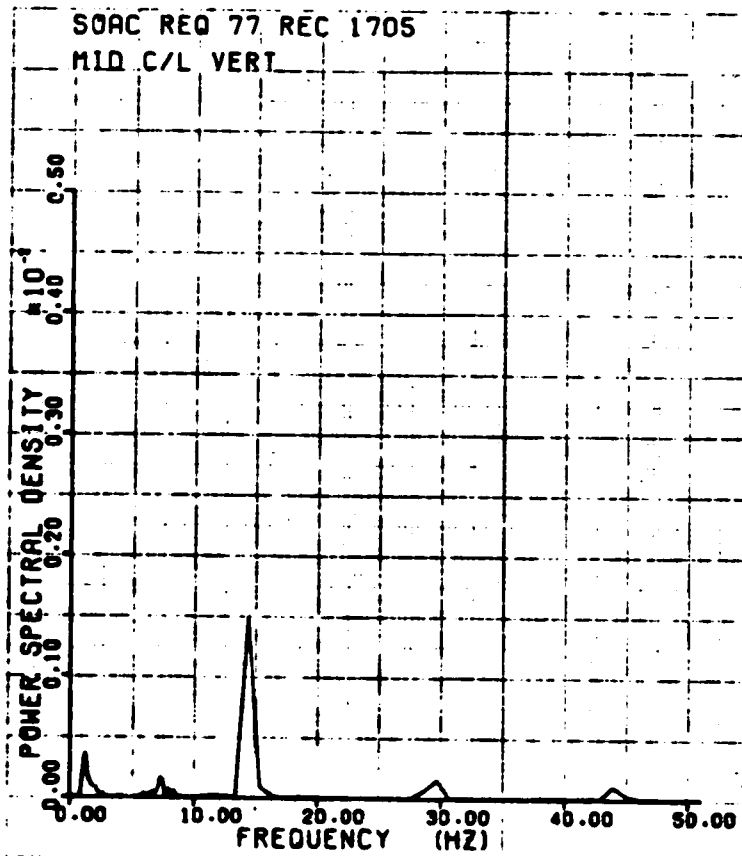
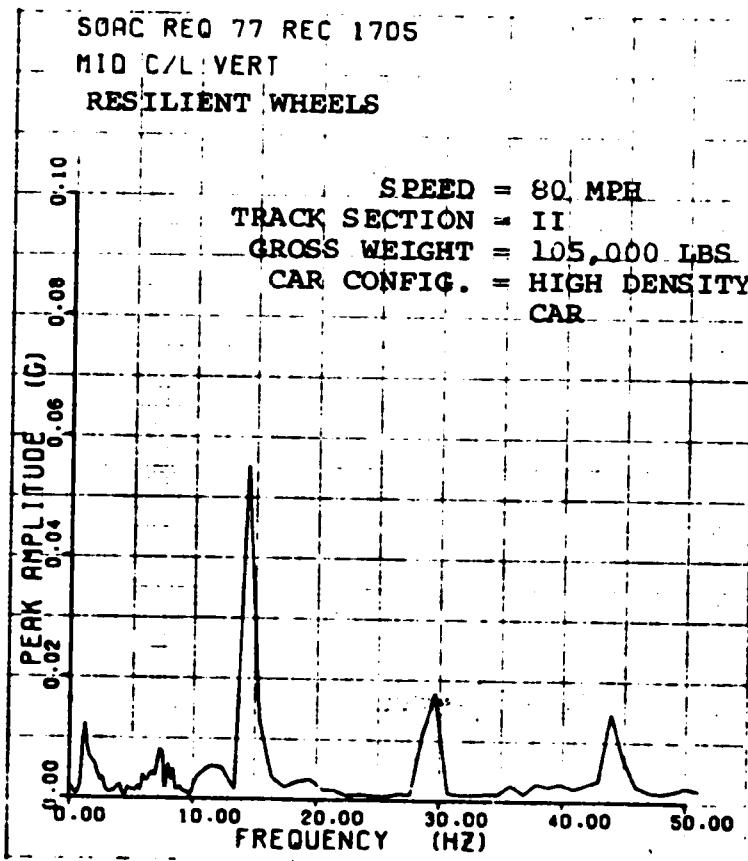


Figure A-91

SOAC REQ 77 REC 1705

AFT C/L VERT

RESILIENT WHEELS

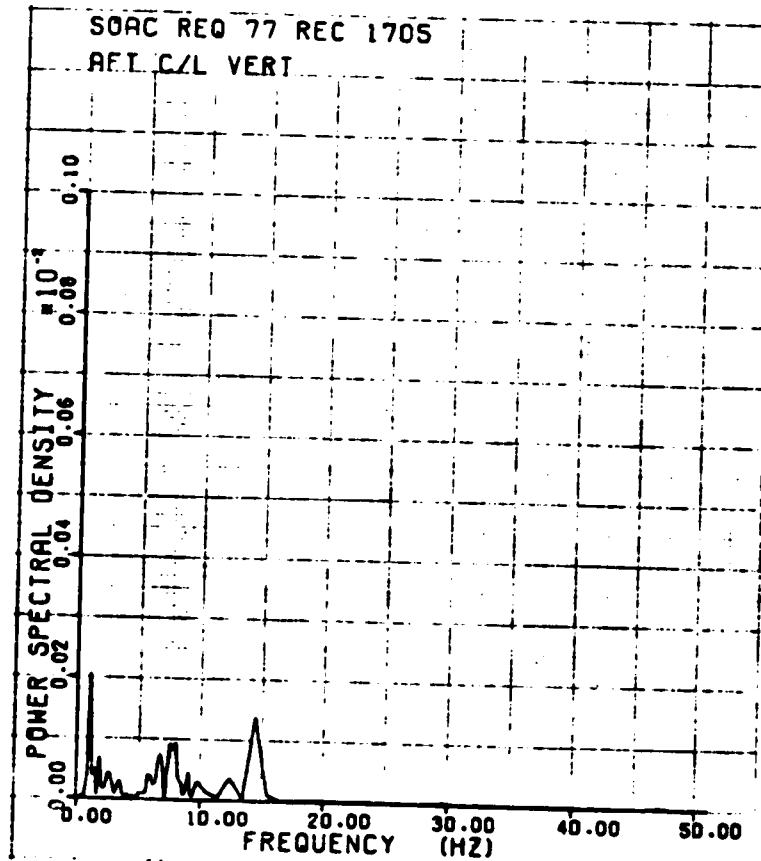
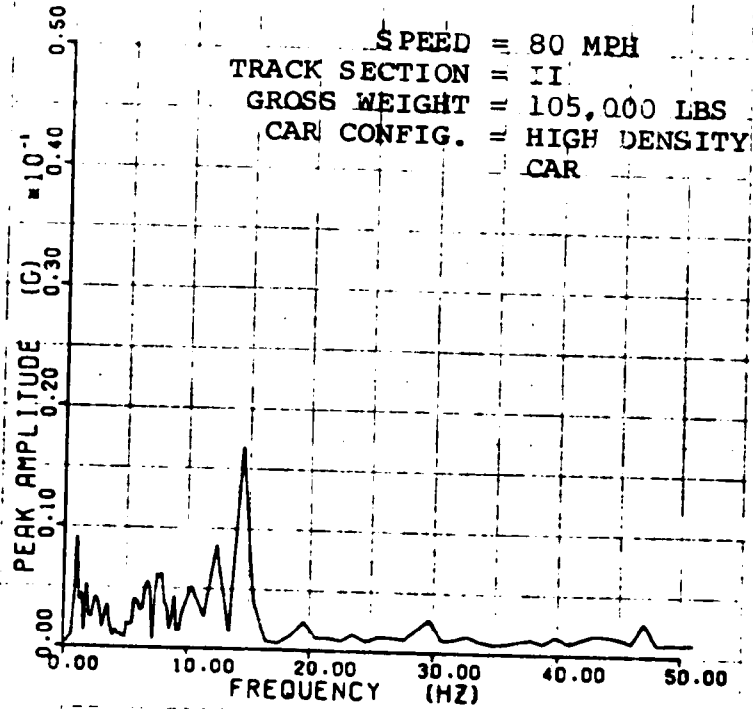
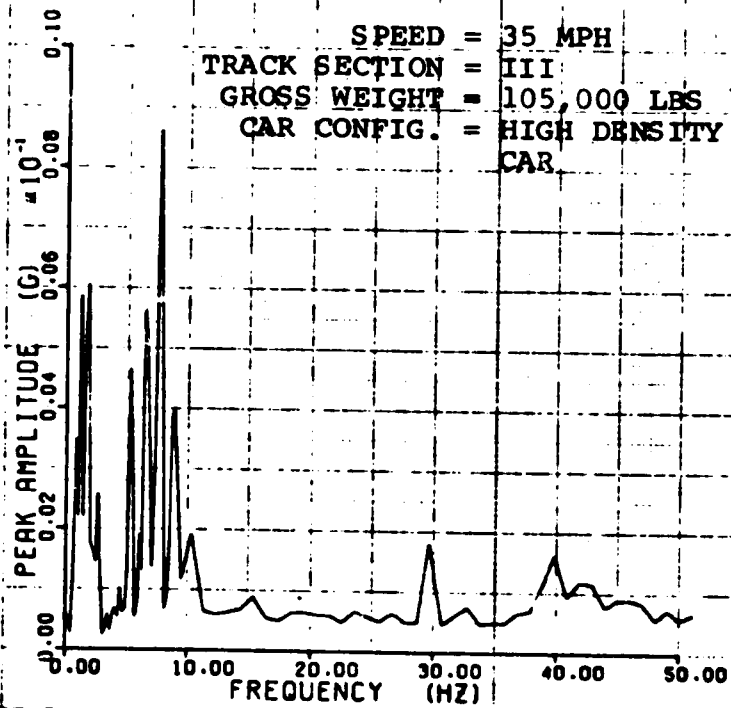


Figure A-92

SOAC REQ 77 REC 1624

FWD C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1624

FWD C/L VERT

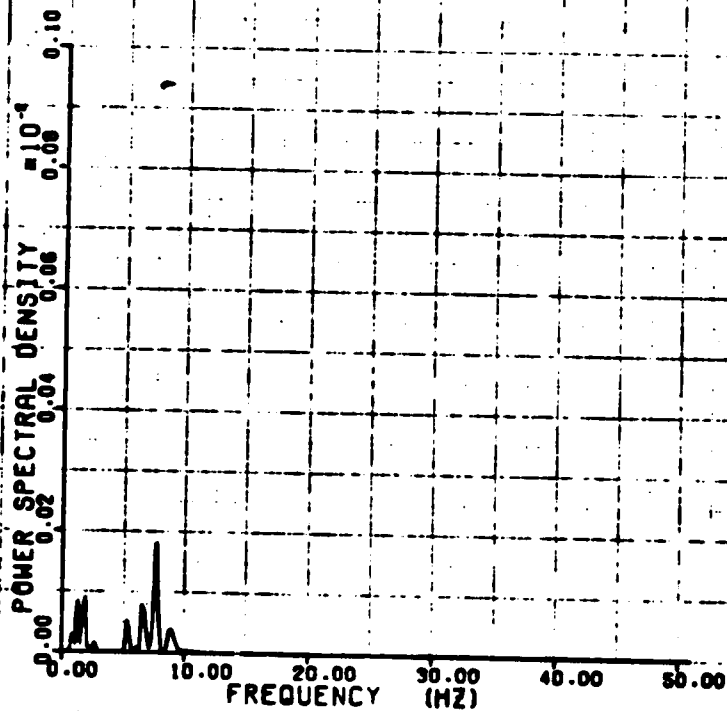
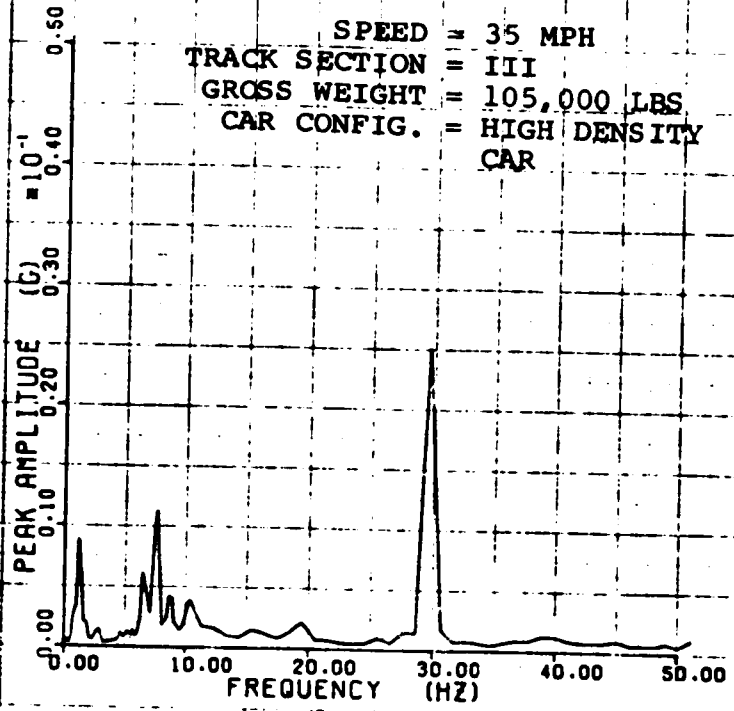


Figure A-93

SOAC REQ 77 REC 1624

MID C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1624

MID C/L VERT

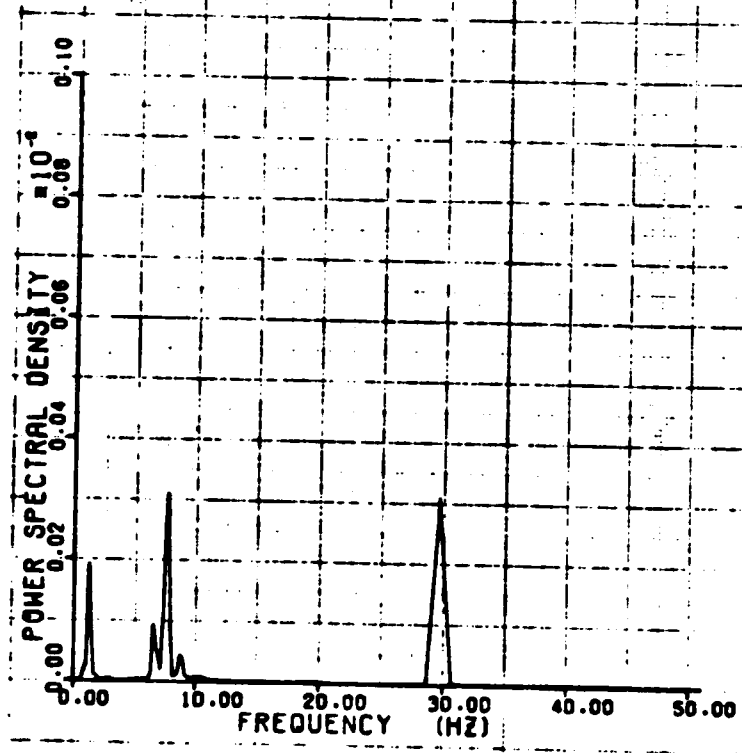


Figure A-94

SOAC REQ 77 REC 1624
AFT C/L VERT
RESILIENT WHEELS

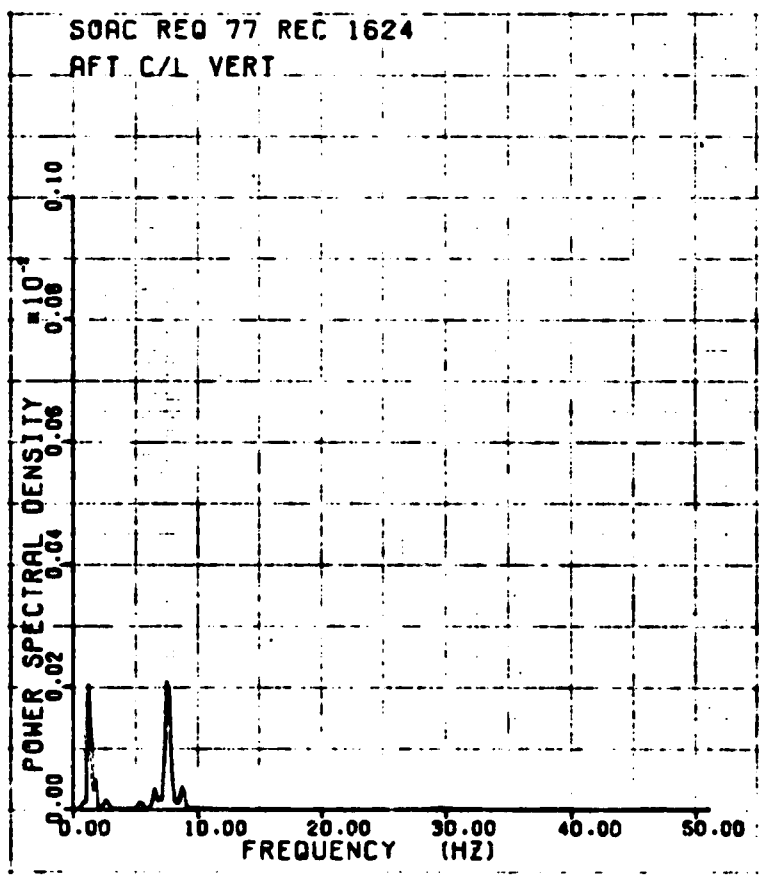
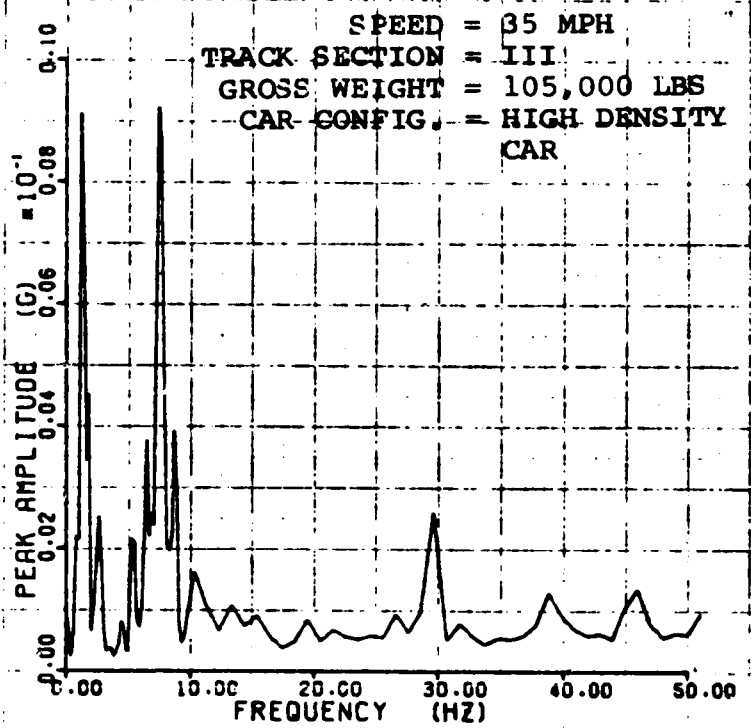


Figure A-95

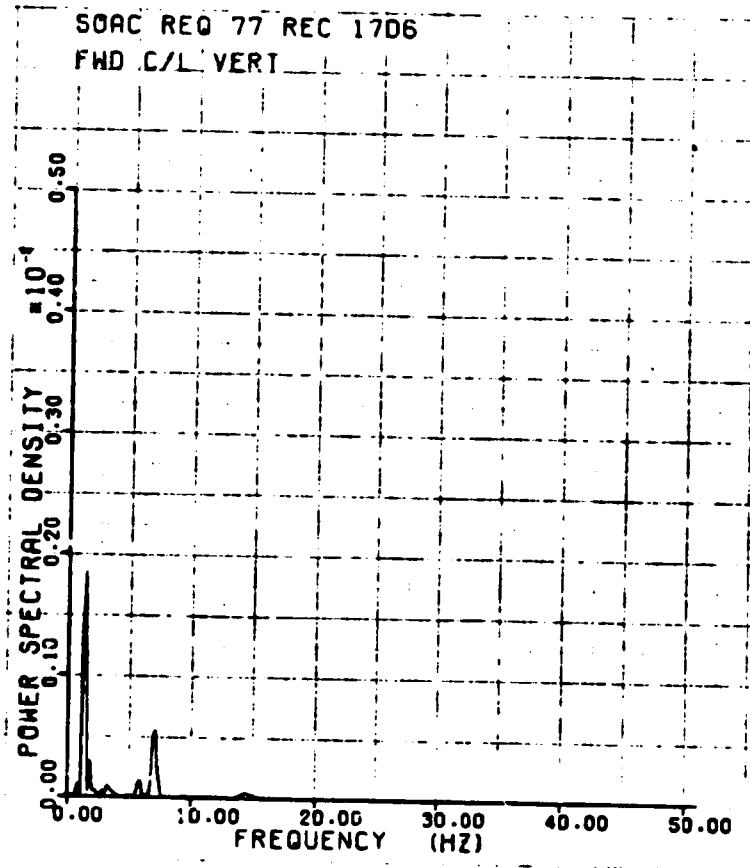
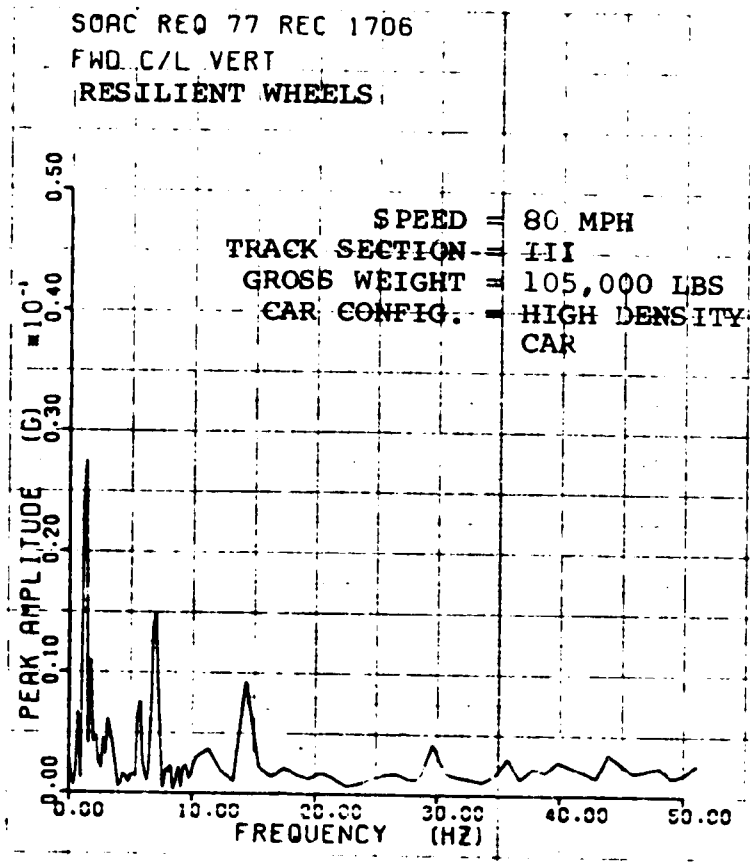


Figure A-96

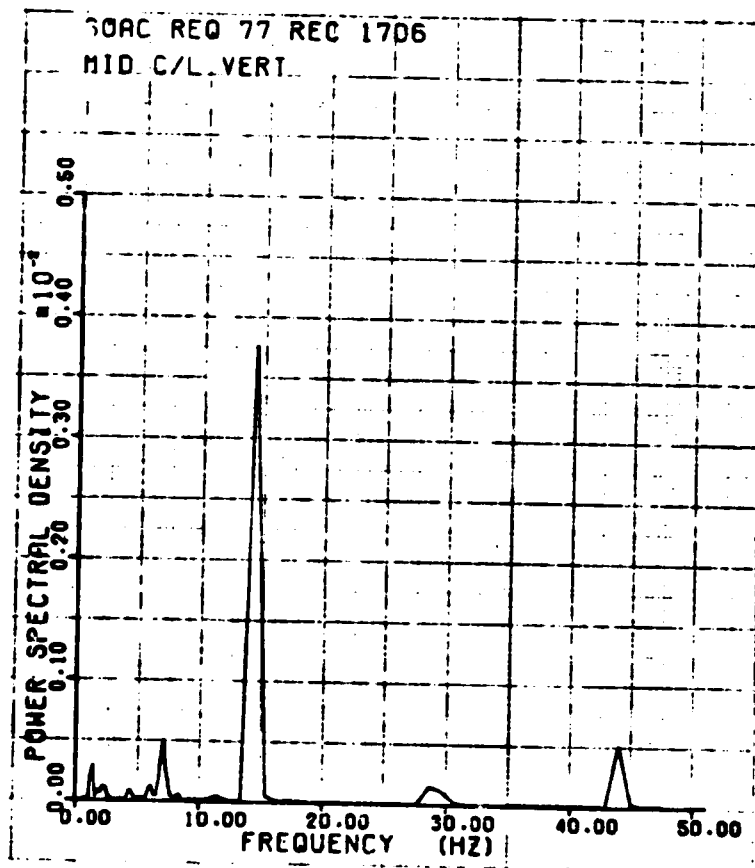
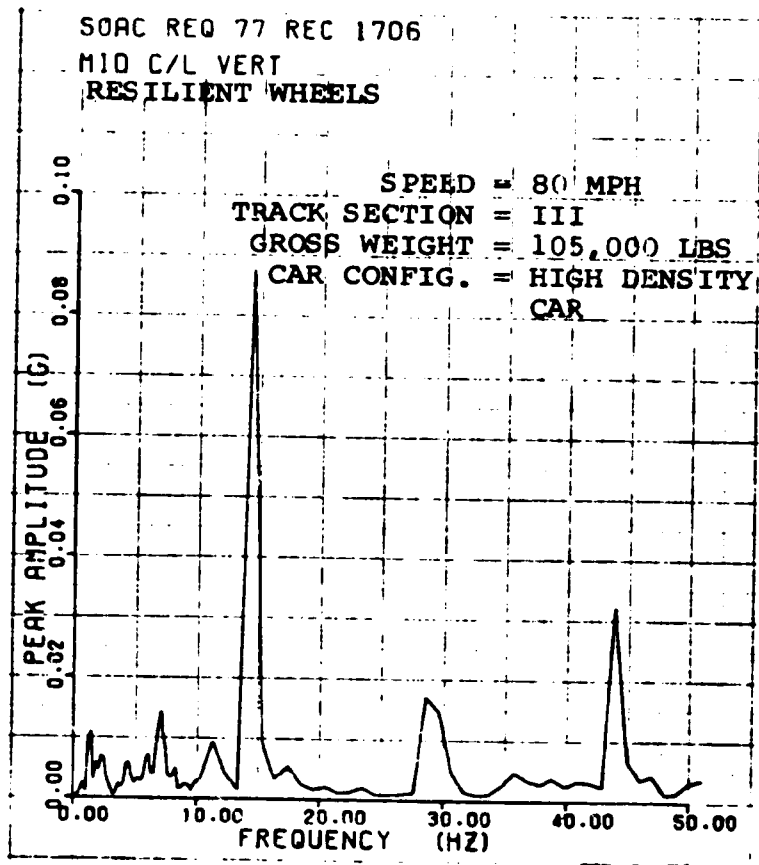
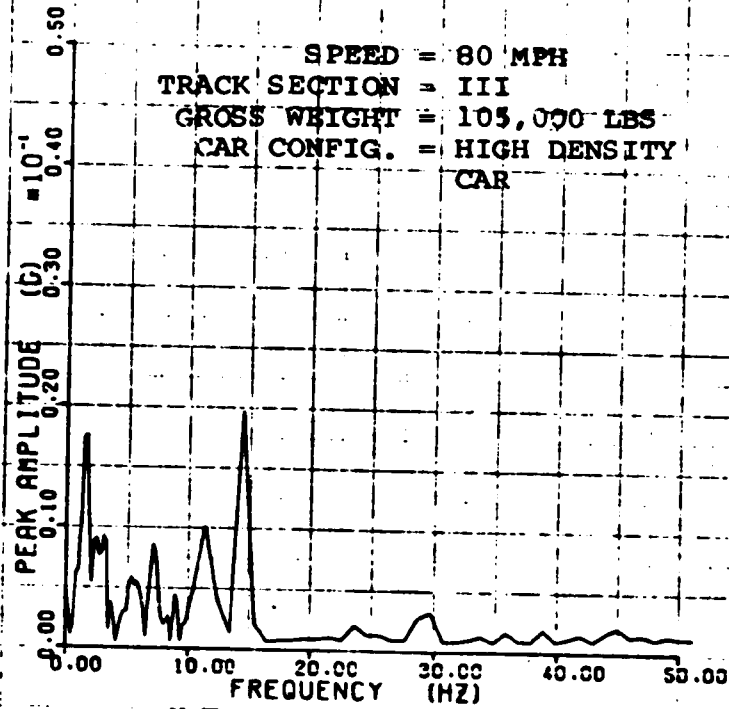


Figure A-97

SOAC REQ 77 REC 1706

AFT C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1706

AFT C/L VERT

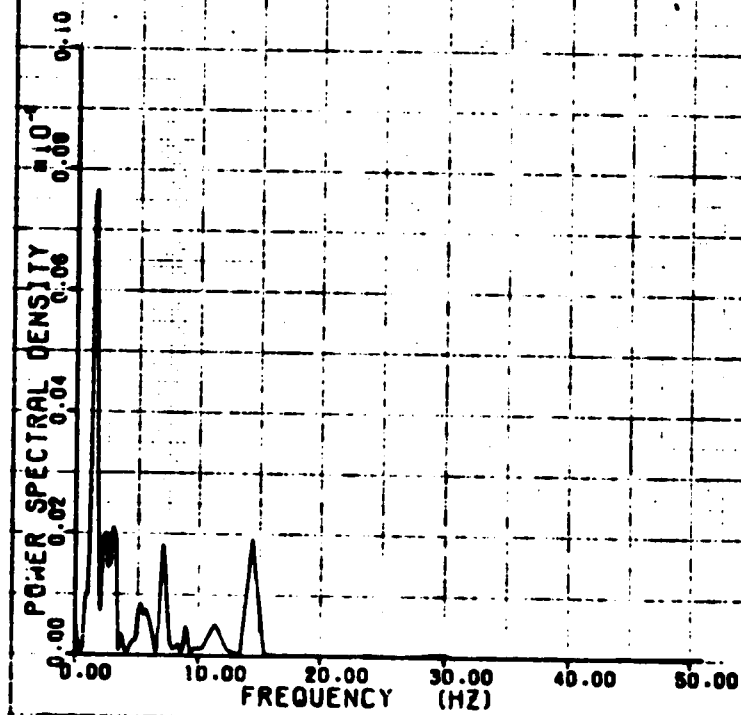
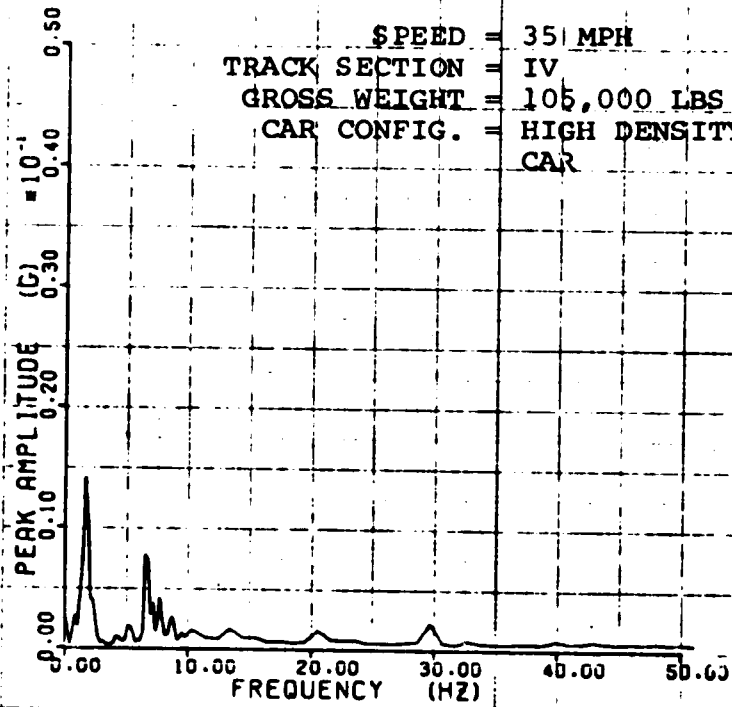


Figure A-98

SOAC REQ 77 REC 1627

FWD C/L VERT
RESILIENT WHEELS



SOAC REQ 77 REC 1627

FWD C/L VERT

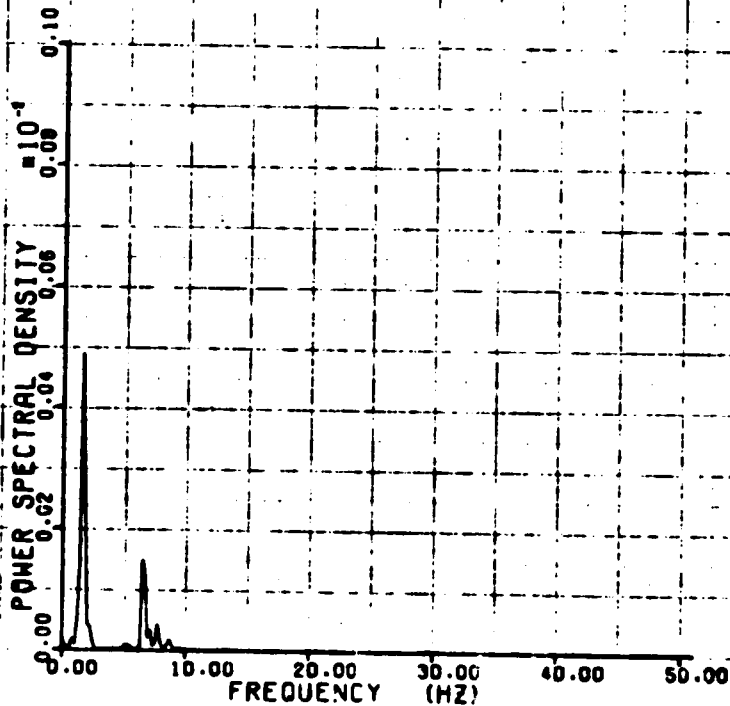


Figure A-99

SOAC REQ 77 REC 1627
MID C/L VERT
RESILIENT WHEELS

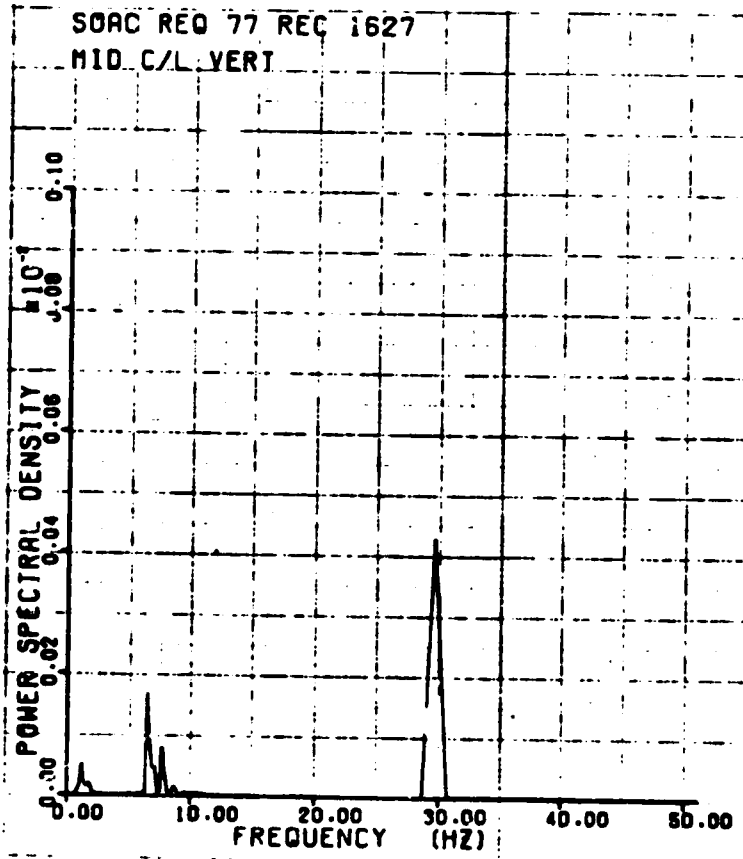
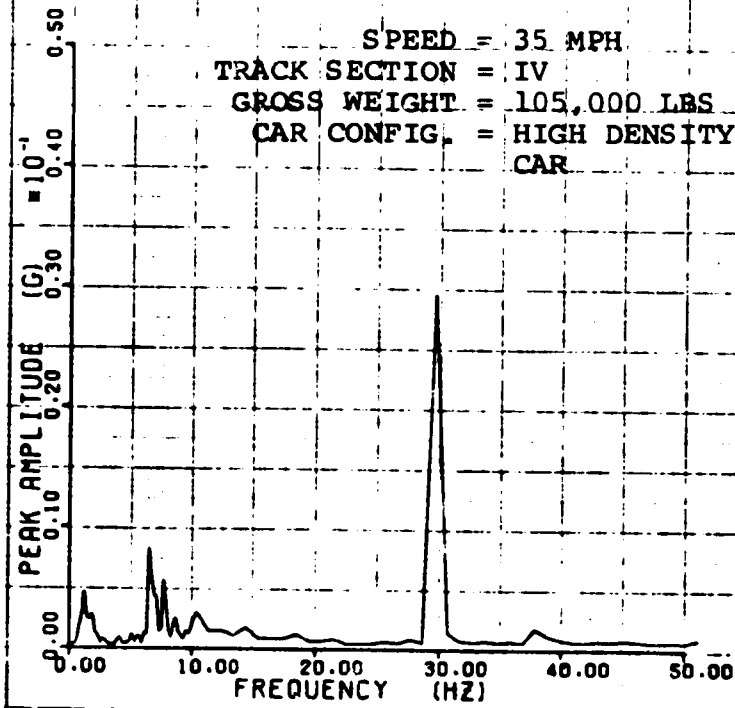


