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COORDINATING RESEARCH COUNCIL INC ATLANTA GA
1980 CRC OCTANE NUMBER REQUIREMENT SURVEY. (U)
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1980 CRC OCTANE NUMBER REQUIREMENT SURVEY

January 1981

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1980 CRC OCTANE NUMBER REQUIREMENT SURVEY

(CRC PROJECT No. CM-123-80)

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Prepared by the

1980 Analysis Panel

of the

CRC-Motor Octane Number Requirement Survey Group

January 1981

CRC-Motor Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

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I. INTRODUCTION

In the 24th annual statistical survey of current model vehicles conducted by the Coordinating Research Council, Inc., test data were obtained on 429 1980 model vehicles including 6 select models of special interest. Maximum octane number requirements under full- and part-throttle operating conditions were determined, and surface ignition knock and rumble, if present, were also reported.

Passenger cars and light-duty trucks including non-commercial vans (1/2 - 3/4 ton without four-wheel drive) were tested according to a weighted distribution. This year's survey includes analyses for the following vehicle categories:

- (1) U.S. and Imported Vehicles -- 429 vehicles;
- (2) U.S. and Imported Cars -- 407 cars.
- (3) U.S. Vehicles -- 344 vehicles.
- (4) U.S. Cars -- 326 cars.
- (5) Imported Vehicles -- 85 vehicles.

It should be noted that the term "cars" designates passenger cars only, while the term "vehicles" includes passenger cars plus vans and light-duty trucks.

The order of testing reference fuels was the same as the 1979 Survey, which is as follows:

Tank Fuel	1st
High Sensitivity Full-Boiling Range Unleaded (FBRSU) Fuels	2nd
Average Sensitivity Full-Boiling Range Unleaded (FBRU) Fuels	3rd
Primary Reference (PR) Fuels	4th

Seventeen laboratories participated in this survey and submitted data on U.S. vehicles; fourteen of these labs also reported data on imported models. Participating laboratories are listed in Appendix A. Members of the CRC-Analysis Panel are identified in Appendix B.

II. SUMMARY

A. Vehicles Tested

Data were collected on 441 1980 model vehicles; however, analysis in this report was based on 429 vehicles. Data for 12 vehicles were excluded because of low odometer mileage. The 429 vehicles included 344 U.S. vehicles

and 85 imported vehicles. There were 326 U.S. passenger cars and 81 imported cars. There were 18 U.S. and 4 imported light-duty trucks and vans. The 1980 Survey included 388 vehicles tested in proportion to estimated production volume, plus 41 additional cars tested to provide larger samples of select models. The vehicles used in this program had an average of 11,253 deposit miles. The production-weighted engine displacement and compression ratio were 3.23 L and 8.40, respectively.

B. Octane Number Requirements

Requirements are expressed as the Research octane number (RON), Motor octane number (MON), and (R+M)/2 octane number of the reference fuel which produced the least audible knock due to either spark or surface ignition, whichever was limiting. Estimated octane number requirements for the U.S. vehicles are weighted in proportion to the 1980 vehicle model production figures and, for the imported models, in proportion to import sales volume in the U.S.

Maximum and part-throttle octane number requirements at the 50% and 90% satisfaction levels for the sample of 1980 U.S. and Imported Vehicles, U.S. and Imported Cars, U.S. Vehicles, U.S. Cars, and Imported Vehicles are given in Table I. A summary of the Research and Motor octane number requirements for FBRU fuels only is shown below:

FBRU Octane Number Requirements

1980 and Changes From 1979

	<u>Research</u> <u>Octane No.</u>		<u>Motor</u> <u>Octane No.</u>	
	<u>50%</u> <u>Sat.</u>	<u>90%</u> <u>Sat.</u>	<u>50%</u> <u>Sat.</u>	<u>90%</u> <u>Sat.</u>
<u>WEIGHTED POPULATION</u>				
<u>Maximum Octane Number Requirements</u>				
All U.S. and Imported Vehicles	90.8	95.1	83.5	86.2
Δ from 1979*	-0.9	-1.9	0.9	-0.2
All U.S. and Imported Cars	90.6	95.1	83.4	86.2
Δ from 1979*	-1.1	-1.8	0.8	-0.2
All U.S. Vehicles	91.4	95.5	83.8	86.4
Δ from 1979*	-0.9	-1.9	0.8	-0.3
All U.S. Cars	91.3	95.5	83.8	86.4
Δ from 1979*	-1.2	-1.9	0.7	-0.3
Imported Vehicles	89.0	92.6	82.3	84.6
Δ from 1979*	0.1	-1.3	1.2	0.5

* The 1980 FBRU fuels over the RON range were 0.3 to 1.4 units lower in sensitivity than the 1979 FBRU fuels.

FBRU Octane Number Requirements

1980 and Changes From 1979

(Continued)

<u>WEIGHTED POPULATION</u>	<u>Research Octane No.</u>		<u>Motor Octane No.</u>	
	<u>50% Sat.</u>	<u>90% Sat.</u>	<u>50% Sat.</u>	<u>90% Sat.</u>
<u>Part-Throttle Octane Number Requirements</u>				
All U.S. and Imported Vehicles	86.4	93.1	80.6	84.9
Δ from 1979*	-1.8	-1.3	-0.2	+0.5
U.S. and Imported Cars	86.4	92.8	80.6	84.7
Δ from 1979*	-1.5	-0.9	0.0	+0.7
U.S. Vehicles	86.5	93.7	80.7	85.3
Δ from 1979*	-2.3	-0.8	-0.3	+0.8
U.S. Cars	86.5	93.5	80.7	85.1
Δ from 1979*	-2.1	-0.7	-0.3	+0.8
Imported Vehicles	85.7	91.6	80.2	83.9
Δ from 1979*	+3.5	-2.3	+3.0	-0.2

Maximum octane requirements for the select models at the 50% and 90% satisfaction levels for PR, FBRU, and FBRSU fuels are shown in Table II, and summarized below for FBRU fuels only.

Select Models

Maximum FBRU Octane Number Requirements

<u>Select Model</u>	<u>No. Tested</u>	<u>Research Octane No.</u>		<u>Motor Octane No.</u>	
		<u>50% Sat.</u>	<u>90% Sat.</u>	<u>50% Sat.</u>	<u>90% Sat.</u>
NC5 225/HC5 225					
IC5 225/LC5 225	24	91.1	95.9	83.6	86.7
NC7 228/HC7 228					
IC7 228/LC7 228	21	86.2	90.5	80.4	83.3
NIJ 244	12	92.1	94.1	84.3	85.5
OCA 242/MCA 242	14	91.9	93.9	84.1	85.4
O V250/M V250	14	92.3	95.4	84.4	86.3
PC 137/KC 137/DC 137	15	93.8	98.2	85.4	88.3

* See footnote, page 2.

C. Maximum Octane Number Requirements at Part-Throttle

Incidence of part-throttle knock with FBRU being equal to or greater than full-throttle knock was about the same in 1980 as it was in 1979. Maximum requirements occurred at part-throttle in 14.5% of all 1980 model vehicles with FBRU fuels, compared with 15.9% in 1979.

D. Tank Fuel Knock Reported by Trained Observer

In the 1980 Survey, 49.9% of the weighted vehicle population was found to knock on tank fuel, compared with 47% in the 1979 Survey. Note that these values reflect a combination of both vehicle octane requirements and the customer's choice of octane quality of the gasoline used in the vehicle.

E. After-Run on Tank Fuel

Out of 404 vehicles tested by trained observers, there were 10 reported incidents of after-run on tank fuel. Note that trained observers' reports are based on a single data point made on the fuel in the test vehicle tank with spark timing at manufacturer's recommended setting. Owners reported a higher percentage of after-run (11.5% vs 2.5%).

F. Surface Ignition and Rumble

There was one car in the 1980 Survey reported with both surface ignition and spark knock; none had rumble.

G. Road Octane Number Depreciation

Road octane number depreciation of FBRU fuels in the range 86 to 100 RON varied from 1.4 to 4.2, compared with 1.2 to 5.5 in the 1979 Survey. Depreciation of FBRSU fuels in the range of 87 to 101 RON varied from 2.7 to 4.9, compared with 2.2 to 6.0 last year.

III. TEST VEHICLES

A total of 429 1980 model vehicles was tested in this year's survey. Non-commercial vans and light-duty trucks (1/2 - 3/4 ton without four-wheel drive) were included as part of the total vehicle population. Of the 429 vehicles tested, there were 326 U.S. and 81 imported cars plus 18 U.S. and 4 imported vans and light-duty trucks. There are an additional 12 vehicles with less than 4000 odometer miles which were not included in the analyses; however, the test data for these cars are listed in Appendix E with observation numbers 800 to 811.

To provide a statistical sample of vehicles on the road, 388 vehicles were tested in proportion to their percentage of total vehicle production, and 41 additional cars were tested to provide a larger sample of each of 6 select models of special interest, all of which had automatic transmissions. Specifications for the select models are shown in Table III.

In the 1980 Survey, 77% of the vehicles were equipped with automatic transmissions, and 70% were equipped with air conditioners. The vehicles used in this program had an average of 11,253 deposit miles. Table IV shows the distribution of odometer mileage for vehicles tested in both the 1980 and 1979 Surveys. The 1980 distribution is also shown as a bar chart in Figure 1. The weighted engine displacement for the 1980 fleet was 3.23 L; the weighted compression ratio was 8.40.

Participants were assigned specific vehicle models in a pattern which minimized data bias due to differences in testing and vehicle sampling. The United States was divided into four geographical areas, and assignments for vehicles of a given model were divided among laboratories within each geographical area. The basic timing was adjusted to the manufacturers' recommended setting prior to test. A total of 100 vehicles was adjusted. Thirty-five vehicles were more than $\pm 2^\circ$ from the manufacturer's specification when received, compared with 67 in the 1979 Survey. Number of vehicles and the degrees advanced or retarded are shown in Table V.

IV. REFERENCE FUELS

Average laboratory octane number ratings and blending data for the FBRU and FBRSU fuels are shown in Tables D-I and D-II of Appendix D. Sensitivities of the 1980 full-boiling range reference fuels are summarized in Table D-III, and a comparison of sensitivities of 1980 and 1979 fuels is shown in Table D-IV. The 1980 FBRU fuels over the RON range were 0.3 to 1.4 octane numbers lower in sensitivity and were 6.3% to 24.8% lower in aromatic content than the 1979 fuels. The FBRSU fuels were 0.8 higher to 0.4 lower in sensitivity. Inspection data furnished by the fuel supplier are shown in Table D-V.

A. Primary Reference (PR) Fuel

Isooctane and normal heptane, meeting ASTM specifications, were blended in two octane number increments from 76 to 82 RON, and in one octane number increments from 82 to 100 RON.

B. Average Sensitivity Full-Boiling Range Unleaded (FBRU) Reference Fuels

FBRU fuels were prepared from three base blends (RMFD-326-80, RMFD-327-80, and RMFD-328-80) in two octane number increments from 78 to 84 RON, and in one octane number increments from 84 to 101 RON.

C. High Sensitivity Full-Boiling Range
Unleaded (FBRSU) Reference Fuels

FBRSU fuels were prepared from three base blends (RMFD-329-80, RMFD-330-80, and RMFD-331-80) in two octane number increments from 78 to 84 RON, and in one octane number increments from 84 to 101 RON.

V. TEST TECHNIQUE

The test technique (CRC Designation E-15-80) specified that octane number requirements be determined at level road acceleration conditions. The order of fuel testing was Tank Fuel, FBRSU, FBRU, and PR fuels. Knocking tendency was investigated at both maximum throttle and part-throttle to determine the most critical condition. The occurrence of other abnormal combustion noise, such as surface ignition knock and rumble, was also reported.

The octane number requirement of a vehicle is defined as the Research or Motor octane number of the highest octane test fuel which produces borderline knock due either to spark or surface ignition, whichever is limiting. The maximum octane number requirement of the vehicle is defined as the highest of these requirements, whether at full- or part-throttle. Maximum octane number requirements were obtained over the speed range with PR fuel only. In addition, maximum part-throttle requirements were determined with FBRU fuels down to the limit of the lowest available fuel.

VI. DISCUSSION OF RESULTS

A. General

Of the 17 participating laboratories, 3 used level roads, 13 used chassis dynamometers, and 1 used both. Weather conditions under which tests were conducted varied considerably among participants. On the average, the barometer was 29.71 in. Hg., ambient temperature was 74°F, and humidity was 70 gr/lb. Test conditions for individual observations are reported in Appendix E.

B. Distribution of Maximum Octane Number Requirements

The octane number requirement data were used to prepare satisfaction curves for the following samples of 1980 model vehicles: (1) U.S. and Imported Vehicles; (2) U.S. and Imported Cars; (3) U.S. Vehicles; (4) U.S. Cars; and (5) Imported Vehicles.

In preparing these curves, the percentages of vehicles satisfied were weighted in accordance with final 1980 U.S. model-year production data and with U.S. sales figures in the case of imports. Each curve should, therefore, provide an estimate of the distribution of octane number requirements of the appropriate vehicle population on the road. The procedure for assigning weighting factors is described in Appendix I.

1. U.S. and Imported Vehicles

In the 1980 Survey, maximum octane number requirements were determined on 429 U.S. and imported vehicles with PR, FBRU, and FBRSU fuels.

Maximum Research octane number requirements for all three reference fuel series are shown in Figures 2a (rectangular coordinates) and 2b (probability plot). Maximum Research, Motor, and (R+M)/2 octane number requirements are listed in Table VI. The 50% and 90% satisfaction level requirements are as follows:

<u>Fuel</u>	<u>Maximum Octane Number Requirements</u>					
	<u>50% Satisfied</u>			<u>90% Satisfied</u>		
	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
PR	89.4	89.4	89.4	92.8	92.8	92.8
FBRU	90.8	83.5	87.2	95.1	86.2	90.6
FBRSU	92.7	82.2	87.5	97.7	85.2	91.4

Comparisons of 1980 and 1979 Survey maximum Research, Motor, and (R+M)/2 octane number requirements are shown in Tables VII, VIII, and IX, respectively, for the three fuel series. Distributions of maximum RON requirements are shown in Figure 3 for PR fuel, Figure 4 for FBRU fuels, and Figure 5 for FBRSU fuels. The differences at the 50% and 90% satisfaction levels are summarized below:

Differences Between 1980 and 1979 Maximum Octane Number Requirements

<u>Fuel</u>	<u>50% Satisfied</u>			<u>90% Satisfied</u>		
	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
PR	0.1	0.1	0.1	-0.2	-0.2	-0.2
FBRU	-0.9	0.9	0.0	-1.9	-0.2	-1.1
FBRSU	0.3	0.2	0.3	-0.1	-0.8	-0.5

Confidence limits for maximum octane number requirement distributions of 1980 U.S. and imported vehicles are given in Appendix G, Table G-1. The 95% confidence limits for Research octane requirements were from ± 0.25 to ± 0.37 at the 50% satisfaction level and from ± 0.34 to ± 0.50 at the 90% satisfaction level.

2. U.S. and Imported Cars

Maximum octane number requirements were determined on 407 U.S. and imported cars with PR, FBRU, and FBRSU fuels.

Maximum Research, Motor, and (R+M)/2 octane number requirements on all three fuel series are given in Table X. Maximum octane number requirements at the 50% and 90% satisfaction levels are summarized below:

Fuel	Maximum Octane Number Requirements					
	50% Satisfied			90% Satisfied		
	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR	89.2	89.2	89.2	92.7	92.7	92.7
FBRU	90.6	83.4	87.0	95.1	86.2	90.6
FBRSU	92.4	82.0	87.2	97.5	85.0	91.3

The maximum Research octane number requirements for 1980 U.S. and imported cars are compared with 1979 model-year data in Table XI for PR, FBRU, and FBRSU fuels; corresponding comparisons of Motor and (R+M)/2 octane number requirements are given in Tables XII and XIII, respectively. Differences between 1980 and 1979 data at the 50% and 90% satisfaction levels are as follows:

Fuel	Differences Between 1980 and 1979 Maximum Octane Number Requirements					
	50% Satisfied			90% Satisfied		
	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR	0.0	0.0	0.0	-0.5	-0.5	-0.5
FBRU	-1.1	0.8	-0.2	-1.8	-0.2	-1.0
FBRSU	-0.2	-0.2	-0.2	-0.2	-0.9	-0.5

Confidence limits for maximum octane number requirement distributions of 1980 U.S. and imported cars are given in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.25 to ± 0.40 at the 50% satisfaction level and from ± 0.34 to ± 0.54 at the 90% satisfaction level.