Figure A-100

SOAC REQ 77 REC 1627
AFT C/L VERT
RESILIENT WHEELS

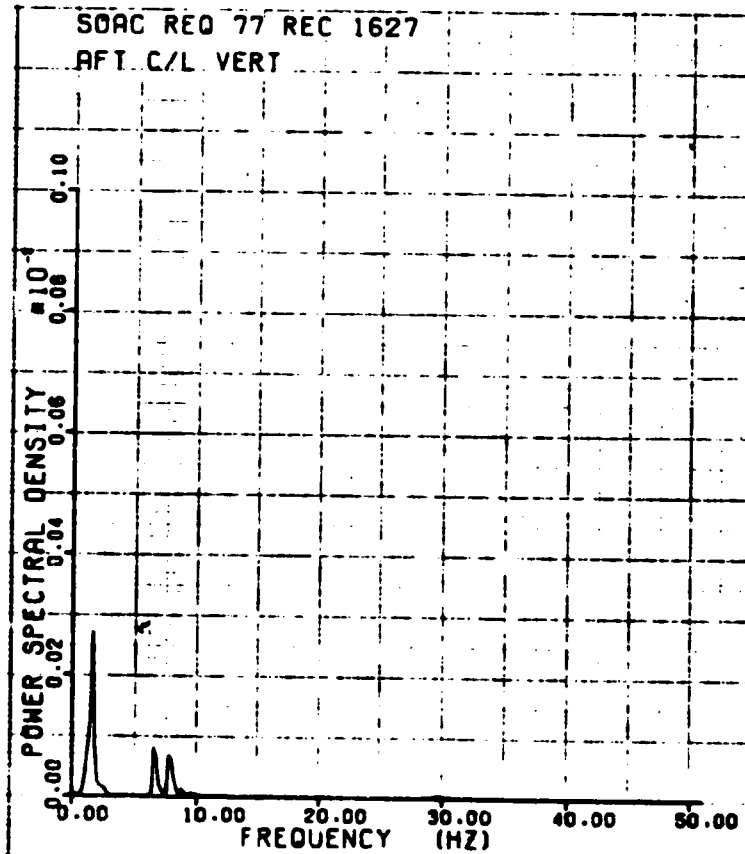
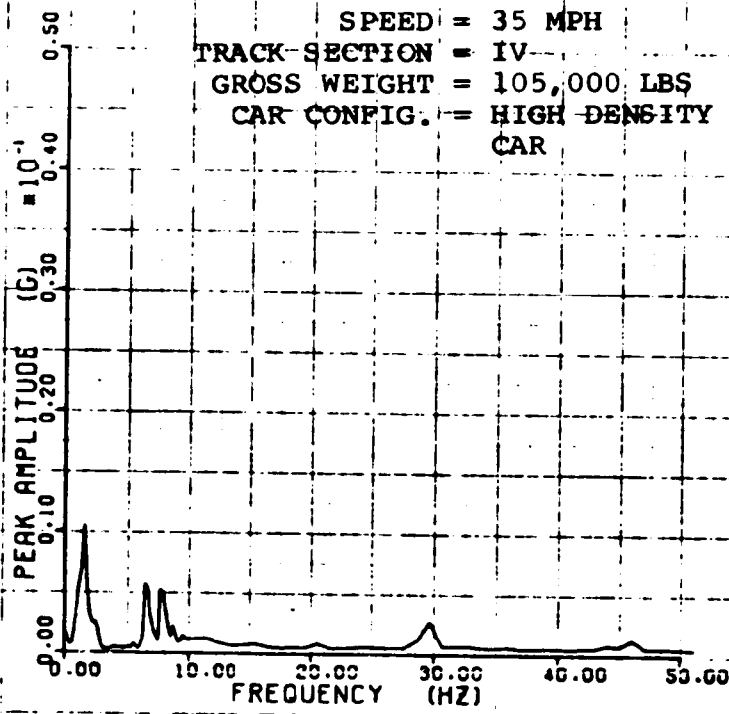


Figure A-101

SOAC REQ 77 REC 1707

FWD C/L VERT

RESILIENT WHEELS

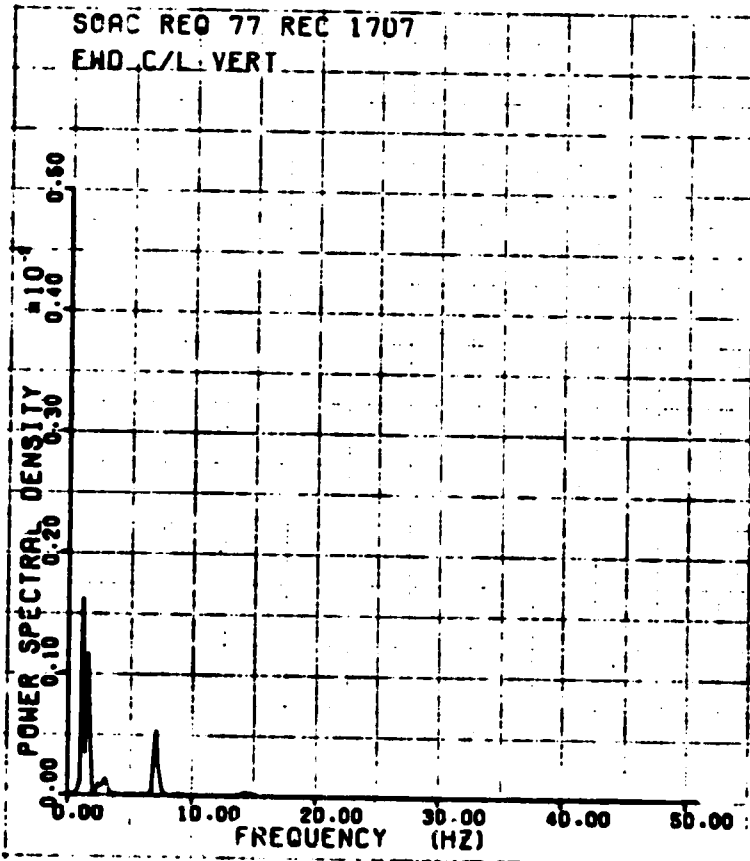
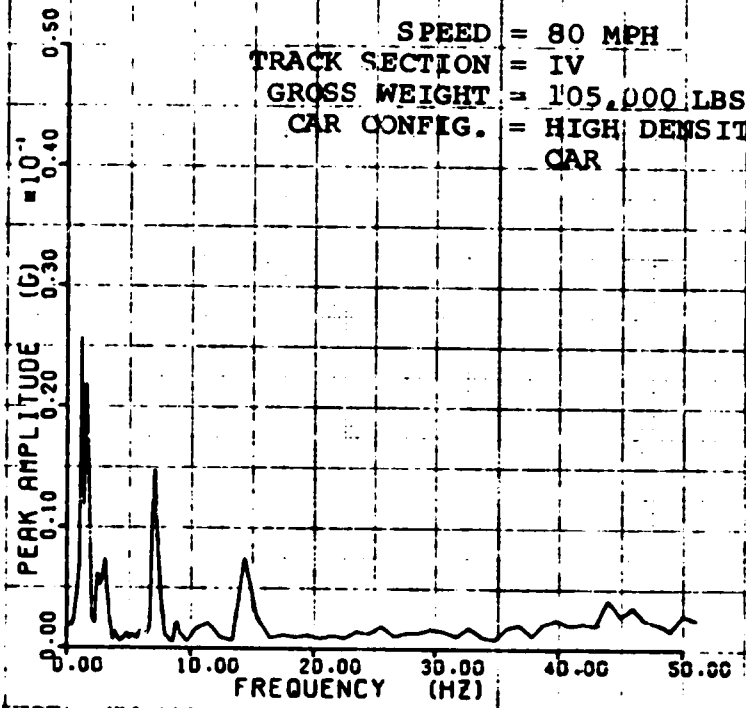


Figure A-102

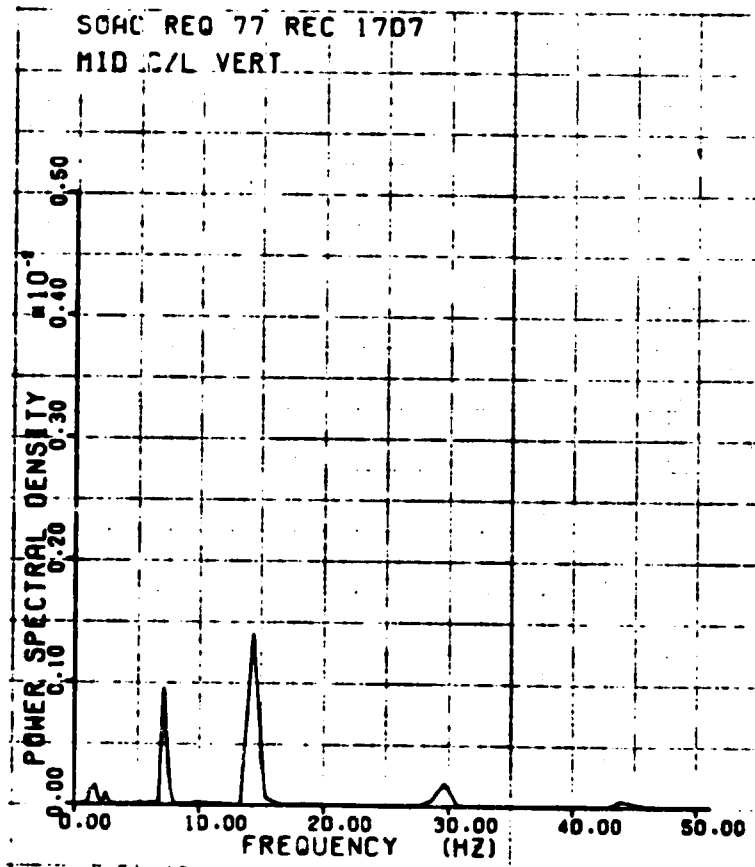
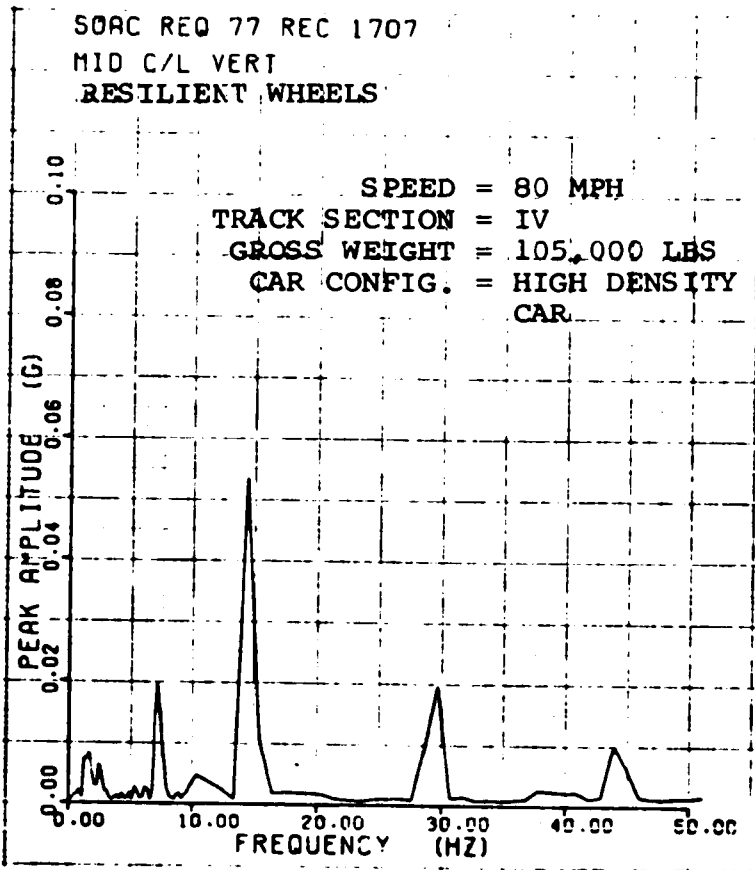
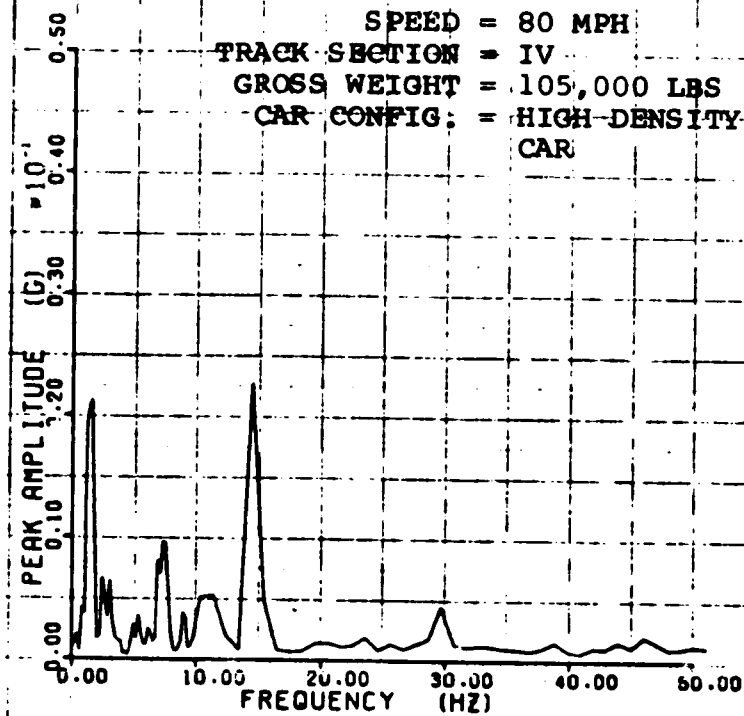


Figure A-103

SOAC REQ 77 REC 1707

REF C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1707

REF C/L VERT

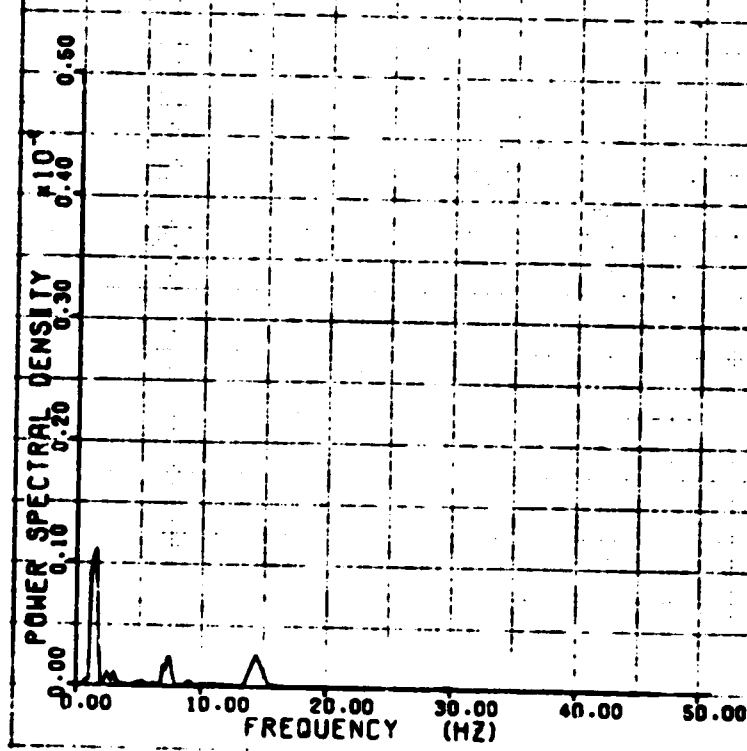
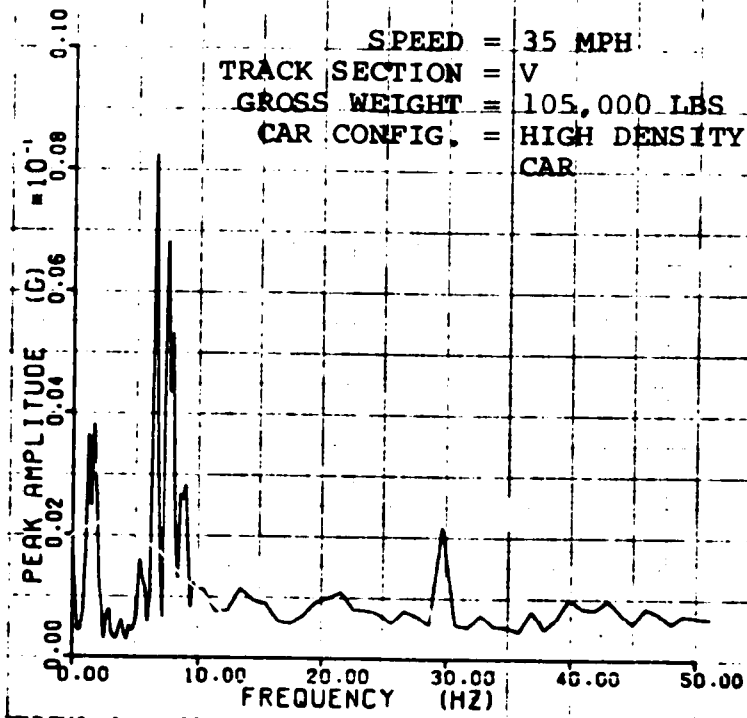


Figure A-104

SOAC REQ 77 REC 1630

FWD C/L VERT.

RESILIENT WHEELS



SOAC REQ 77 REC 1630

FWD C/L VERT

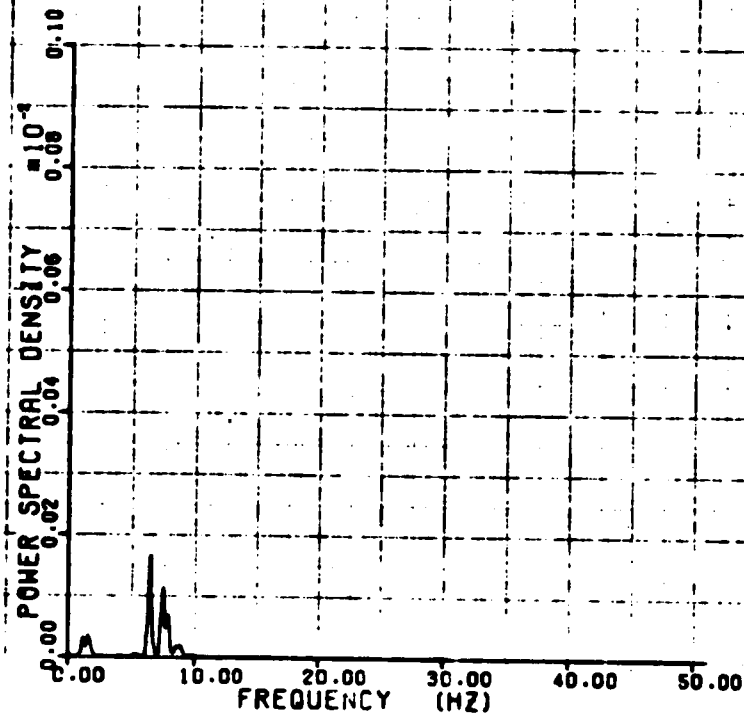


Figure A-105

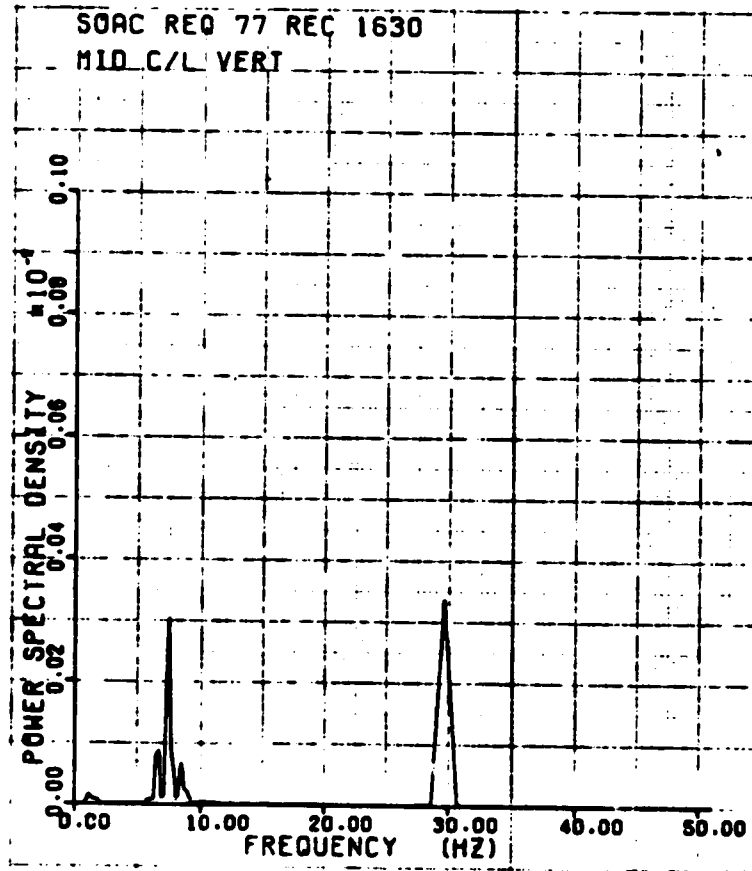
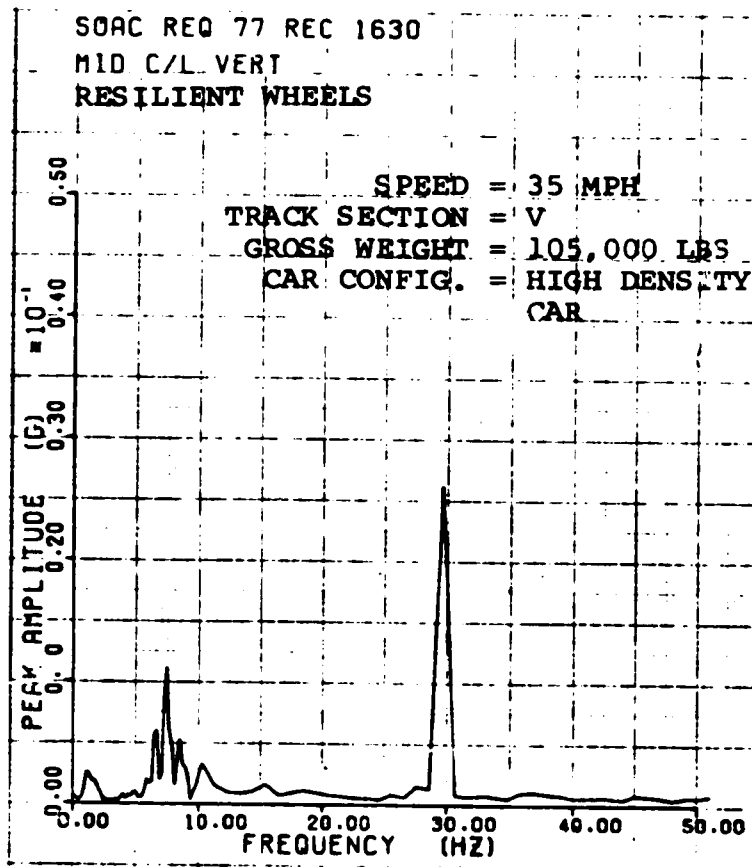
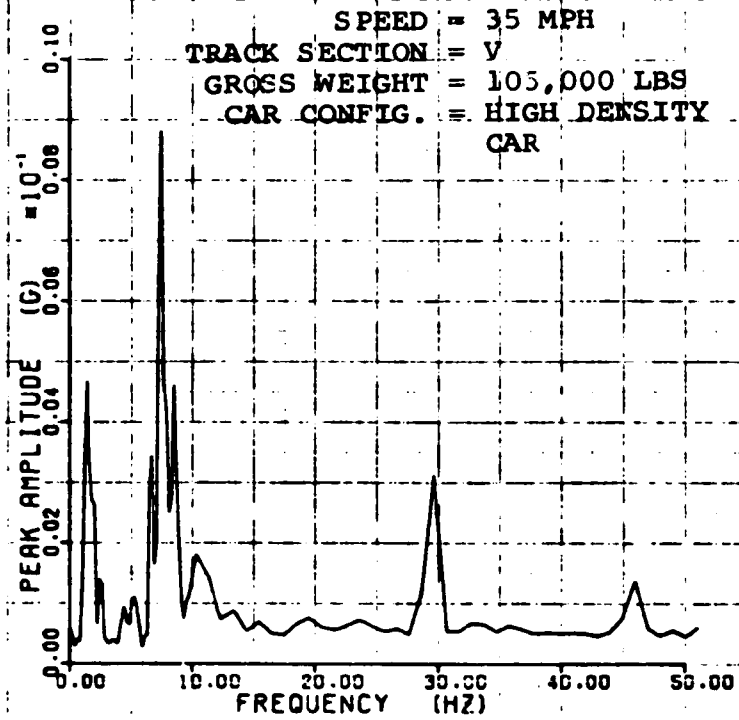


Figure A-106

SOAC REQ 77 REC 1630

AFT C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1630

AFT C/L VERT

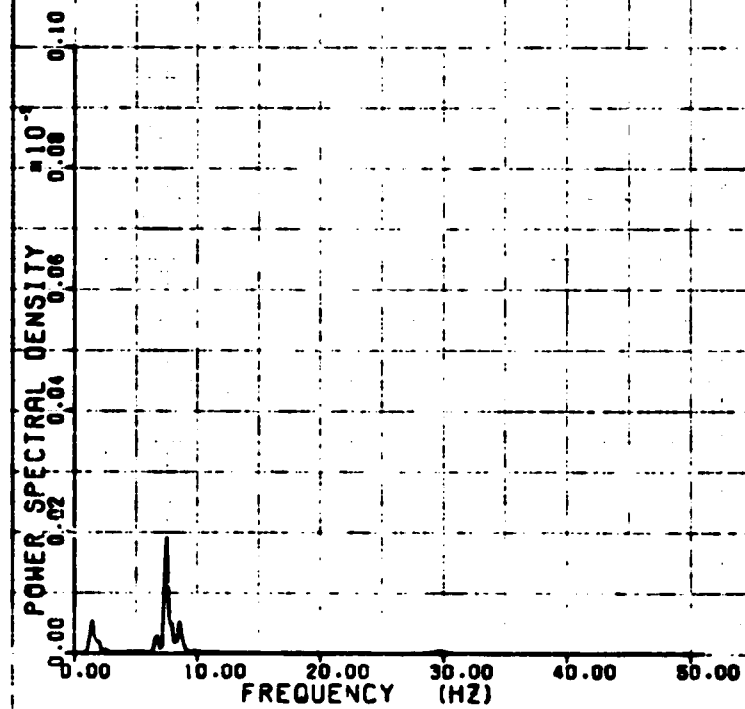
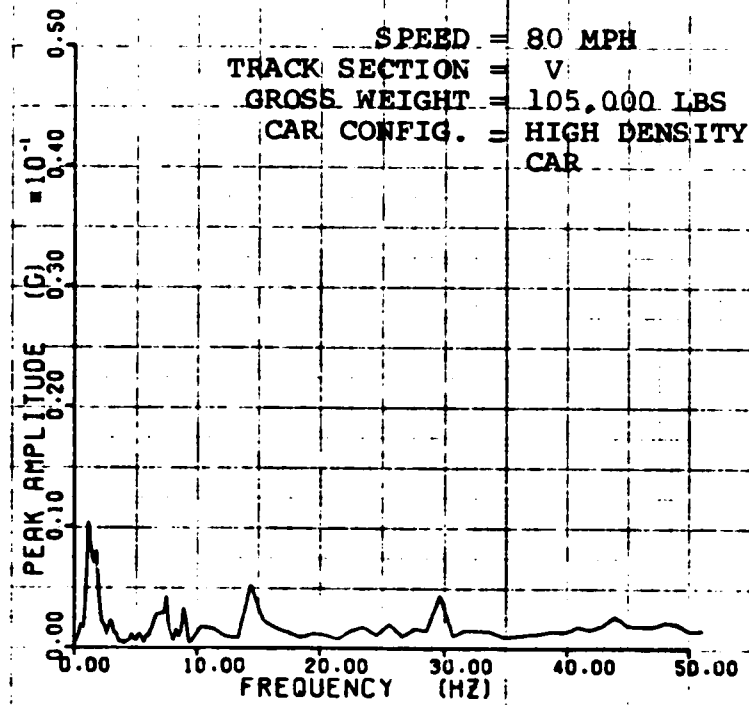


Figure A-107

SOAC REQ 77 REC 1709

FWD C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1709

FWD C/L VERT

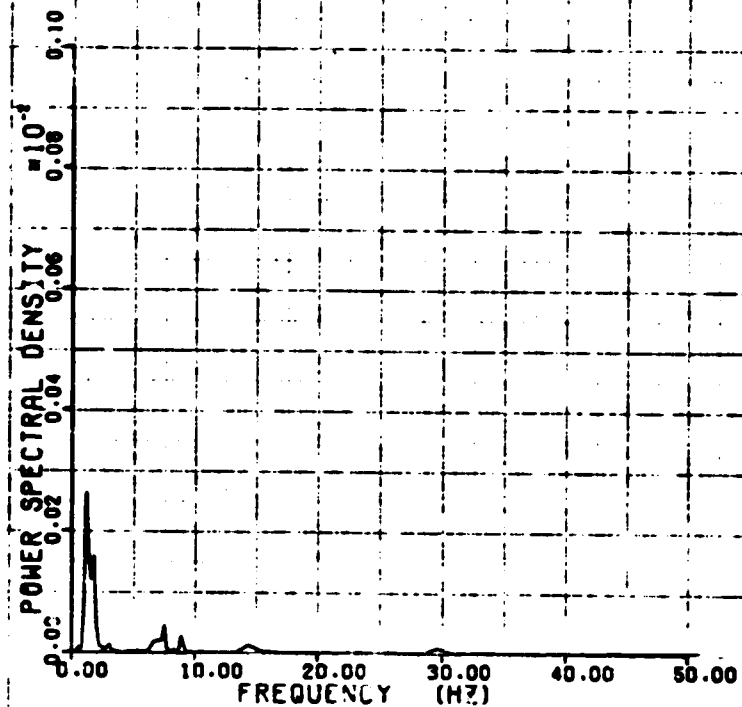


Figure A-108

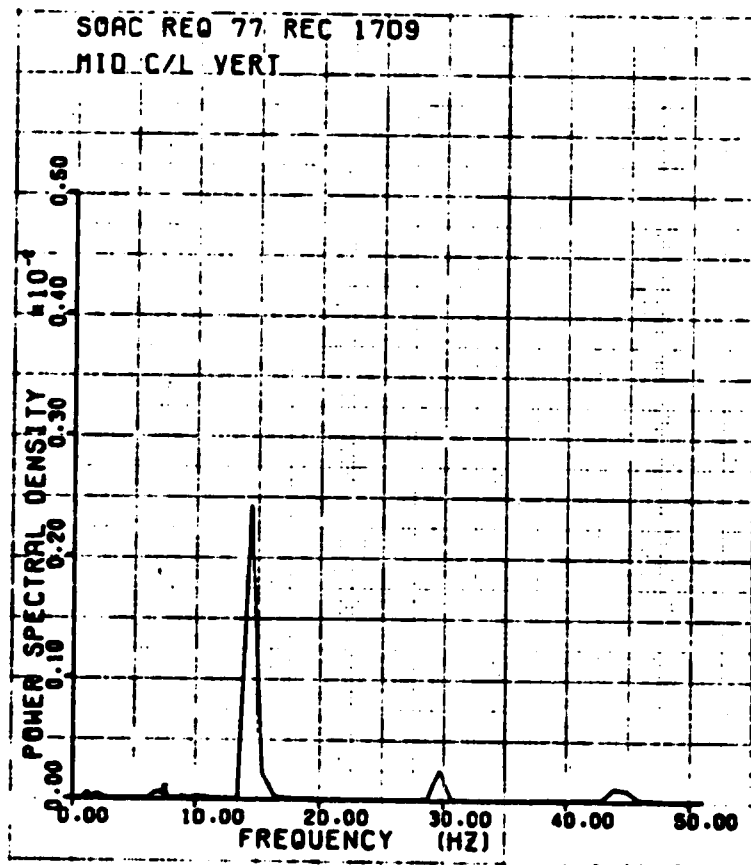
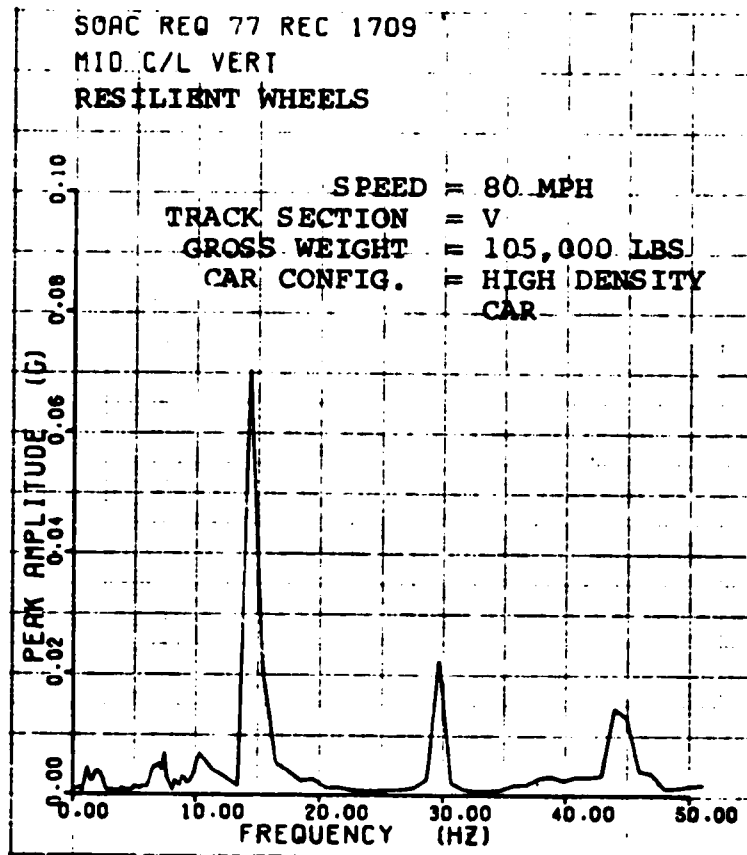
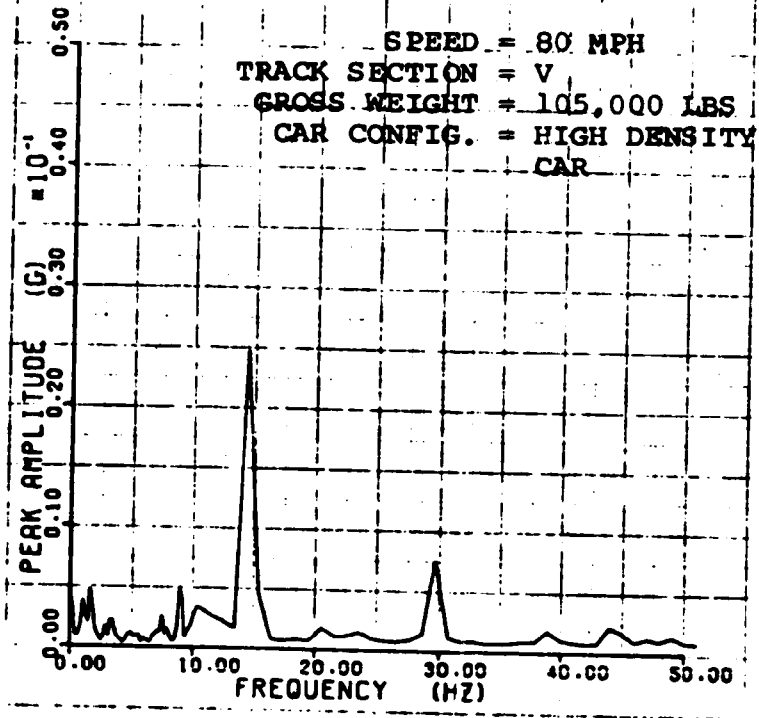