3. U.S. Vehicles

Maximum octane number requirements were determined on 344 U.S. vehicles with PR, FBRU, and FBRSU fuels.

Distributions of maximum Research octane number requirements are plotted in Figures 6a and 6b for the three fuel series. Research, Motor, and (R+M)/2 octane number requirements for the U.S. vehicles are given in Table XIV. Octane number requirements at the 50% and 90% satisfaction levels are listed below:

<u>Fuel</u>	<u>Maximum Octane Number Requirements</u>					
	<u>50% Satisfied</u>			<u>90% Satisfied</u>		
	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
PR	89.8	89.8	89.8	93.0	93.0	93.0
FBRU	91.4	83.8	87.6	95.5	86.4	90.9
FBRSU	93.4	82.6	88.0	98.1	85.5	91.8

A comparison of octane number requirements of 1980 and 1979 U.S. vehicles for the three fuel series is shown in Tables XV, XVI, and XVII in terms of RON, MON, and (R+M)/2, respectively. Distributions of maximum Research octane number requirements are shown in Figure 7 for PR fuel, in Figure 8 for FBRU fuels, and in Figure 9 for FBRSU fuels. Differences between octane number requirements of 1980 and 1979 U.S. vehicles at the 50% and 90% satisfaction levels are given in the following table:

<u>Fuel</u>	<u>Differences Between 1980 and 1979 Maximum Octane Number Requirements</u>					
	<u>50% Satisfied</u>			<u>90% Satisfied</u>		
	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
PR	0.3	0.3	0.3	-0.3	-0.3	-0.3
FBRU	-0.9	0.8	0.0	-1.9	-0.3	-1.1
FBRSU	0.2	0.1	0.2	0.0	-0.7	-0.4

Confidence limits for maximum octane number requirement distributions of 1980 U.S. vehicles are listed in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.26 to ± 0.39 at the 50% satisfaction level and from ± 0.36 to ± 0.53 at the 90% satisfaction level.

4. U.S. Cars

Maximum octane number requirements were determined on 326 U.S. cars with PR, FBRU, and FBRSU fuels.

Maximum Research, Motor, and (R+M)/2 octane number requirements for all three fuel series are listed in Table XVIII, and summarized below at the 50% and 90% satisfaction levels:

<u>Fuel</u>	<u>Maximum Octane Number Requirements</u>					
	<u>50% Satisfied</u>			<u>90% Satisfied</u>		
	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
PR	89.6	89.6	89.6	93.0	93.0	93.0
FBRU	91.3	83.8	87.5	95.5	86.4	90.9
FBRSU	93.1	82.5	87.8	97.9	85.4	91.6

The maximum Research, Motor, and (R+M)/2 octane number requirements of U.S. cars in the 1980 and 1979 Surveys are compared in Tables XIX, XX, and XXI, respectively, for all three fuel series. The differences at the 50% and 90% satisfaction levels are as follows:

<u>Fuel</u>	<u>Differences Between 1980 and 1979 Maximum Octane Number Requirements</u>					
	<u>50% Satisfied</u>			<u>90% Satisfied</u>		
	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
PR	-0.1	-0.1	-0.1	-0.5	-0.5	-0.5
FBRU	-1.2	0.7	-0.3	-1.9	-0.3	-1.1
FBRSU	-0.4	-0.2	-0.2	-0.4	-1.0	-0.8

Confidence limits for maximum octane number requirement distributions of 1980 U.S. cars are given in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.28 to ± 0.41 at the 50% satisfaction level and from ± 0.37 to ± 0.56 at the 90% satisfaction level.

5. Imported Vehicles

Maximum octane number requirements were determined on 85 imported vehicles with PR, FBRU, and FBRSU fuels.

Maximum Research octane number requirements for all three reference fuel series are shown in Figures 10a and 10b. Maximum octane number requirements for RON, MON, and (R+M)/2 are listed in Table XXII. The 50% and 90% satisfaction level maximum octane requirements are listed below:

Maximum Octane Number Requirements						
Fuel	50% Satisfied			90% Satisfied		
	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR	88.0	88.0	88.0	91.5	91.5	91.5
FBRU	89.0	82.3	85.6	92.6	84.6	88.6
FBRSU	90.8	81.1	86.0	95.0	83.5	89.2

The maximum Research, Motor, and (R+M)/2 octane number requirements of imported vehicles in the 1980 and 1979 Surveys are compared in Tables XXIII, XXIV, and XXV, respectively, for all three fuel series. The differences at the 50% and 90% satisfaction levels are as follows:

Differences Between 1980 and 1979 Maximum Octane Number Requirements						
Fuel	50% Satisfied			90% Satisfied		
	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR	0.5	0.5	0.5	0.0	0.0	0.0
FBRU	0.1	1.2	0.6	-1.3	0.5	-0.4
FBRSU	1.5	1.0	1.3	0.1	-0.2	-0.1

Confidence limits for maximum octane number requirement distributions of 1980 imported vehicles are given in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.61 to ± 0.72 at the 50% satisfaction level and from ± 0.83 to ± 0.97 at the 90% satisfaction level.

6. Select Models

The select model group consisted of a total of six engine-chassis combinations. Five of these were the select models from the program scheduled to be tested. One other model (NIJ 244) had a sufficient number tested in the statistical sample and was included as a select model. The identification and specifications of the engine-chassis combinations are given in Table III.

Maximum Research and Motor octane number requirements for select models are shown for 50% and 90% satisfaction levels on PR, FBRU, and FBRSU fuels in Table II. Maximum octane number requirements for each select model at various satisfaction levels are listed in Appendix H, Table H-I. Maximum Research, Motor, and (R+M)/2 octane number requirements for the individual cars of each select model are given in Table H-II.

Maximum Research octane number satisfaction curves for the six select models are shown in Figures 11 through 16 for all three fuel series. The individual data points plotted on the figures represent the maximum requirements obtained on FBRU reference fuel. Each curve was constructed by use of the "Z" method, which is discussed in Appendix I. The 95% confidence limits for maximum requirements are given in Appendix G, Table G-III.

C. Engine Speed for Maximum and Part-Throttle Octane Number Requirements

Engine speeds where maximum octane number requirements occurred for each select model are shown in Table XXVI for PR, FBRU, and FBRSU fuels. Weighted data for all 1980 U.S. and imported vehicles are shown in Table XXVII and Figure 17 for both maximum and part-throttle octane number requirements. Vehicles tended to knock at higher speeds as the sensitivity of the reference fuel increased. Part-throttle octane requirements occurred at somewhat lower speeds than the maximum throttle requirements.

D. Octane Number Requirements at Part-Throttle

1. Maximum Octane Number Requirements at Part-Throttle

The throttle positions for maximum octane number requirements of tested vehicles were reported as full-throttle and/or part-throttle. The number and percentage of vehicles having FBRU part-throttle octane number requirements equal to or greater than full-throttle requirements are shown in Table XXVIII. The 1979 Survey data are shown for comparison. The percentages of all vehicles having maximum requirements at part-throttle were 15.9% for 1980, compared with 14.6% for 1979.

2. Part-Throttle Octane Number Requirement Distributions on FBRU Fuels

Part-throttle octane number requirements were determined on FBRU fuels at the critical manifold vacuum as defined in the CRC Test Procedure (Appendix C, Attachment 1). Weighted population distributions were developed from these data for the five vehicle categories: (1) U.S. and Imported Vehicles (389 vehicles); (2) U.S.

and Imported Cars (375 cars); (3) U.S. Vehicles (312 vehicles); (4) U.S. Cars (296 cars); (5) Imported Vehicles (77 vehicles). Part-throttle Research, Motor, and (R+M)/2 octane number requirements for each respective category are summarized in Tables XXIX, XXX, XXXI, XXXII, and XXXIII. Distribution of part-throttle Research octane number requirements are presented in Figures 18a and 18b for U.S. and imported vehicles, Figures 19a and 19b for U.S. vehicles, and Figures 20a and 20b for imported vehicles.

Maximum FBRU Research octane number requirements are compared with part-throttle requirements for U.S. and imported vehicles in Table XXXIV and Figure 21. The difference between maximum and part-throttle Research octane number requirements decreased with increasing octane number.

Part-throttle FBRU Research and Motor octane number requirements for the 1980 and 1979 Surveys are compared in Table XXXV for U.S. and imported vehicles, as well as U.S. vehicles only. Distributions of the part-throttle FBRU Research octane number requirements of the 1980 and 1979 U.S. and imported vehicles are shown in Figure 22 and U.S. vehicles only in Figure 23. At the 50% satisfaction level, the requirements of the 1980 U.S. and imported vehicle sample were 1.8 RON and 0.2 MON lower than the 1979 sample; at the 90% satisfaction level, the 1980 models were 1.3 RON lower and 0.5 MON higher than the 1979 models. Requirements for the 1980 U.S. vehicles only were 2.3 RON and 0.3 MON lower than the 1979 U.S. vehicles at the 50% satisfaction level and 0.8 RON lower and 0.8 MON higher at the 90% satisfaction level.

Confidence limits for part-throttle Research and Motor octane number requirement distributions for all five categories of 1980 vehicles are shown in Appendix G, Table G-II. The 95% confidence limits at the 50% and 90% satisfaction levels ranged from ± 0.51 to ± 0.87 for RON and ± 0.33 to ± 0.55 for MON for all cases except imported vehicles, which have much wider confidence ranges.

E. Tank Fuel

As required by the program, tank fuel was tested for incidence of knock whenever an owner's questionnaire was obtained; however, owner's questionnaires were obtained only when the vehicle tested had a regular driver and the ignition timing did not have to be reset. To gain additional information, tank fuel ratings were made by many participants on many other vehicles which did not meet the restrictions listed.

1. Owner-Observer Comparison of Tank Fuel Knock

Owner questionnaires were completed for 218 vehicles which had spark timing set to manufacturers' specifications. Of these vehicles, 51.1% were reported by trained observers to be knocking on tank fuel. Of the same 218 vehicles, 31.2% were reported by the owner to be knocking on tank fuel. This results in an owner versus observer detected knock ratio of 0.61 for 1980. Owner-observer comparison of tank fuel knock data for 1980, along with previous survey data, is presented in Table XXXVI.

2. Objectionable vs. Unobjectionable Knock

Objectionable knock was reported by the owners in 33 of the 218 vehicles tested. Of those owners reporting knock, 48.5% found that knock to be objectionable. This percentage of objectionable knock is much lower than the 60.8% reported in the previous 1979 Survey, as shown in Table XXXVI.

3. Tank Fuel Knock Reported by Trained Observers

Tank fuel knock observations were reported on 374 of the 429 test vehicles. The percentages of all 1980 vehicles and the select models knocking on tank fuel are shown in Table XXXVII. On a weighted basis, 49.9% of the 1980 vehicles knocked on tank fuel compared with 47.3% of the vehicles in the 1979 Survey and 47.2% in the 1978 Survey. It should be noted that these values on percent of all vehicles knocking reflect not only the octane requirements of the vehicles tested, but also the choice of the octane quality of the gasoline purchased by the customer.

4. After-Run on Tank Fuel

After-run was reported by trained observers on 10 of 404 vehicles tested on tank fuel for after-run in 1980. Owner questionnaires were completed for 218 vehicles on after-run. Of these vehicles, there were 25 reports of after-run on tank fuel. The higher percentage of after-run reports from owners is credible, since the trained observers' reports are based on a single data point (one observation) made on the fuel in the test vehicle's tank at the time of the Survey, while owners' reports are based on multiple observations using fuels of various octane quality.

Maximum FBRU octane requirements and tank fuel octane numbers for the vehicles with after-run reported by the owners (spark advance at manufacturers' recommended setting) are shown in Table XXXVIII.

F. Surface Ignition and Rumble

There was 1 car in the 1980 Survey reported with both surface ignition and spark knock; none had rumble. In the 1979 Survey, there were 3 reports of surface ignition.

G. Road Octane Number Depreciation of FBRU and FBRSU Fuels

Road octane number ratings and road octane number depreciation for FBRU and FBRSU fuels were determined from the octane requirement data for all vehicles. The results are shown in Table XXXIX.

In this report, the road octane number rating of FBRU and FBRSU fuels is defined as the primary reference fuel octane level which satisfied the same percentage of vehicles. Depreciation values were established by subtracting the road octane number rating of the fuel from its Research octane number. Depreciation values of FBRU fuels in the range 86 to 100 RON varied from 1.4 to 4.2, compared with 1.2 to 5.5 in the 1979 Survey. Depreciation of FBRSU fuels in the range 87 to 101 RON varied from 2.7 to 4.9, compared with 2.2 to 6.0 in last year's survey.

H. Speed Range Octane Number Requirements

Primary reference fuel octane number requirements at various engine speeds were determined on 337 U.S. and imported vehicles. Results were analyzed on 6 select models. The data are presented in Appendix F.

I. Gear Position for Maximum Requirements

The transmission gear position where maximum octane number requirements were observed with FBRU fuels is shown in Table J-1 of Appendix J. Of the 429 vehicles tested, 66% of the automatic transmission cars had the maximum requirements in the highest gear and 30% in passing gear. Eighty-five percent of the manual transmission cars had maximum requirements in the highest gear and 8% in a lower gear. Overall, 69% had maximum requirements in the highest gear and 25% in passing or lower gear.

T A B L E S
A N D
F I G U R E S

TABLE I
OCTANE NUMBER REQUIREMENTS WITH 95% CONFIDENCE LIMITS

Weighted Population			Research Octane No.		Motor Octane No.	
	Fuel	No. Vehicles	50% Sat.	90% Sat.	50% Sat.	90% Sat.
A. Maximum Octane Number Requirements						
U.S. and Imported Vehicles	PR	429	89.4 ±0.25	92.8 ±0.34	89.4 ±0.25	92.8 ±0.34
	FBRU	429	90.8 ±0.32	95.1 ±0.43	83.5 ±0.20	86.2 ±0.27
	FBRSU	429	92.7 ±0.37	97.7 ±0.50	82.2 ±0.21	85.2 ±0.29
U.S. and Imported Cars	PR	407	89.2 ±0.25	92.7 ±0.34	89.2 ±0.25	92.7 ±0.34
	FBRU	407	90.6 ±0.35	95.1 ±0.47	83.4 ±0.22	86.2 ±0.29
	FBRSU	407	92.4 ±0.40	97.5 ±0.54	82.0 ±0.23	85.0 ±0.31
U.S. Vehicles	PR	344	89.8 ±0.26	93.0 ±0.36	89.8 ±0.26	93.0 ±0.36
	FBRU	344	91.4 ±0.34	95.5 ±0.46	83.8 ±0.22	86.4 ±0.29
	FBRSU	344	93.4 ±0.39	98.1 ±0.53	82.6 ±0.23	85.5 ±0.31
U.S. Cars	PR	326	89.6 ±0.28	93.0 ±0.37	89.6 ±0.28	93.0 ±0.37
	FBRU	326	91.3 ±0.37	95.5 ±0.50	83.8 ±0.23	86.4 ±0.31
	FBRSU	326	93.1 ±0.41	97.9 ±0.56	82.5 ±0.24	85.4 ±0.32
Imported Vehicles	PR	85	88.0 ±0.61	91.5 ±0.83	88.0 ±0.61	91.5 ±0.83
	FBRU	85	89.0 ±0.65	92.6 ±0.88	82.3 ±0.41	84.6 ±0.56
	FBRSU	85	90.8 ±0.72	95.0 ±0.97	81.1 ±0.42	83.5 ±0.57
B. Part-Throttle Octane Number Requirements						
U.S. and Imported Vehicles	FBRU	389	86.4 ±0.53	93.1 ±0.72	80.6 ±0.34	84.9 ±0.46
	FBRU	375	86.4 ±0.51	92.8 ±0.69	80.6 ±0.33	84.7 ±0.44
U.S. Vehicles	FBRU	312	86.5 ±0.65	93.7 ±0.87	80.7 ±0.41	85.3 ±0.55
U.S. Cars	FBRU	296	86.5 ±0.61	93.5 ±0.82	80.7 ±0.39	85.1 ±0.52
Imported Vehicles	FBRU	77	85.7 ±1.14	91.6 ±1.54	80.2 ±0.73	83.9 ±0.99

TABLE II

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

<u>Car Model</u>	<u>No. Tested</u>	<u>PR</u>	<u>Research Octane No.</u>		<u>Motor Octane No.</u>	
			<u>FBRU</u>	<u>FBRSU</u>	<u>FBRU</u>	<u>FBRSU</u>
<u>50% Satisfied</u>						
NC5 225/HC5 225 IC5 225/LC5 225	24	88.6	91.1	93.7	83.6	82.8
NC7 228/HC7 228 IC7 228/LC7 228	21	84.6	86.2	87.2	80.4	79.0
NIJ 244	12	90.3	92.1	92.8	84.3	82.2
OCA 242/MCA 242	14	91.0	91.9	93.1	84.1	82.5
O V250/M V250	14	91.4	92.3	93.0	84.4	82.4
PC 137/KC 137/DC 137	15	92.2	93.8	95.3	85.4	83.8
<u>90% Satisfied</u>						
NC5 225/HC5 225 IC5 225/LC5 225	24	92.3	95.9	98.6	86.7	85.8
NC7 228/HC7 228 IC7 228/LC7 228	21	88.3	90.5	91.6	83.3	81.7
NIJ 244	12	91.6	94.1	94.9	85.5	83.5
OCA 242/MCA 242	14	92.7	93.9	96.1	85.4	84.4
O V250/M V250	14	93.6	95.4	95.7	86.3	83.9
PC 137/KC 137/DC 137	15	95.8	98.2	99.6	88.3	86.5

TABLE III

1980 SELECT MODEL SPECIFICATIONS

<u>Model</u>	<u>Disp. l</u>	<u>Engine Type</u>	<u>Brake Horse- Power</u>	<u>Carb. Bbl.</u>	<u>Comp. Ratio</u>
Chevrolet: Malibu	4.4	V-8	120	2	8.3
Chrysler: Volare/Aspen/Le Baron	3.7	L-6	90	1	8.4
Ford Motor: Fairmont/Zephyr	4.2	V-8	119	2	8.8
Ford Motor: LTD/Marquis	5.0	V-8	130	2VV	8.4
General Motors: "X" Body	2.5	L-4	90	2	8.2
General Motors: "X" Body	2.8	V-6	115	2	8.5

TABLE IV

DISTRIBUTION OF ODOMETER MILEAGE
FOR TESTED VEHICLES

	<u>No. of Vehicles Within Mileage Increments</u>	
	<u>1980 Vehicles</u>	<u>1979 Vehicles</u>
0 - 1,999	0	1
2,000 - 3,999	0	8
4,000 - 5,999	44	48
6,000 - 7,999	86	122
8,000 - 9,999	67	94
10,000 - 11,999	68	74
12,000 - 13,999	56	50
14,000 - 15,999	36	31
16,000 - 17,999	33	29
18,000 - 19,999	21	9
20,000 - 24,999	11	21
25,000 - 25,999	5	3
30,000 +	2	0
No. of Vehicles	429	490
Average Mileage	11,253	10,371

TABLE V

1980 BASIC TIMING ADJUSTMENTS

<u>Degrees</u>	<u>No. of Vehicles</u>	
	+	-
1	12	10
2	28	15
3	6	4
4	7	7
5	2	2
6	2	2
7	0	0
8	0	0
9	0	0
10	0	0
11	1	2
	58	42
Total	100	

TABLE VI

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Vehicles

<u>Percent Satisfied</u>	<u>PR Fuels</u>	<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
		<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
10	84.3	85.6	80.1	82.9	86.8	78.9	82.8
20	86.3	88.0	81.7	84.8	89.6	80.4	85.0
30	87.6	89.1	82.4	85.7	90.7	81.0	85.9
40	88.6	90.0	83.0	86.5	91.7	81.6	86.7
50	89.4	90.8	83.5	87.2	92.7	82.2	87.5
60	90.1	91.7	84.0	87.8	93.7	82.8	88.3
70	90.8	92.6	84.6	88.6	94.8	83.4	89.1
80	91.6	93.7	85.3	89.5	96.1	84.2	90.1
90	92.8	95.1	86.2	90.6	97.7	85.2	91.4
95	93.9	96.1	86.8	91.5	98.9	86.2	92.5
98	95.0	97.5	87.7	92.6	100.0	87.3	93.6
99	95.5	98.8	88.6	93.7	H	H	H

TABLE VII

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	84.3	84.8	-0.5	85.6	86.2	-0.6	86.8	86.9	-0.1
20	86.3	86.6	-0.3	88.0	88.6	-0.6	89.6	89.3	0.3
30	87.6	87.6	0.0	89.1	90.1	-1.0	90.7	90.6	0.1
40	88.6	88.5	0.1	90.0	91.0	-1.0	91.7	91.6	0.1
50	89.4	89.3	0.1	90.8	91.7	-0.9	92.7	92.4	0.3
60	90.1	90.1	0.0	91.7	92.6	-0.9	93.7	93.6	0.1
70	90.8	90.9	-0.1	92.6	93.8	-1.2	94.8	94.9	-0.1
80	91.6	91.7	-0.1	93.7	95.1	-1.4	95.1	96.0	0.1
90	92.8	93.0	-0.2	95.1	97.0	-1.9	97.7	97.8	-0.1
95	93.9	94.3	-0.4	96.1	99.5	-3.4	98.9	100.0	-1.1
98	95.0	96.0	-1.0	97.5	H	-	100.0	H	-
99	95.5	97.2	-1.7	98.8	H	-	H	H	-

TABLE VIII

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

<u>Percent Satisfied</u>	<u>PR Fuels</u>			<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>
10	84.3	84.8	-0.5	80.1	79.7	0.4	78.9	78.0	0.9
20	86.3	86.6	-0.3	81.7	81.0	0.7	80.4	80.2	0.2
30	87.6	87.6	0.0	82.4	81.8	0.6	81.0	80.9	0.1
40	88.6	88.5	0.1	83.0	82.2	0.8	81.6	81.5	0.1
50	89.4	89.3	0.1	83.5	82.6	0.9	82.2	82.0	0.2
60	90.1	90.1	0.0	84.0	83.2	0.8	82.8	82.7	0.1
70	90.8	90.9	-0.1	84.6	84.0	0.6	83.4	83.7	-0.3
80	91.6	91.7	-0.1	85.3	84.9	0.6	84.2	84.4	-0.2
90	92.8	93.0	-0.2	86.2	86.4	-0.2	85.2	86.0	-0.8
95	93.9	94.3	-0.4	86.8	88.4	-1.6	86.2	88.0	-1.8
98	95.0	96.0	-1.0	87.7	H	-	87.3	H	-
99	95.5	97.2	-1.7	88.6	H	-	H	H	-

TABLE IX

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	84.3	84.8	-0.5	82.9	83.0	-0.1	82.8	82.4	0.4
20	86.3	86.6	-0.3	84.8	84.8	0.0	85.0	84.8	0.2
30	87.6	87.6	0.0	85.7	86.0	-0.3	85.9	85.8	0.1
40	88.6	88.5	0.1	86.5	86.6	-0.1	86.7	86.6	0.1
50	89.4	89.3	0.1	87.2	87.2	0.0	87.5	87.2	0.3
60	90.1	90.1	0.0	87.8	87.9	-0.1	88.3	88.2	0.1
70	90.8	90.9	-0.1	88.6	88.9	-0.3	89.1	89.3	-0.2
80	91.6	91.7	-0.1	89.5	90.0	-0.5	90.1	90.2	-0.1
90	92.8	93.0	-0.2	90.6	91.7	-1.1	91.4	91.9	-0.5
95	93.9	94.3	-0.4	91.5	94.0	-2.5	92.5	94.0	-1.5
98	95.0	96.0	-1.0	92.6	H	-	93.6	H	-
99	95.5	97.2	-1.7	93.7	H	-	H	H	-

TABLE X

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Cars

<u>Percent Satisfied</u>	<u>PR Fuels</u>	<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
		<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
10	83.8	85.2	79.8	82.5	86.3	78.6	82.4
20	86.2	87.8	81.6	84.7	89.4	80.3	84.8
30	87.5	89.0	82.3	85.6	90.5	80.9	85.7
40	88.4	89.8	82.9	86.3	91.4	81.5	86.4
50	89.2	90.6	83.4	87.0	92.4	82.0	87.2
60	90.0	91.4	83.9	87.7	93.3	82.6	88.0
70	90.6	92.4	84.4	88.4	94.5	83.2	88.8
80	91.4	93.6	85.2	89.4	96.0	84.1	90.0
90	92.7	95.1	86.2	90.6	97.5	85.0	91.3
95	94.1	96.2	86.8	91.5	98.8	86.2	92.5
98	95.1	97.8	87.9	92.8	100.3	87.5	93.9
99	95.6	99.1	88.9	94.0	H	H	H

TABLE XI

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Cars

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	83.8	84.4	-0.6	85.2	85.8	-0.6	86.3	86.4	-0.1
20	86.2	86.4	-0.2	87.8	88.2	-0.4	89.4	88.9	0.5
30	87.5	87.5	0.0	89.0	89.7	-0.7	90.5	90.4	0.1
40	88.4	88.5	-0.1	89.8	90.8	-1.0	91.4	91.6	-0.2
50	89.2	89.2	0.0	90.6	91.7	-1.1	92.4	92.6	-0.2
60	90.0	89.8	0.2	91.4	92.7	-1.3	93.3	93.6	-0.3
70	90.6	90.6	0.0	92.4	93.7	-1.3	94.5	94.5	0.0
80	91.4	91.6	-0.2	93.6	95.0	-1.4	96.0	95.8	0.2
90	92.7	93.2	-0.5	95.1	96.9	-1.8	97.5	97.7	-0.2
95	94.1	94.5	-0.4	96.2	98.5	-2.3	98.8	99.4	-0.6
98	95.1	96.2	-1.1	97.8	100.6	-2.8	100.3	101.4*	-1.1
99	95.6	97.4	-1.8	99.1	H	-	H	H	-

* Extrapolated

TABLE XII

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Cars

<u>Percent Satisfied</u>	<u>PR Fuels</u>			<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>
10	83.8	84.4	-0.6	79.8	79.4	0.4	78.6	78.2	0.4
20	86.2	86.4	-0.2	81.6	80.8	0.8	80.3	79.9	0.4
30	87.5	87.5	0.0	82.3	81.5	0.8	80.9	80.8	0.1
40	88.4	88.5	-0.1	82.9	82.1	0.8	81.5	81.6	-0.1
50	89.2	89.2	0.0	83.4	82.6	0.8	82.0	82.2	-0.2
60	90.0	89.8	0.2	83.9	83.2	0.7	82.6	82.8	-0.2
70	90.6	90.6	0.0	84.4	84.0	0.4	83.2	83.4	-0.2
80	91.4	91.6	-0.2	85.2	84.8	0.4	84.1	84.3	-0.2
90	92.7	93.2	-0.5	86.2	86.4	-0.2	85.0	85.9	-0.9
95	94.1	94.5	-0.4	86.8	87.6	-0.8	86.2	87.5	-1.3
98	95.1	96.2	-1.1	87.9	89.3	-1.4	87.5	89.1	-1.6
99	95.6	97.4	-1.8	88.9	H	-	H	H	-

TABLE XIII

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Cars

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	83.8	84.4	-0.6	82.5	82.6	-0.1	82.4	82.3	0.1
20	86.2	86.4	-0.2	84.7	84.5	0.2	84.8	84.4	0.4
30	87.5	87.5	0.0	85.6	85.6	0.0	85.7	85.6	0.1
40	88.4	88.5	-0.1	86.3	86.4	-0.1	86.4	86.6	-0.2
50	89.2	89.2	0.0	87.0	87.2	-0.2	87.2	87.4	-0.2
60	90.0	89.8	0.2	87.7	88.0	-0.3	88.0	88.2	-0.2
70	90.6	90.6	0.0	88.4	88.8	-0.4	88.8	89.0	-0.2
80	91.4	91.6	-0.2	89.4	89.9	-0.5	90.0	90.0	0.0
90	92.7	93.2	-0.5	90.6	91.6	-1.0	91.3	91.8	-0.5
95	94.1	94.5	-0.4	91.5	93.0	-1.5	92.5	93.4	-0.9
98	95.1	96.2	-1.1	92.8	95.0	-2.2	93.9	95.2	-1.3
99	95.6	97.4	-1.8	94.0	H	-	H	H	-

TABLE XIV

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. Vehicles

<u>Percent Satisfied</u>	<u>PR Fuels</u>	<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
		<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
10	85.3	86.8	80.9	83.9	88.3	79.8	84.0
20	87.0	88.8	82.2	85.5	90.3	80.8	85.5
30	88.2	89.8	82.8	86.3	91.4	81.4	86.4
40	89.1	90.6	83.4	87.0	92.4	82.0	87.2
50	89.8	91.4	83.8	87.6	93.4	82.6	88.0
60	90.4	92.3	84.4	88.3	94.5	83.2	88.8
70	91.1	93.2	85.0	89.1	95.6	83.9	89.7
80	91.9	94.2	85.6	89.9	96.6	84.5	90.6
90	93.0	95.5	86.4	90.9	98.1	85.5	91.8
95	94.1	96.5	87.0	91.7	99.1	86.4	92.7
98	95.2	98.0	88.1	93.1	100.2	87.4	93.8
99	95.6	99.6	89.3	94.4	H	H	H

TABLE XV

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Vehicles

<u>Percent Satisfied</u>	<u>PR Fuels</u>			<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>
10	85.3	85.6	-0.3	86.8	87.6	-0.8	88.3	88.7	-0.4
20	87.0	87.1	-0.1	88.8	89.5	-0.7	90.3	90.2	0.1
30	88.2	88.0	0.2	89.8	90.5	-0.7	91.4	91.4	0.0
40	89.1	88.8	0.3	90.6	91.4	-0.8	92.4	92.2	0.2
50	89.8	89.5	0.3	91.4	92.3	-0.9	93.4	93.2	0.2
60	90.4	90.2	0.2	92.3	93.2	-0.9	94.5	94.2	0.3
70	91.1	91.0	0.1	93.2	94.2	-1.0	95.6	95.2	0.4
80	91.9	91.9	0.0	94.2	95.6	-1.4	96.6	96.5	0.1
90	93.0	93.3	-0.3	95.5	97.4	-1.9	98.1	98.1	0.0
95	94.1	94.7	-0.6	96.5	98.9	-2.4	99.1	99.6	-0.5
98	95.2	96.4	-1.2	98.0	101.5	-3.5	100.2	102.0*	-1.8
99	95.6	97.6	-2.0	99.6	H	-	H	H	-

* Extrapolated

TABLE XVI

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Vehicles

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	85.3	85.6	-0.3	80.9	80.4	0.5	79.8	79.1	0.7
20	87.0	87.1	-0.1	82.2	81.4	0.8	80.8	80.6	0.2
30	88.2	88.0	0.2	82.8	82.0	0.8	81.4	81.4	0.0
40	89.1	88.8	0.3	83.4	82.5	0.9	82.0	81.9	0.1
50	89.8	89.5	0.3	83.8	83.0	0.8	82.6	82.5	0.1
60	90.4	90.2	0.2	84.4	83.6	0.8	83.2	83.2	0.0
70	91.1	91.0	0.1	85.0	84.3	0.7	83.9	83.9	0.0
80	91.9	91.9	0.0	85.6	85.3	0.3	84.5	84.8	-0.3
90	93.0	93.3	-0.3	86.4	86.7	-0.3	85.5	86.2	-0.7
95	94.1	94.7	-0.6	87.0	87.9	-0.9	86.4	87.7	-1.3
98	95.2	96.4	-1.2	88.1	90.0	-1.9	87.4	89.6*	-2.2
99	95.6	97.6	-2.0	89.3	H	-	H	H	-