Figure A-109

SOAC REQ 77 REC 1709

AFT. C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1709

AFT C/L VERT

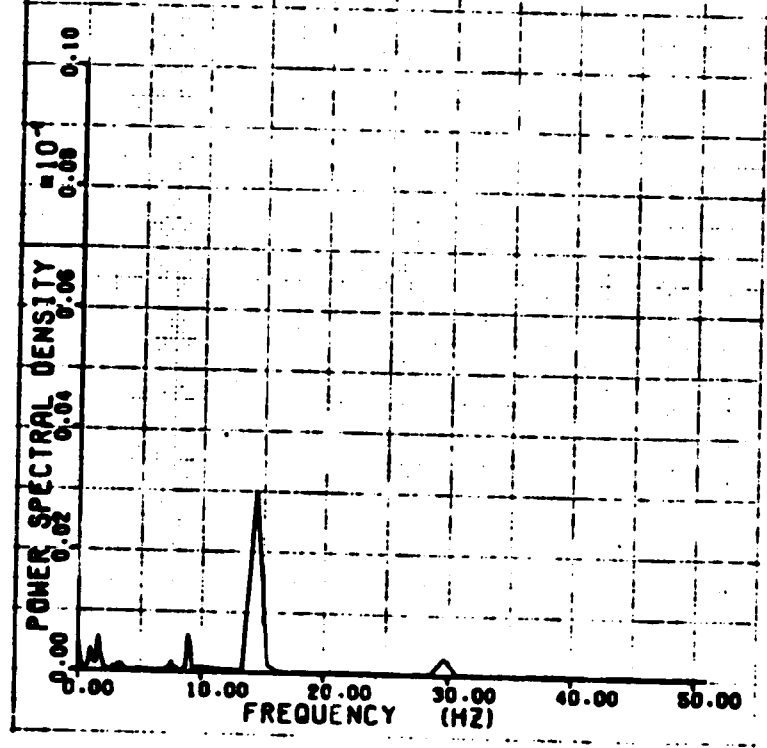


Figure A-110

SOAC REQ 77 REC 1631
FWD C/L VERT
RESILIENT WHEELS

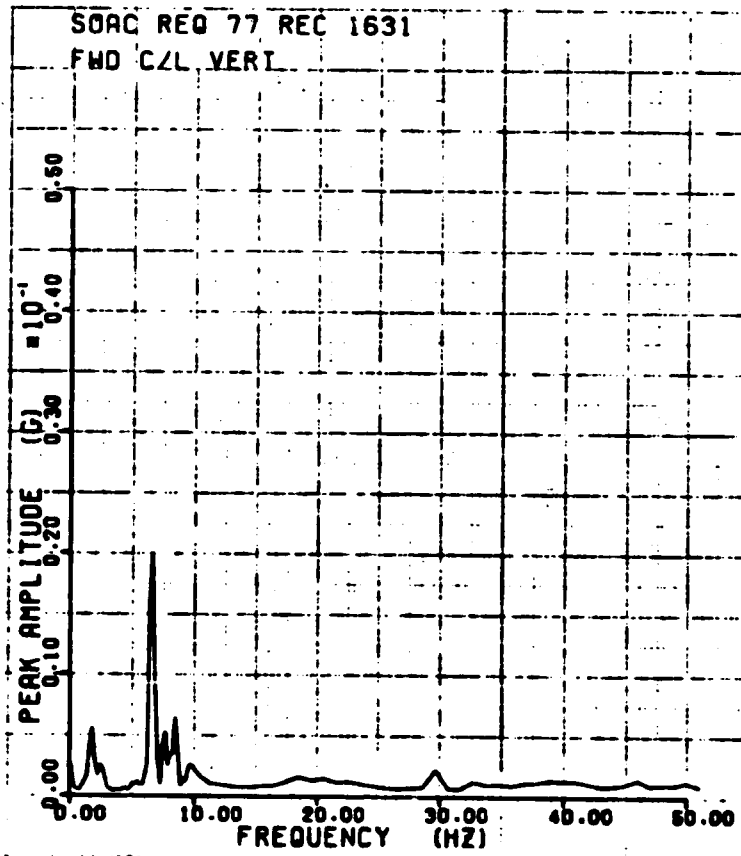
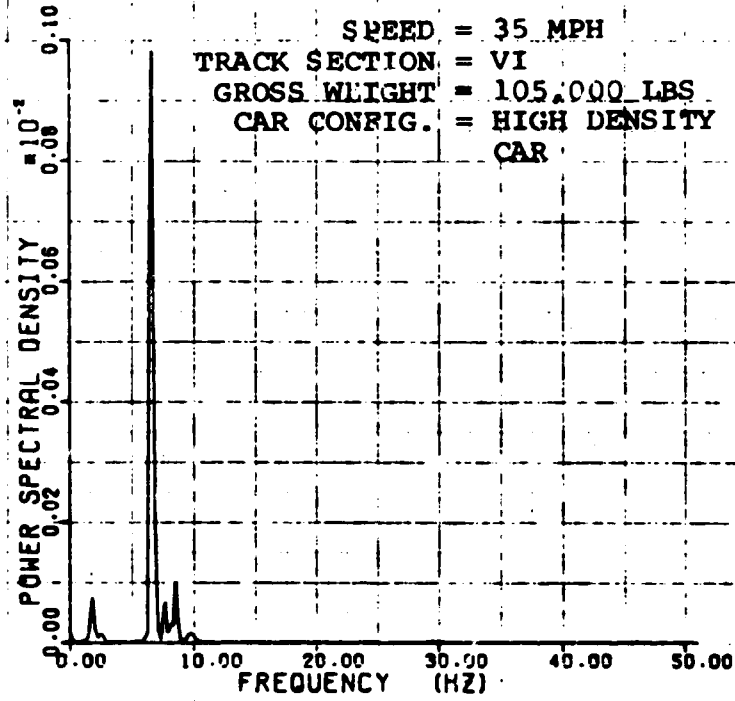
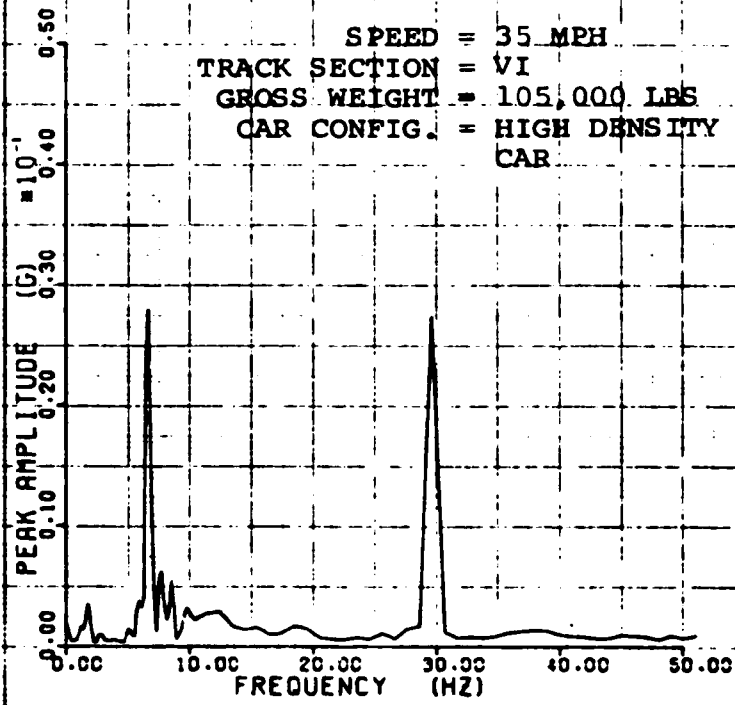


Figure A-111

SOAC REQ 77 REC 1631
MID C/L VERT
RESILIENT WHEELS



SOAC REQ 77 REC 1631
MID C/L VERT

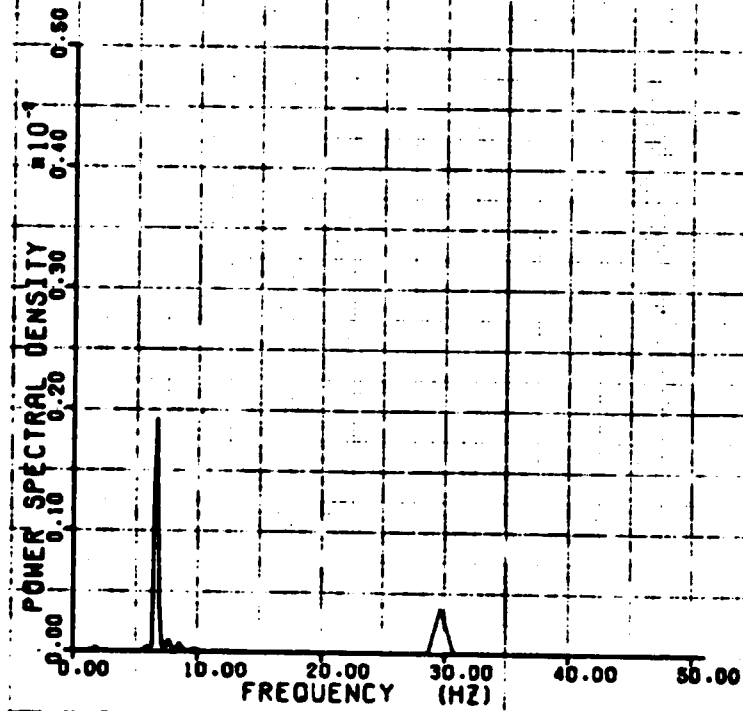


Figure A-112

SOAC REQ 77 REC 1631

AFT C/L VERT

RESILIENT WHEELS

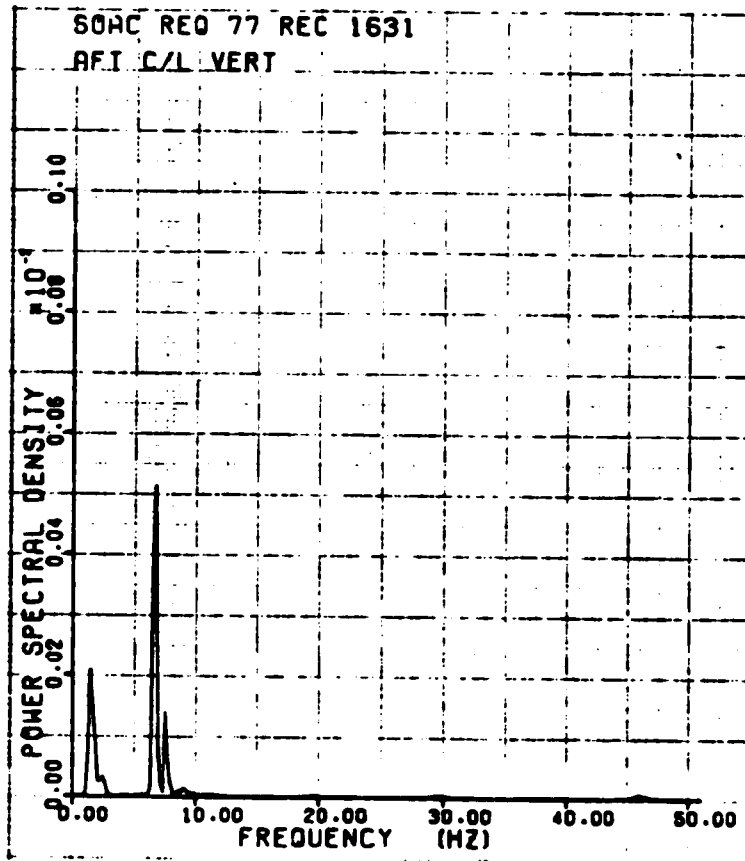
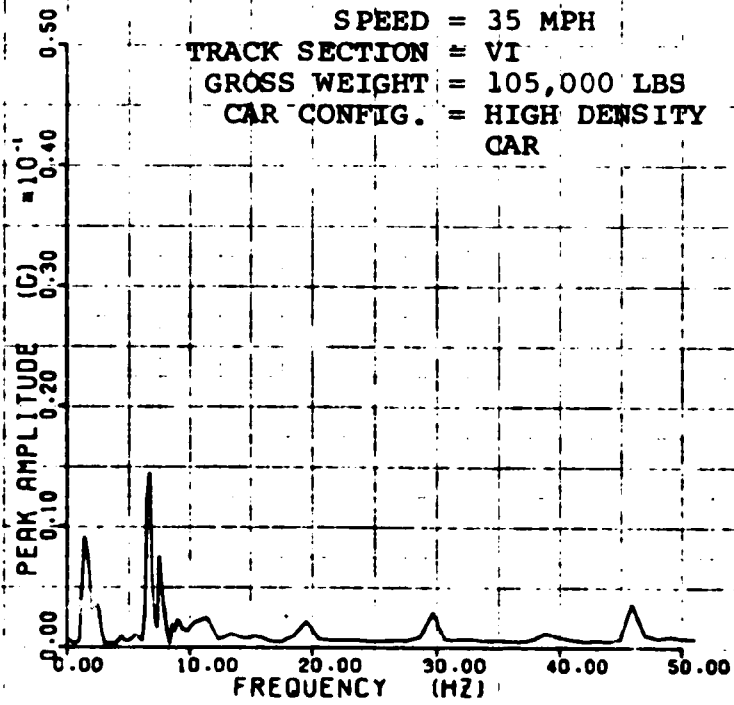


Figure A-113

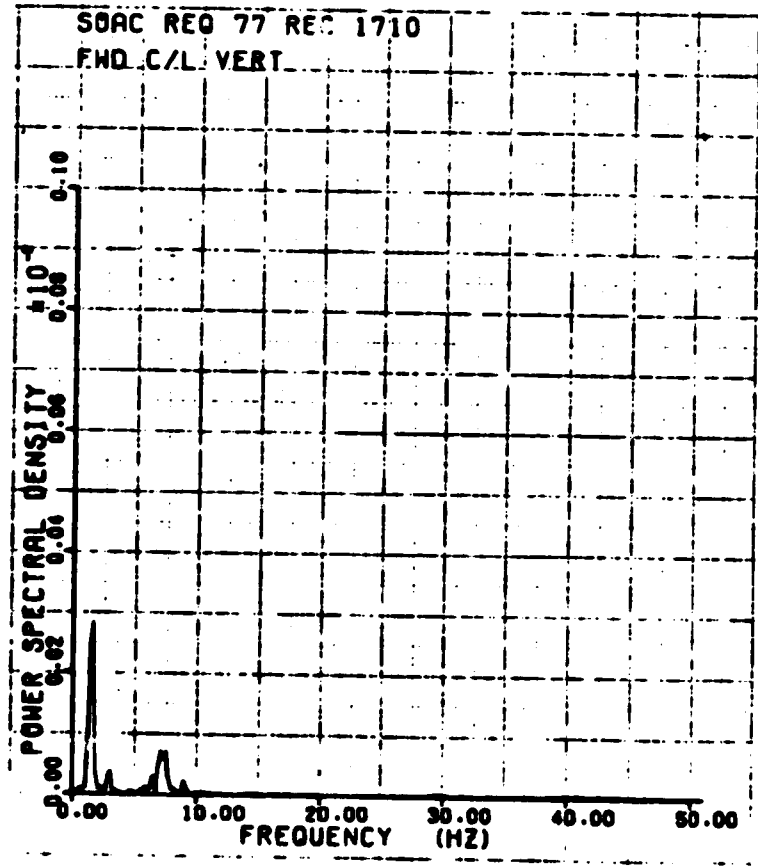
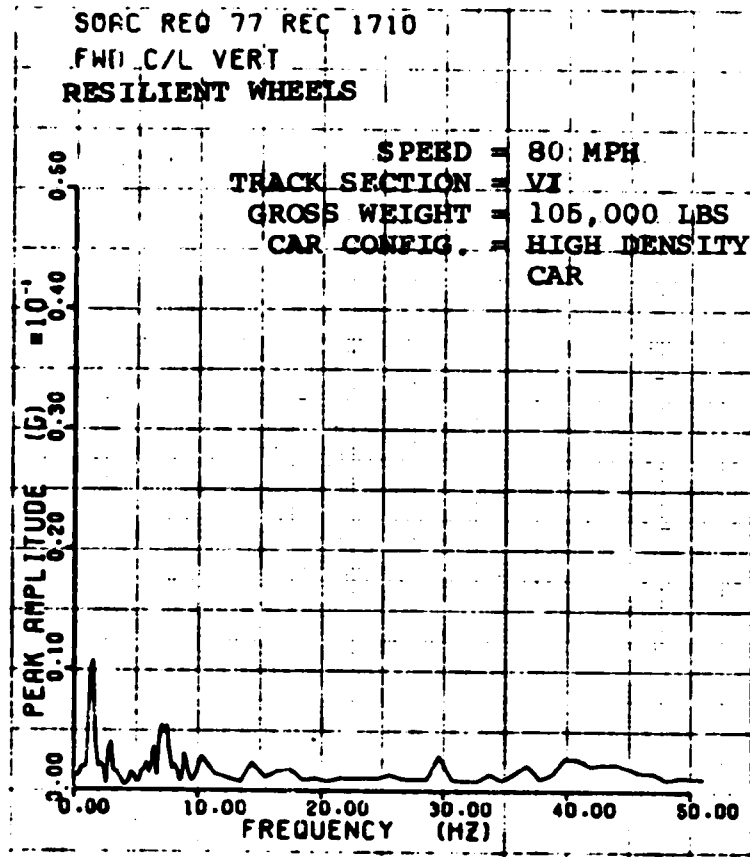
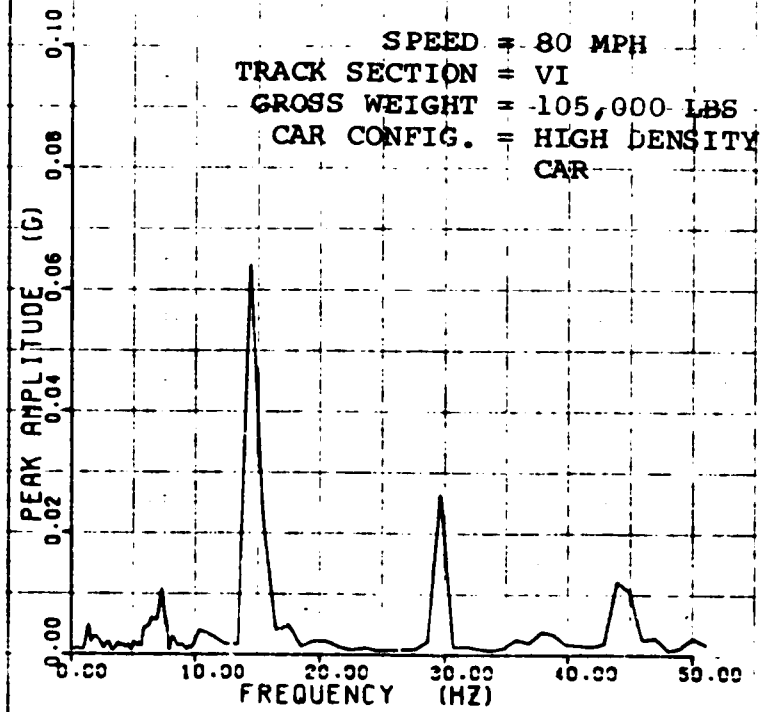


Figure A-114

SOAC REQ 77 REC 1710

MID C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1710

MID C/L VERT

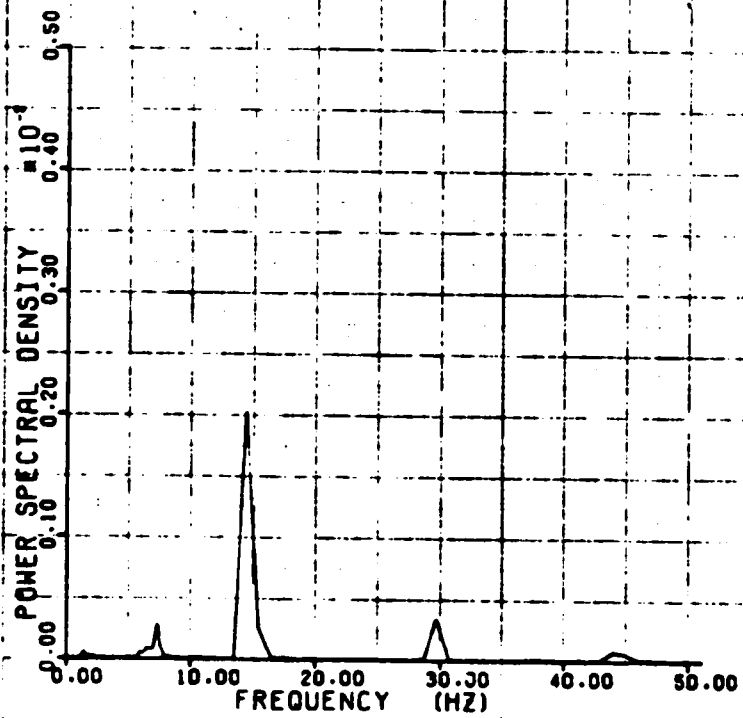


Figure A-115

SOAC REQ 77 REC 1710

AFT C/L VERT

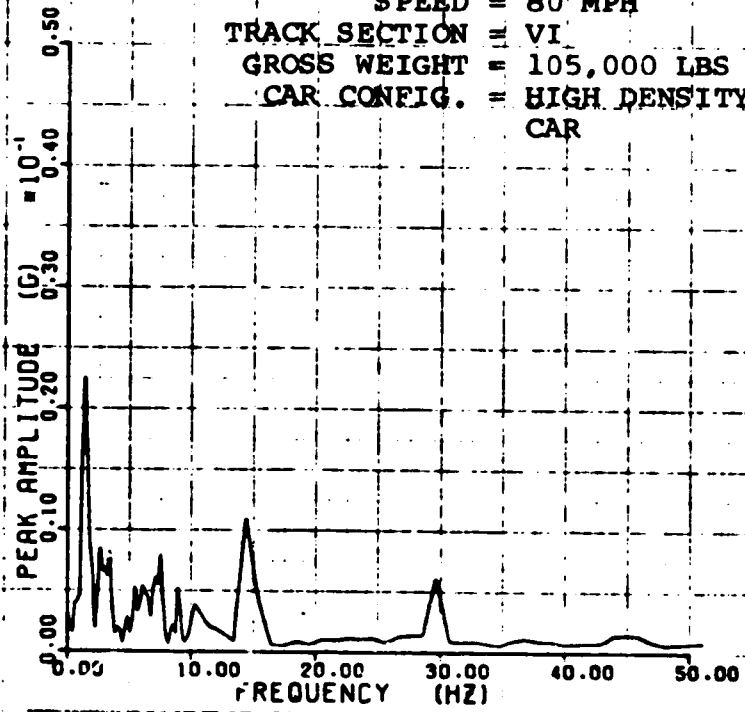
RESILIENT WHEELS

SPEED = 80 MPH

TRACK SECTION = VI

GROSS WEIGHT = 105,000 LBS

CAR CONFIG. = HIGH DENSITY
CAR



SOAC REQ 77 REC 1710

AFT C/L VERT

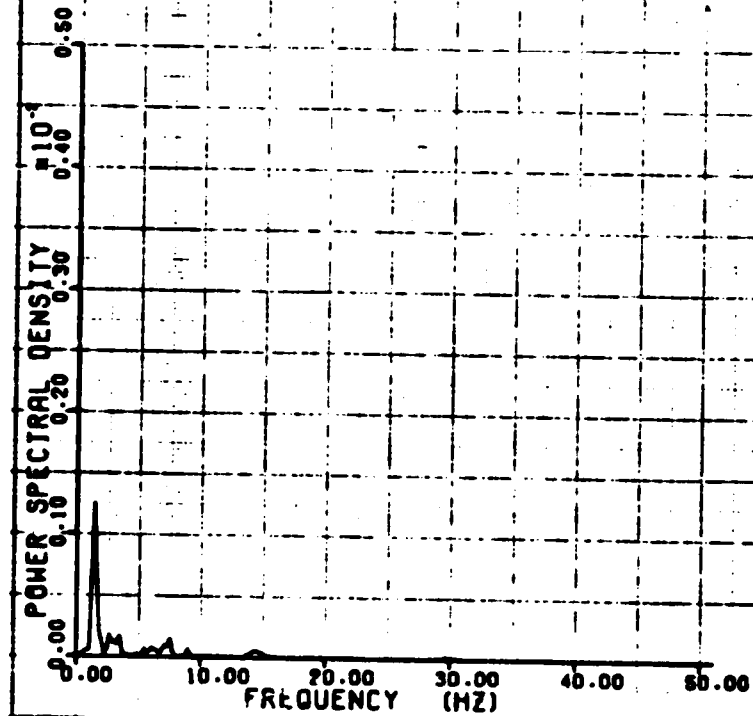
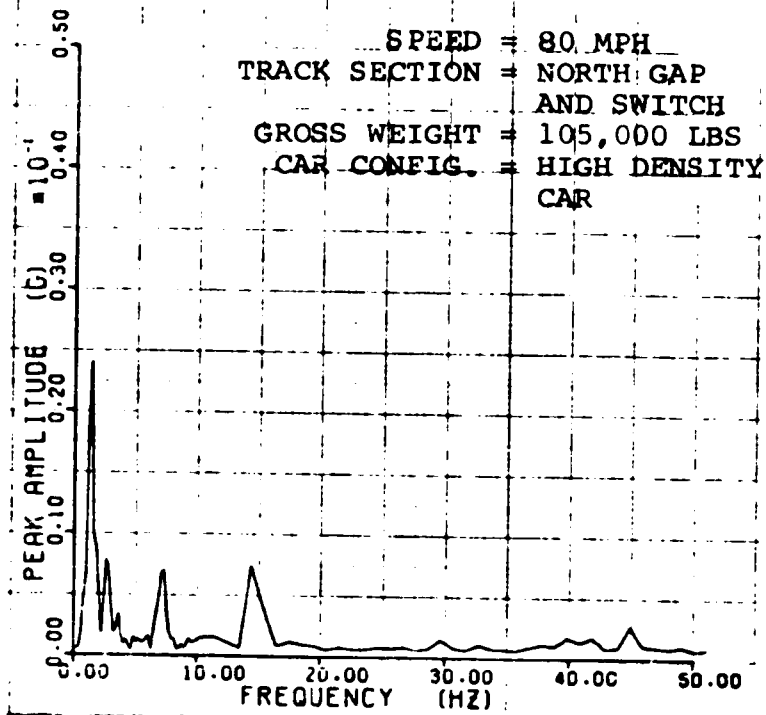


Figure A-116

SOAC REQ 77 REC 1711

FWD C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1711

FWD C/L VERT

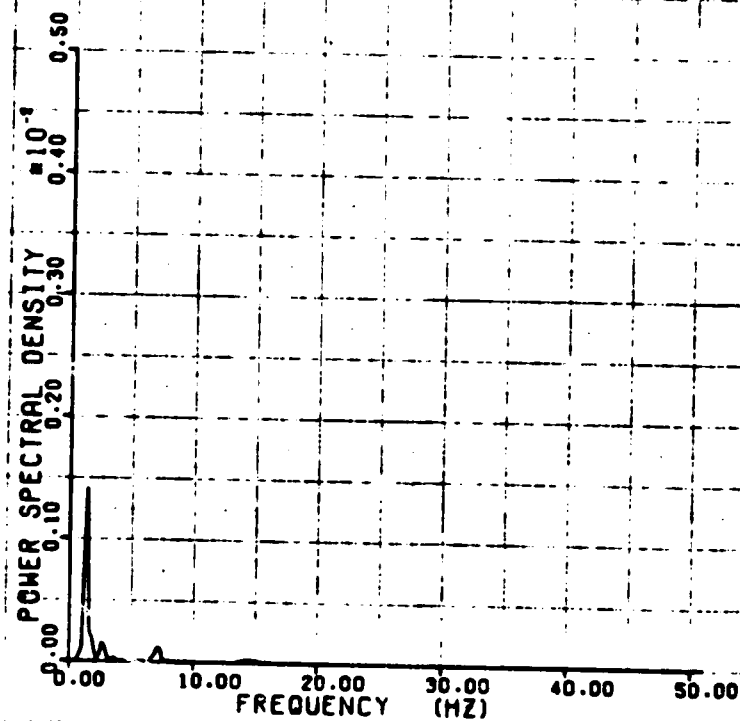


Figure A-117

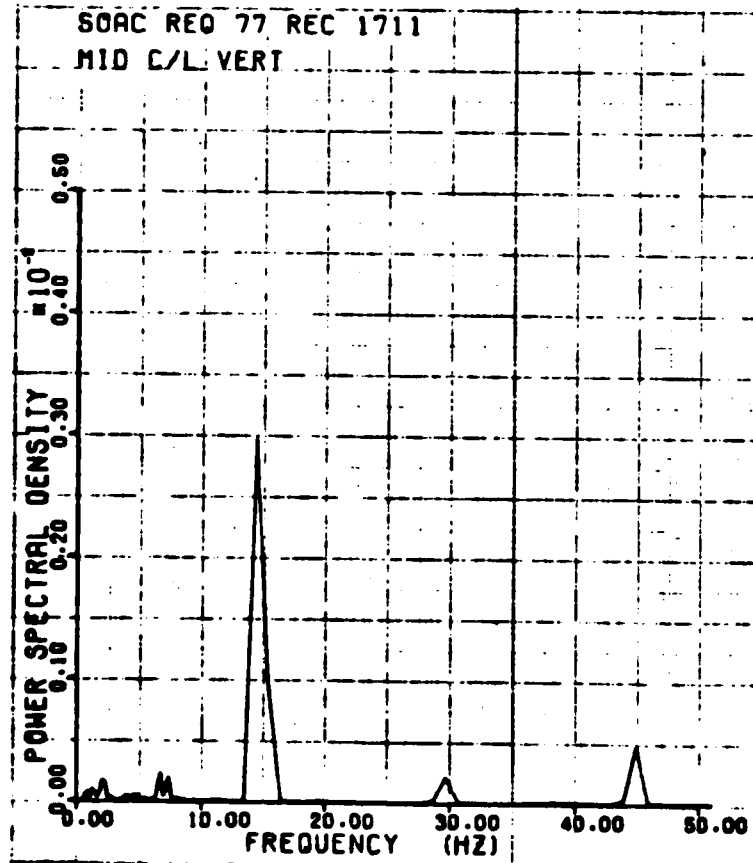
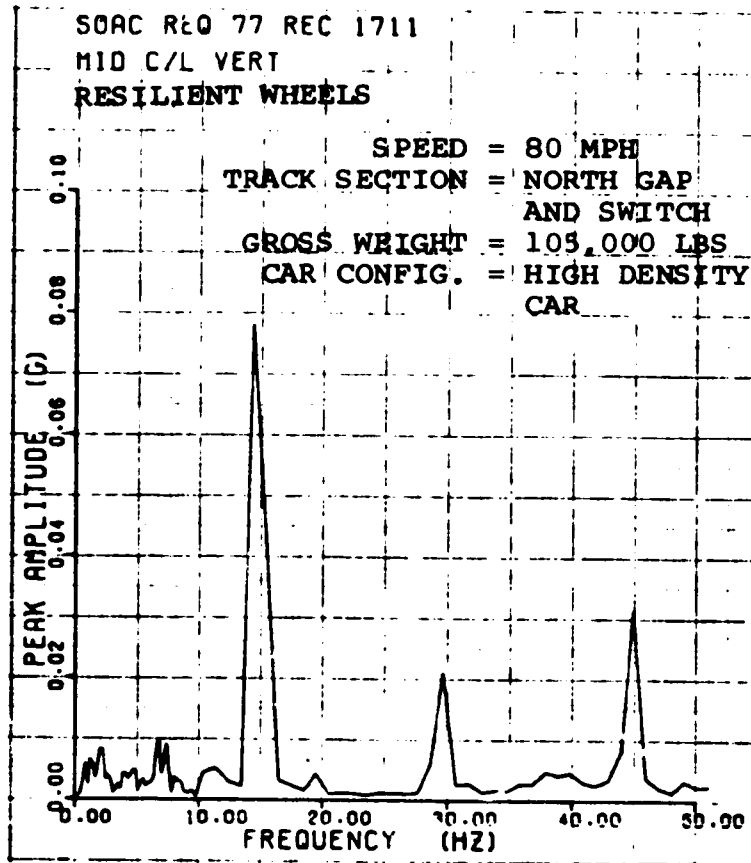
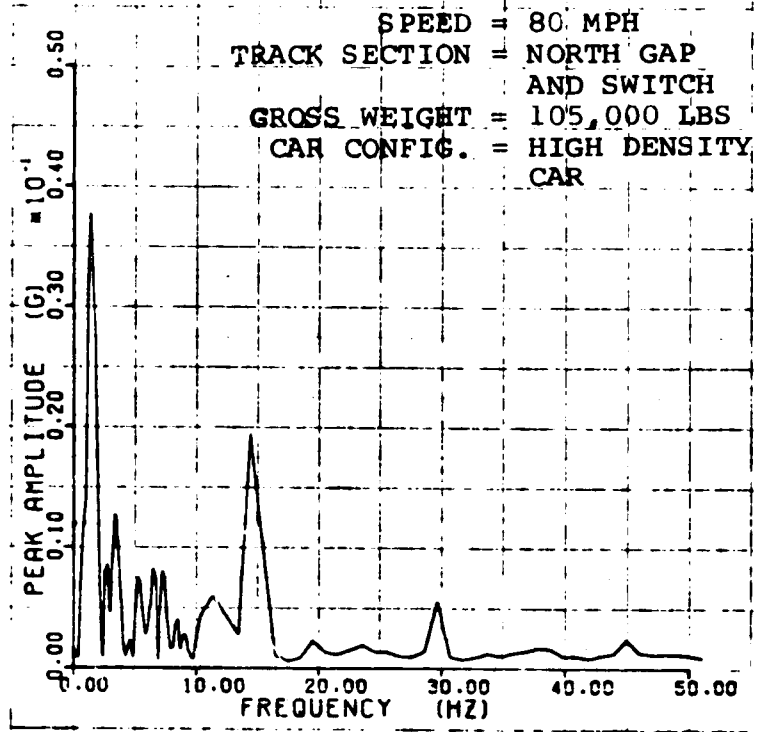


Figure A-118

SOAC REQ 77 REC 1711

AFT C/L VERT

RESILIENT WHEELS



SOAC REQ 77 REC 1711

AFT C/L VERT

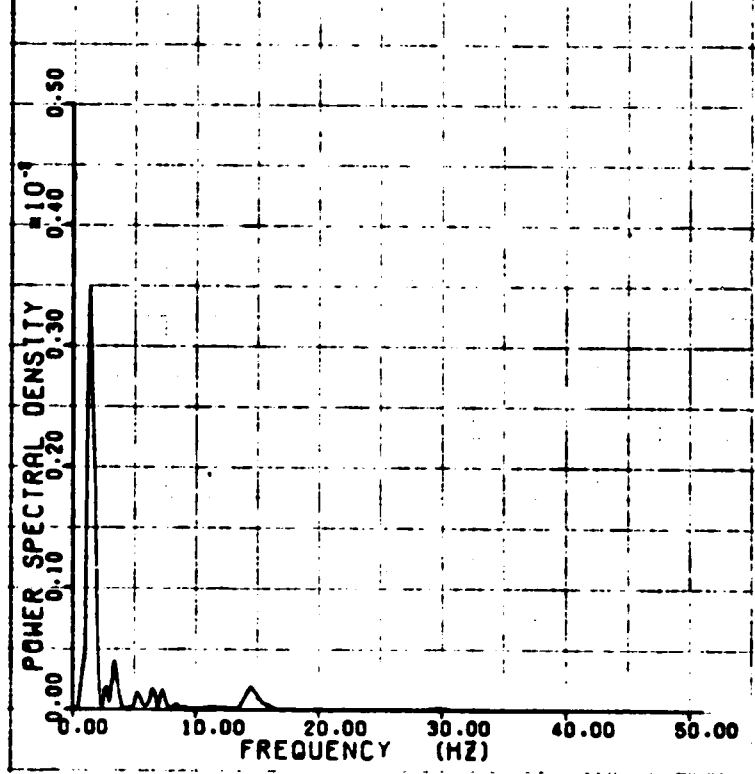


Figure A-119

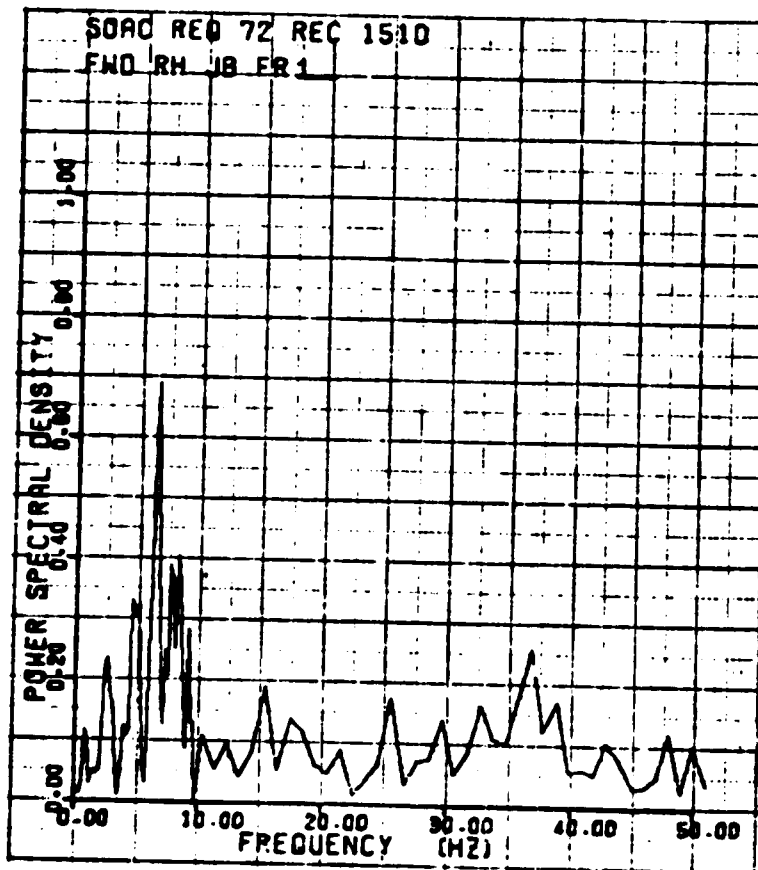
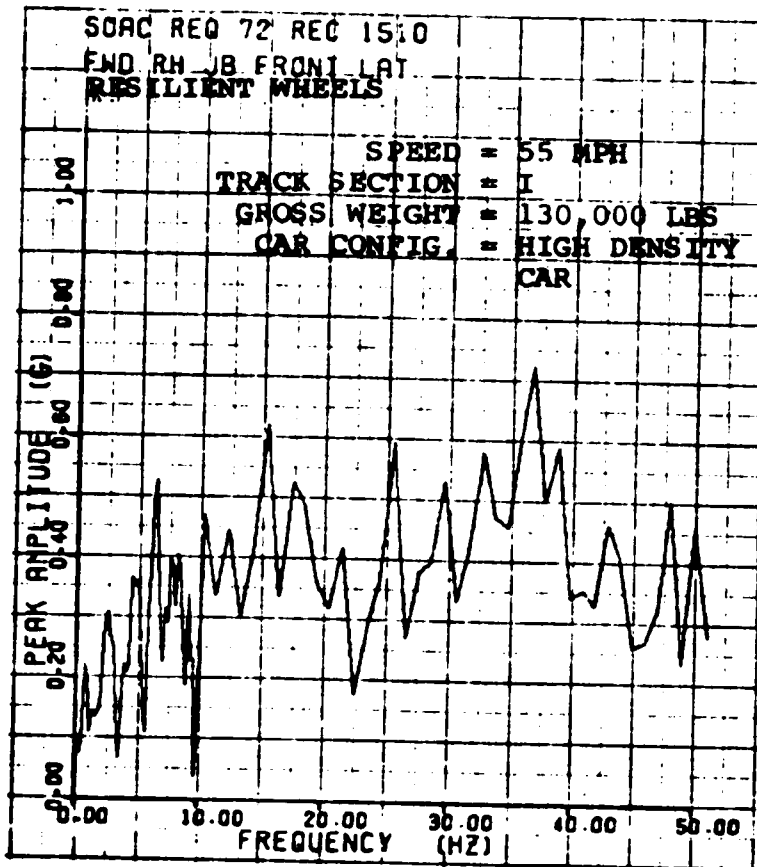