* Extrapolated

TABLE XVII

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Vehicles

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	85.3	85.6	-0.3	83.9	84.0	-0.1	84.0	83.9	0.1
20	87.0	87.1	-0.1	85.5	85.4	0.1	85.5	85.4	0.1
30	88.2	88.0	0.2	86.3	86.2	0.1	86.4	86.4	0.0
40	89.1	88.8	0.3	87.0	87.0	0.0	87.2	87.0	0.2
50	89.8	89.5	0.3	87.6	87.6	0.0	88.0	87.8	0.2
60	90.4	90.2	0.2	88.3	88.4	-0.1	88.8	88.7	0.1
70	91.1	91.0	0.1	89.1	89.2	-0.1	89.7	89.6	0.1
80	91.9	91.9	0.0	89.9	90.4	-0.5	90.6	90.6	0.0
90	93.0	93.3	-0.3	90.9	92.0	-1.1	91.8	92.2	-0.4
95	94.1	94.7	-0.6	91.7	93.4	-1.7	92.7	93.6	-0.9
98	95.2	96.4	-1.2	93.1	95.8	-2.7	93.8	95.8	-2.0
99	95.6	97.6	-2.0	94.4	H	-	H	H	-

TABLE XVIII

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. Cars

<u>Percent Satisfied</u>	<u>PR Fuels</u>	<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
		<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
10	85.1	86.5	80.7	83.6	87.8	79.5	83.6
20	86.9	88.8	82.2	85.5	90.2	80.7	85.4
30	88.1	89.7	82.8	86.3	91.2	81.3	86.3
40	89.0	90.5	83.3	86.9	92.2	81.9	87.0
50	89.6	91.3	83.8	87.5	93.1	82.5	87.8
60	90.2	92.1	84.2	88.1	94.2	83.1	88.6
70	90.8	93.1	84.8	89.0	95.3	83.7	89.5
80	91.7	94.2	85.6	89.9	96.5	84.4	90.4
90	93.0	95.5	86.4	90.9	97.9	85.4	91.7
95	94.4	96.6	87.1	91.8	99.1	86.4	92.7
98	95.3	98.3	88.3	93.3	100.6	87.6	94.1
99	95.7	H	H	H	H	H	H

TABLE XIX

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Cars

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	85.1	85.4	-0.3	86.5	87.7	-1.2	87.8	88.4	-0.6
20	86.9	87.0	-0.1	88.8	89.5	-0.7	90.2	90.4	-0.2
30	88.1	88.1	0.0	89.7	90.7	-1.0	91.2	91.5	-0.3
40	89.0	88.9	0.1	90.5	91.6	-1.1	92.2	92.5	-0.3
50	89.6	89.7	-0.1	91.3	92.5	-1.2	93.1	93.5	-0.4
60	90.2	90.4	-0.2	92.1	93.2	-1.1	94.2	94.4	-0.2
70	90.8	91.2	-0.4	93.1	94.5	-1.4	95.3	95.5	-0.2
80	91.7	92.1	-0.4	94.2	95.6	-1.4	96.5	96.7	-0.2
90	93.0	93.5	-0.5	95.5	97.4	-1.9	97.9	98.3	-0.4
95	94.4	94.9	-0.5	96.6	98.8	-2.2	99.1	99.0	0.1
98	95.3	96.6	-1.3	98.3	101.0	-2.7	100.6	H	-
99	95.7	97.8	-2.1	H	H	-	H	H	-

TABLE XX

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Cars

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	85.1	85.4	-0.3	80.7	80.5	0.2	79.5	79.6	-0.1
20	86.9	87.0	-0.1	82.2	81.4	0.8	80.7	80.8	-0.1
30	88.1	88.1	0.0	82.8	82.1	0.7	81.3	81.5	-0.2
40	89.0	88.9	0.1	83.3	82.6	0.7	81.9	82.1	-0.2
50	89.6	89.7	-0.1	83.8	83.1	0.7	82.5	82.7	-0.2
60	90.2	90.4	-0.2	84.2	83.6	0.6	83.1	83.3	-0.2
70	90.8	91.2	-0.4	84.8	84.5	0.3	83.7	84.2	-0.5
80	91.7	92.1	-0.4	85.6	85.3	0.3	84.4	85.0	-0.6
90	93.0	93.5	-0.5	86.4	86.7	-0.3	85.4	86.4	-1.0
95	94.4	94.9	-0.5	87.1	87.8	-0.7	86.4	87.1	-0.7
98	95.3	96.6	-1.3	88.3	89.6	-1.3	87.6	H	-
99	95.7	97.8	-2.1	H	H	-	H	H	-

TABLE XXI

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Cars

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	85.1	85.4	-0.3	83.6	84.1	-0.5	83.6	84.0	-0.4
20	86.9	87.0	-0.1	85.5	85.4	0.1	85.4	85.6	-0.2
30	88.1	88.1	0.0	86.3	86.4	-0.1	86.3	86.5	-0.2
40	89.0	88.9	0.1	86.9	87.1	-0.2	87.0	87.3	-0.3
50	89.6	89.7	-0.1	87.5	87.8	-0.3	87.8	88.0	-0.2
60	90.2	90.4	-0.2	88.1	88.4	-0.3	88.6	88.8	-0.2
70	90.8	91.2	-0.4	89.0	89.5	-0.5	89.5	89.8	-0.3
80	91.7	92.1	-0.4	89.9	90.4	-0.5	90.4	90.8	-0.4
90	93.0	93.5	-0.5	90.9	92.0	-1.1	91.7	92.4	-0.7
95	94.4	94.9	-0.5	91.8	93.3	-1.5	92.7	93.0	-0.3
98	95.3	96.6	-1.3	93.3	95.3	-2.0	94.1	H	-
99	95.7	97.8	-2.1	H	H	-	H	H	-

TABLE XXII

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 Imported Vehicles

<u>Percent Satisfied</u>	<u>PR Fuels</u>	<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
		<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>	<u>(R+M)/2</u>
10	79.4	81.7	77.3	79.5	82.3	75.8	79.0
20	84.5	85.7	80.2	82.9	87.3	79.2	83.3
30	86.1	87.4	81.3	84.4	89.2	80.2	84.7
40	87.3	88.3	81.9	85.1	90.0	80.6	85.3
50	88.0	89.0	82.3	85.6	90.8	81.1	86.0
60	88.8	89.8	82.9	86.4	91.7	81.6	86.7
70	89.7	90.8	83.5	87.2	92.6	82.2	87.4
80	90.5	91.6	84.0	87.8	93.7	82.8	88.3
90	91.5	92.6	84.6	88.6	95.0	83.5	89.2
95	92.8	94.1	85.6	89.8	95.9	84.0	90.0
98	94.2	95.4	86.4	90.9	99.1	86.4	92.8
99	94.8	96.4	86.9	91.7	100.2	87.3	93.8

TABLE XXIII

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 Imported Vehicles

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	79.4	80.3	-0.9	81.7	81.7	0.0	82.3	82.9	-0.6
20	84.5	83.4	1.1	85.7	84.2	1.5	87.3	84.9	2.4
30	86.1	85.4	0.7	87.4	85.6	1.8	89.2	86.0	3.2
40	87.3	86.4	0.9	88.3	87.1	1.2	90.0	88.0	2.0
50	88.0	87.5	0.5	89.0	88.9	0.1	90.8	89.3	1.5
60	88.8	89.2	-0.4	89.8	90.5	-0.7	91.7	90.5	1.2
70	89.7	89.9	-0.2	90.8	91.4	-0.6	92.6	91.6	1.0
80	90.5	90.6	-0.1	91.6	92.4	-0.8	93.7	92.8	0.9
90	91.5	91.5	0.0	92.6	93.9	-1.3	95.0	94.9	0.1
95	92.8	92.0	0.8	94.1	H	-	95.9	H	-
98	94.2	92.5*	1.7	95.4	H	-	99.1	H	-
99	94.8	92.8*	2.0	96.4	H	-	100.2	H	-

*Extrapolated

TABLE XXIV

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 Imported Vehicles

<u>Percent Satisfied</u>	<u>PR Fuels</u>			<u>FBRU Fuels</u>			<u>FBRSU Fuels</u>		
	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>	<u>1980</u>	<u>1979</u>	<u>Δ</u>
10	79.4	80.3	-0.9	77.3	76.8	0.5	75.8	75.8	0.0
20	84.5	83.4	1.1	80.2	78.4	1.8	79.2	77.4	1.8
30	86.1	85.4	0.7	81.3	79.3	2.0	80.2	78.0	2.2
40	87.3	86.4	0.9	81.9	80.1	1.8	80.6	79.3	1.3
50	88.0	87.5	0.5	82.3	81.1	1.2	81.1	80.1	1.0
60	88.8	89.2	-0.4	82.9	82.0	0.9	81.6	80.9	0.7
70	89.7	89.9	-0.2	83.5	82.5	1.0	82.2	81.6	0.6
80	90.5	90.6	-0.1	84.0	83.0	1.0	82.8	82.3	0.5
90	91.5	91.5	0.0	84.6	84.1	0.5	83.5	83.7	-0.2
95	92.8	92.0	0.8	85.6	H	-	84.0	H	-
98	94.2	92.5*	1.7	86.4	H	-	86.4	H	-
99	94.8	92.8*	2.0	86.9	H	-	87.3	H	-

* Extrapolated

TABLE XXV

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 Imported Vehicles

Percent Satisfied	PR Fuels			FBRU Fuels			FBRSU Fuels		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	79.4	80.3	-0.9	79.5	79.2	0.3	79.0	79.4	-0.4
20	84.5	83.4	1.1	82.9	81.3	1.6	83.3	81.2	1.1
30	86.1	85.4	0.7	84.4	82.4	2.0	84.7	82.0	2.7
40	87.3	86.4	0.9	85.1	83.6	1.5	85.3	83.6	1.7
50	88.0	87.5	0.5	85.6	85.0	0.6	86.0	84.7	1.3
60	88.8	89.2	-0.4	86.4	86.2	0.2	86.7	85.7	1.0
70	89.7	89.9	-0.2	87.2	87.0	0.2	87.4	86.6	0.8
80	90.5	90.6	-0.1	87.8	87.7	0.1	88.3	87.6	0.7
90	91.5	91.5	0.0	88.6	89.0	-0.4	89.2	89.3	-0.1
95	92.8	92.0	0.8	89.8	H	-	90.0	H	-
98	94.2	92.5*	1.7	90.9	H	-	92.8	H	-
99	94.8	92.8*	2.0	91.7	H	-	93.8	H	-

* Extrapolated

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

[illegible]

SPEED RANGE	Model:	NC5 225/HC5 225/ IC5 225/LC5 225				NC7 228/HC7 228/ IC7 228/LC7 228				NIJ 244				
		Fuel:		PR	FBRU	FBRSU	PR		FBRU	FBRSU	PR		FBRU	FBRSU
1599 and Lower														
1600 - 1999								14	5		92	75	66	
2000 - 2399			21	17	21		24	24	29	33	8	8	17	
2400 - 2799			58	41	37		62	62	47	53		17	17	
2800 - 3199			17	29	25				19	14				
3200 and Higher			4	13	17									
No. of Cars			24	24	24		21	21	21	21	12	12	12	

SPEED RANGE	Model: OCA 242/MCA 242				0 V250/M V250				PC 137/KC 137/DC 137			
	Fuel:	PR	FBRU	FBRSU	Fuel:	PR	FBRU	FBRSU	Fuel:	PR	FBRU	FBRSU
1599 and Lower		7	14	14		29	28	21		73	60	60
1600 - 1999		79	86	72		57	36	50		27	27	20
2000 - 2399		14		14		14	36	22			13	13
2400 - 2799								7				7
2800 - 3199												
3200 and Higher												
No. of Cars		14	14	14		14	14	14		15	15	15

TABLE XXVII

ENGINE SPEEDS FOR MAXIMUM AND PART-THROTTLE

OCTANE NUMBER REQUIREMENTS

Weighted % of Vehicles Having Requirements
in Indicated (rpm) Ranges

1980 U.S. and Imported Vehicles

<u>Engine Speed Range (rpm)</u>	<u>PR Fuels</u>	<u>FBRU Fuels</u>	<u>FBRSU Fuels</u>
<u>Maximum Octane Number Requirements</u>			
1599 and Lower	14.7	11.5	9.2
1600 - 1999	37.6	30.3	25.4
2000 - 2399	23.8	24.1	21.4
2400 - 2799	14.8	15.3	18.1
2800 - 3199	7.4	11.7	15.8
3200 and Higher	1.7	7.1	10.1
<u>Part-Throttle Octane Number Requirements</u>			
1599 and Lower	-	25.1	-
1600 - 1999	-	36.9	-
2000 - 2399	-	19.9	-
2400 - 2799	-	11.7	-
2800 - 3199	-	2.4	-
3200 and Higher	-	4.0	-

TABLE XXVIII

VEHICLES HAVING FBRU PART-THROTTLE REQUIREMENTS

≥ FULL-THROTTLE REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

	<u>No. Vehicles Tested</u>	<u>No. Vehicles Knocking</u>	<u>% of Vehicles Knocking</u>
1980 U.S. and Imported Vehicles	389	62 (26)*	15.9 (6.7)
1979 U.S. and Imported Vehicles	453	66	14.6

* () indicated greater than full throttle requirement.

TABLE XXIX

PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Vehicles

(389 Vehicles)

<u>Percent Satisfied</u>	<u>Research Octane Number</u>	<u>Motor Octane Number</u>	<u>(R+M)/2 Octane Number</u>
10	<78	-	-
20	80.3	76.2	78.2
30	82.8	78.1	80.5
40	84.9	79.6	82.2
50	86.4	80.6	83.5
60	87.8	81.5	84.6
70	89.4	82.6	86.0
80	90.9	83.5	87.2
90	93.1	84.9	89.0
95	94.7	85.9	90.3

TABLE XXX

PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Cars

(375 Cars)

<u>Percent Satisfied</u>	<u>Research Octane Number</u>	<u>Motor Octane Number</u>	<u>(R+M)/2 Octane Number</u>
10	<78	-	-
20	79.7	75.7	77.7
30	82.4	77.8	80.1
40	84.6	79.4	82.0
50	86.4	80.6	83.5
60	87.8	81.5	84.6
70	89.2	82.5	85.8
80	90.7	83.4	87.0
90	92.8	84.7	88.8
95	94.5	85.8	90.2

TABLE XXXI

PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 U.S. Vehicles

(312 Vehicles)

<u>Percent Satisfied</u>	<u>Research Octane Number</u>	<u>Motor Octane Number</u>	<u>(R+M)/2 Octane Number</u>
10	<78	-	-
20	81.4	77.0	79.2
30	83.8	78.8	81.3
40	85.2	79.8	82.5
50	86.5	80.7	83.6
60	87.8	81.6	84.7
70	89.5	82.7	86.1
80	91.3	83.8	87.5
90	93.7	85.3	89.5
95	95.2	86.2	90.7

TABLE XXXII

PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 U.S. Cars

(296 Cars)

<u>Percent Satisfied</u>	<u>Research Octane Number</u>	<u>Motor Octane Number</u>	<u>(R+M)/2 Octane Number</u>
10	<78	-	-
20	81.3	76.9	79.1
30	83.6	78.6	81.1
40	85.1	79.8	82.4
50	86.5	80.7	83.6
60	87.8	81.6	84.7
70	89.4	82.6	86.0
80	90.9	83.6	87.2
90	93.5	85.1	89.3
95	94.8	86.0	90.4

TABLE XXXIII

PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 Imported Vehicles

(77 Vehicles)

<u>Percent Satisfied</u>	<u>Research Octane Number</u>	<u>Motor Octane Number</u>	<u>(R+M)/2 Octane Number</u>
10	-	-	-
20	<78	-	-
30	79.5	75.6	77.5
40	82.3	77.7	80.0
50	85.7	80.2	83.0
60	87.7	81.5	84.6
70	89.0	82.3	85.6
80	90.3	83.2	86.8
90	91.6	83.9	87.8
95	92.3	84.4	88.4