Figure A-120

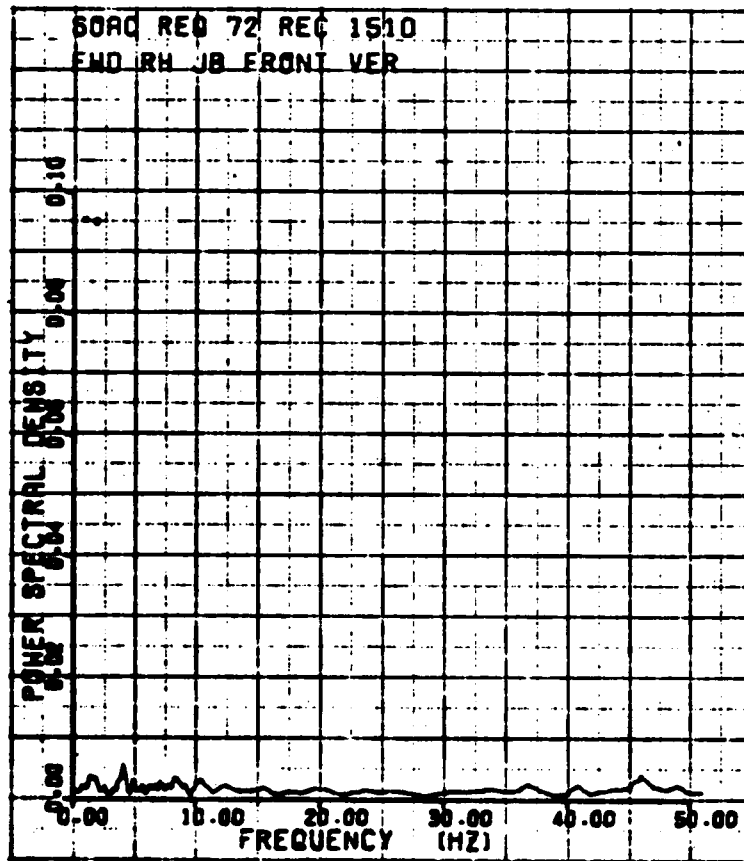
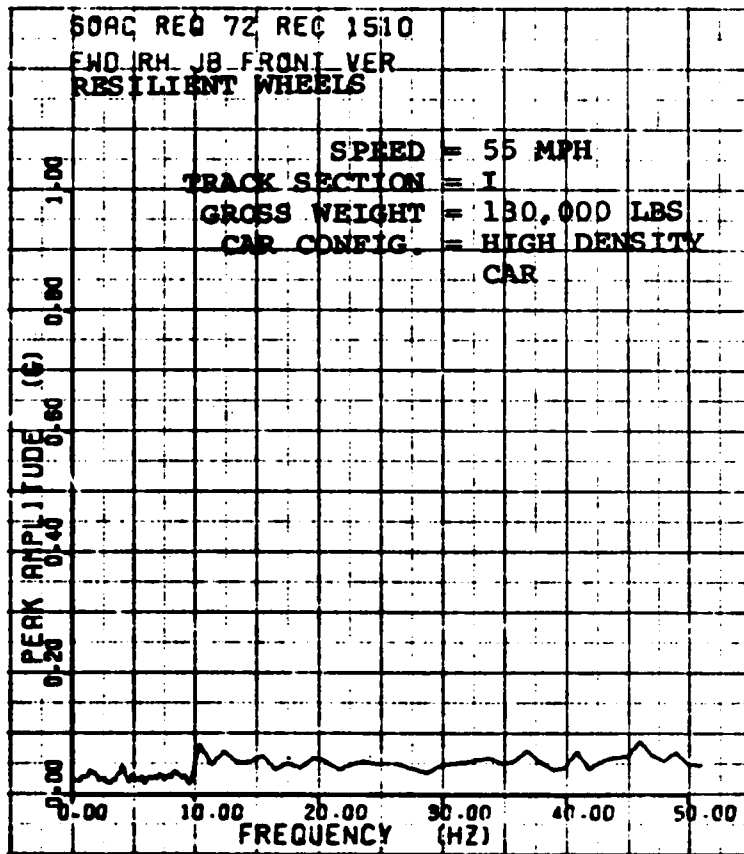


Figure A-121

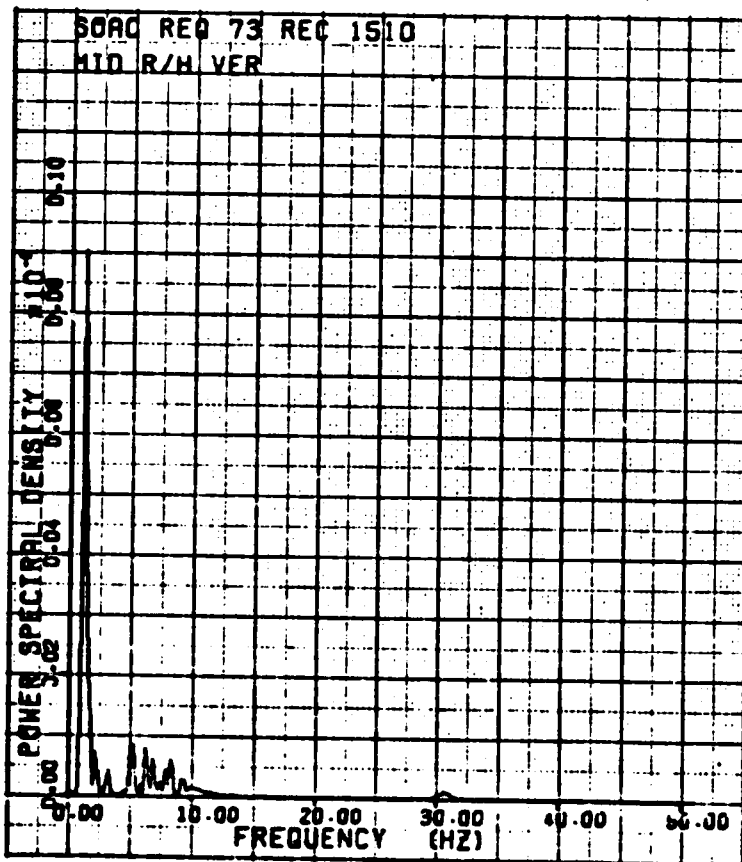
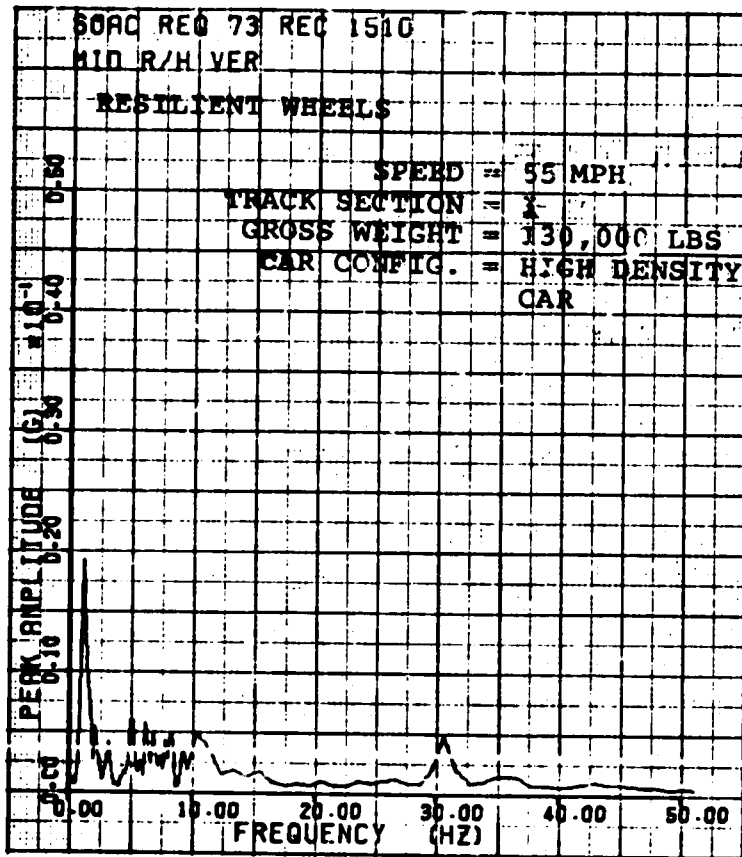


Figure A-122

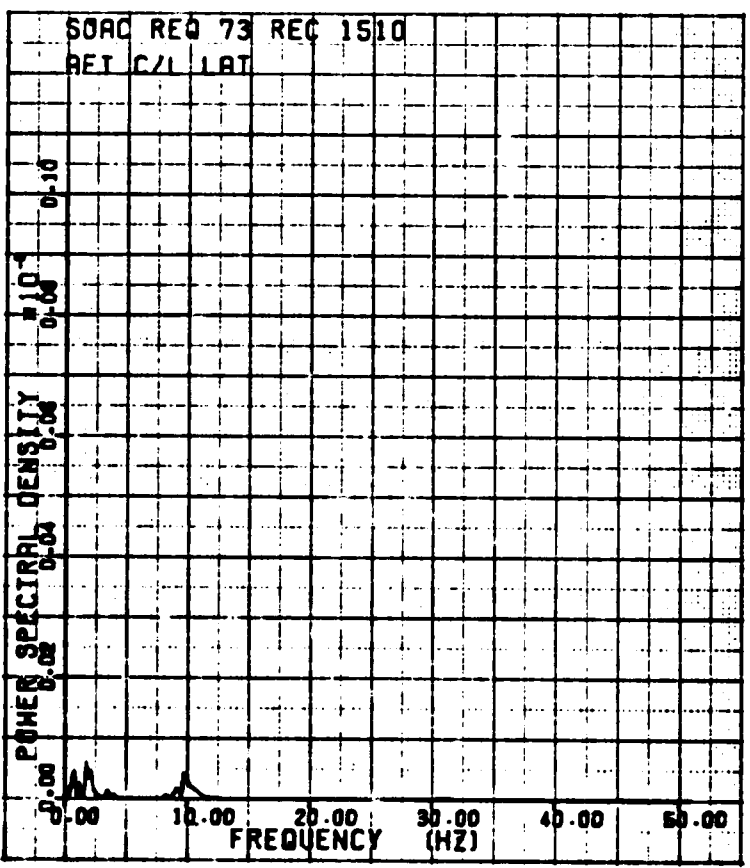
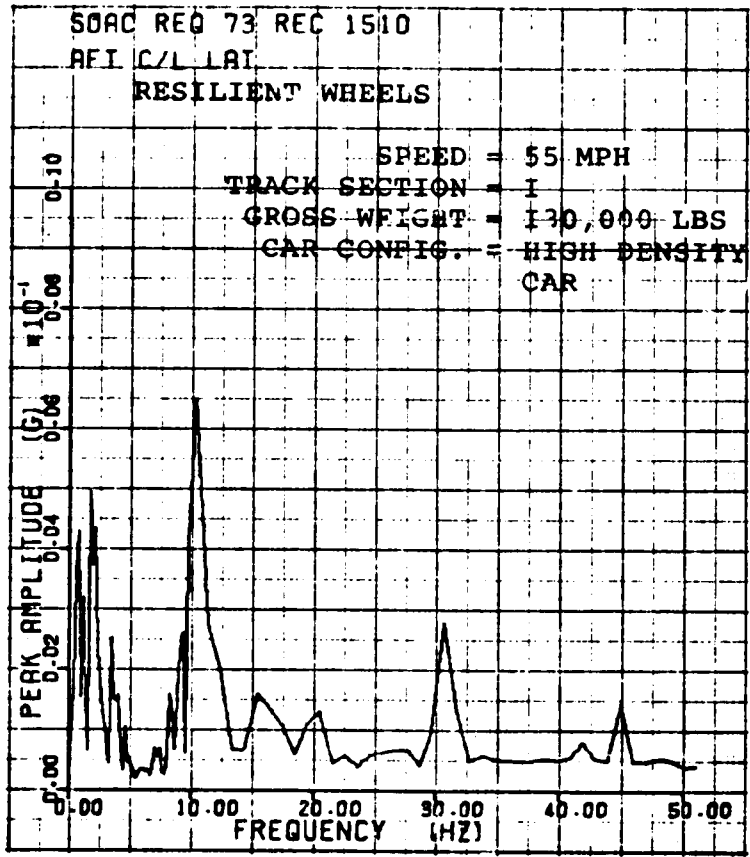


Figure A-123

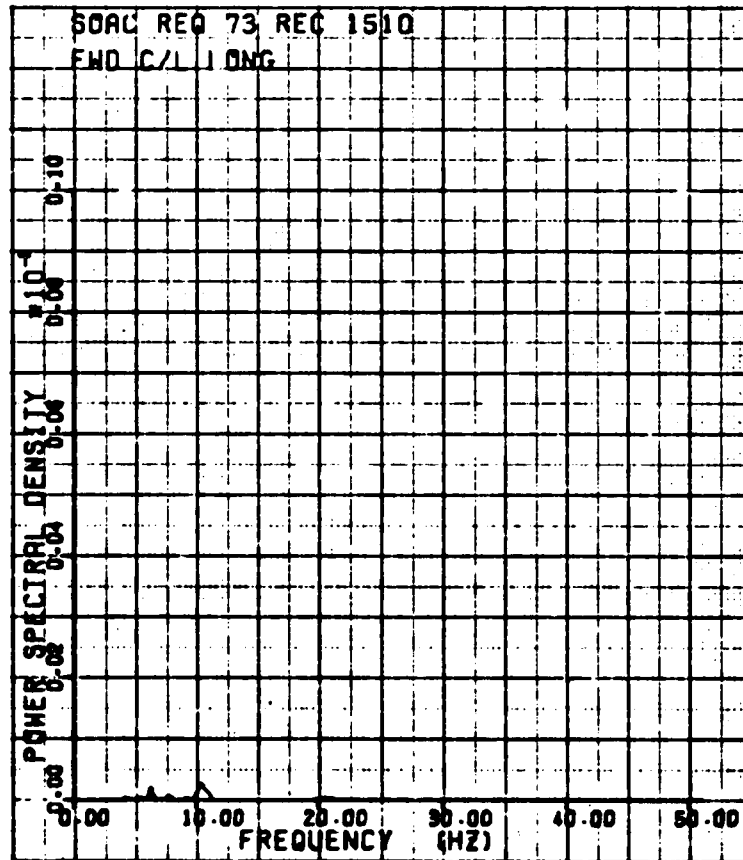
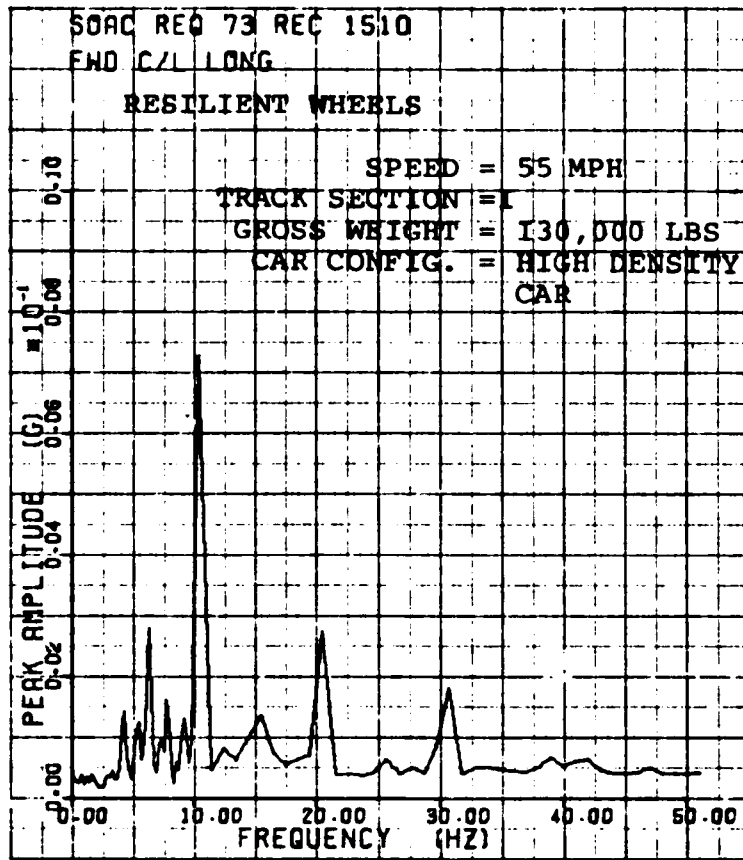


Figure A-124

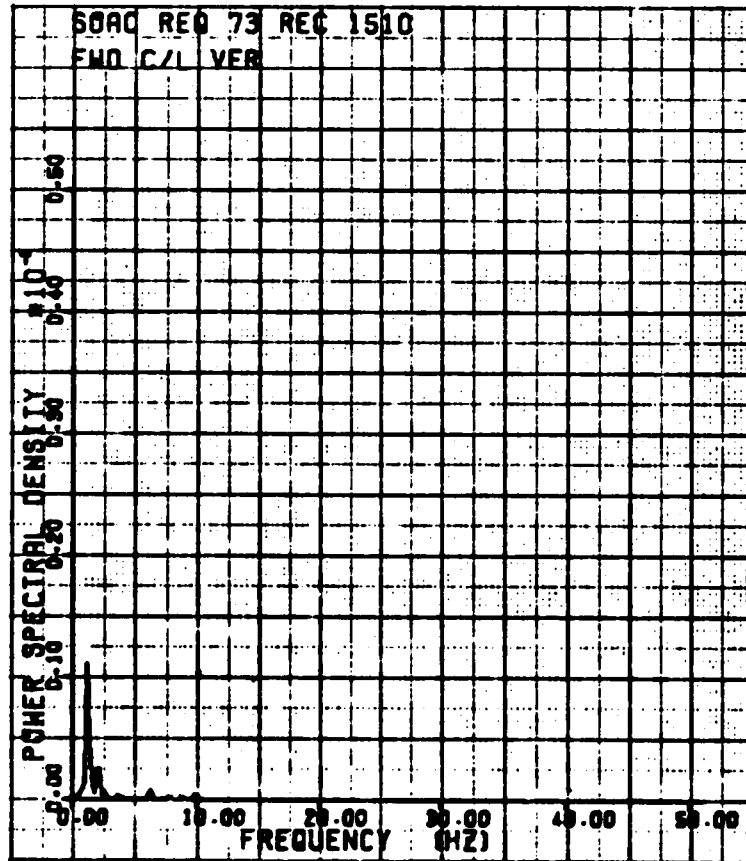
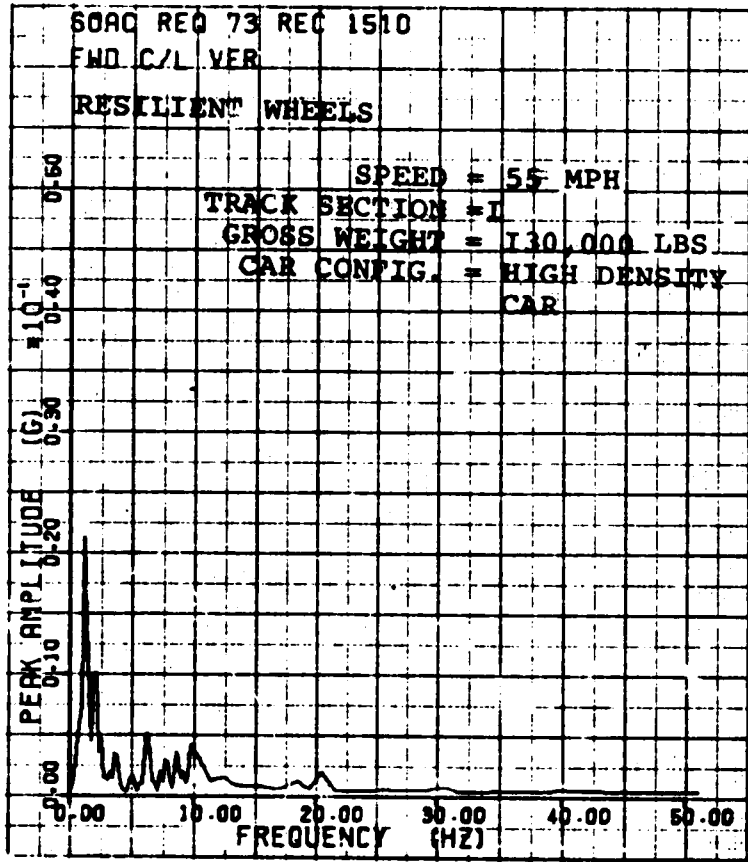


Figure A-125

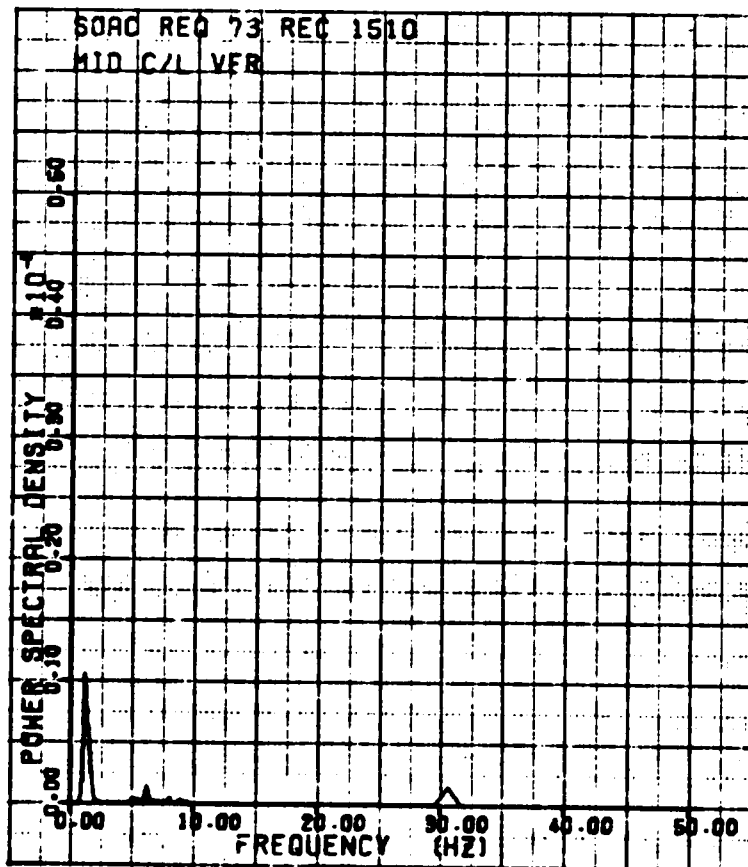
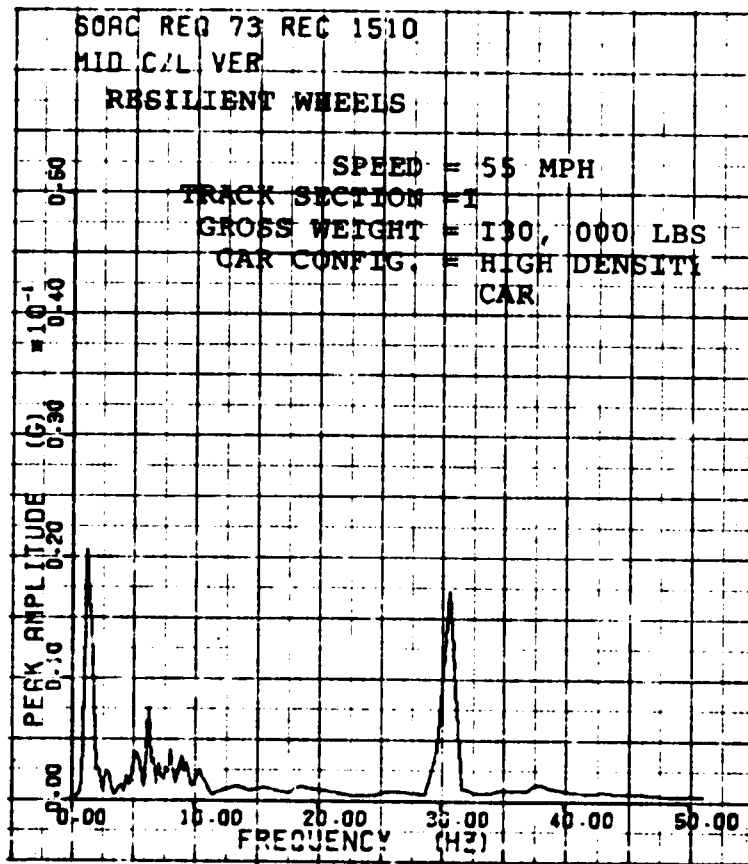


Figure A-126

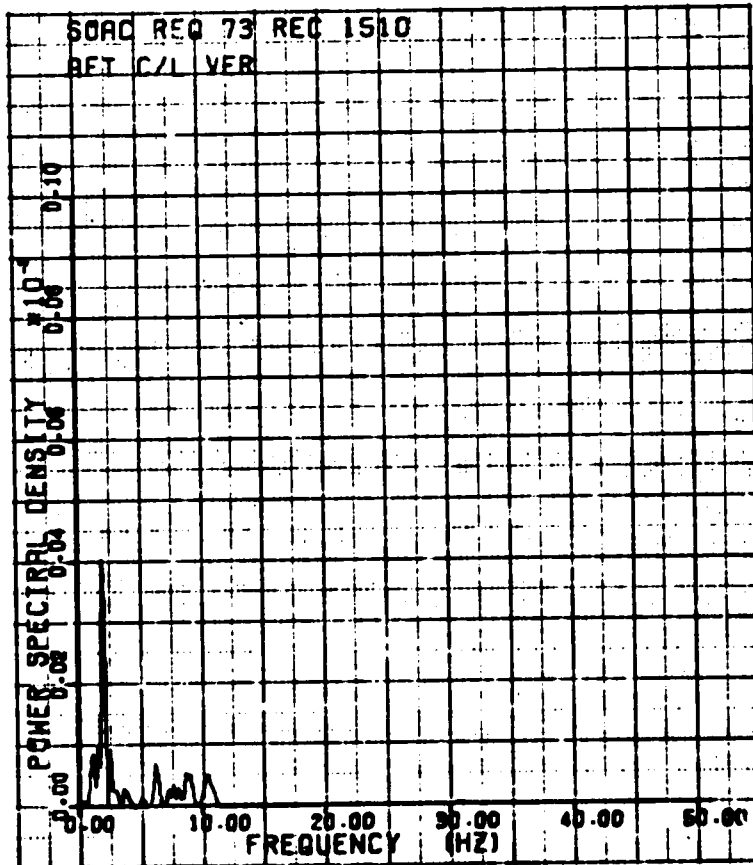
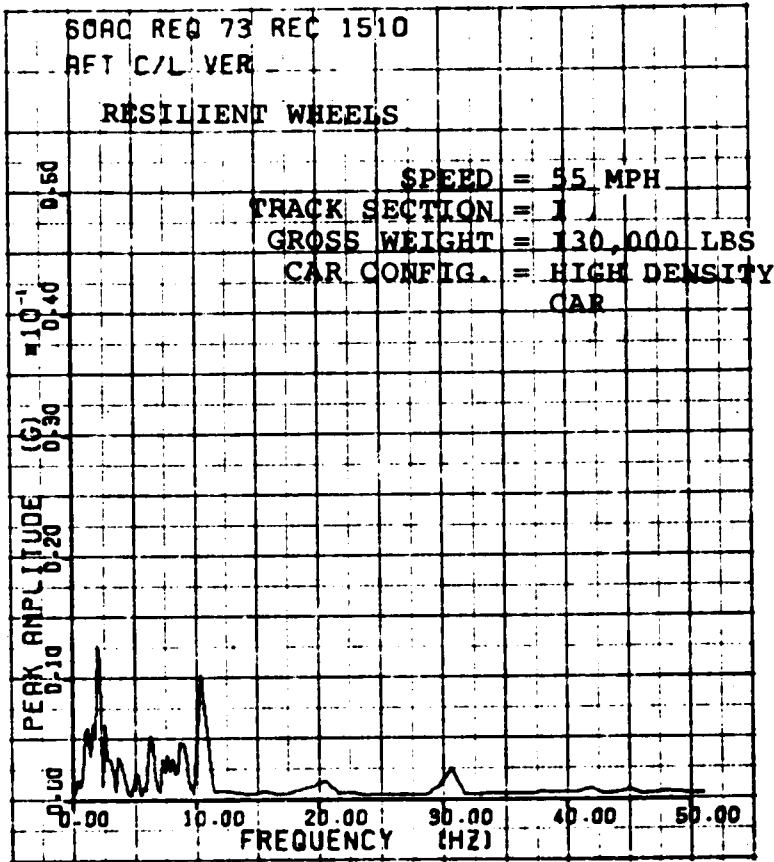


Figure A-127

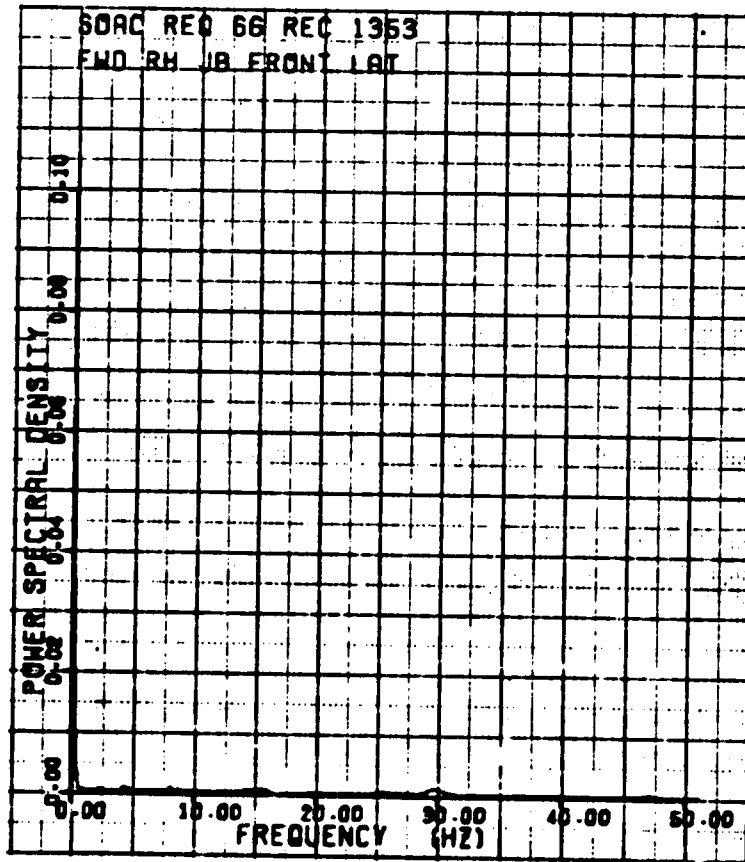
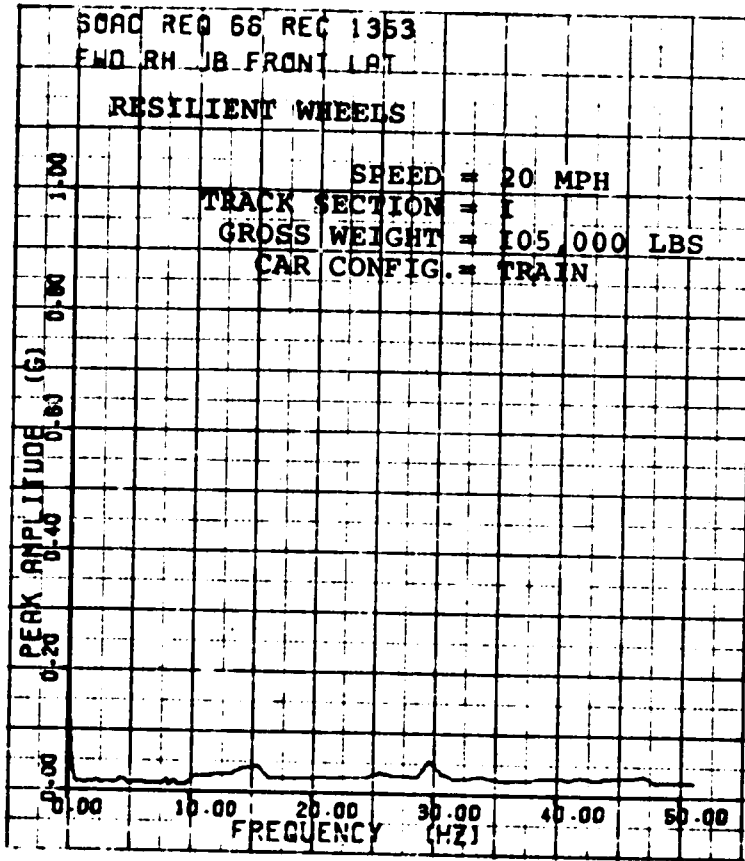


Figure A-128

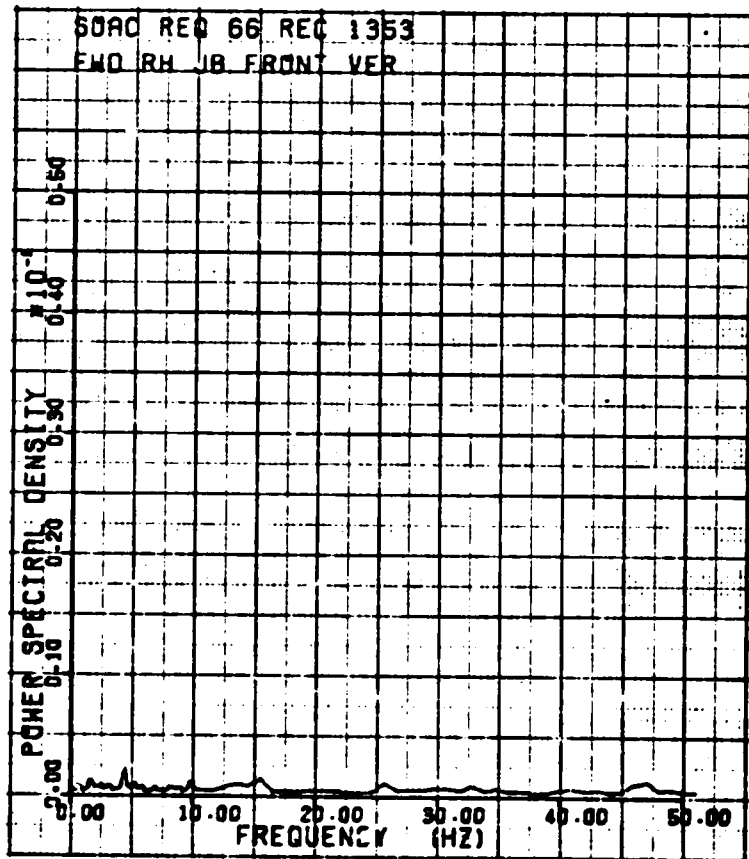
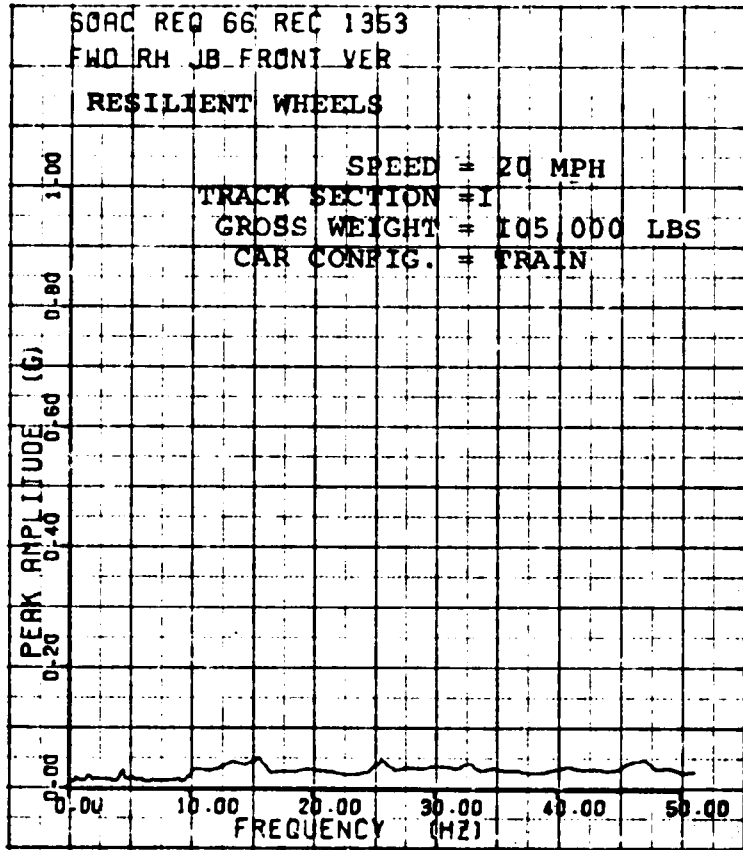
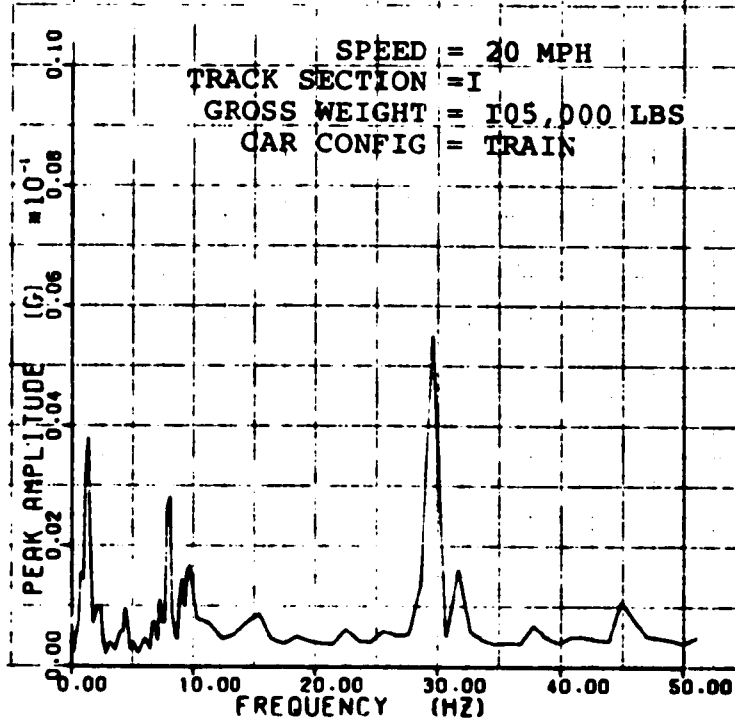