TABLE XXXIV

COMPARISON OF MAXIMUM WITH PART-THROTTLE

FBRU RESEARCH OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Vehicles

<u>Percent Satisfied</u>	<u>Maximum Octane Number</u> (429 Veh)	<u>Part-Throttle Octane Number</u> (389 Veh)	<u>Δ</u>
10	85.6	<78	-
20	88.0	80.3	7.7
30	89.1	82.8	6.3
40	90.0	84.9	5.1
50	90.8	86.4	4.4
60	91.7	87.8	3.9
70	92.6	89.4	3.2
80	93.7	90.9	2.8
90	95.1	93.1	2.0
95	96.1	94.7	1.4

TABLE XXXV

COMPARISON OF PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

1980 and 1979 U.S. Vehicles

Percent Satisfied	U.S. and Imported Vehicles						U.S. Vehicles					
	RON			MON			RON			MON		
	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	<78	<78	-	-	-	-	<78	78.4	-	-	74.5	-
20	80.3	81.4	-1.1	76.2	76.6	-0.4	81.4	83.2	-1.8	77.0	77.8	-0.8
30	82.8	84.2	-1.4	78.1	78.4	-0.3	83.8	85.6	-1.8	78.8	79.3	-0.5
40	84.9	86.4	-1.5	79.6	79.7	-0.1	85.2	87.2	-2.0	79.8	80.1	-0.3
50	86.4	88.2	-1.8	80.6	80.8	-0.2	86.5	88.8	-2.3	80.7	81.0	-0.3
60	87.8	89.6	-1.8	81.5	81.5	0.0	87.8	90.0	-2.2	81.6	81.7	-0.1
70	89.4	90.8	-1.4	82.6	82.1	0.5	89.5	91.1	-1.6	82.7	82.3	0.4
80	90.9	92.2	-1.3	83.5	82.9	0.6	91.3	92.4	-1.1	83.8	83.0	0.8
90	93.1	94.4	-1.3	84.9	84.4	0.5	93.7	94.5	-0.8	85.3	84.5	0.8
95	94.7	97.6	-2.9	85.9	86.8	-0.9	95.2	96.9	-1.7	86.2	86.4	-0.2

TABLE XXXVI

OWNER-OBSERVER COMPARISON OF TANK FUEL KNOCK

(1973-1980 CRC Octane Number Requirement Surveys)

Fuel:	1980	1979		1978		1977		1976		1975		1974		1973	
	Unleaded	Unleaded**	Unleaded**	Unleaded**	Unleaded**	Unleaded**	Unleaded**	Unleaded	Unleaded	Unleaded	Unleaded	Mixed*	Mixed*	Mixed*	Mixed*
(No. of Reports)	(218)	(196)	(105)	(225)	(200)	(216)	(238)								
<u>% Knocking</u>															
Trained Observer	51.1	52.6	50.5	54.7	63.8	89.4	24.7	16							
Owner	31.2	26.0	32.4	29.3	40.5	21.8	11.2	10							
<u>% Owners Objecting</u>															
Based on Total Reports	15.1	15.8	15.2	10.2	20.0	9.7	4.1	4							
Based on Those Reporting Knock	48.5	60.8	46.9	34.8	49.4	44.5	36.6	40							
Owner-Observer Ratio	0.61	0.49	0.64	0.54	0.63	0.24	0.45	0.59							

* Mixed: Premium, regular, and subregular grades.

** Some vehicles were designed for leaded fuels.

TABLE XXXVII

TANK FUEL KNOCK REPORTED BY TRAINED OBSERVERS

I. 1980 Select Models

<u>Model</u>	<u>No. in Survey</u>	<u>Cars Tested on Tank Fuel</u>		
		<u>No. Tested*</u>	<u>No. Knocking</u>	<u>% Knocking</u>
NC5 225/HC5 225/ IC5 225/LC5 225	24	23	15	65.2
NC7 228/HC7 228/ IC7 228/LC7 228	21	20	1	5.0
NIJ 244	12	11	10	90.9
OCA 242/MCA 242	14	11	7	63.6
O V250/M V250	14	11	7	63.6
PC 137/KC 137/DC 137	15	15	10	66.7

II. All Vehicles

			<u>% Knocking (Weighted Population)</u>
1980	429	374	49.9
1979	490	414	47.3
1978	434	338	47.2
1977	478	457	44.2

* Tank fuel tests were optional when owner questionnaires were not obtained.

TABLE XXXVIII

1980 VEHICLES REPORTED TO AFTER-RUN ON TANK FUEL

	<u>Total Observations</u>		<u>Both Owner/Rater Data No Spark Adjustment</u>	
	<u>Owner</u>	<u>Rater</u>	<u>Owner</u>	<u>Rater</u>
Vehicles Tested	218	404	180	180
After-Run Reported	25	10	20	3

AFTER-RUN REPORTED BY OWNER

(Vehicle Received with Spark at Manufacturer's Recommended Setting)

<u>Obs. No.</u>	<u>Vehicle Code</u>	<u>FBRU Maximum RON Requirement</u>	<u>Tank Fuel</u>	
			<u>RON</u>	<u>MON</u>
282	KL 217M	94.0*	91.2	83.3
106	KC 137	96.0	94.3	83.7
297	NC5 225	98.0	92.2	82.1
60	LC7 228	87.0	91.0	83.4
64	LC5 225	93.0	94.8	83.8
65	LC5 225M	95.0	94.5	83.7
286	LC7 228	86.0	95.1	85.1
32	LIA 238	90.0	91.4	83.5
253	MCA 133	89.0	94.4	84.4
254	MW V258	92.0	92.0	83.3
120	NLV 225M	92.0	93.1	83.4
78	NC7 228	87.0	93.0	83.0
387	NC5 225	98.0*	93.6	84.5
61	OCA 223	94.5	90.9	83.4
242	OI 250	94.0	92.0	ND
112	PL 217	93.0	94.8	84.6
81	PL 217M	89.0	93.3	84.0
268	SW V258S	94.0	91.5	83.0
68	W 216M	91.0*	94.2	84.7
293	Z 214M	88.0	92.6	84.2

* = Part-throttle

ND = No data reported

TABLE XXXIX

ROAD OCTANE DEPRECIATION OF 1980 FBRU AND FBRSU FUELS

1980 U.S. and Imported Vehicles

RON	FBRU Fuels				FBRSU Fuels			
	% Satisfied	Sensi-tivity	Road Octane Rating	Depre-ciation	% Satisfied	Sensi-tivity	Road Octane Rating	Depre-ciation
84	6.2	5.1	82.2	1.8	4.9	7.0	81.1	2.9
85	8.3	5.3	83.4	1.6	6.1	7.3	82.1	2.9
86	11.1	5.6	84.6	1.4	8.4	7.6	83.5	2.5
87	14.5	6.0	85.4	1.6	10.5	8.0	84.3	2.7
88	20.1	6.3	86.2	1.8	12.5	8.4	85.0	3.0
89	28.9	6.7	87.5	1.5	16.0	8.9	85.7	3.3
90	40.3	7.0	88.6	1.4	23.5	9.4	86.8	3.2
91	51.7	7.4	89.5	1.5	33.0	9.8	88.0	3.0
92	64.0	7.8	90.4	1.6	42.8	10.2	88.9	3.1
93	73.9	8.2	91.1	1.9	53.1	10.6	89.6	3.4
94	82.0	8.5	91.9	2.1	62.7	11.0	90.3	3.7
95	89.5	8.9	92.9	2.1	71.2	11.5	90.9	4.1
96	94.5	9.3	93.8	2.2	79.0	11.9	91.6	4.4
97	97.3	9.7	94.7	2.3	86.9	12.3	92.5	4.5
98	98.5	9.9	95.3	2.7	91.3	12.6	93.1	4.9
99	99.1	10.2	95.6	3.4	95.5	12.7	94.1	4.9
100	99.4	10.4	95.8	4.2	98.0	12.7	95.1	4.9
101	-	-	-	-	98.8	13.1	95.4	4.6

FIGURE 1
DISTRIBUTION OF ODOMETER MILEAGE
FOR 1980 MODEL VEHICLES TESTED

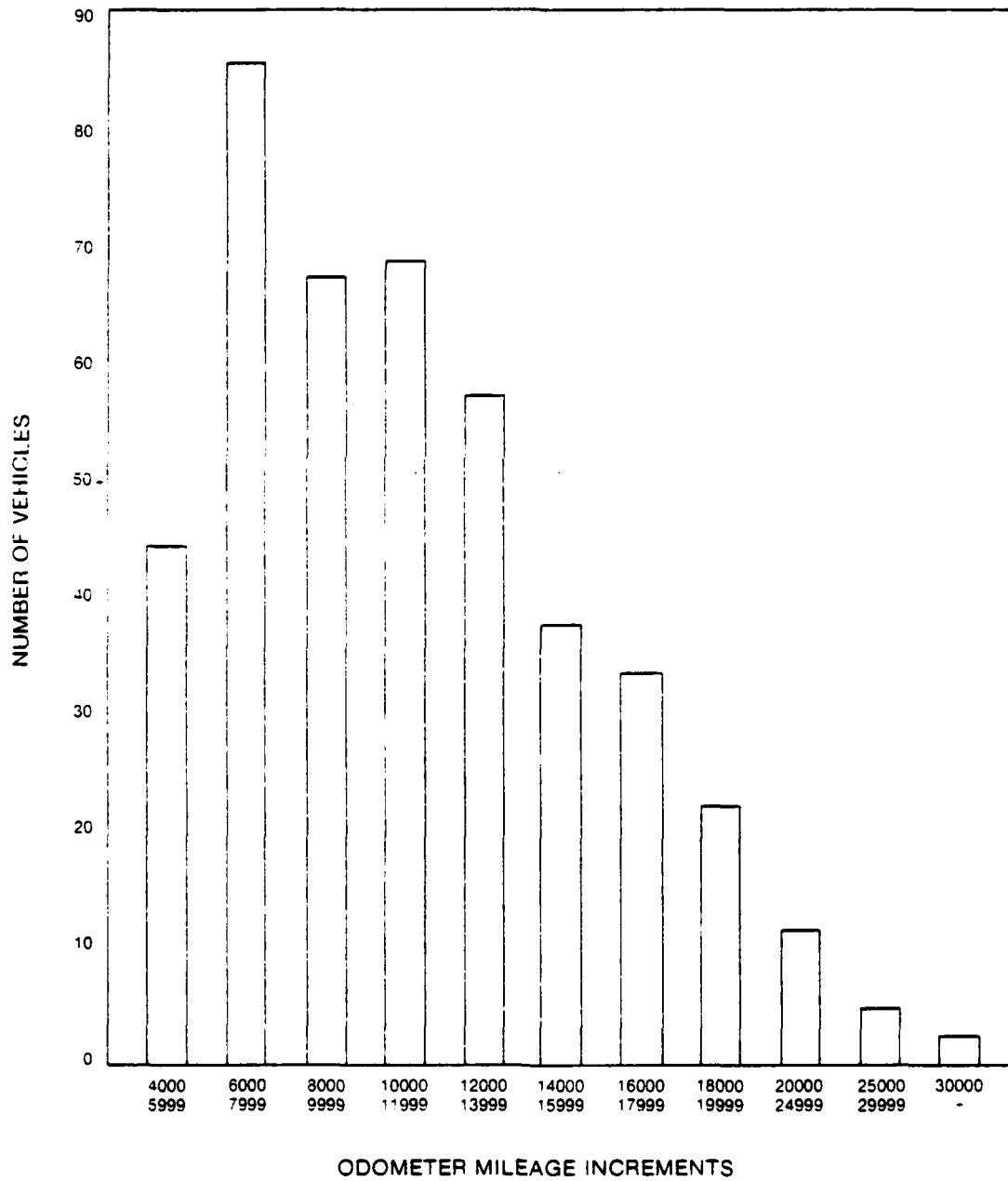


FIGURE 2a

DISTRIBUTION OF
MAXIMUM RON REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES

—————	PR FUEL	429 VEHICLES
- - - - -	FBRU FUEL	429 VEHICLES
- . - . -	FBRSU FUEL	429 VEHICLES

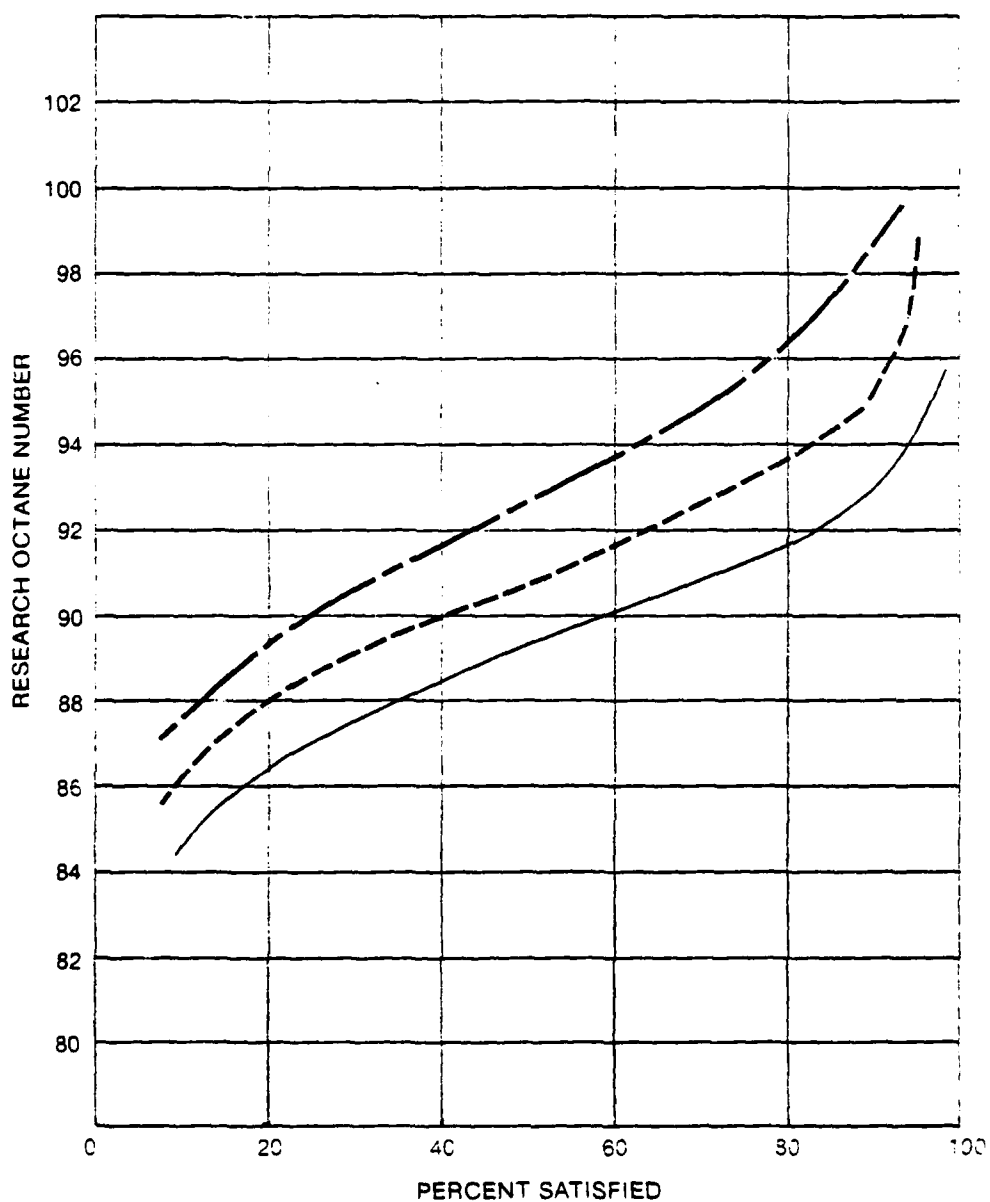


FIGURE 2b
DISTRIBUTION OF MAXIMUM RON REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES

— PR FUEL 429 VEHICLES
- - - FBRU FUEL 429 VEHICLES
- - - FBRSU FUEL 429 VEHICLES

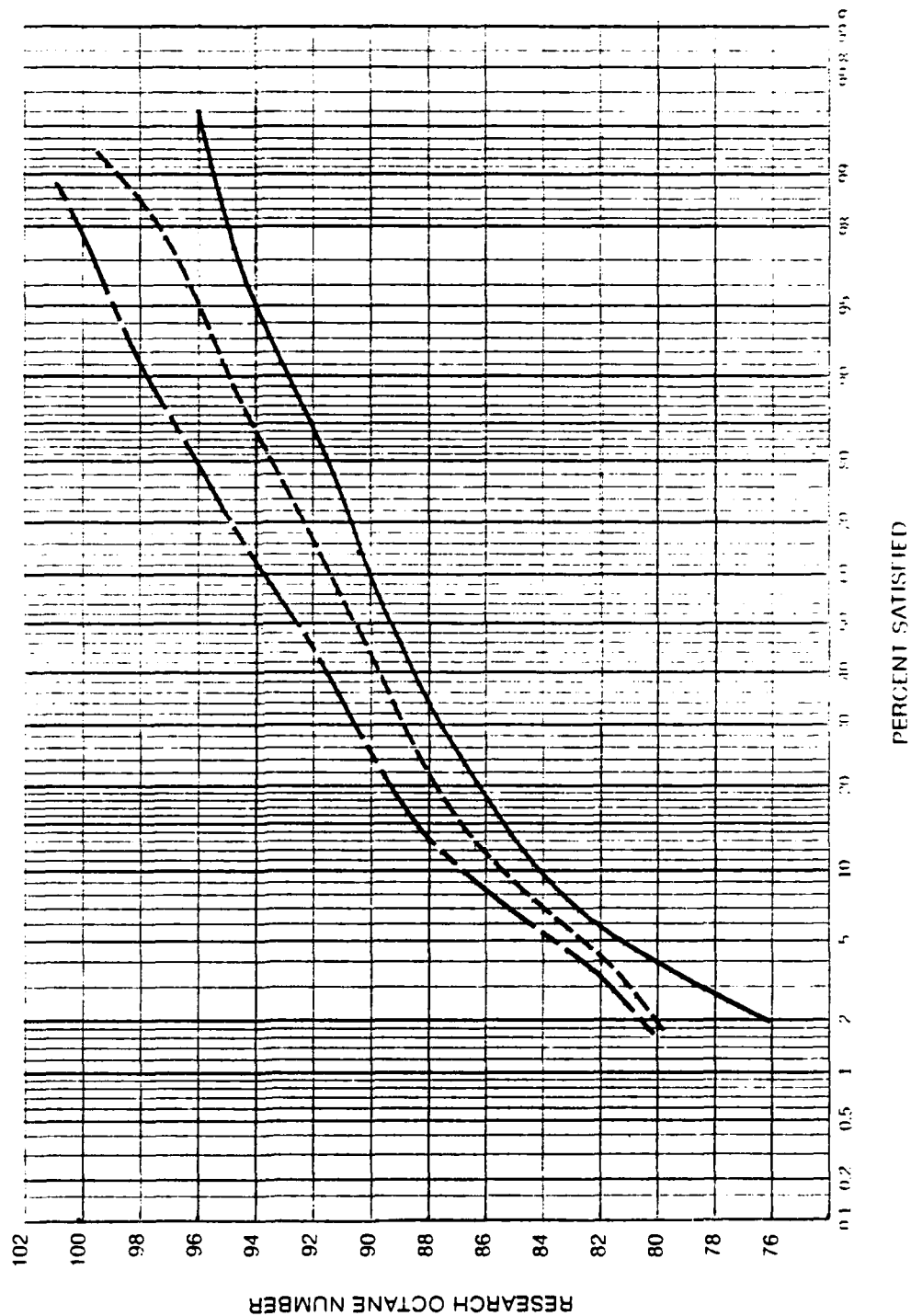


FIGURE 3
COMPARISON OF
MAXIMUM PR FUEL REQUIREMENTS
1980 AND 1979 U.S. AND IMPORTED VEHICLES

———— 1980 SURVEY: 429 VEHICLES
----- 1979 SURVEY: 478 VEHICLES

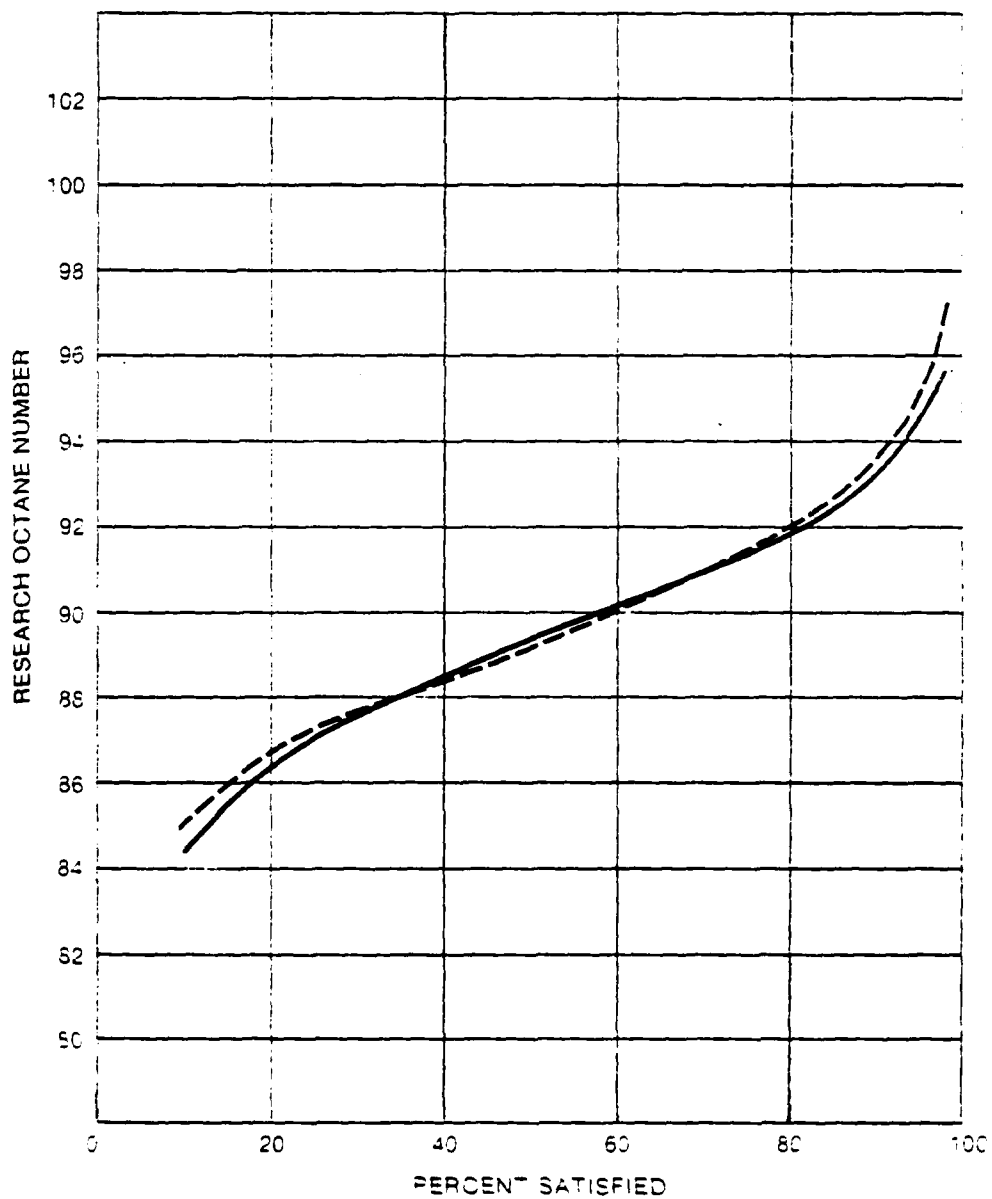


FIGURE 4
COMPARISON OF
MAXIMUM FBRU FUEL RON REQUIREMENTS
1980 AND 1979 U.S. AND IMPORTED VEHICLES

———— 1980 SURVEY 429 VEHICLES
----- 1979 SURVEY 490 VEHICLES

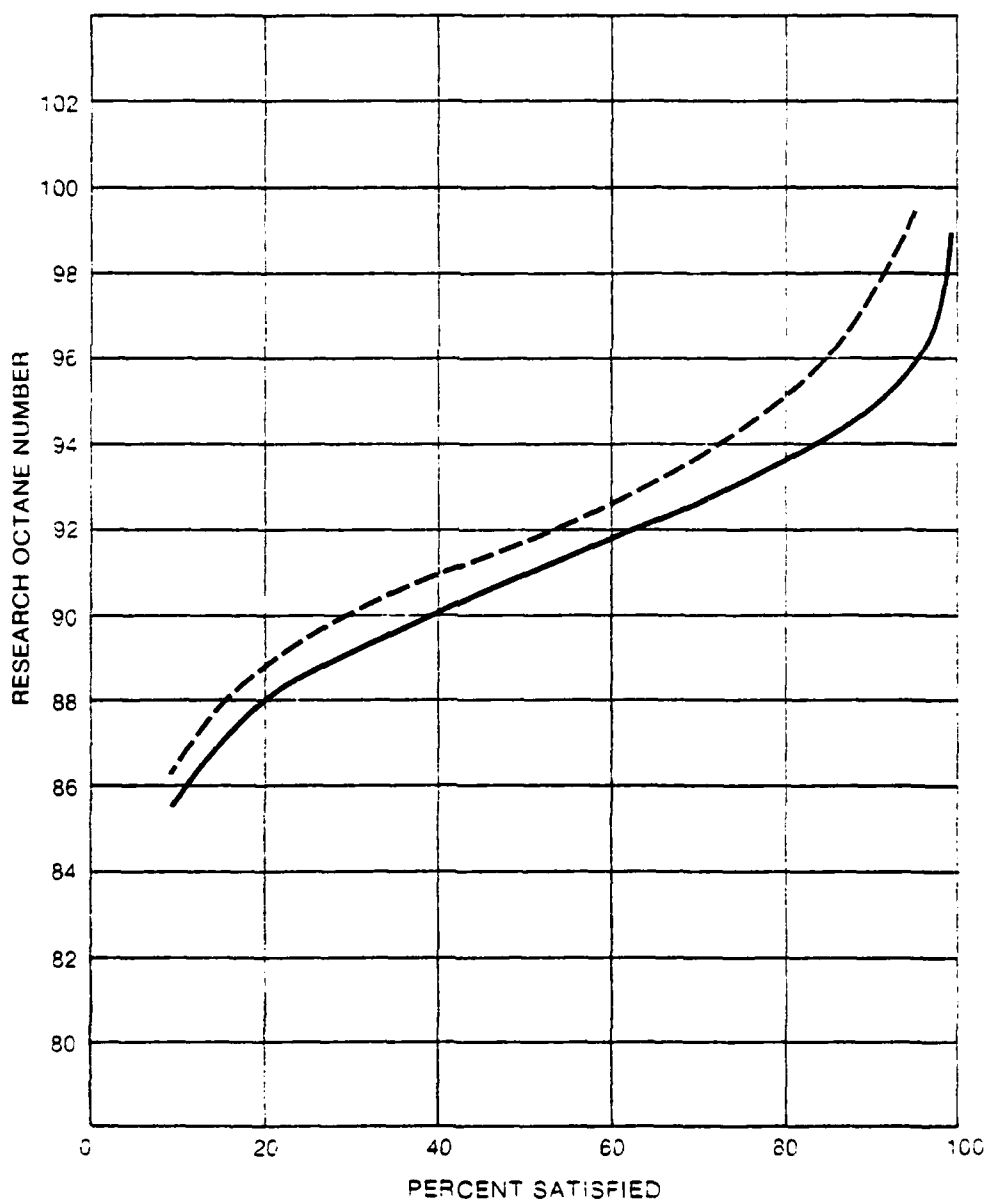


FIGURE 5
COMPARISON OF
MAXIMUM FBRSU FUEL RON REQUIREMENTS
1980 AND 1979 U.S. AND IMPORTED VEHICLES

———— 1980 SURVEY: 429 VEHICLES
----- 1979 SURVEY: 478 VEHICLES

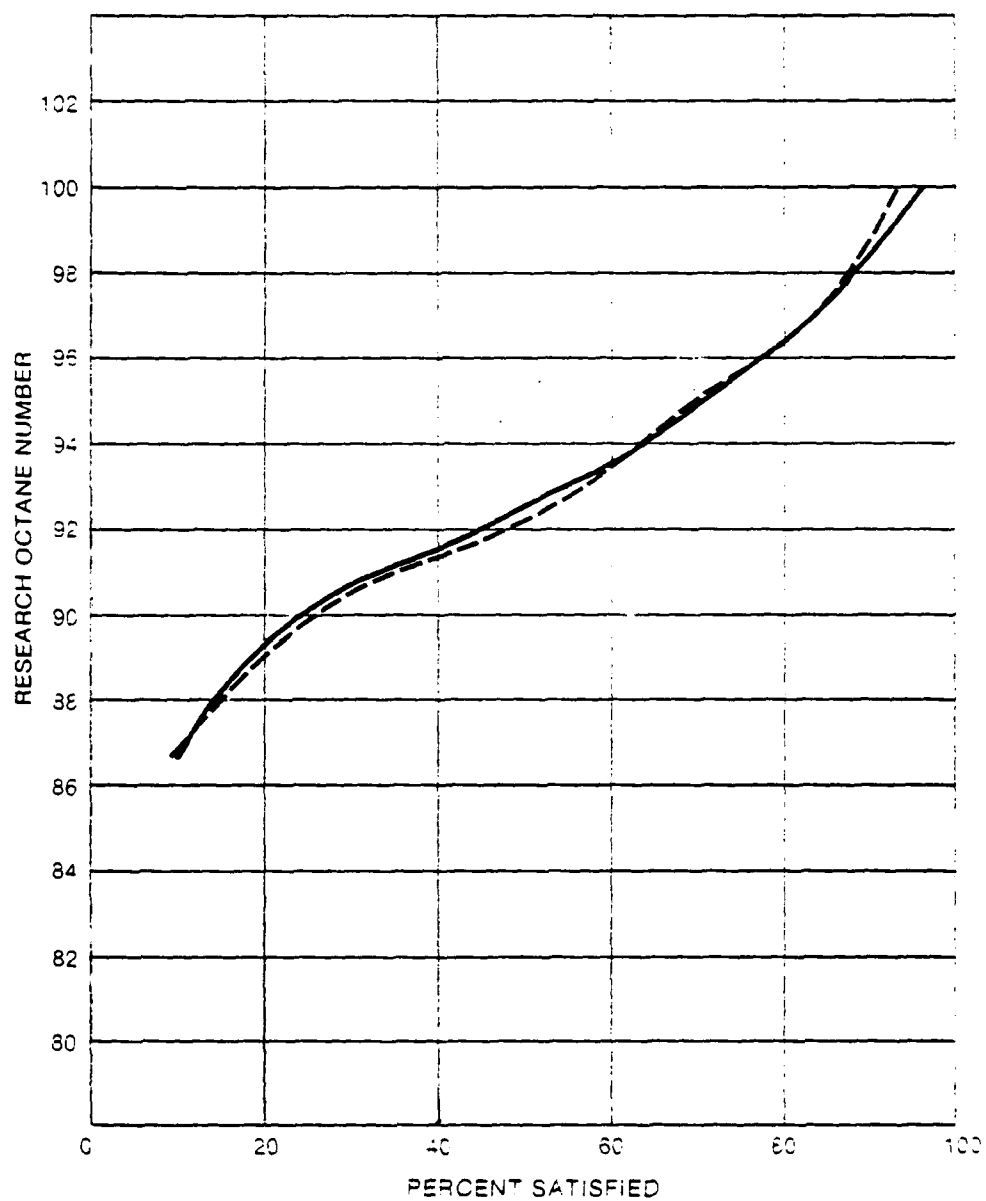


FIGURE 6a
DISTRIBUTION OF
MAXIMUM RON REQUIREMENTS
1980 U.S. VEHICLES

—————	PR FUEL	344 VEHICLES