Figure A-129

SOAC REQ 67 REC 1353

MID R/H VER

RESILIENT WHEELS



SOAC REQ 67 REC 1353

MID R/H VER

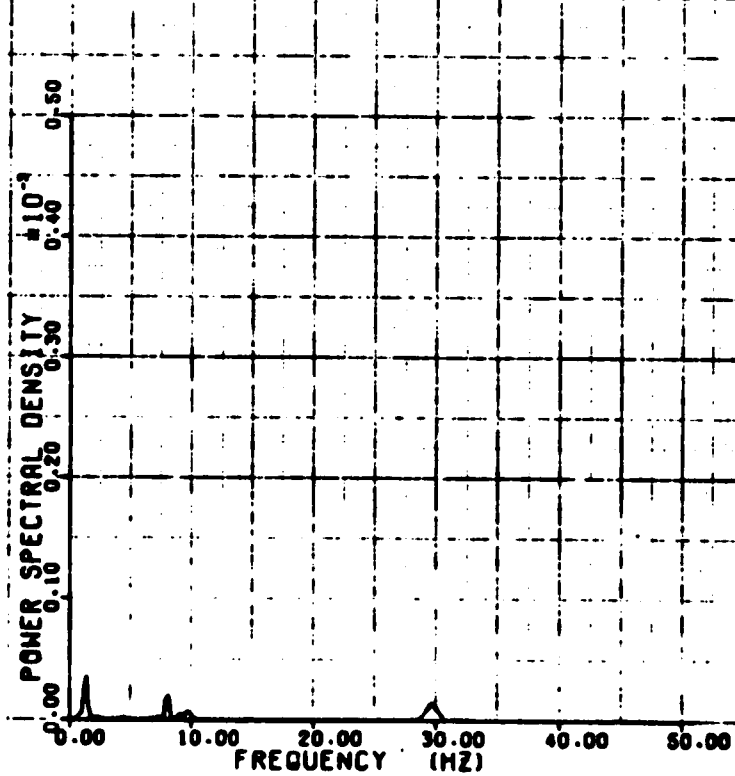


Figure A-130

SOAC REQ 67 REC 1353
AFT C/L LRI
RESILIENT WHEELS

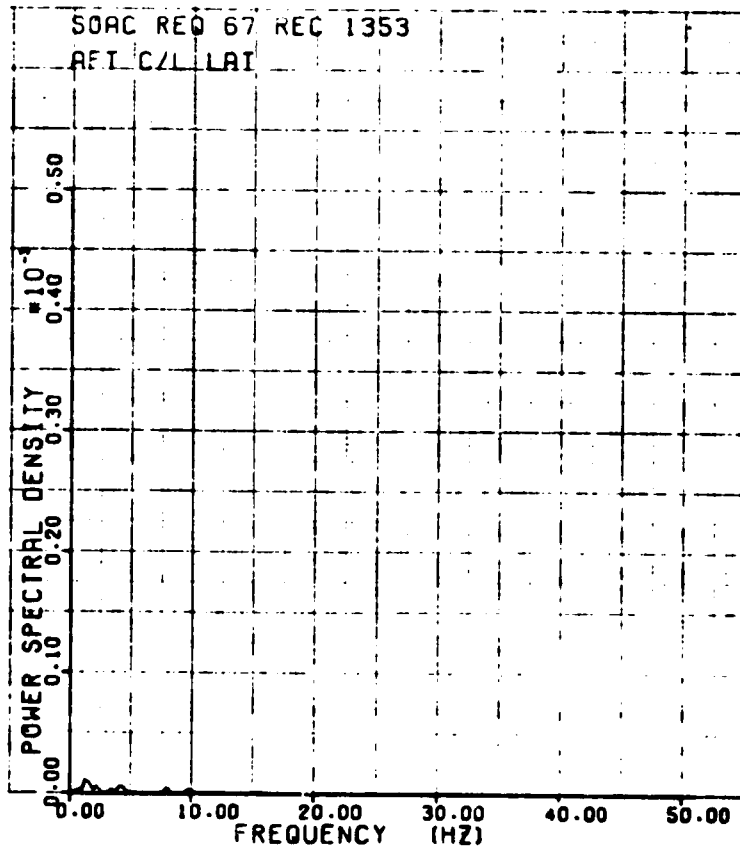
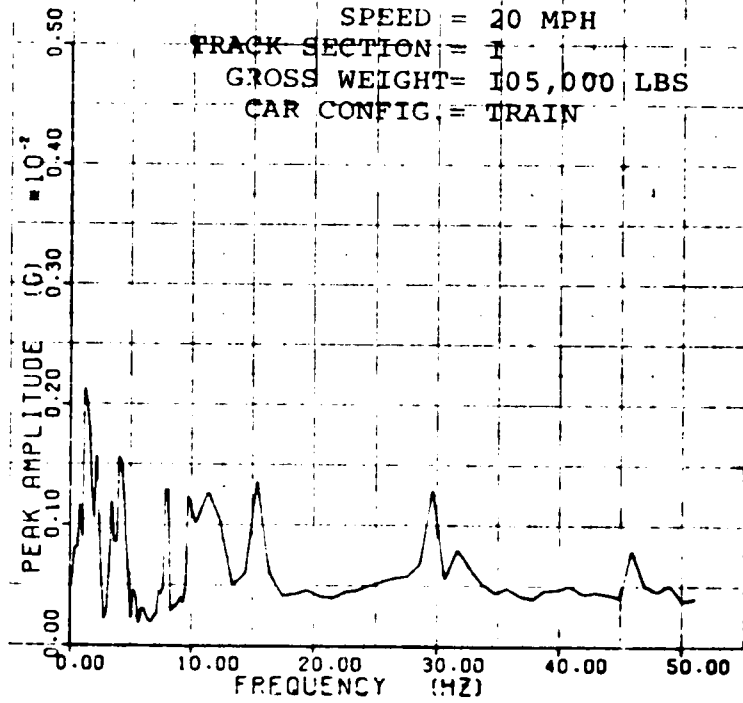


Figure A-131

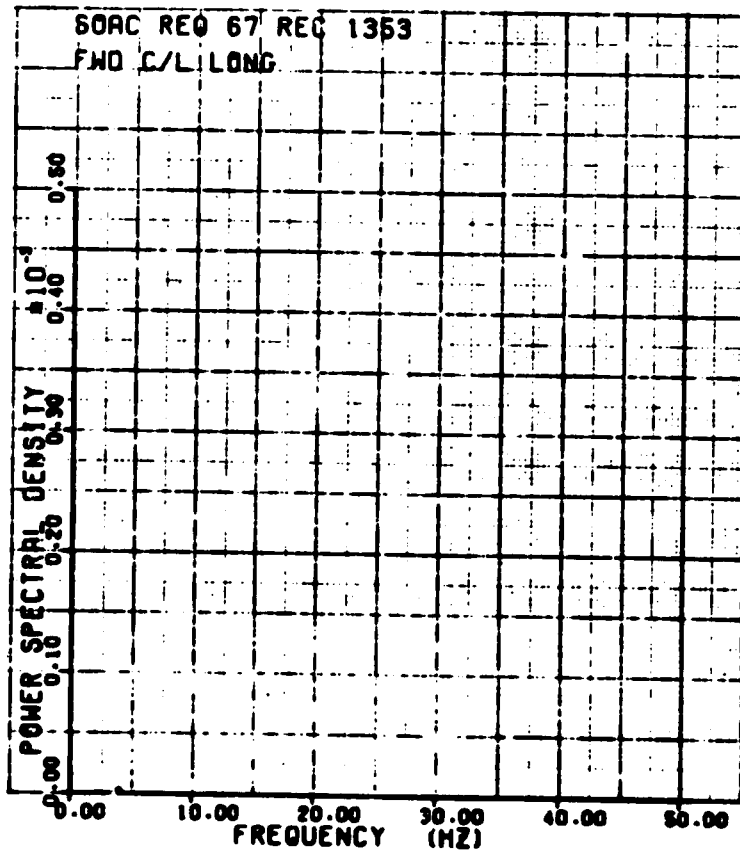
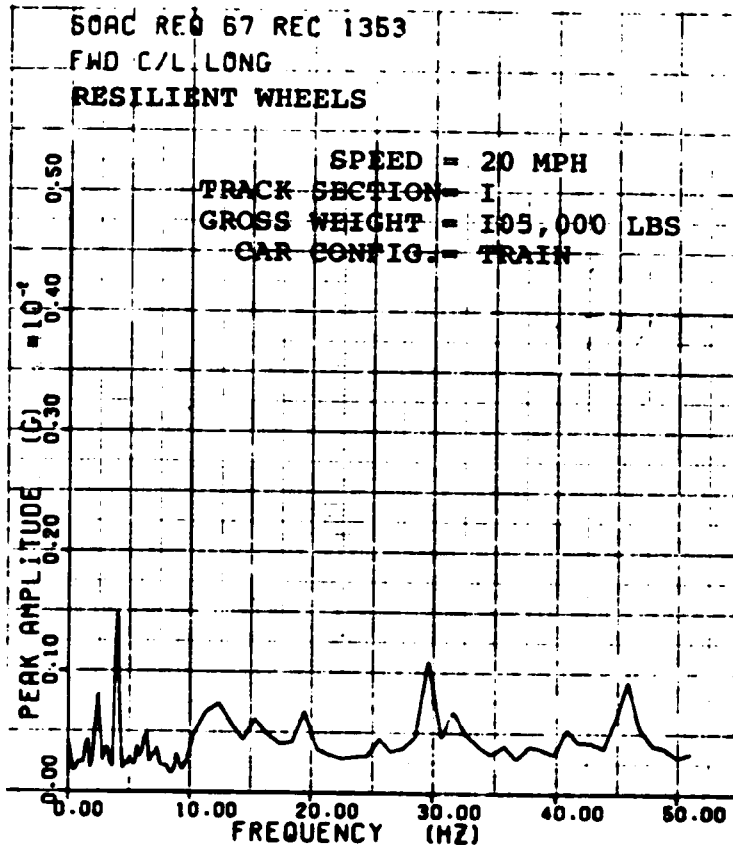


Figure A-132

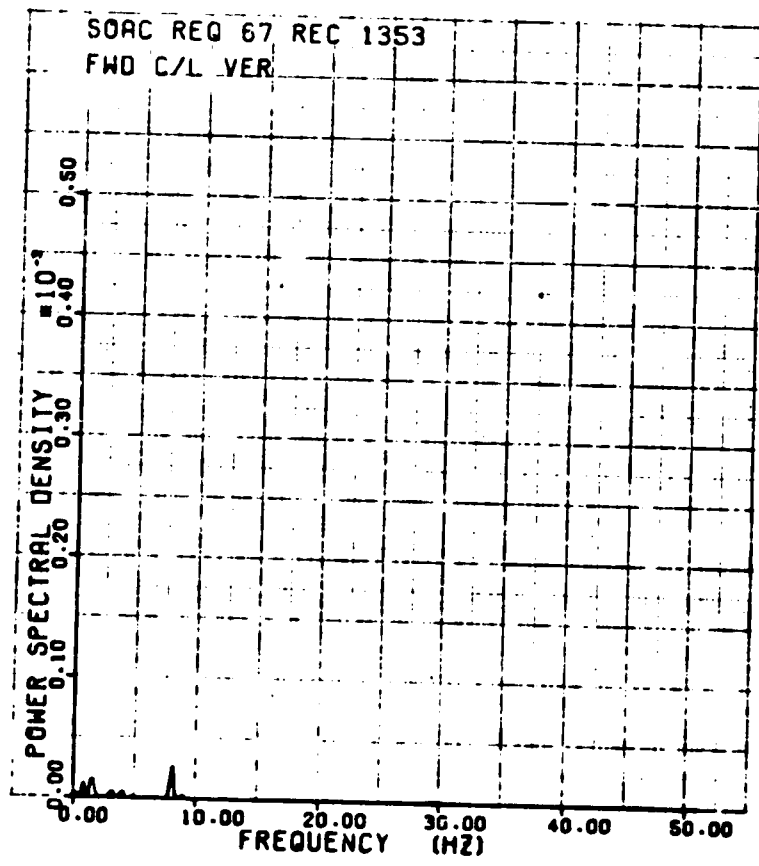
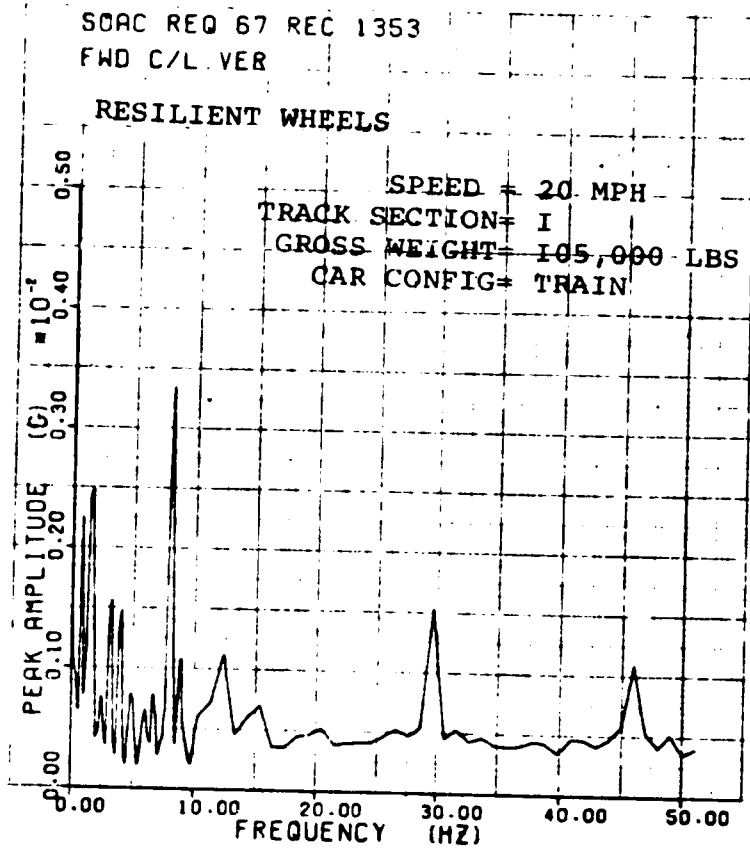
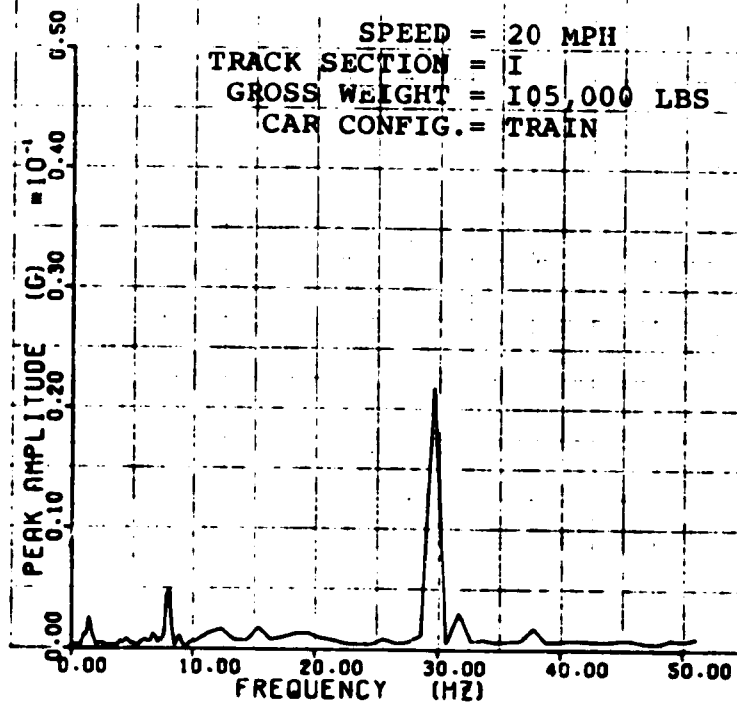


Figure A-133

SOAC REQ 67 REC 1353

MID C/L VER

RESILIENT WHEELS



SOAC REQ 67 REC 1353

MID C/L VER

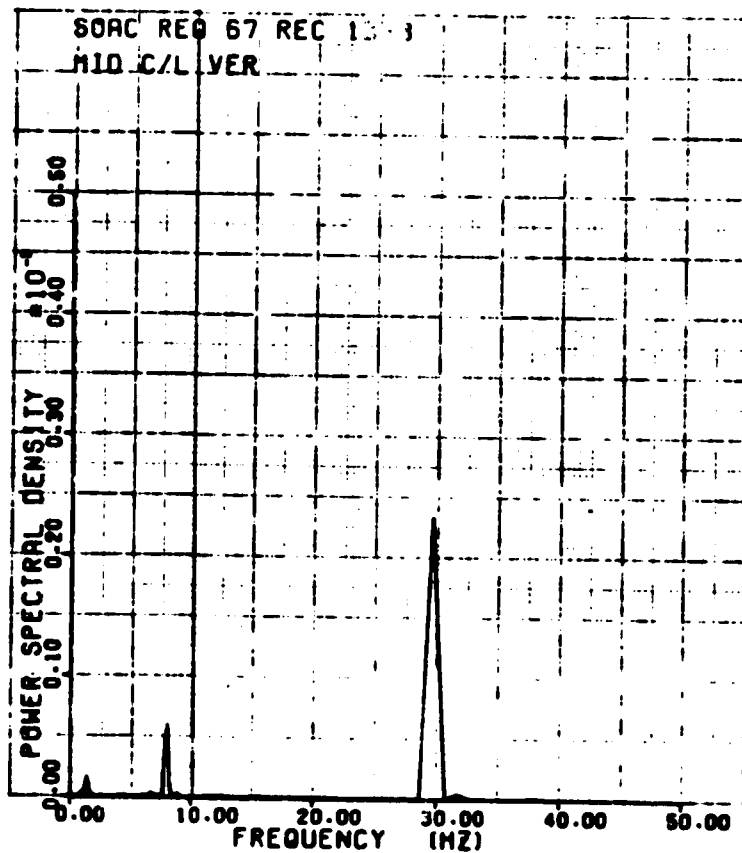


Figure A-134

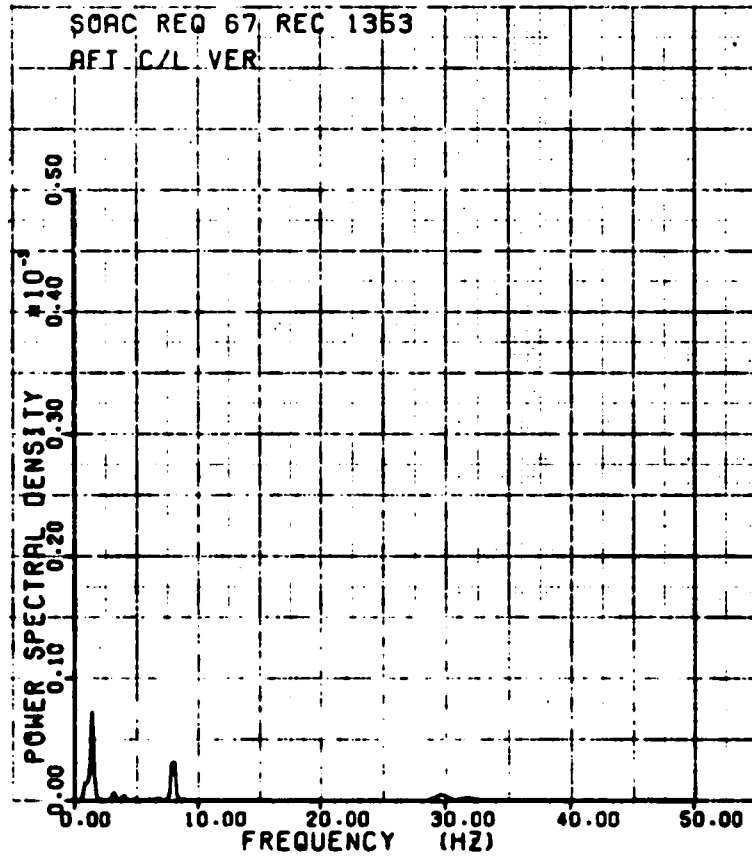
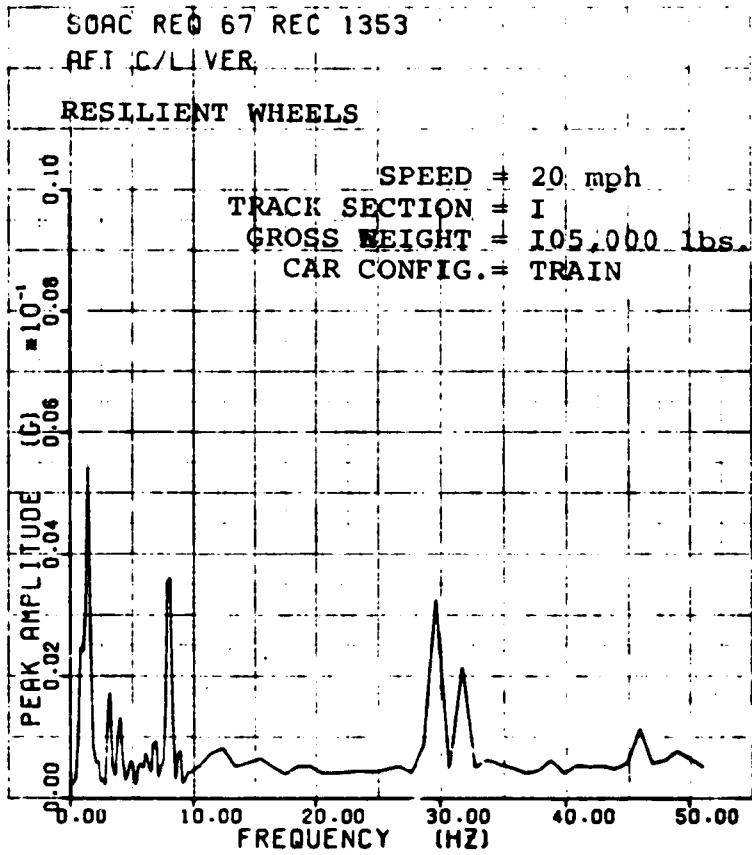


Figure A-135

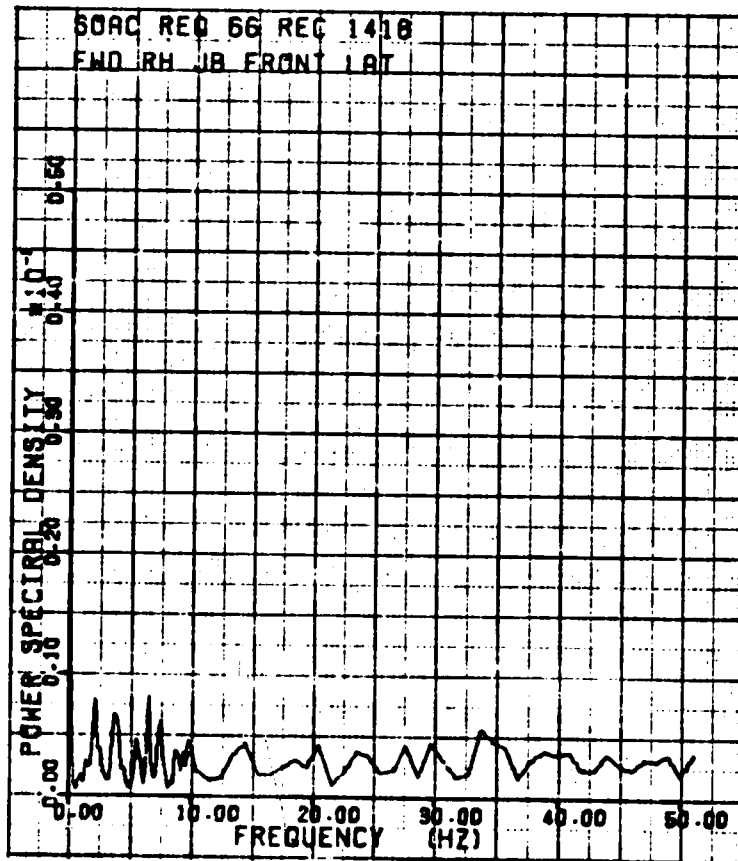
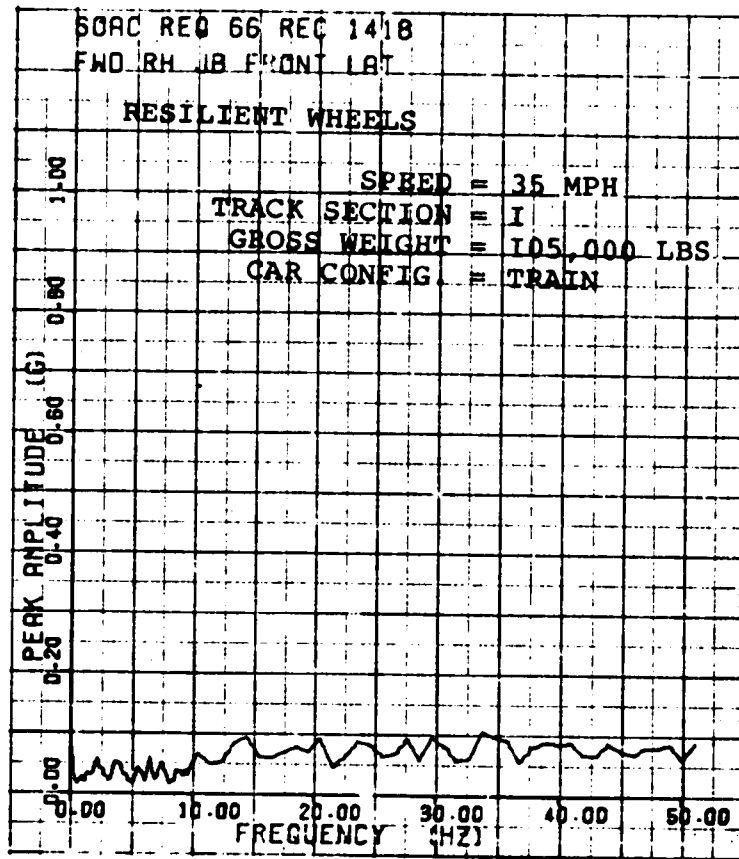


Figure A-136

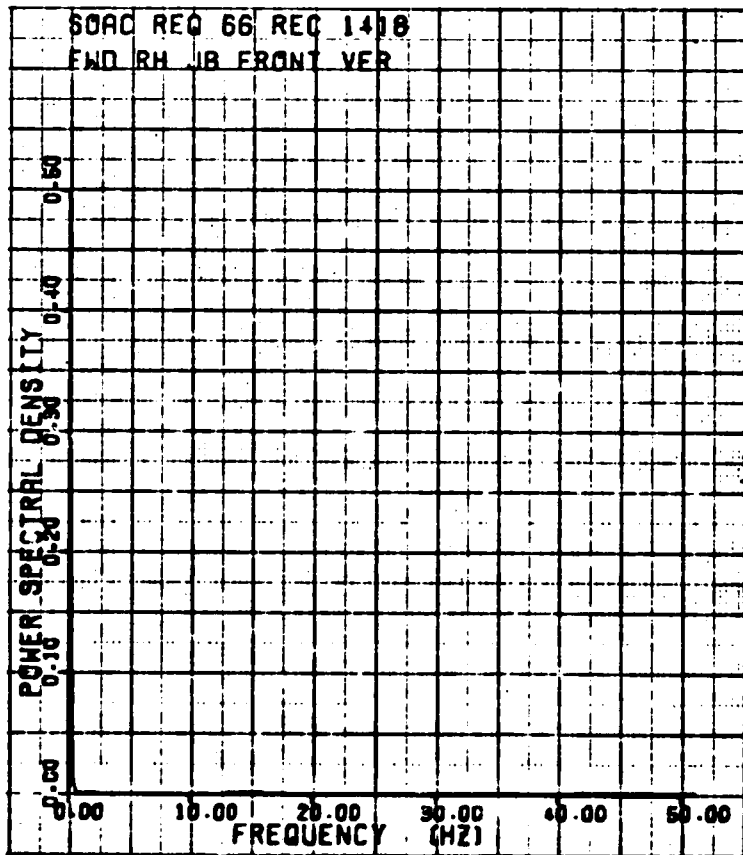
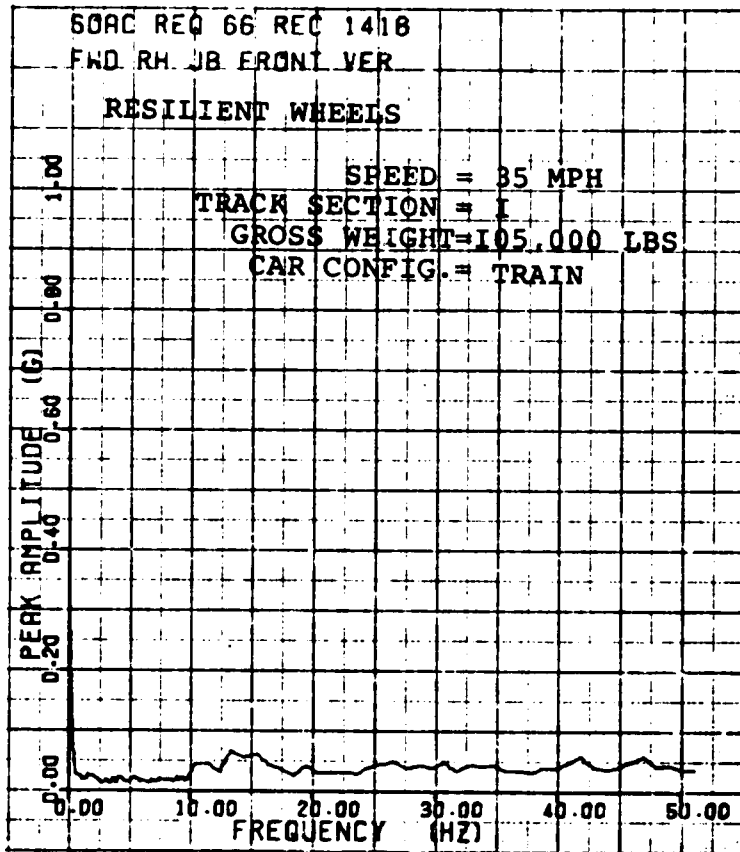


Figure A-137

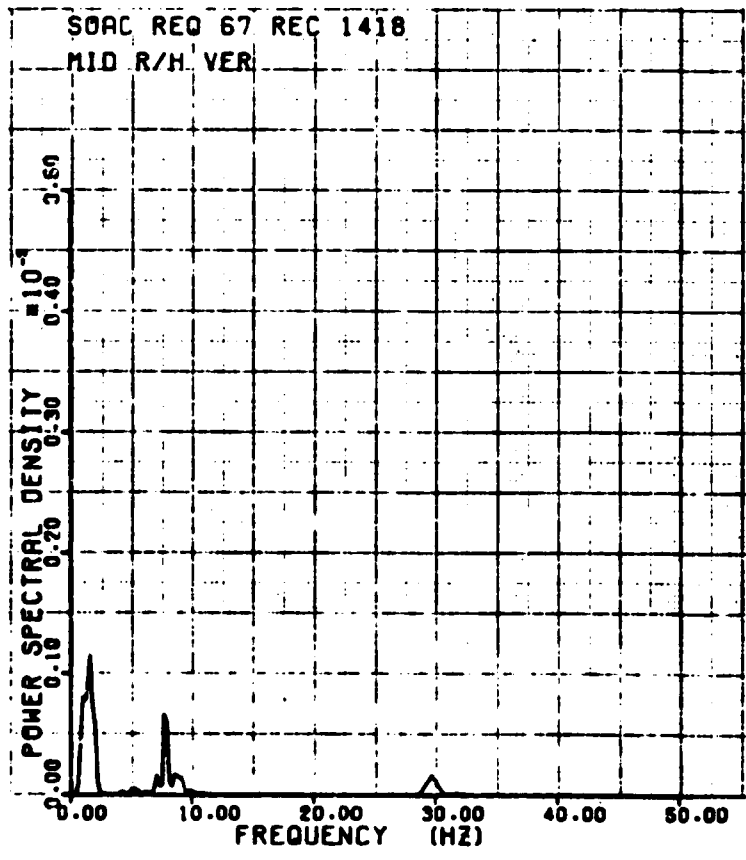
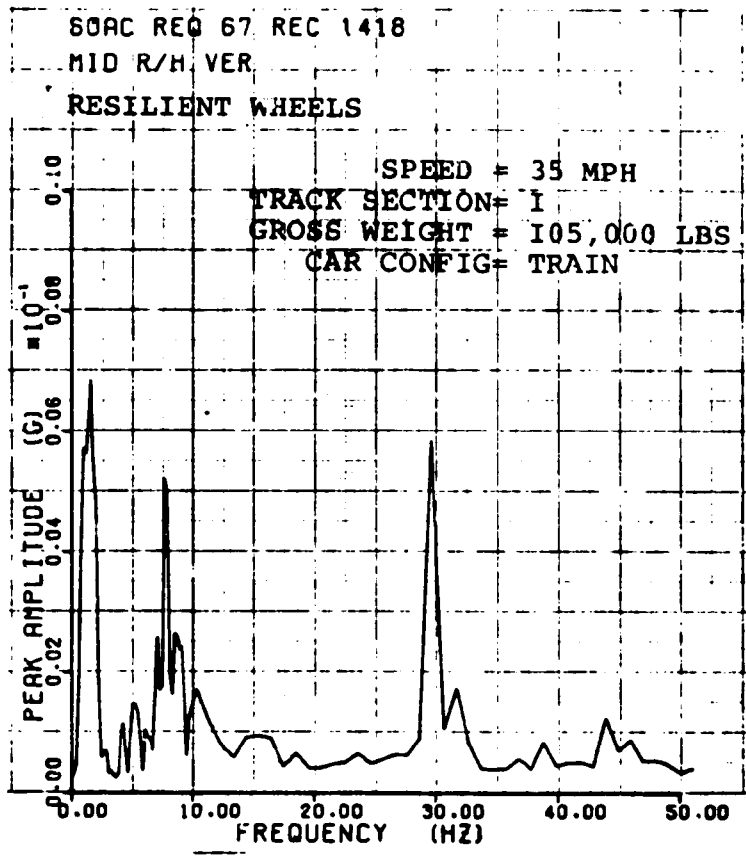
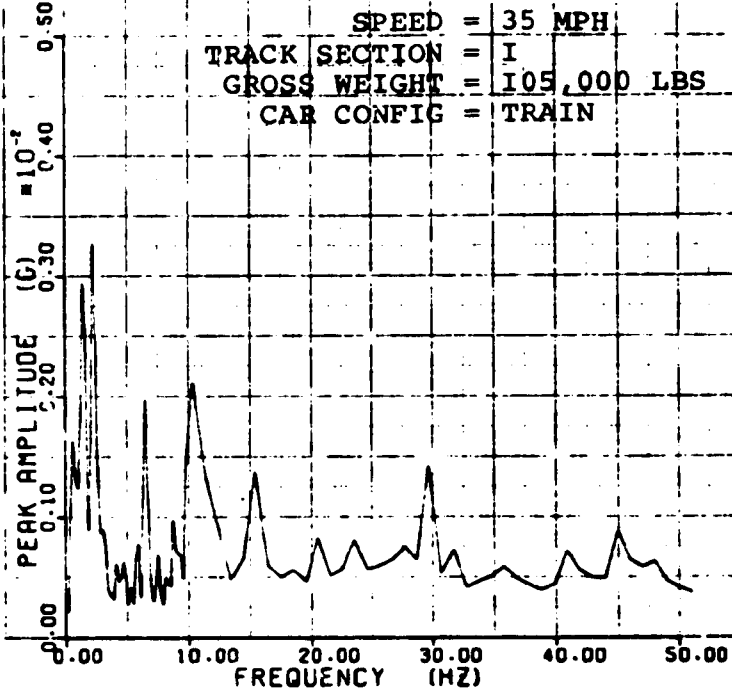