- - - - -	FBRU FUEL	344 VEHICLES
· · · · ·	FBRSU FUEL	344 VEHICLES

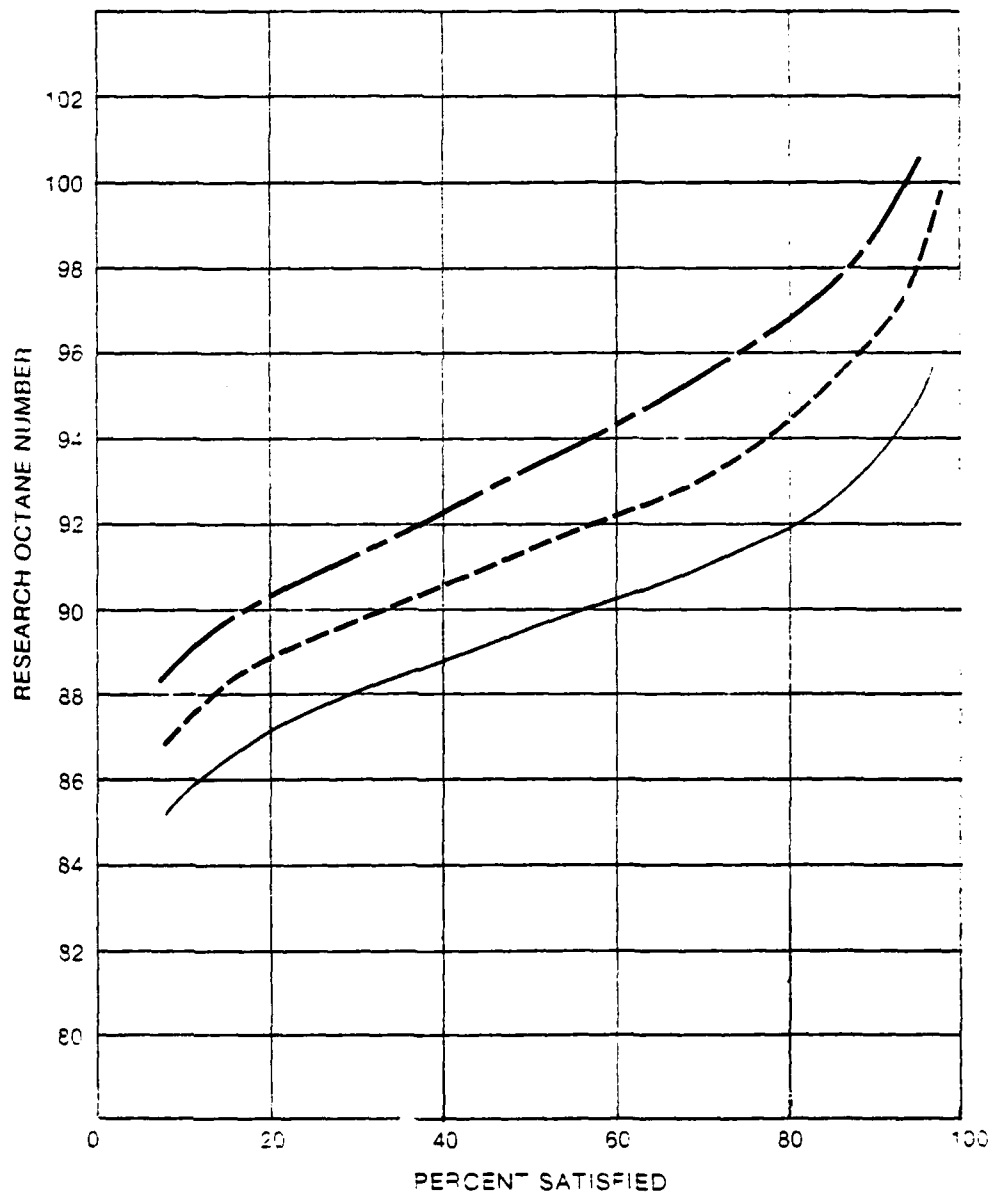


FIGURE 6b

DISTRIBUTION OF MAXIMUM RON REQUIREMENTS

1980 U.S. VEHICLES

—— PR FUEL 344 VEHICLES
----- FBRU FUEL 344 VEHICLES
- - - - FBRSU FUEL 344 VEHICLES

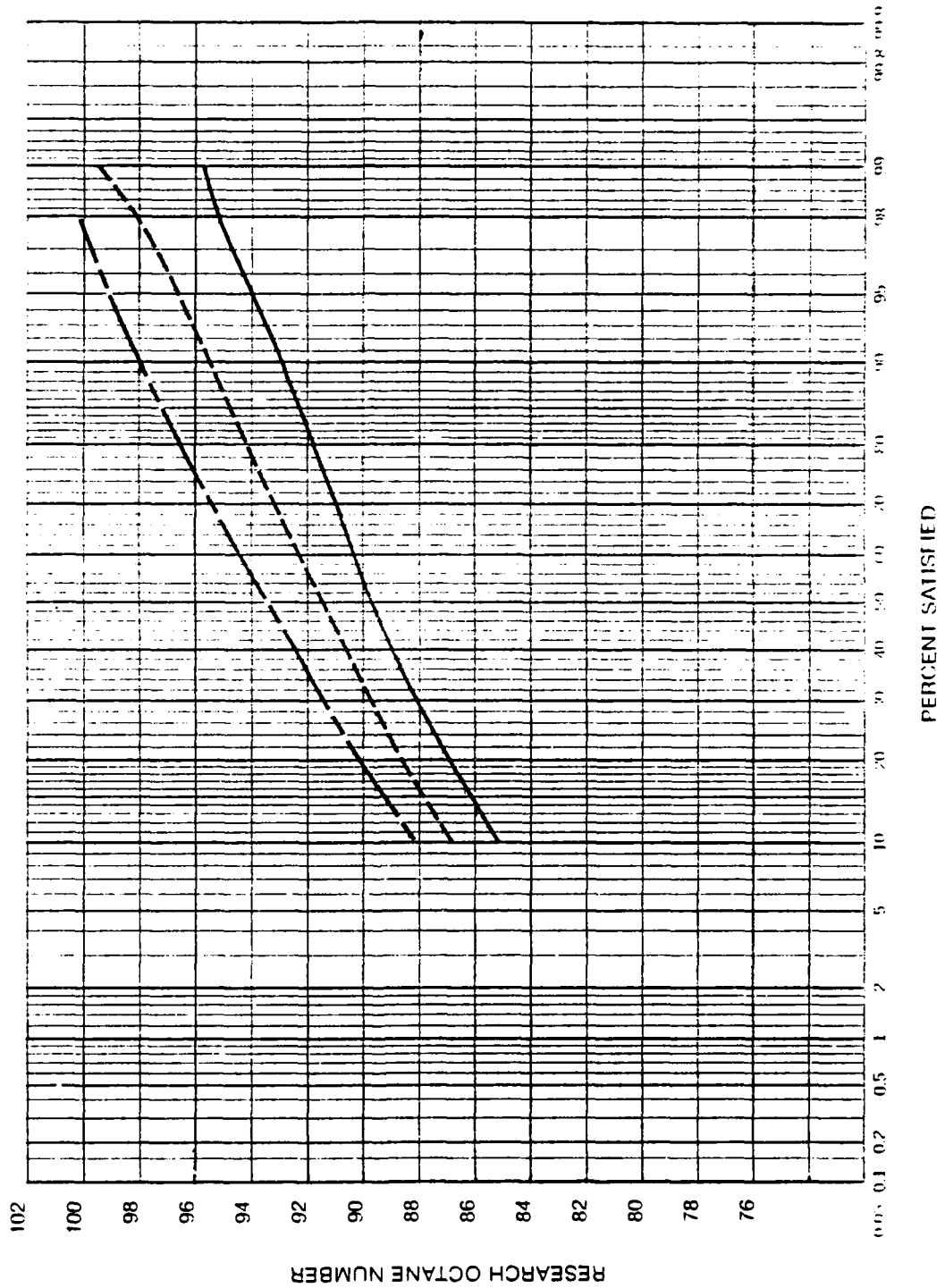


FIGURE 7
COMPARISON OF
MAXIMUM PR FUEL REQUIREMENTS
1980 AND 1979 U.S. VEHICLES

———— 1980 SURVEY 344 VEHICLES
----- 1979 SURVEY 423 VEHICLES

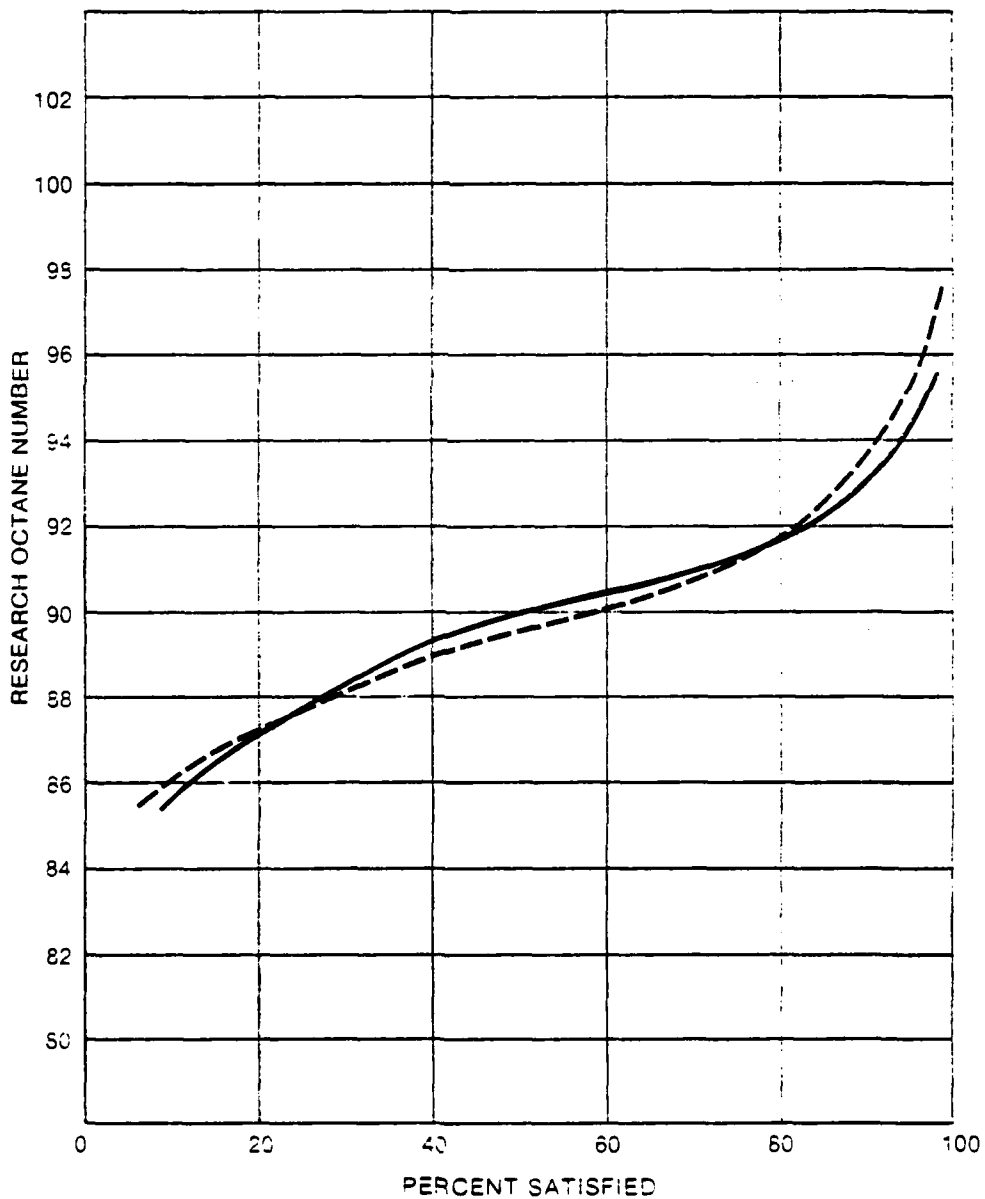


FIGURE 8
COMPARISON OF
MAXIMUM FBRU FUEL REQUIREMENTS
1980 AND 1979 U.S. VEHICLES

————— 1980 SURVEY 344 VEHICLES
----- 1979 SURVEY 435 VEHICLES

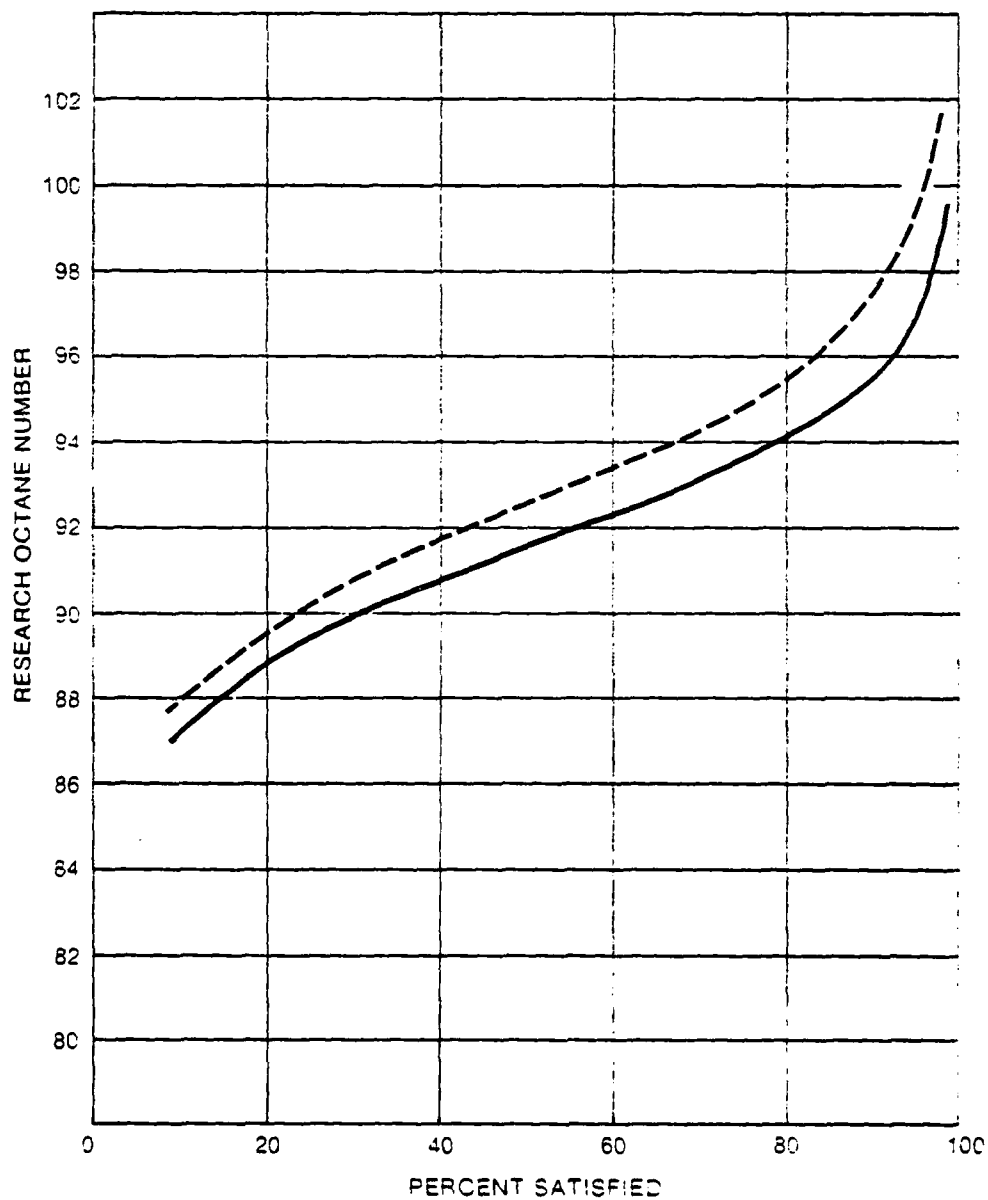


FIGURE 9
COMPARISON OF
MAXIMUM FBRSU FUEL REQUIREMENTS
1980 AND 1979 U.S. VEHICLES

————— 1980 SURVEY 344 VEHICLES
----- 1979 SURVEY 423 VEHICLES