Figure A-138

SOAC REQ 67 REC 1418

AFT C/L LAT

RESILIENT WHEELS



SOAC REQ 67 REC 1418

AFT C/L LAT

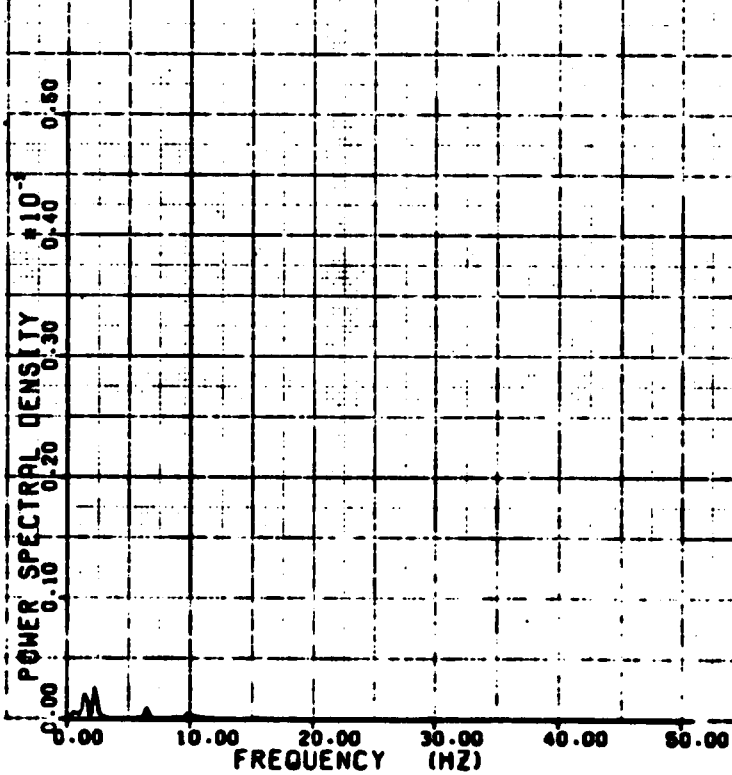


Figure A-139

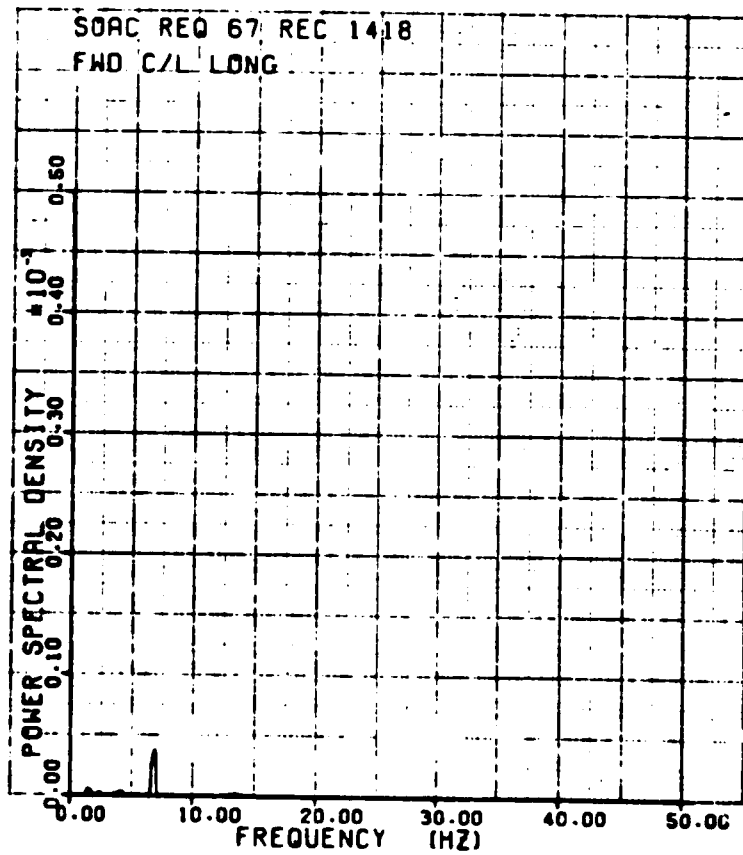
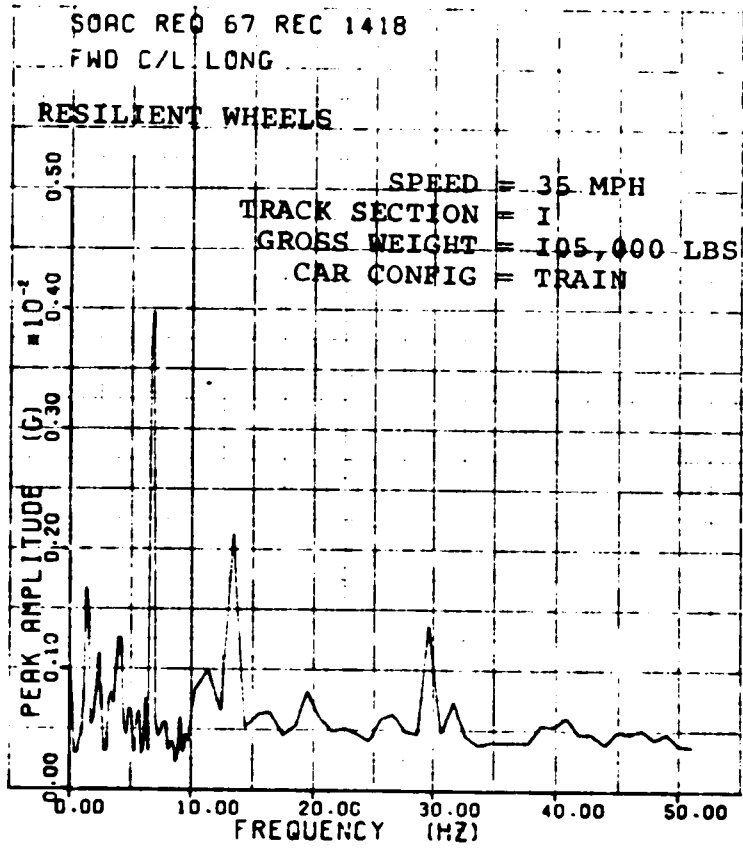


Figure A-140

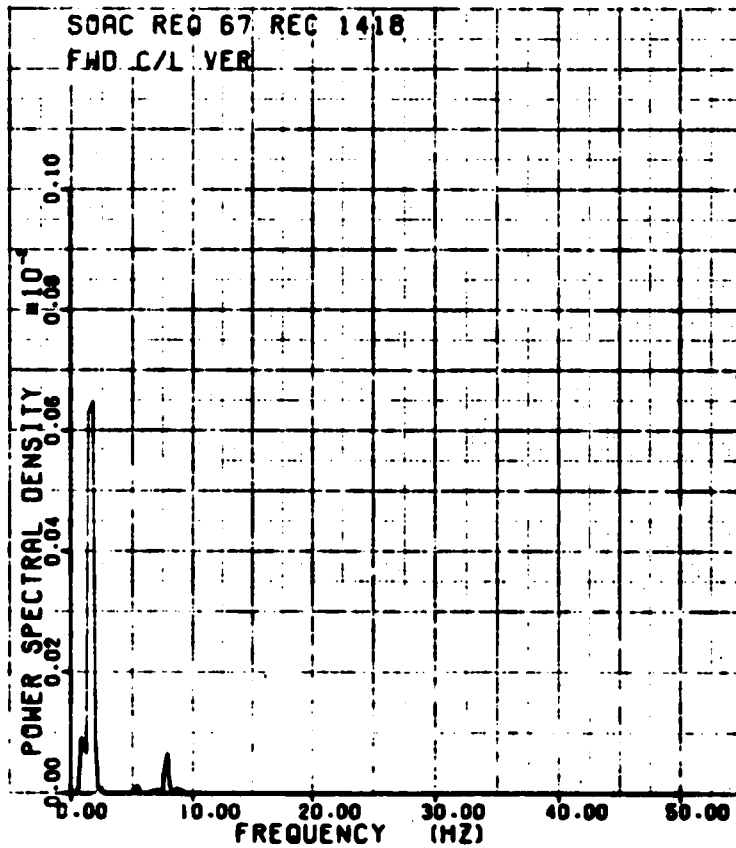
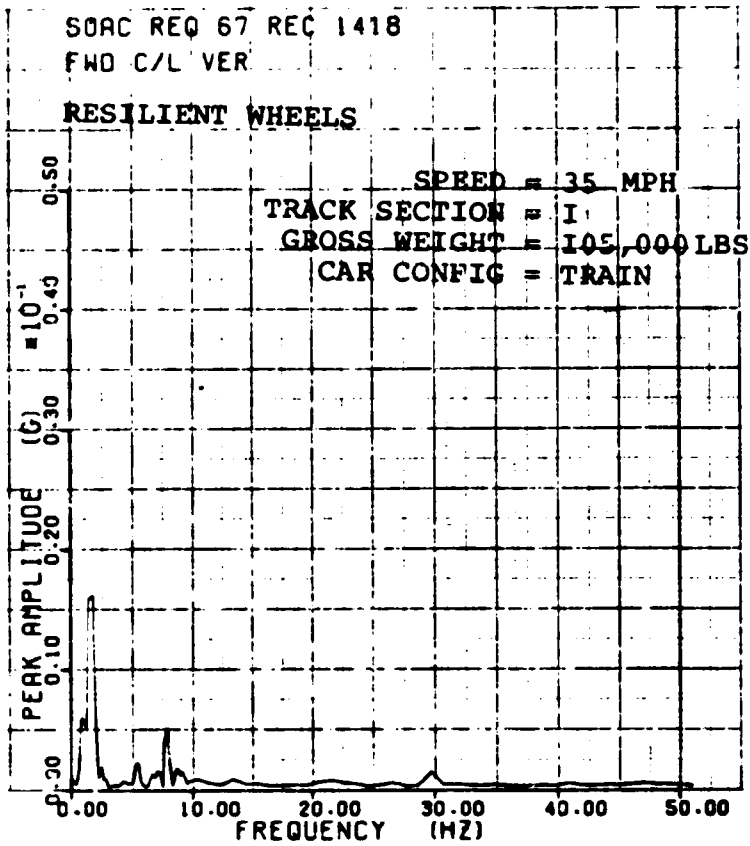


Figure A-141

SOARC REQ 67 REC 1418

MID C/L VER

RESILIENT WHEELS

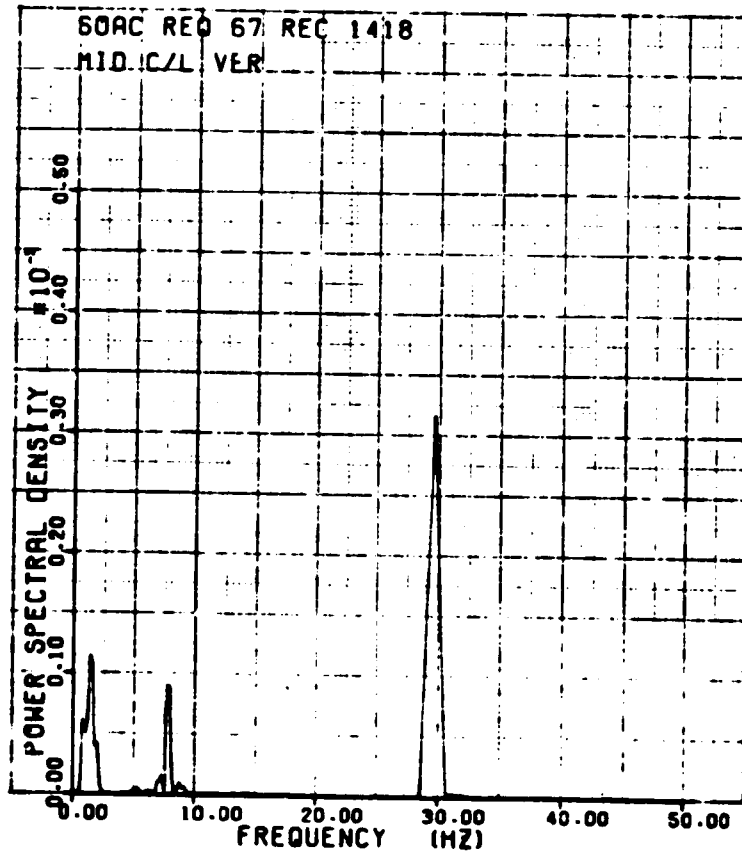
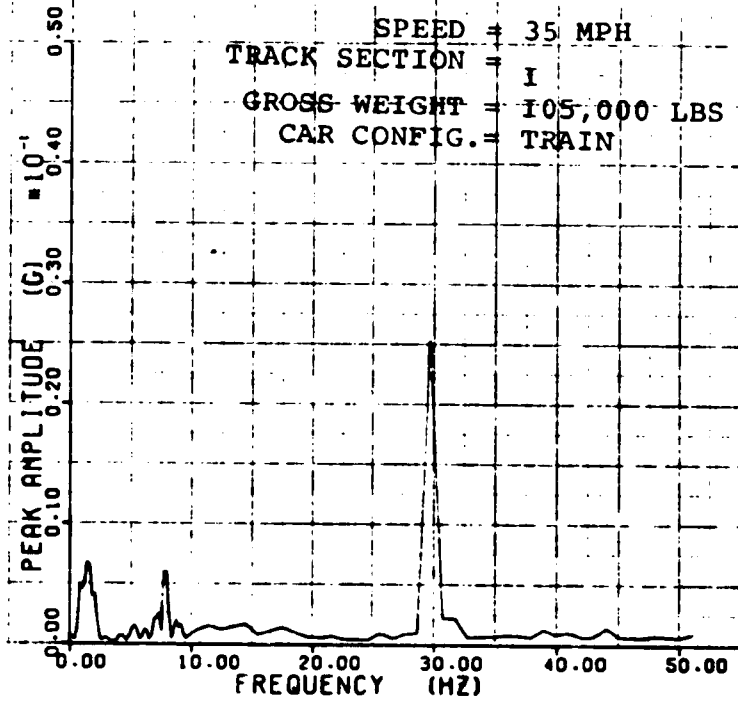


Figure A-142

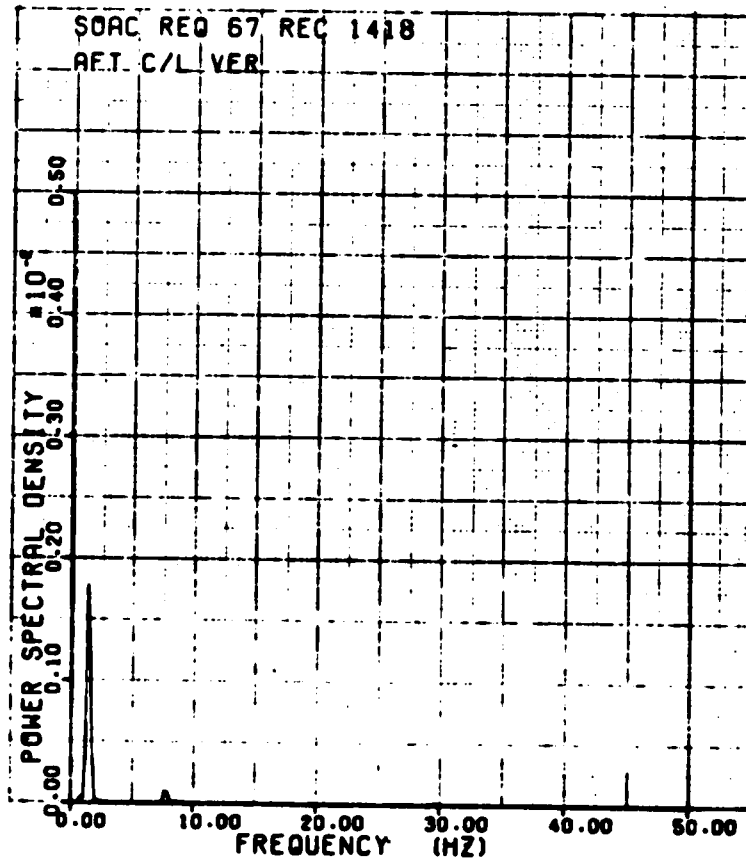
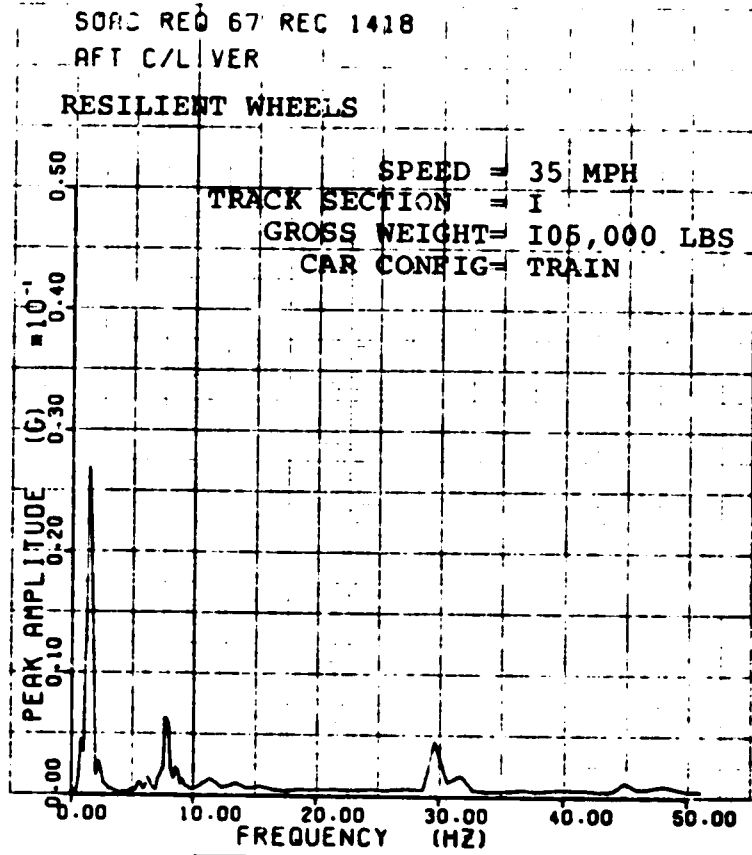


Figure A-143

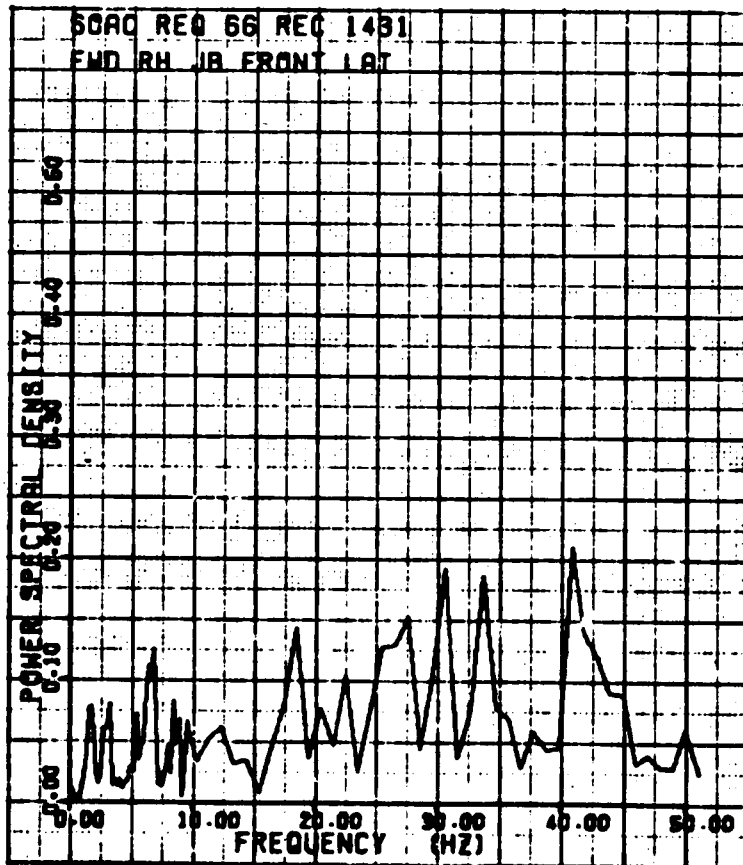
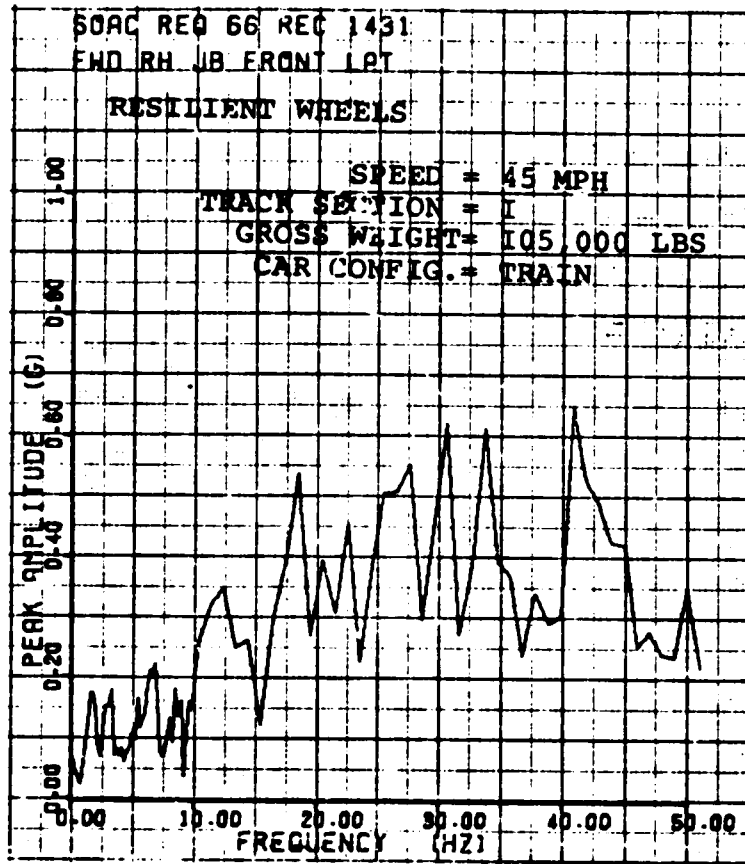


Figure A-144

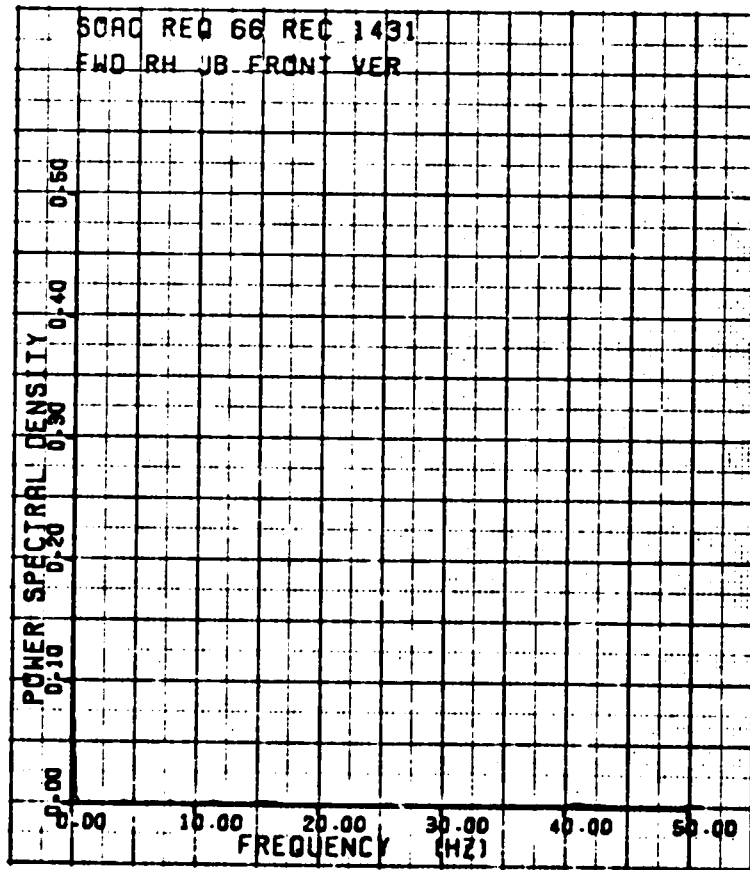
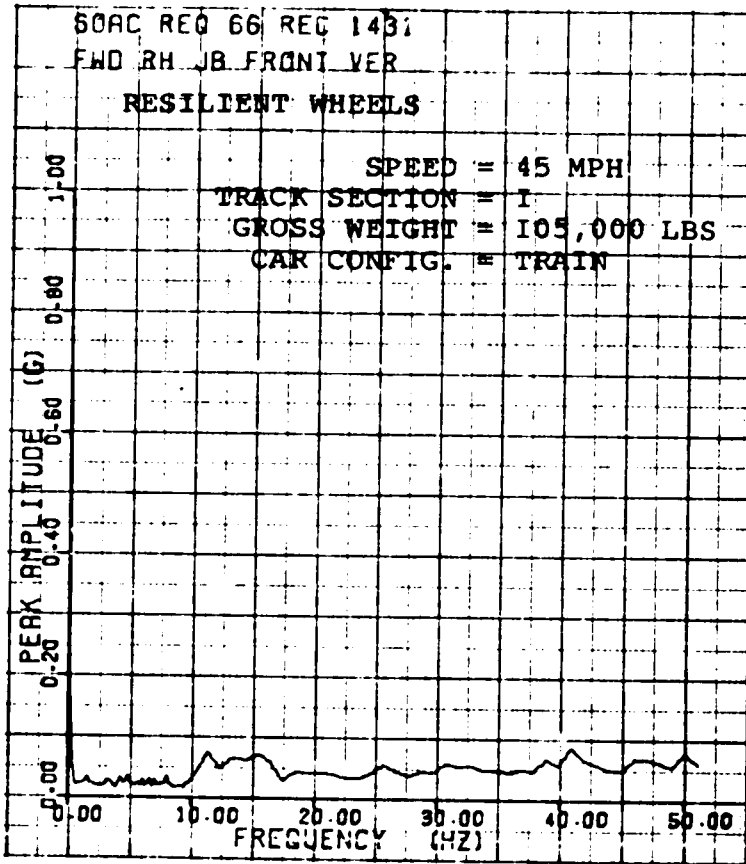


Figure A-145

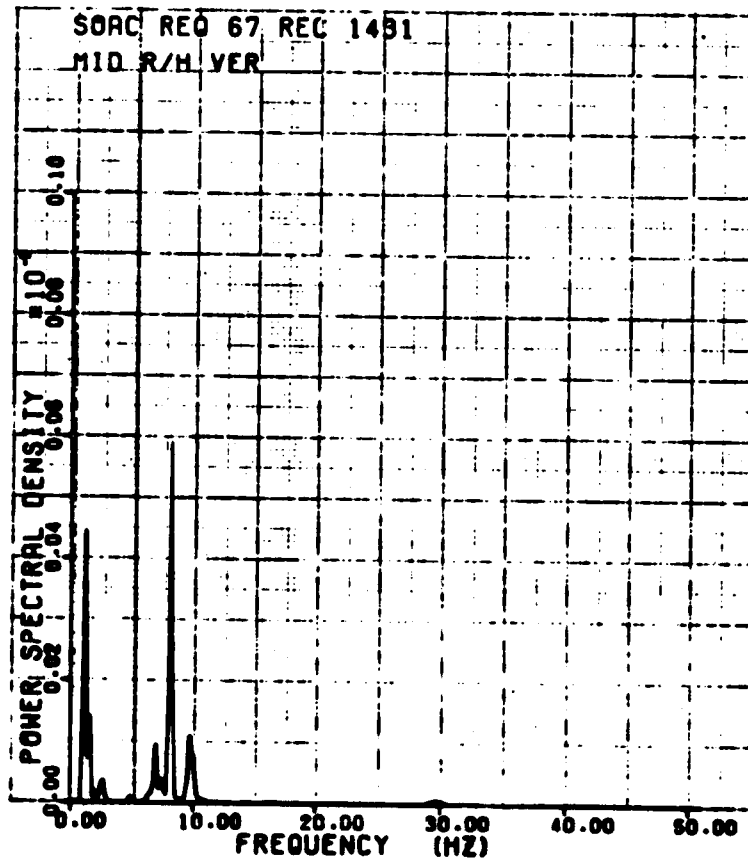
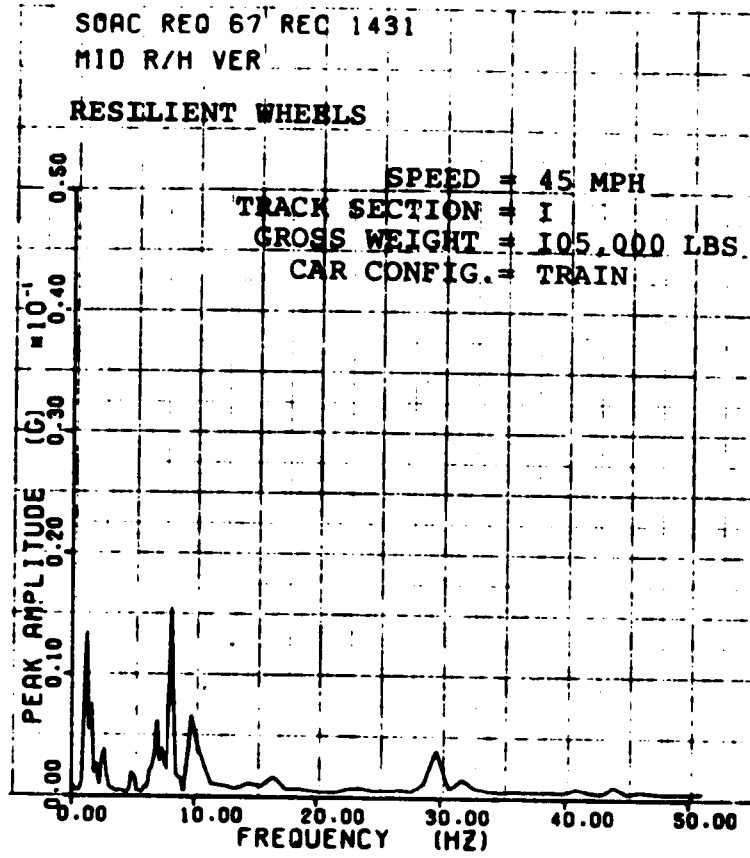


Figure A-146

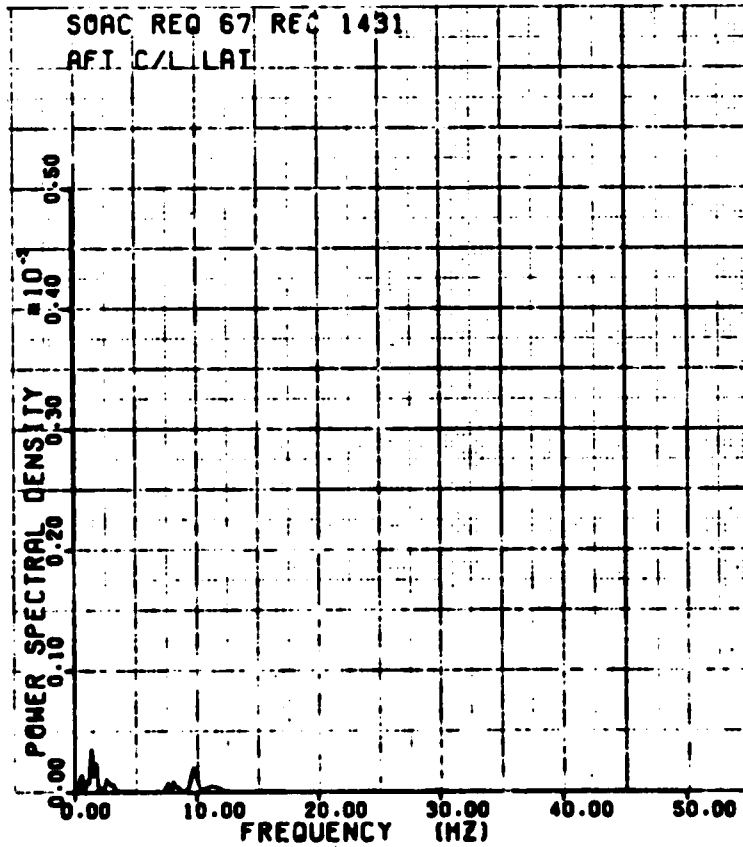
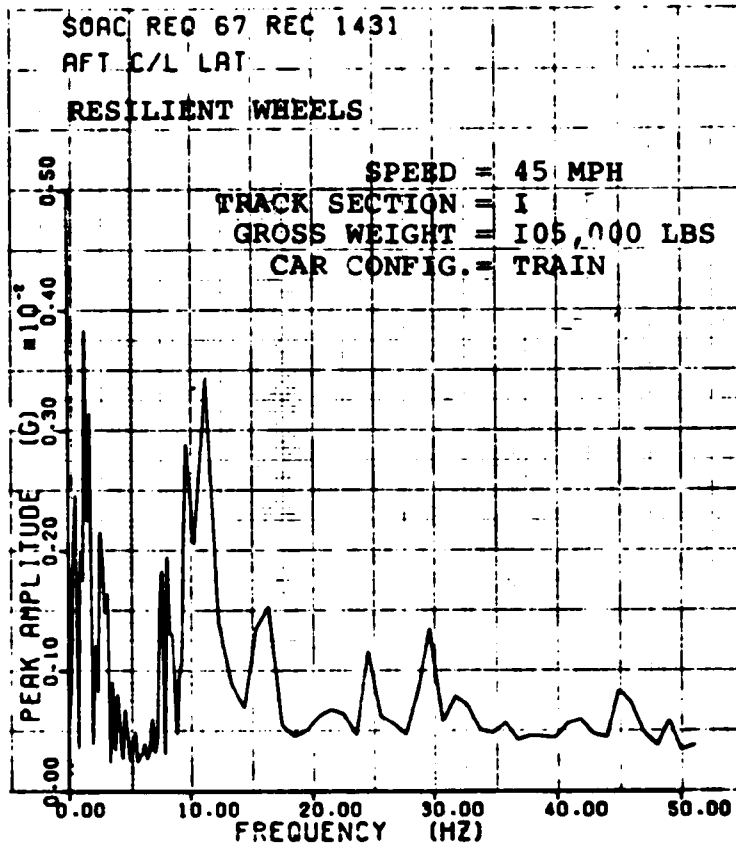


Figure A-147

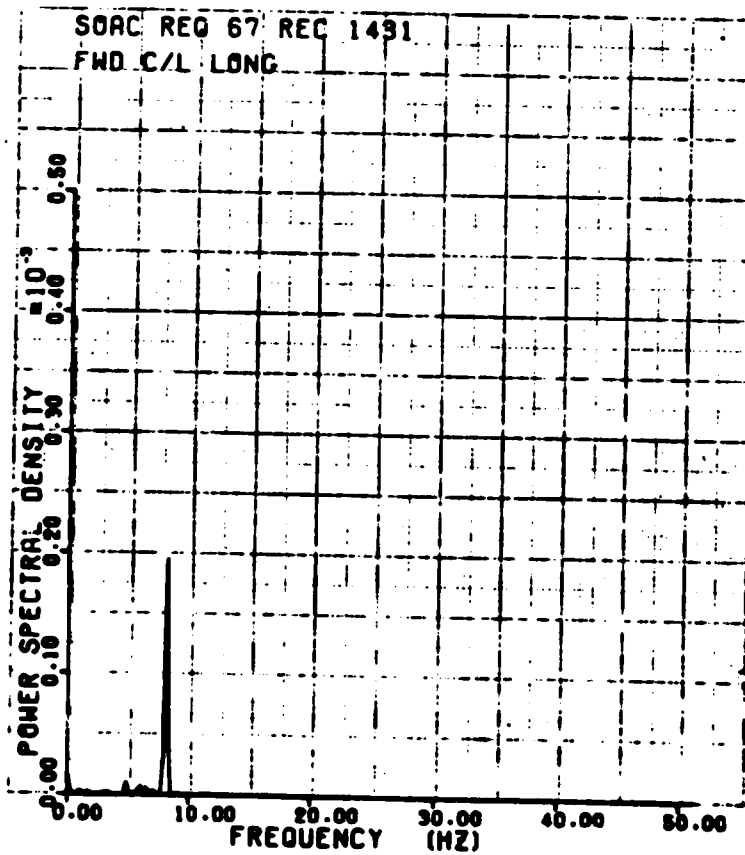
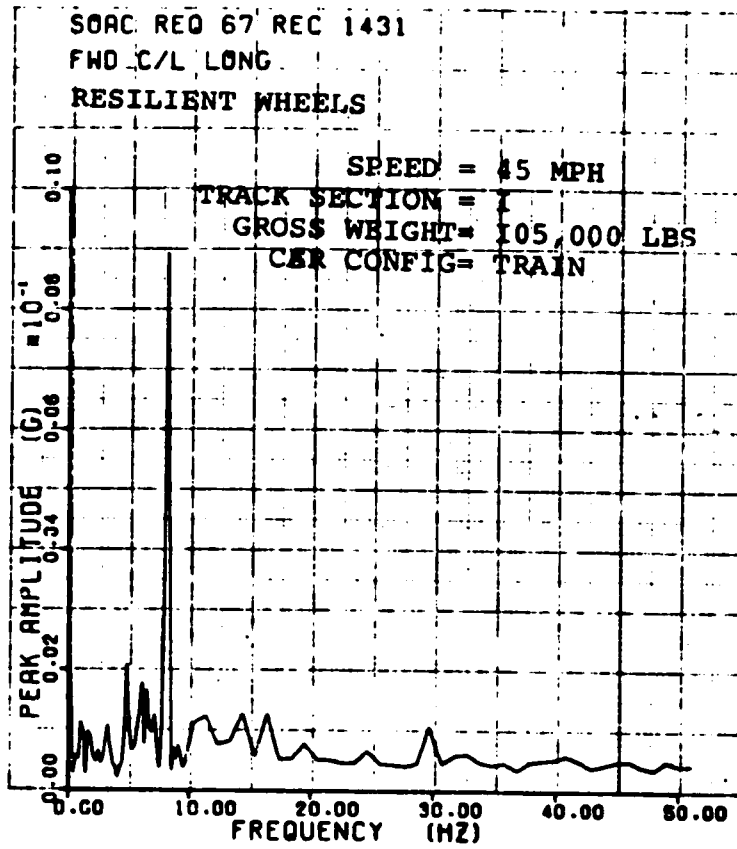


Figure A-148

SOAC REQ 67 REC 1431

FWD C/L VER

RESILIENT WHEELS

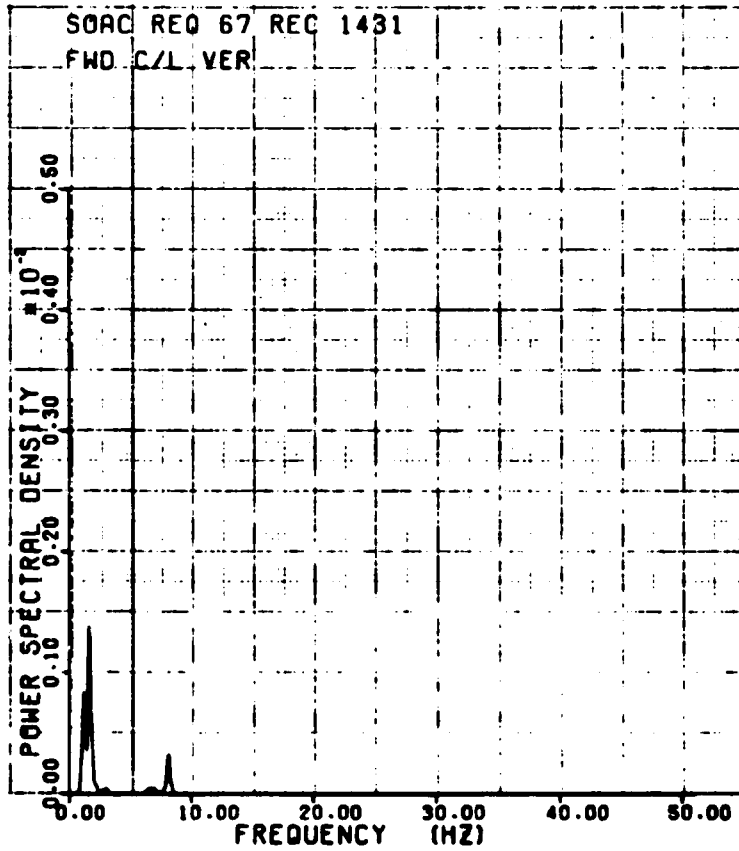
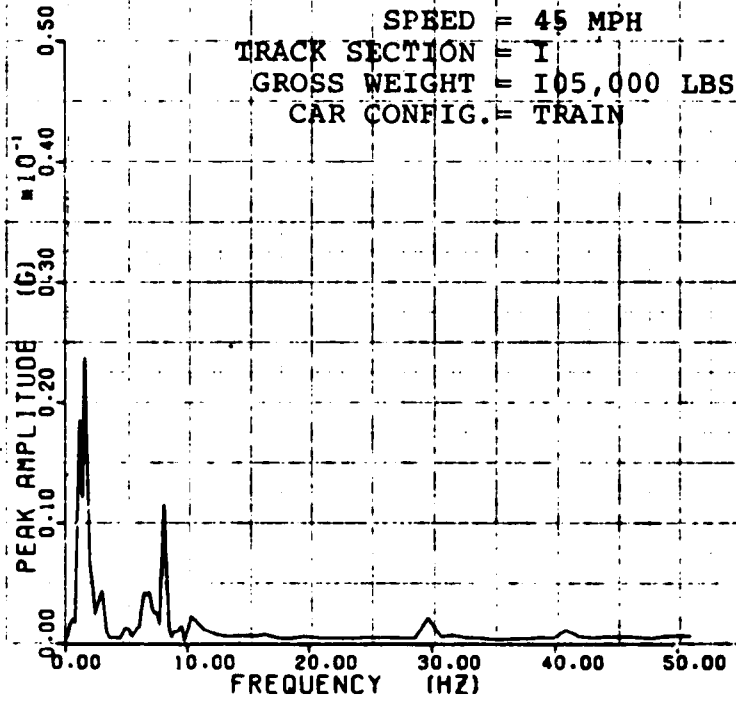
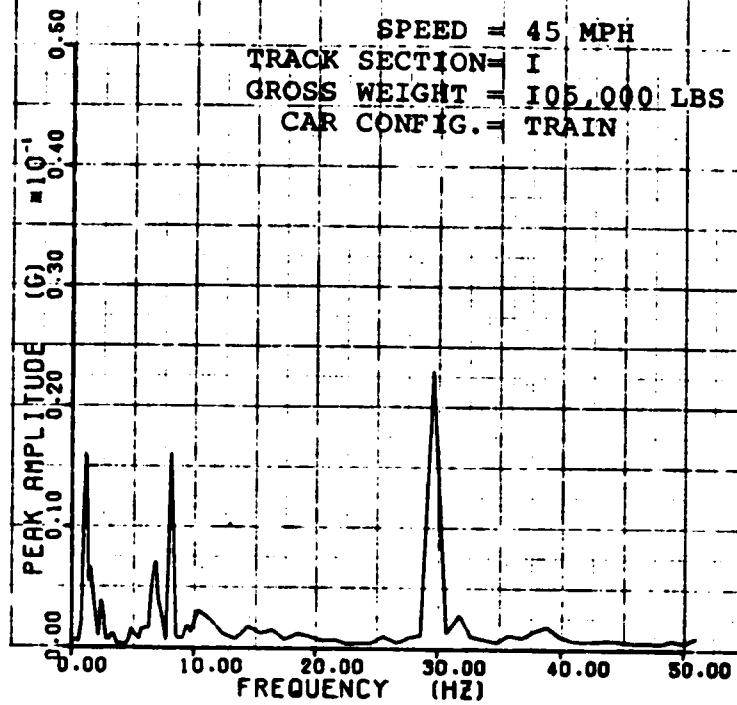


Figure A-149

SOAC REQ 67 REC 1431

MID C/L VER

RESILIENT WHEELS



SOAC REQ 67 REC 1431

MID C/L VER

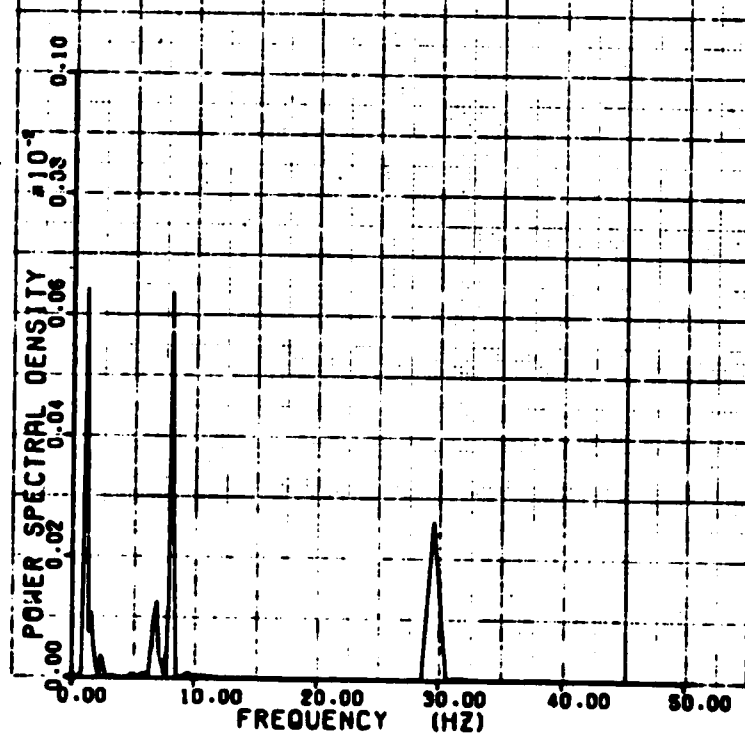


Figure A-150

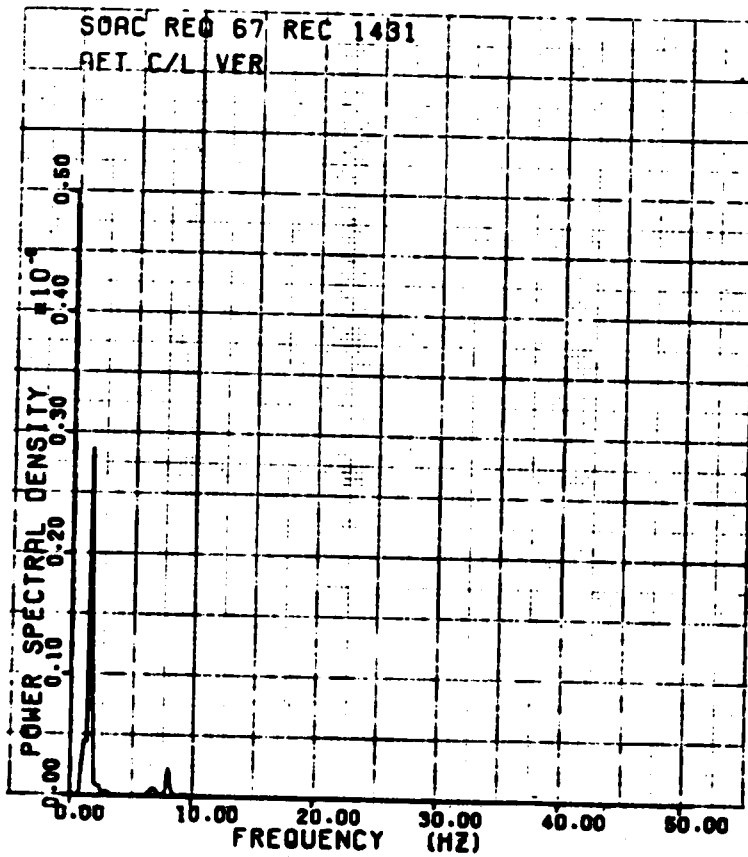
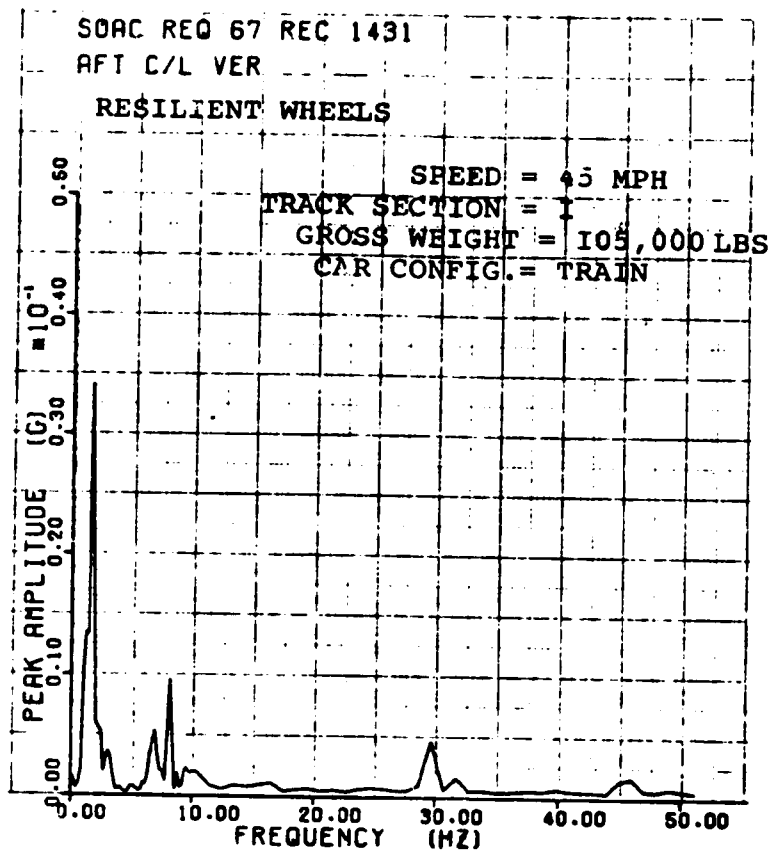


Figure A-151

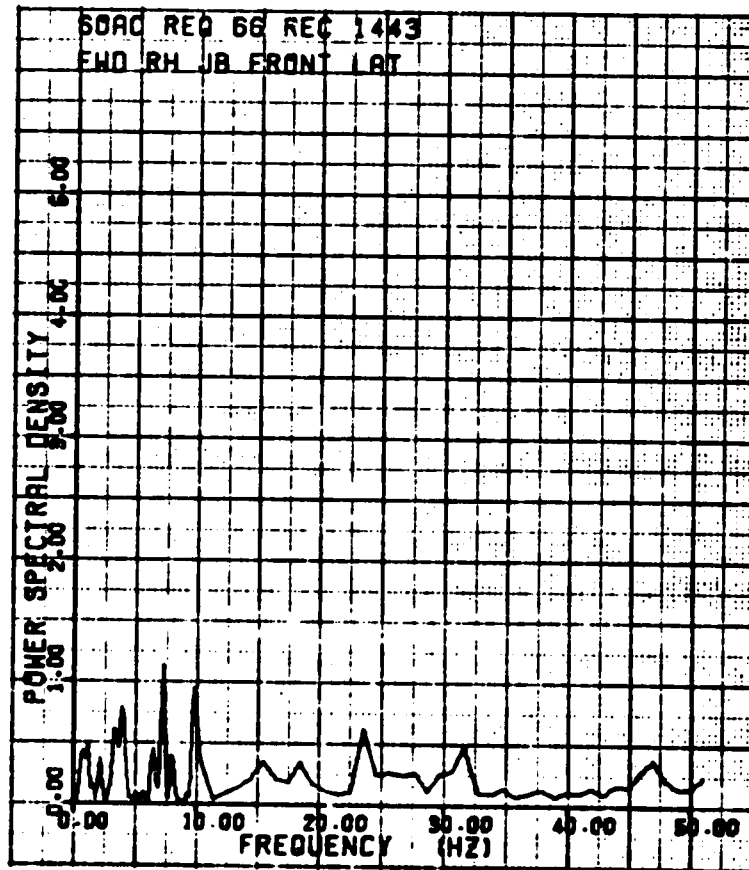
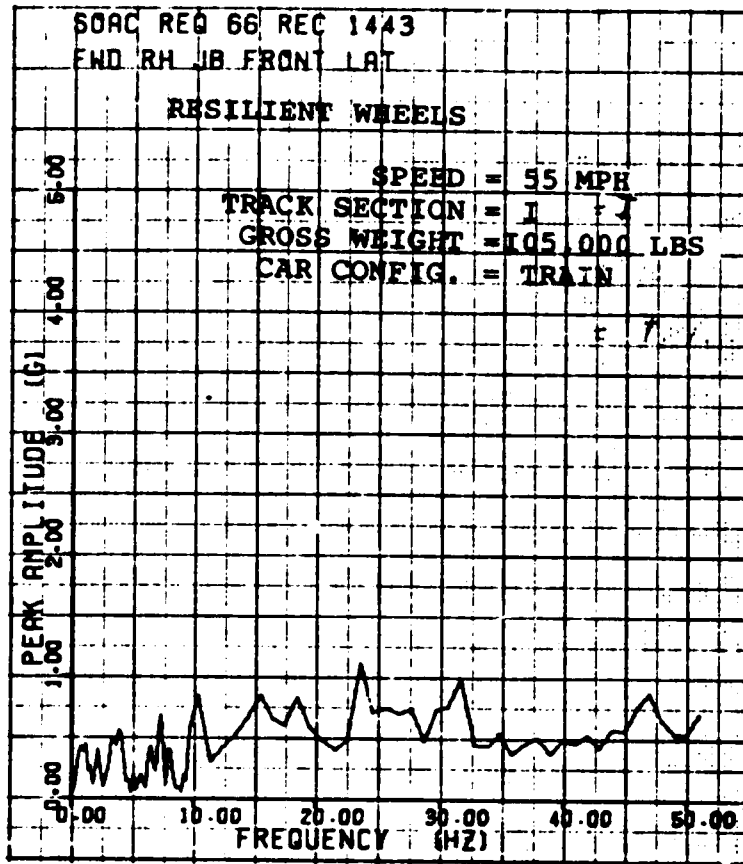


Figure A-152

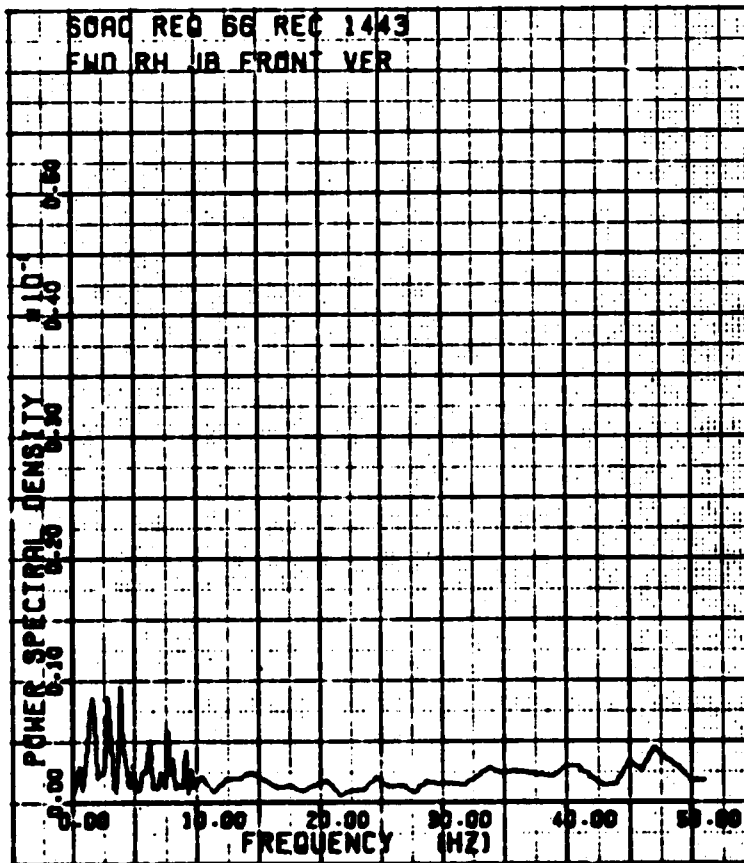
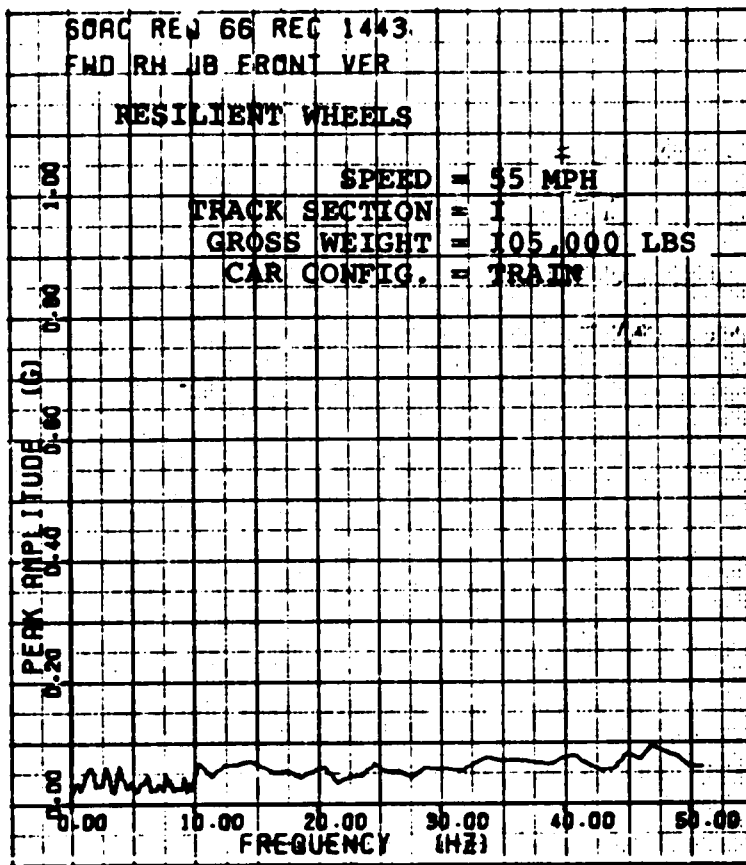


Figure A-153

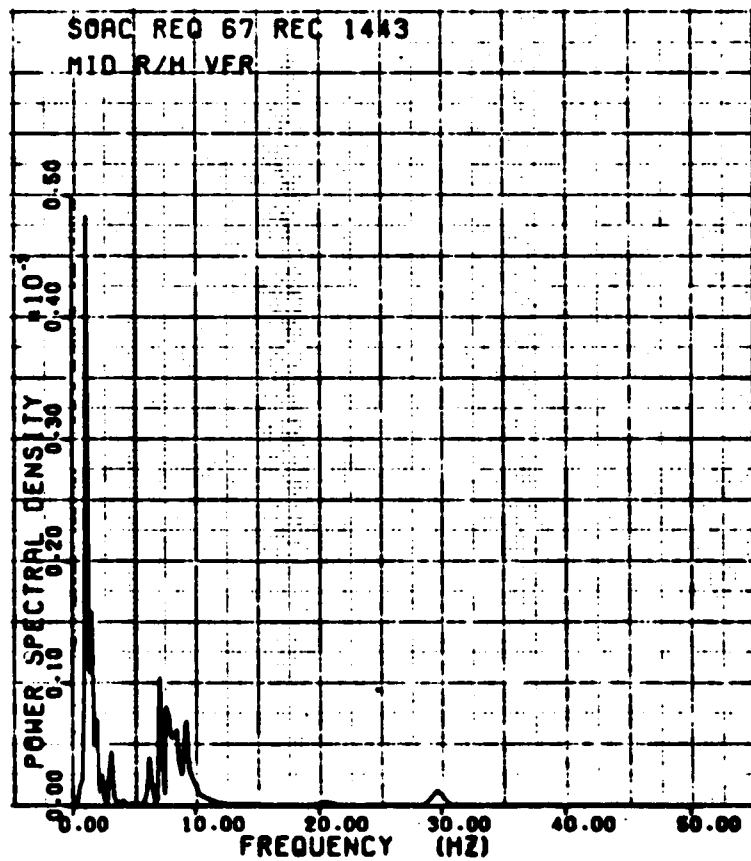
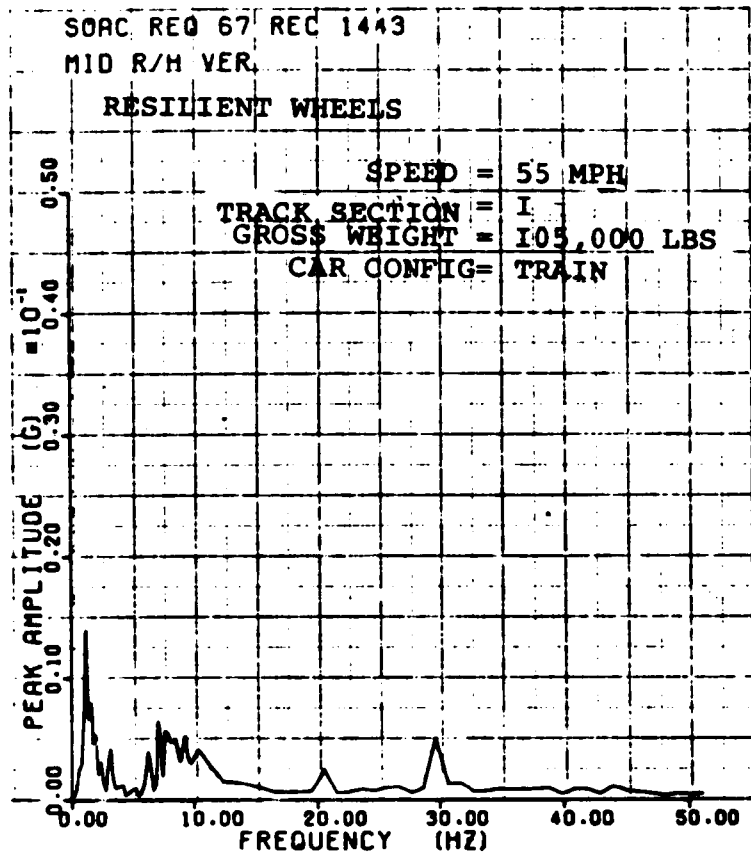


Figure A-154

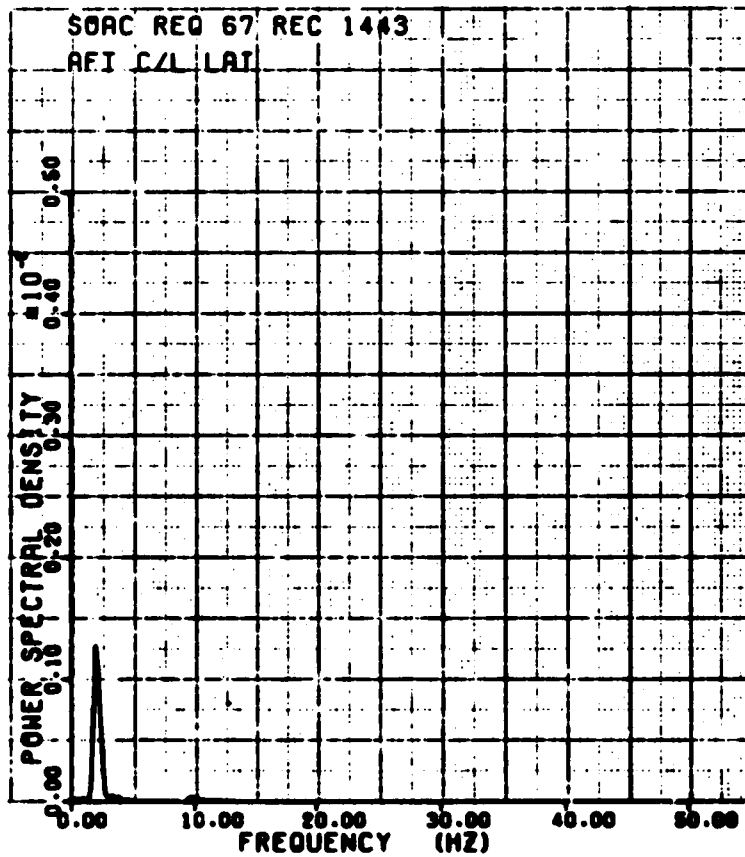
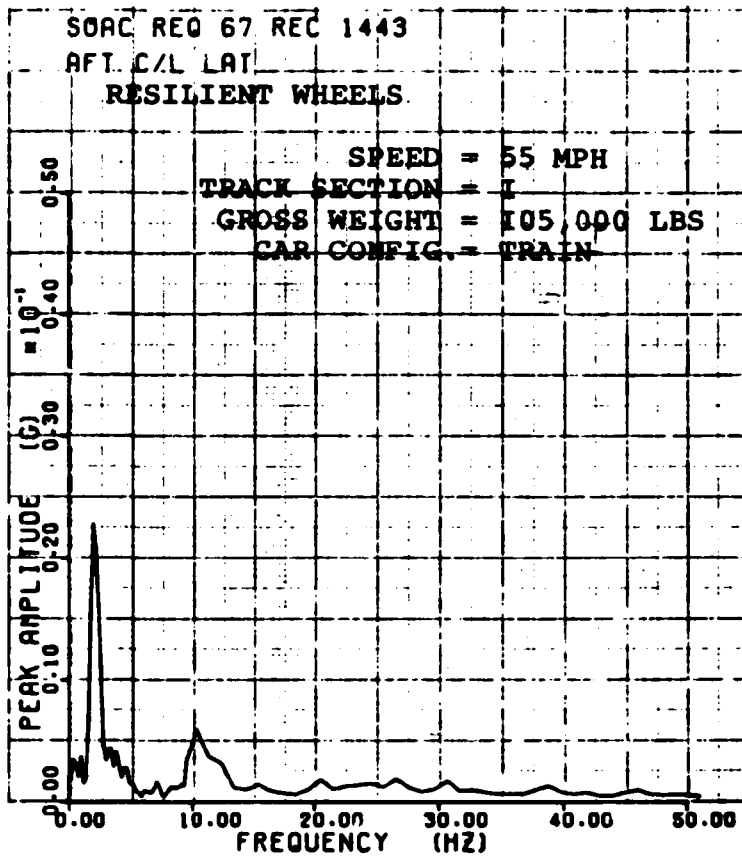


Figure A-155

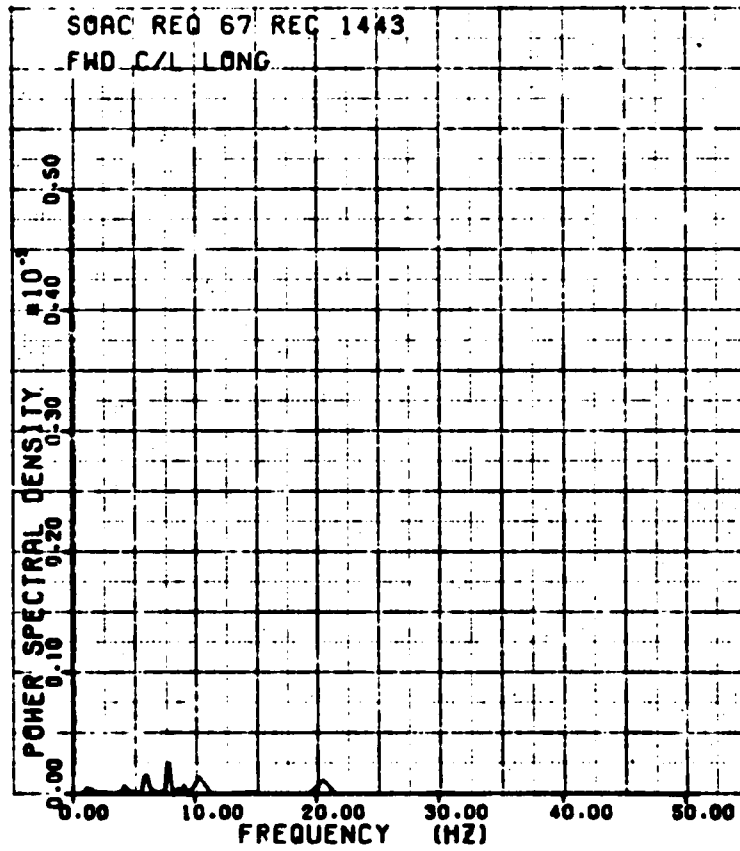
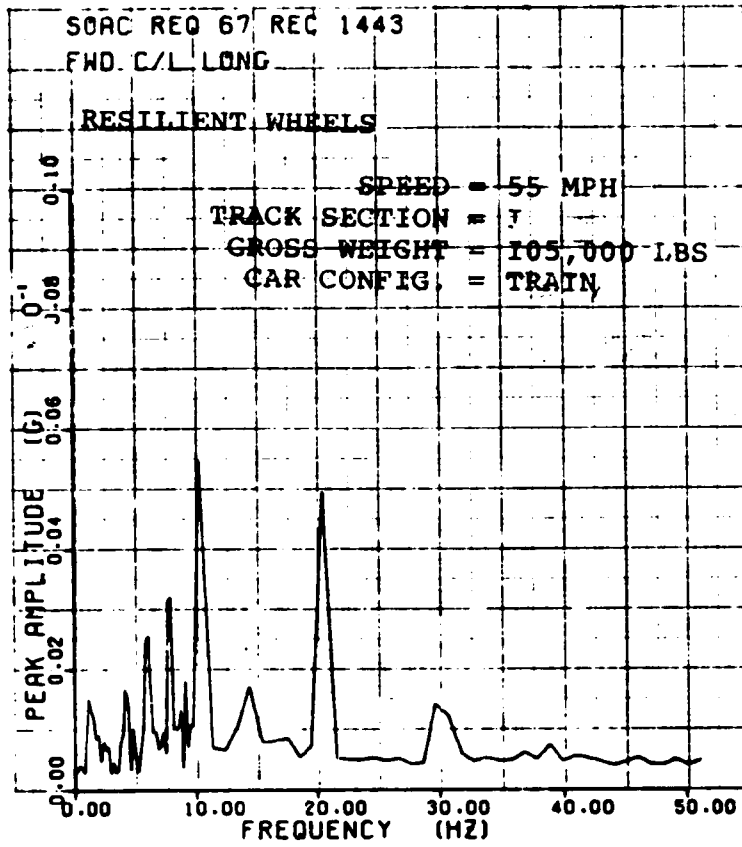


Figure A-156

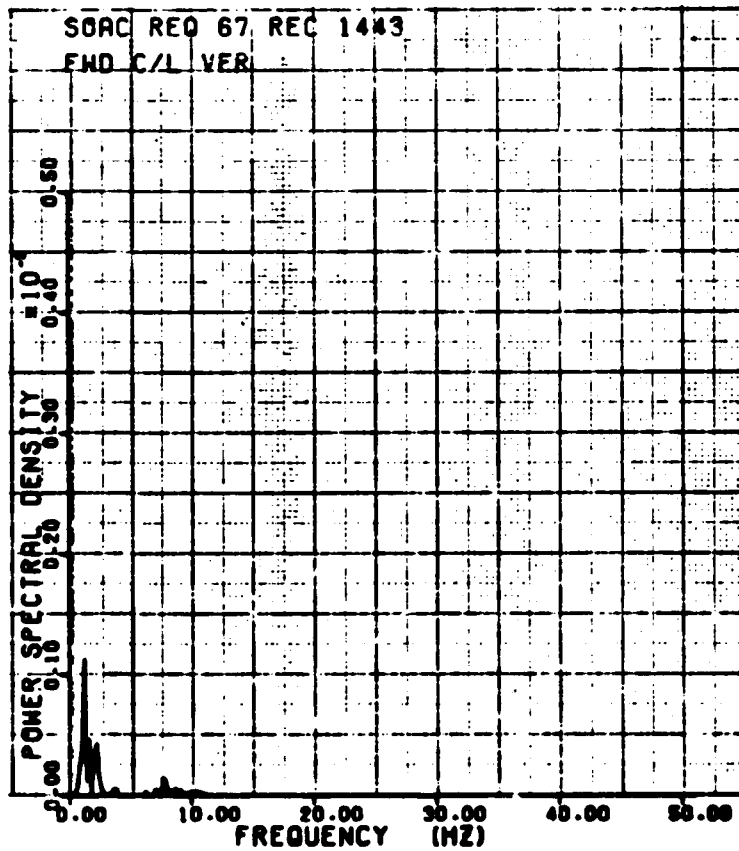
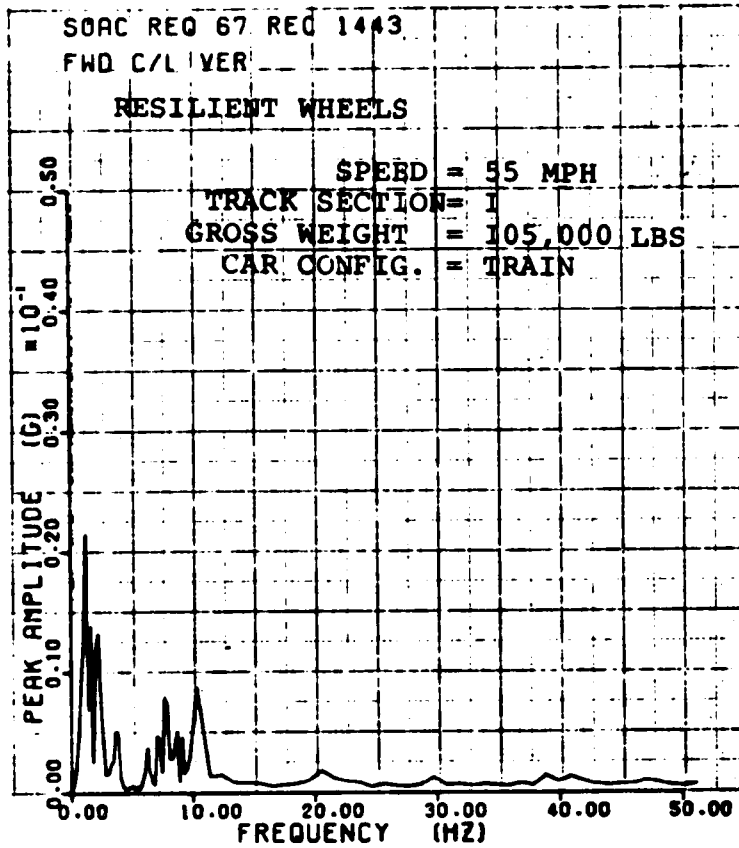


Figure A-157

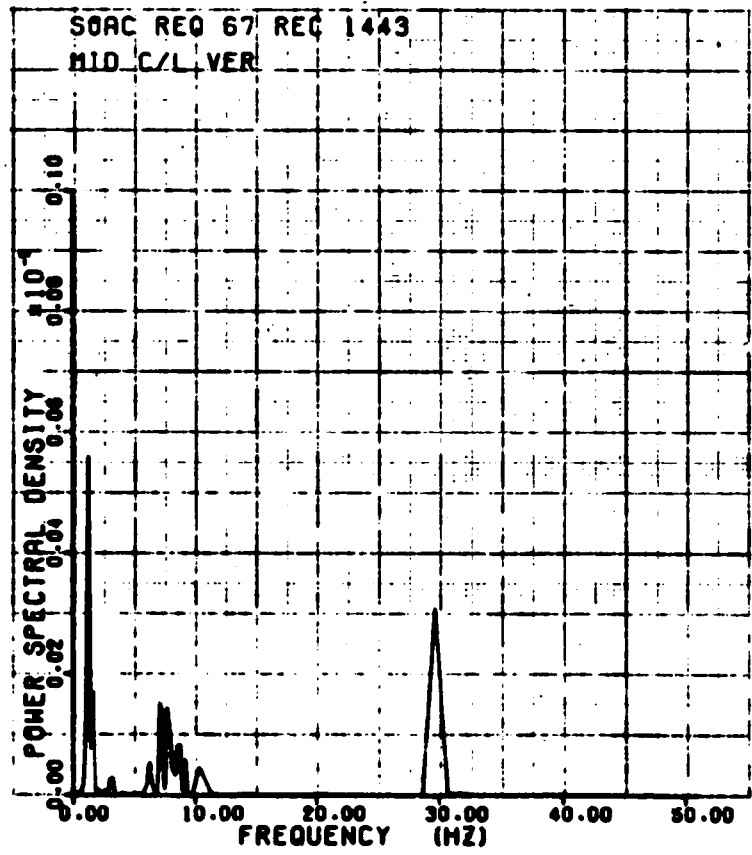
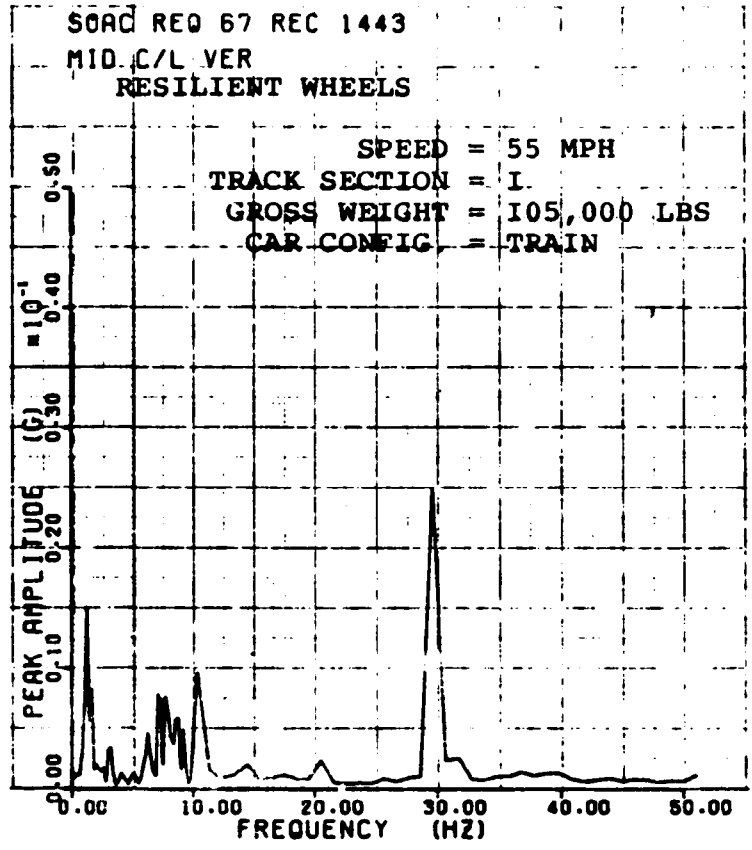


Figure A-158

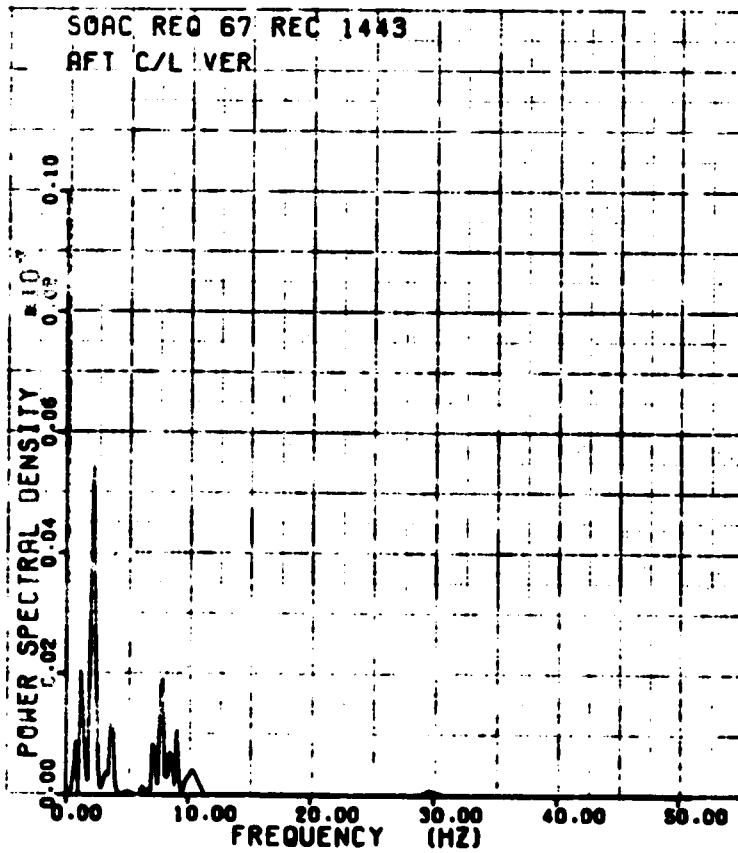
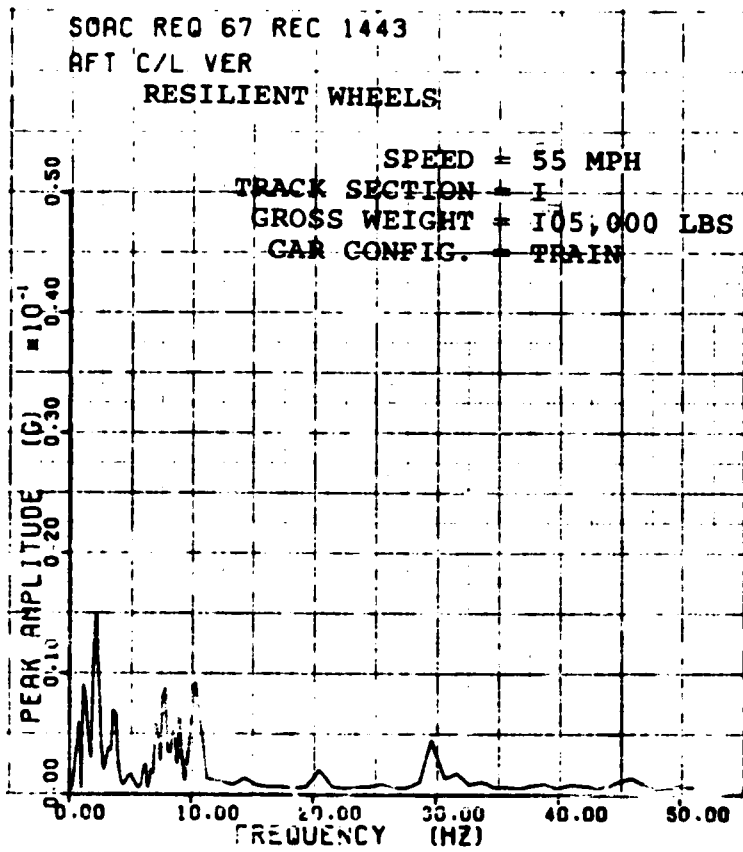


Figure A-159

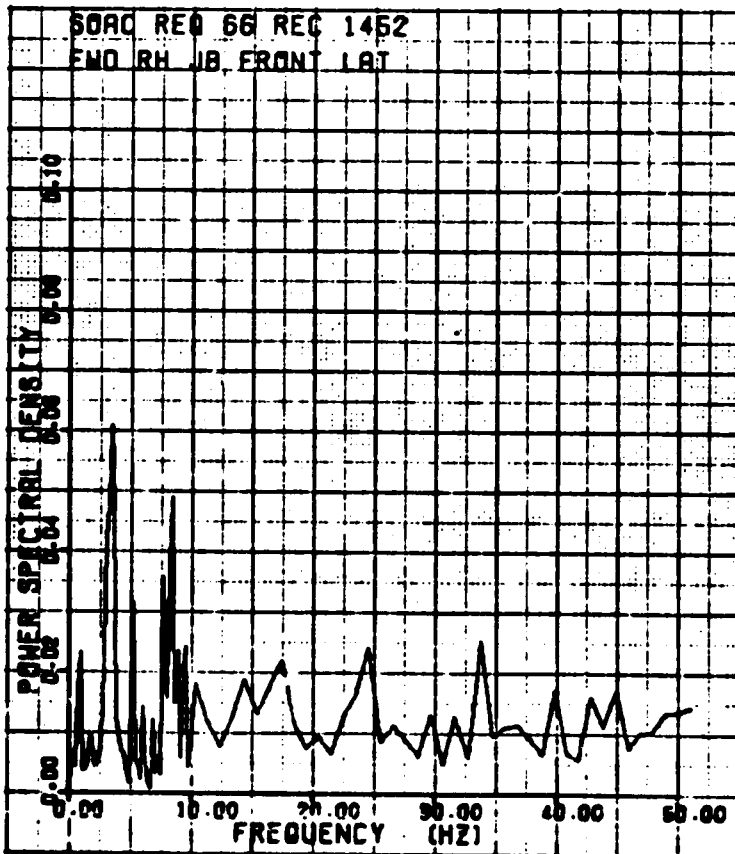
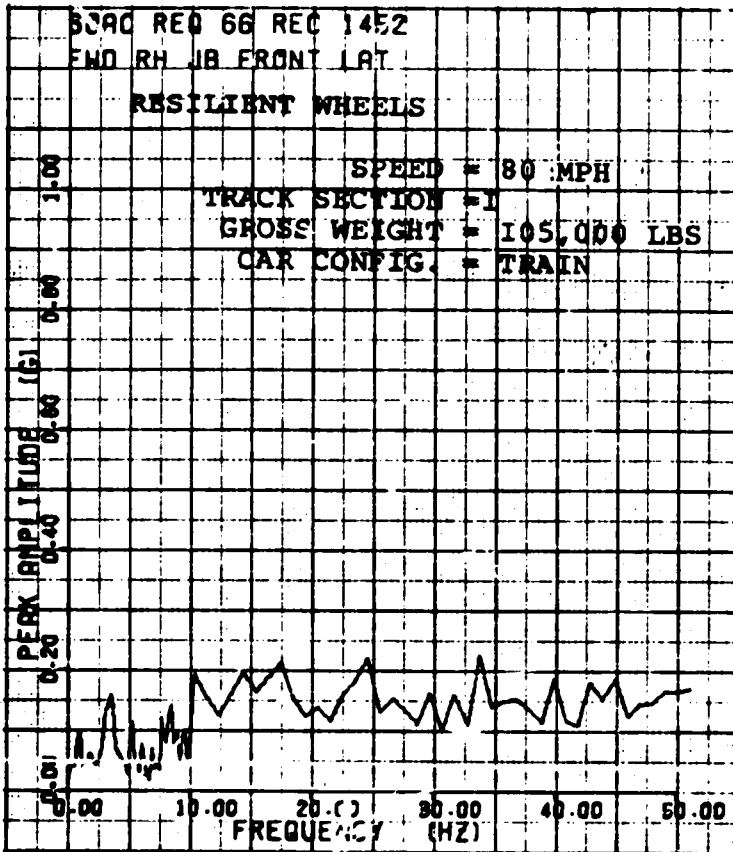


Figure A-160

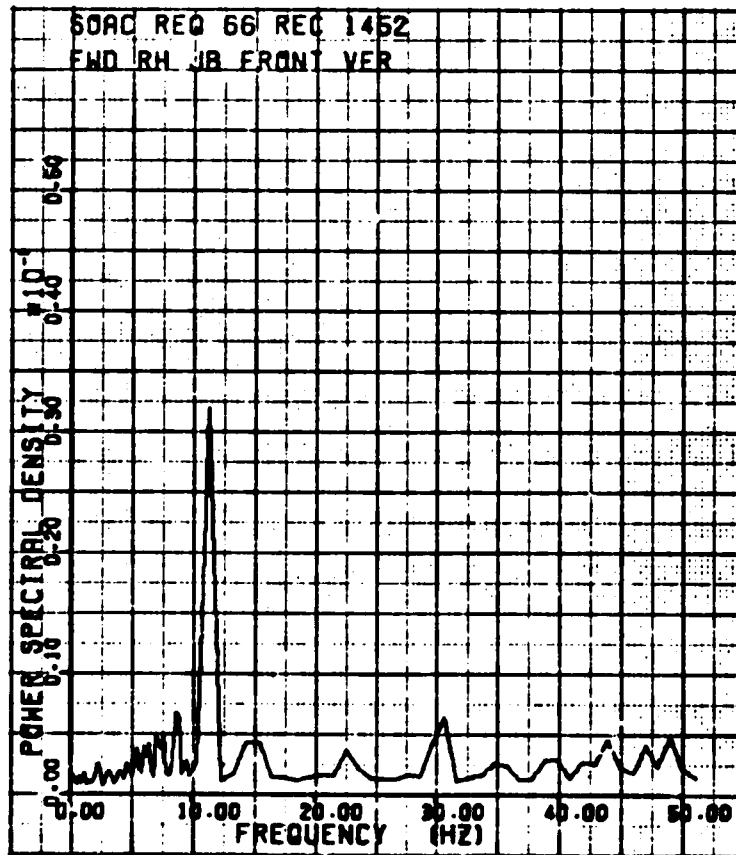
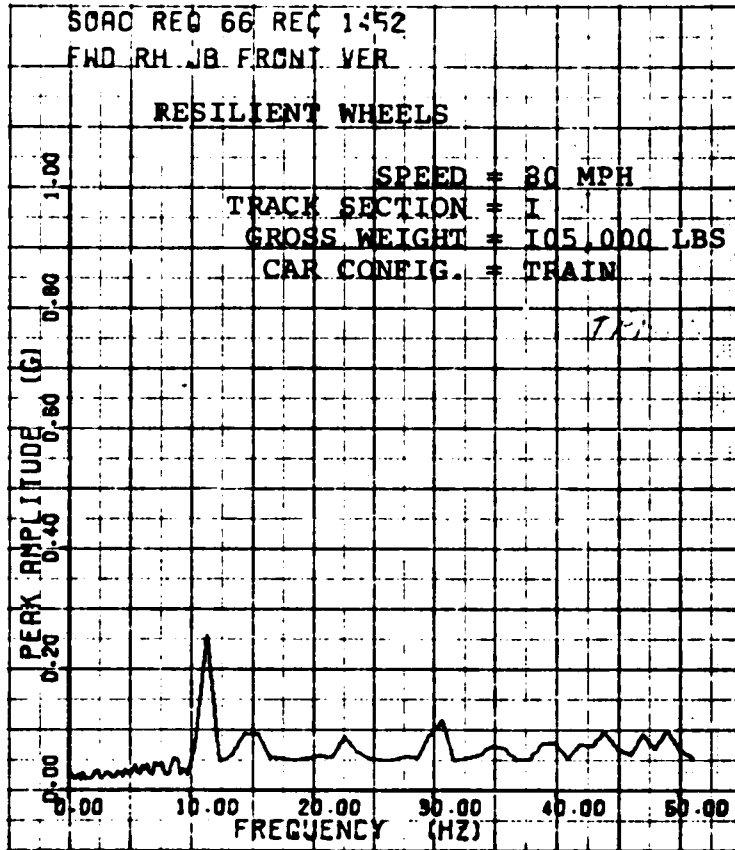
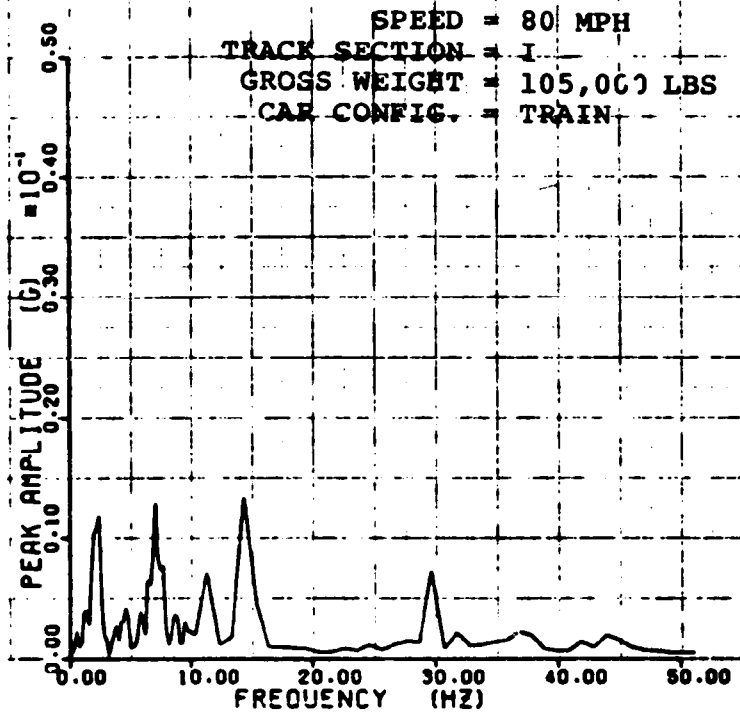


Figure A-161

SOAC REQ 67 REC 1452

MID R/H VER

RESILIENT WHEELS



SOAC REQ 67 REC 1452

MID R/H VER

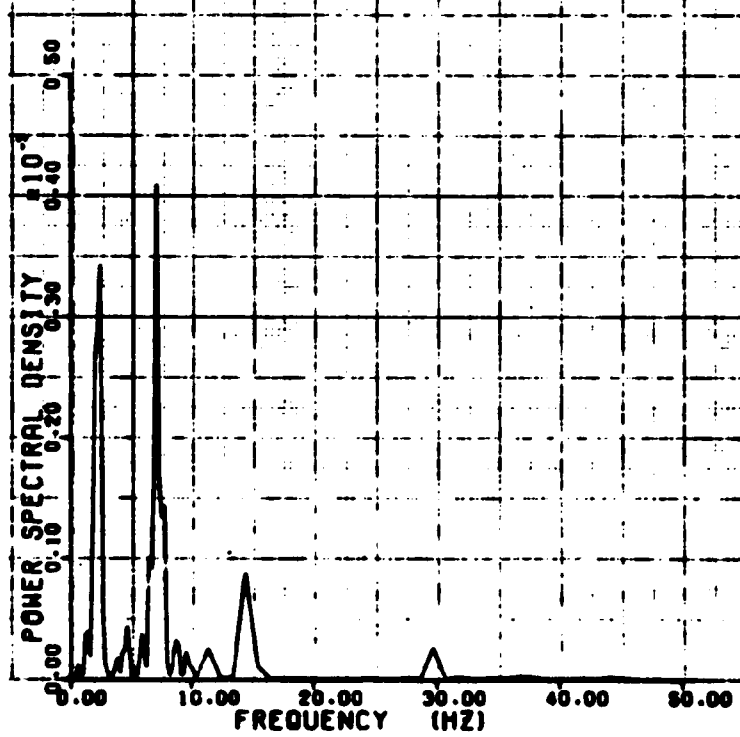


Figure A-162

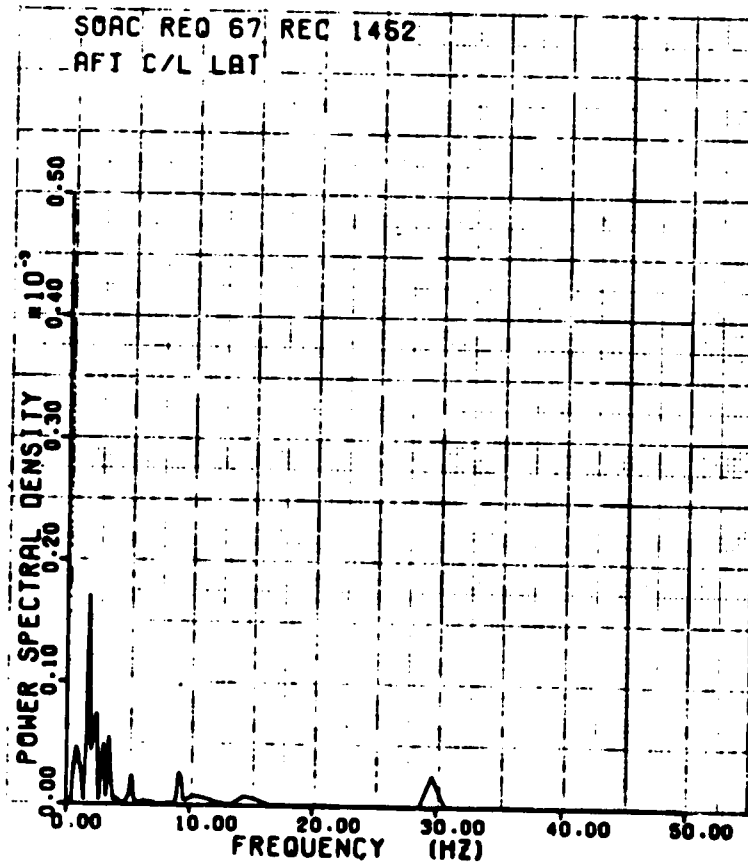
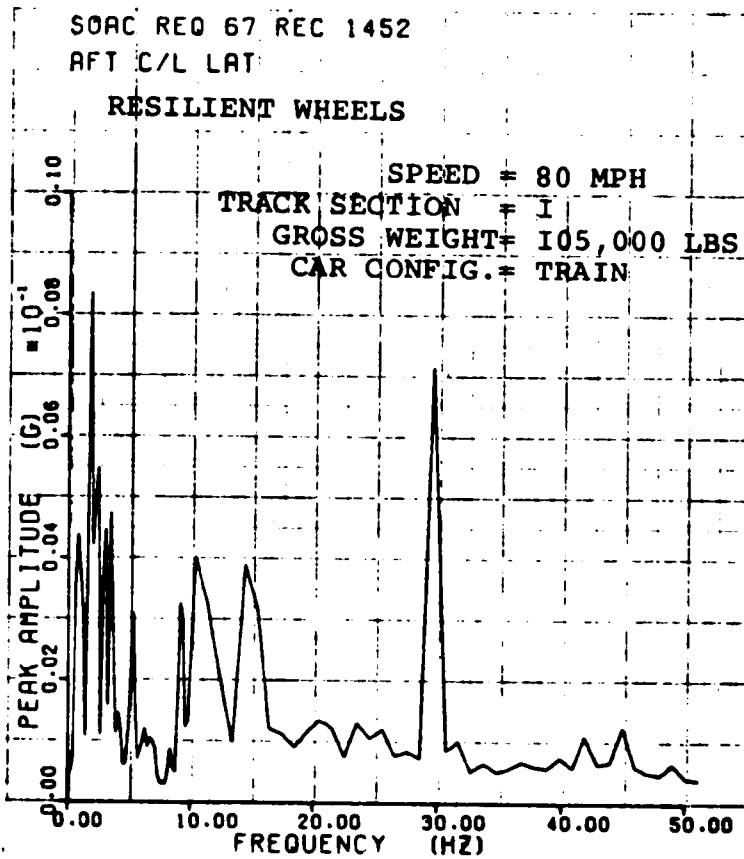
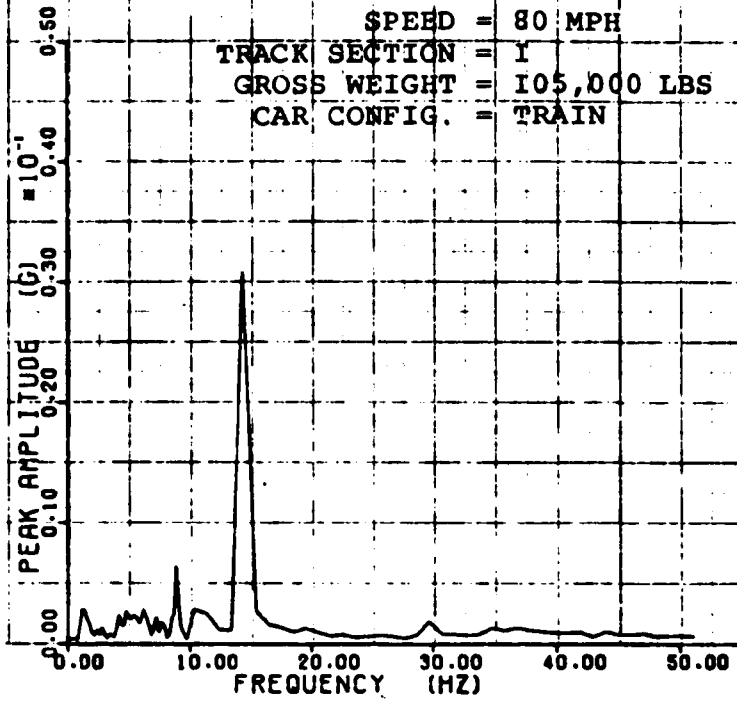


Figure A-163

SOAC REQ 67 REC 1452

FWD C/L LONG

RESILIENT WHEELS



SOAC REQ 67 REC 1452

FWD C/L LONG

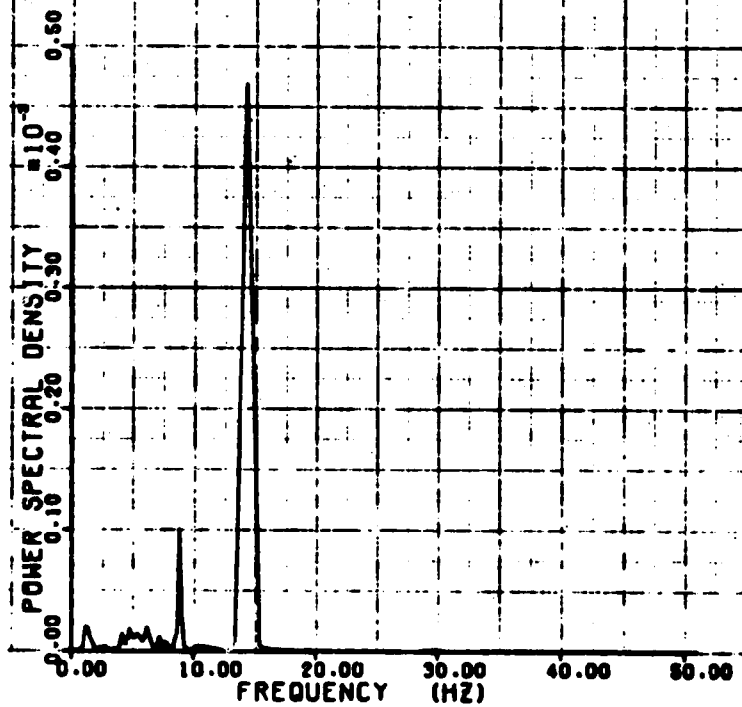


Figure A-164

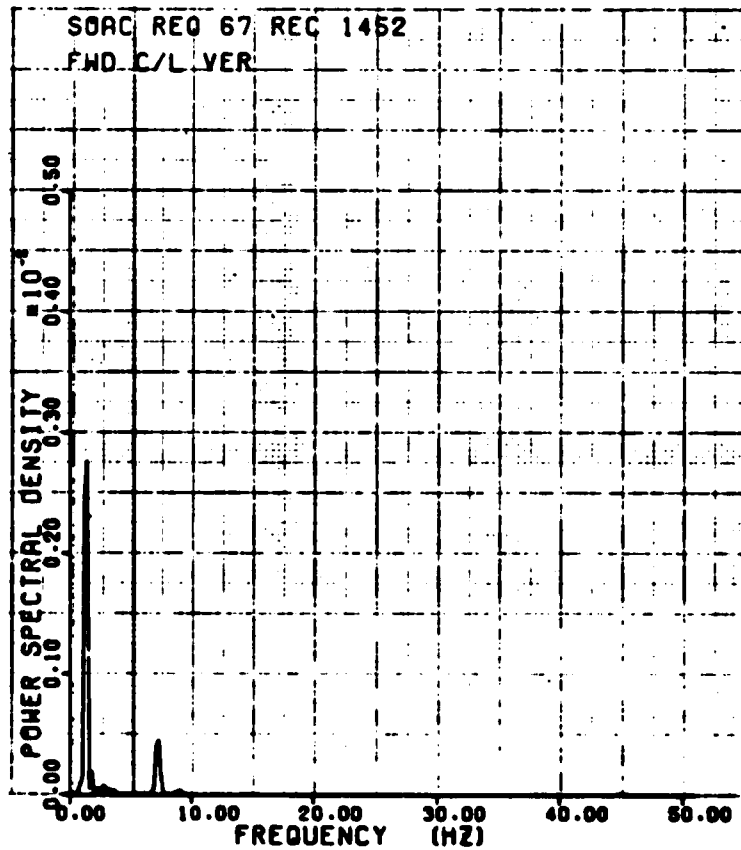
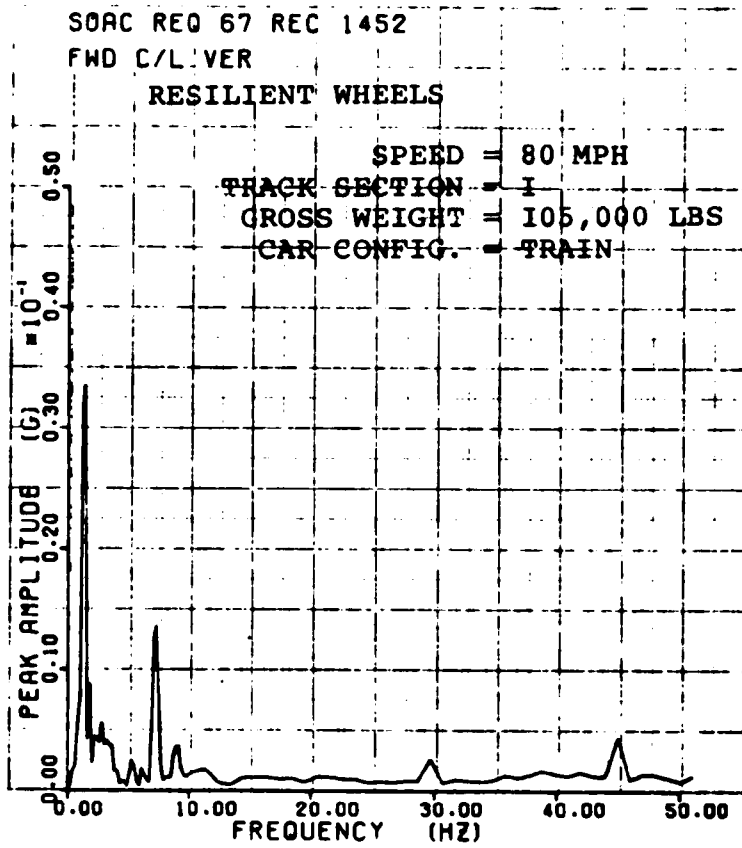


Figure A-165

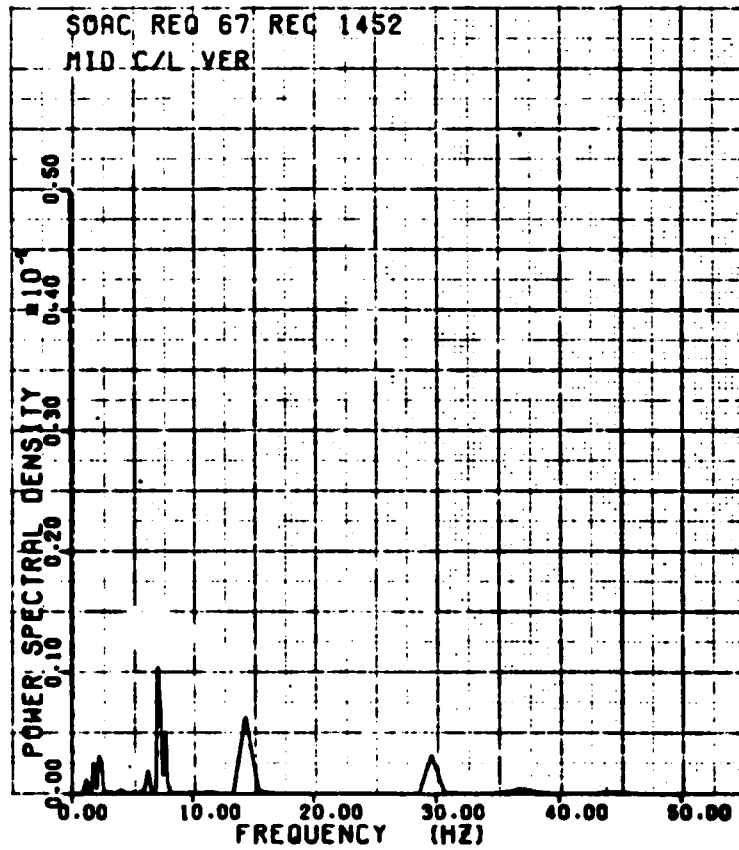
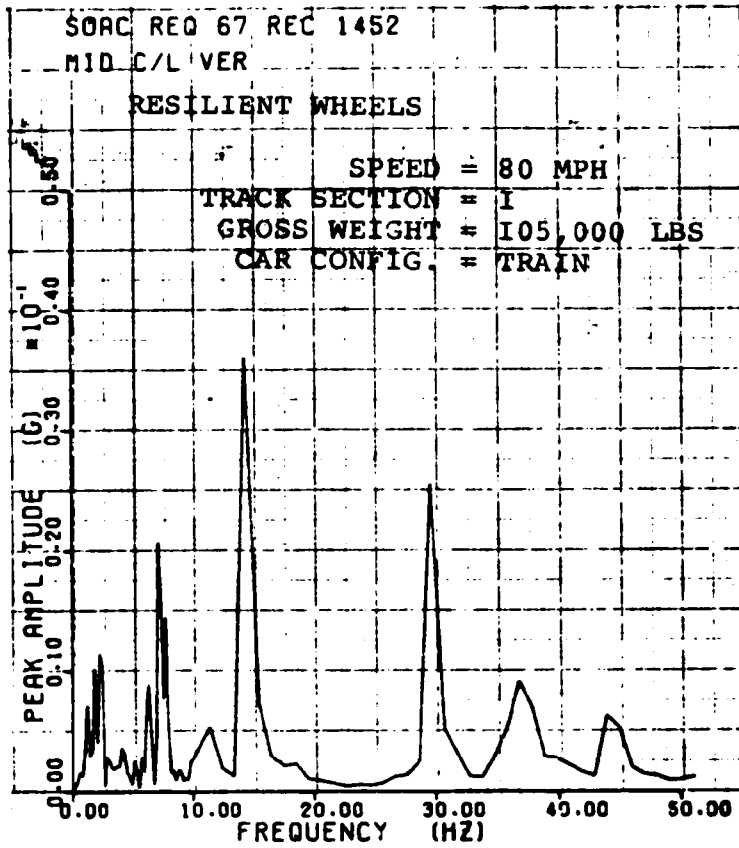


Figure A-166

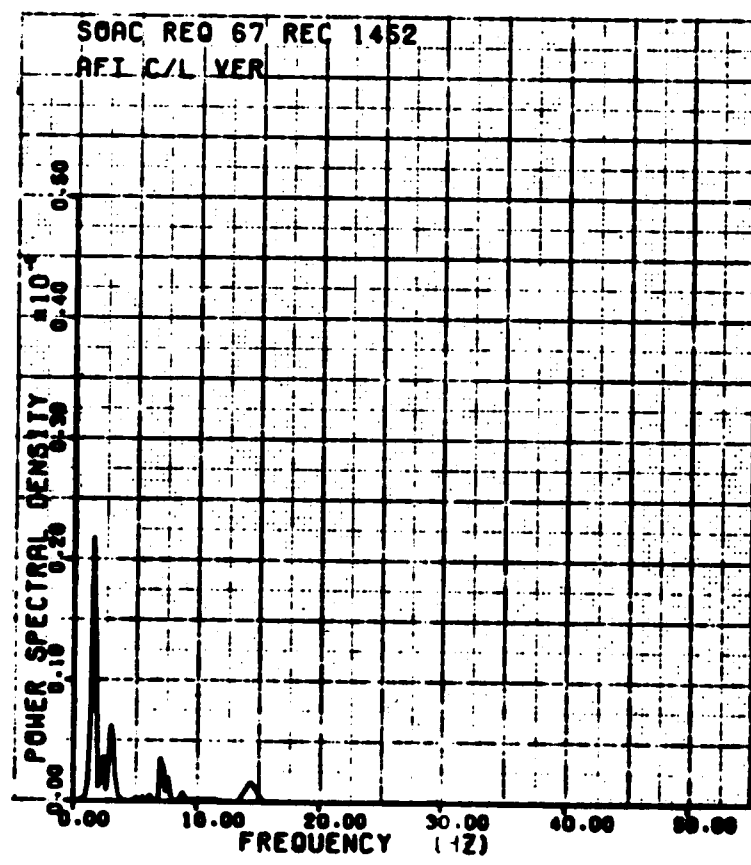
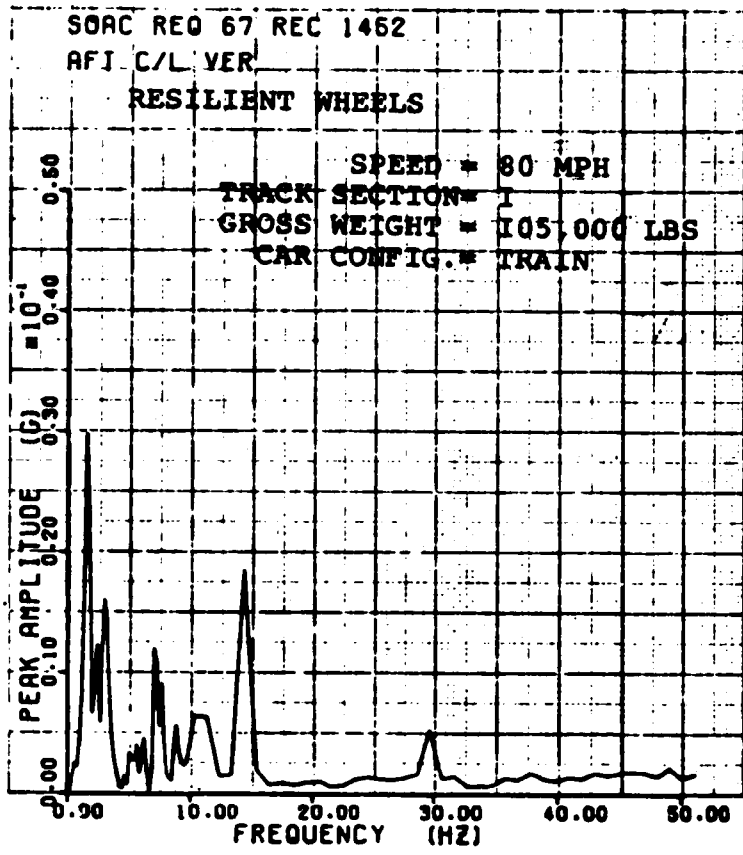


Figure A-167