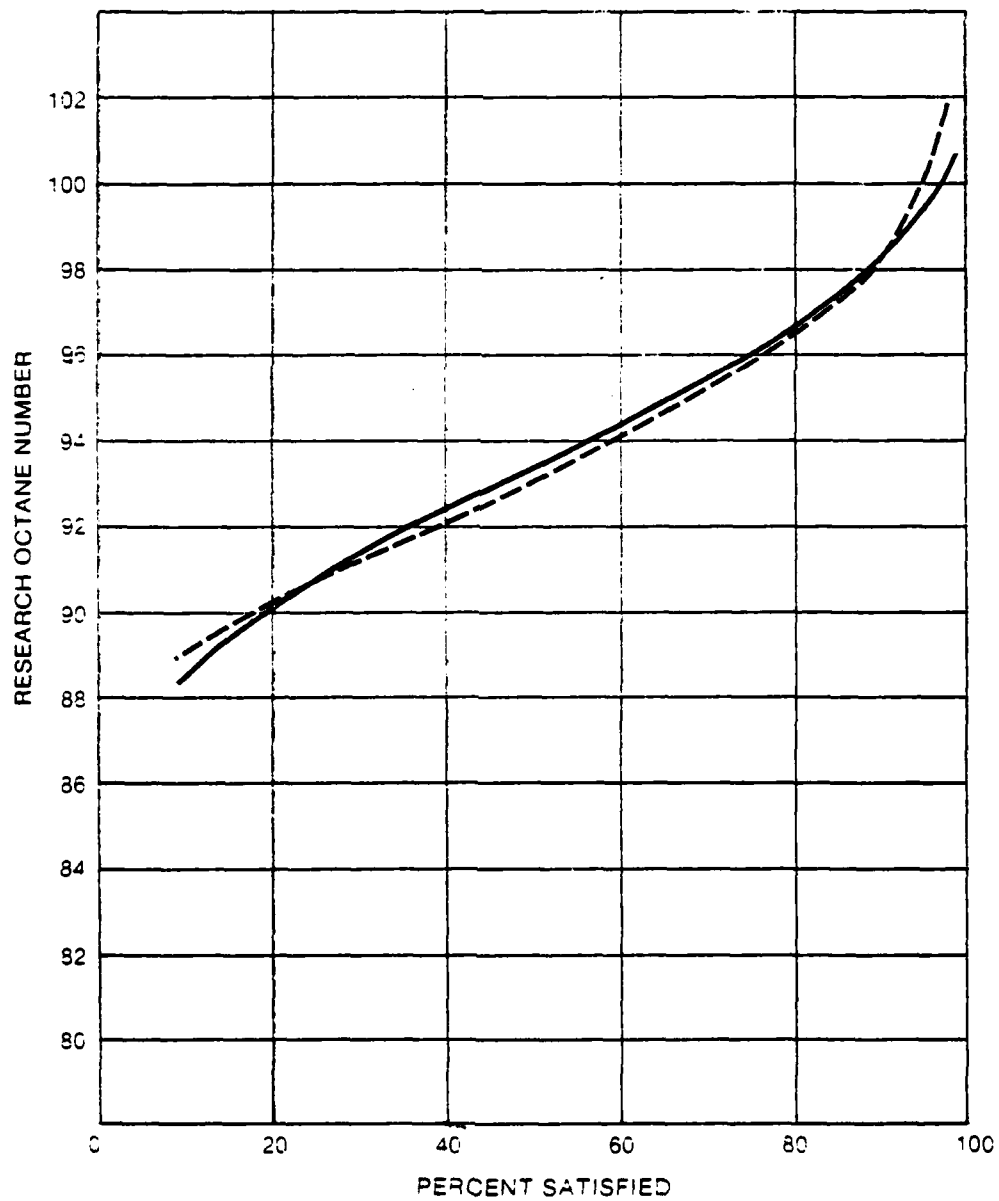


FIGURE 10a
DISTRIBUTION OF
MAXIMUM RON REQUIREMENTS
1980 IMPORTED VEHICLES

—————	PR FUEL	85 VEHICLES
- - - - -	FBRU FUEL	85 VEHICLES
- - - - -	FBRSU FUEL	85 VEHICLES

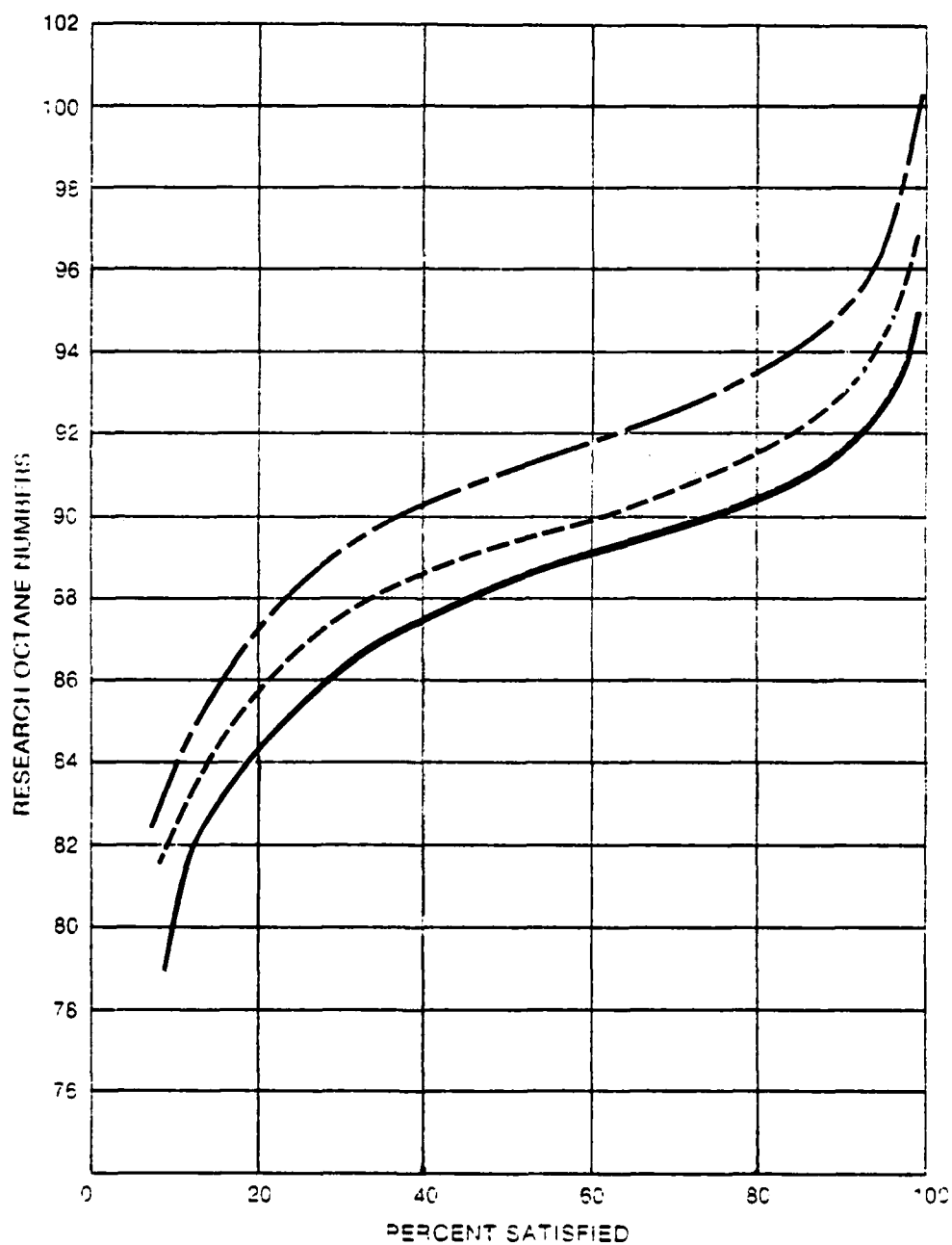


FIGURE 10b
DISTRIBUTION OF MAXIMUM RON REQUIREMENTS
1980 IMPORTED VEHICLES

PR FUEL 85 VEHICLES
FBRU FUEL 85 VEHICLES
FBRSU FUEL 85 VEHICLES

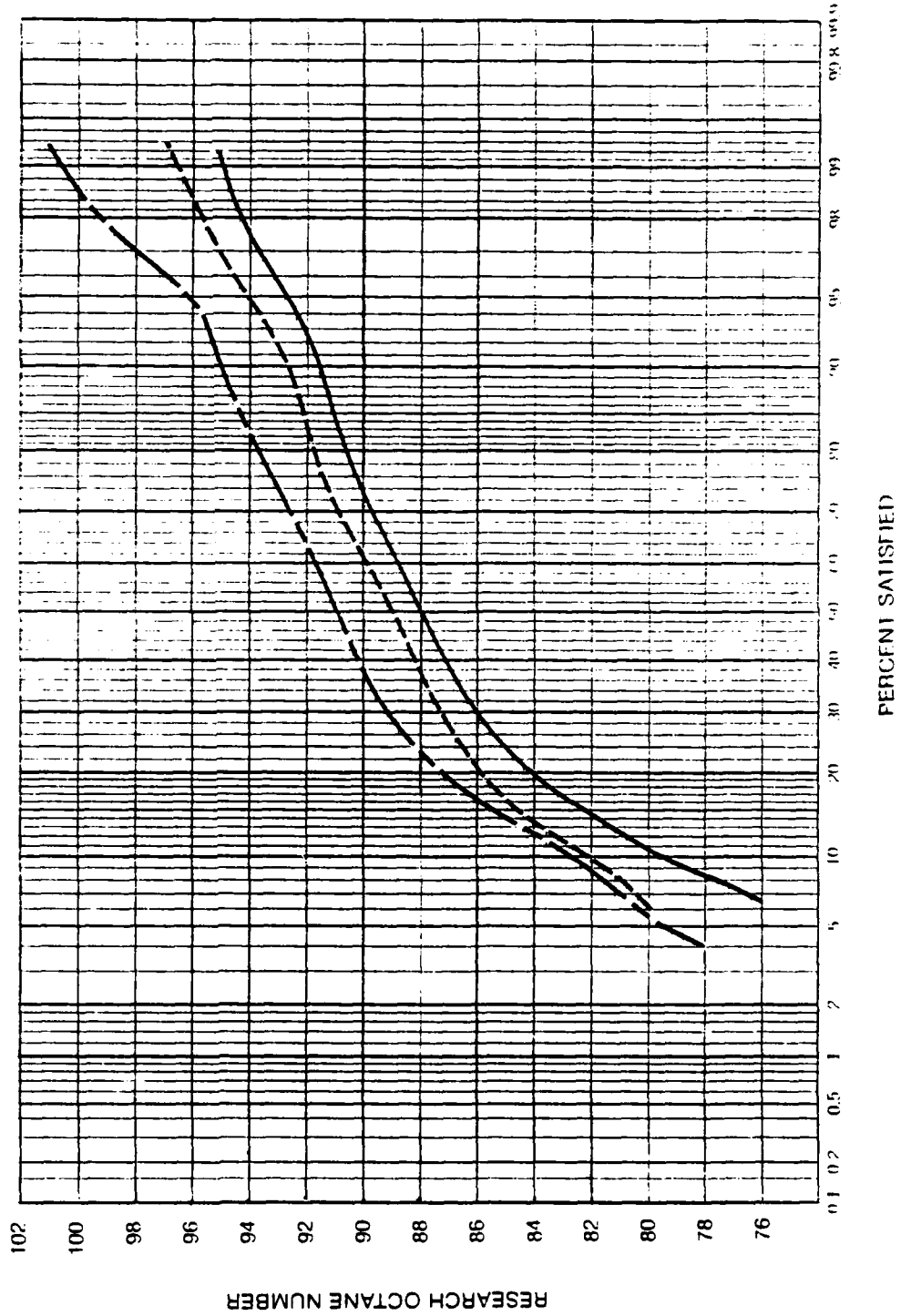


FIGURE 11
DISTRIBUTION OF
MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL NC5 225/HC5 225/IC5 225/LC5 225

PR FUEL 24 CARS
FBRU FUEL 24 CARS
FBRSU FUEL 24 CARS

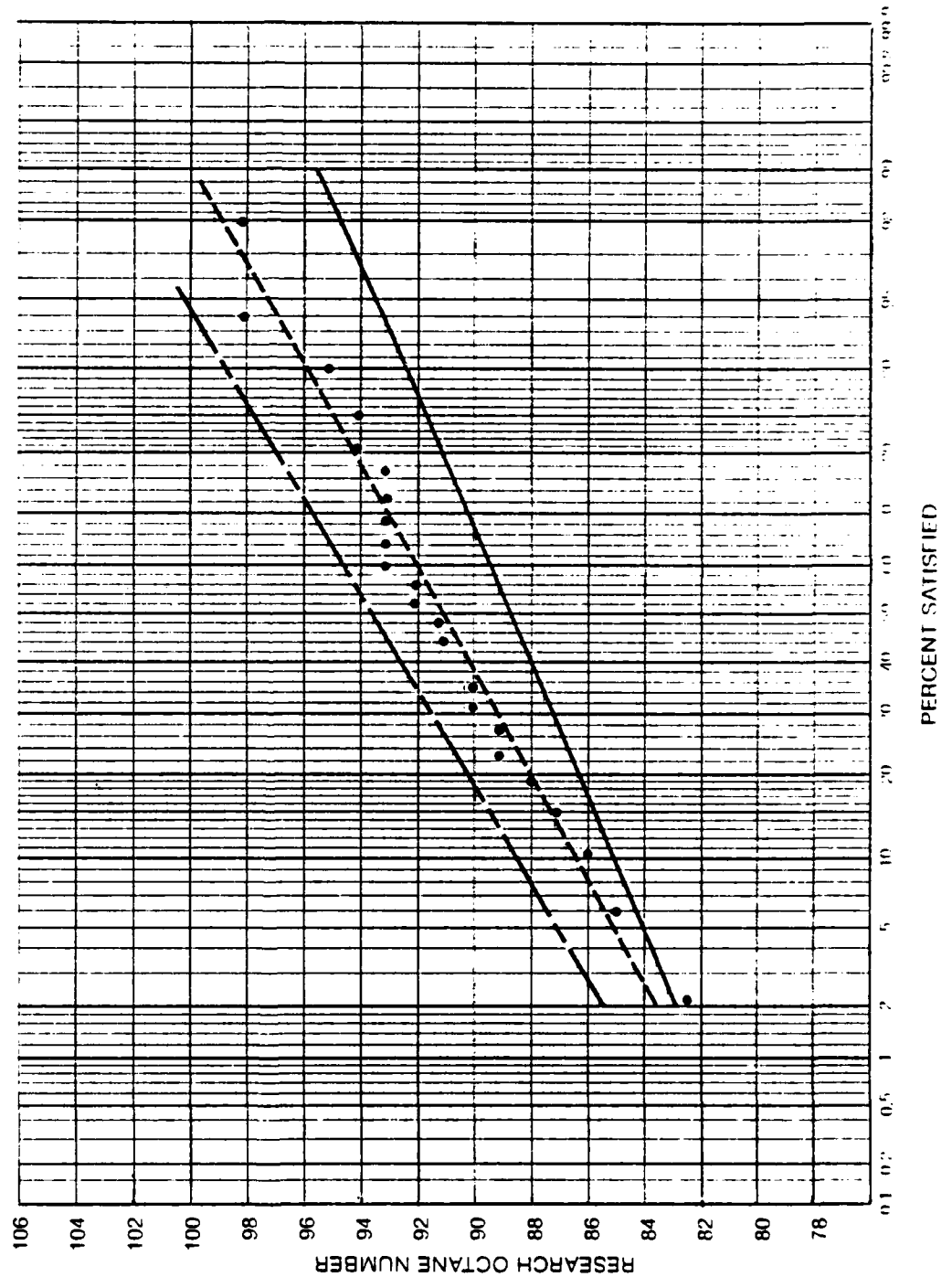


FIGURE 12
DISTRIBUTION OF
MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL NC7 228/HC7 228/IC7 228/LC7 228

PR FUEL	21	CARS
FBRU FUEL	21	CARS
FBRSU FUEL	21	CARS

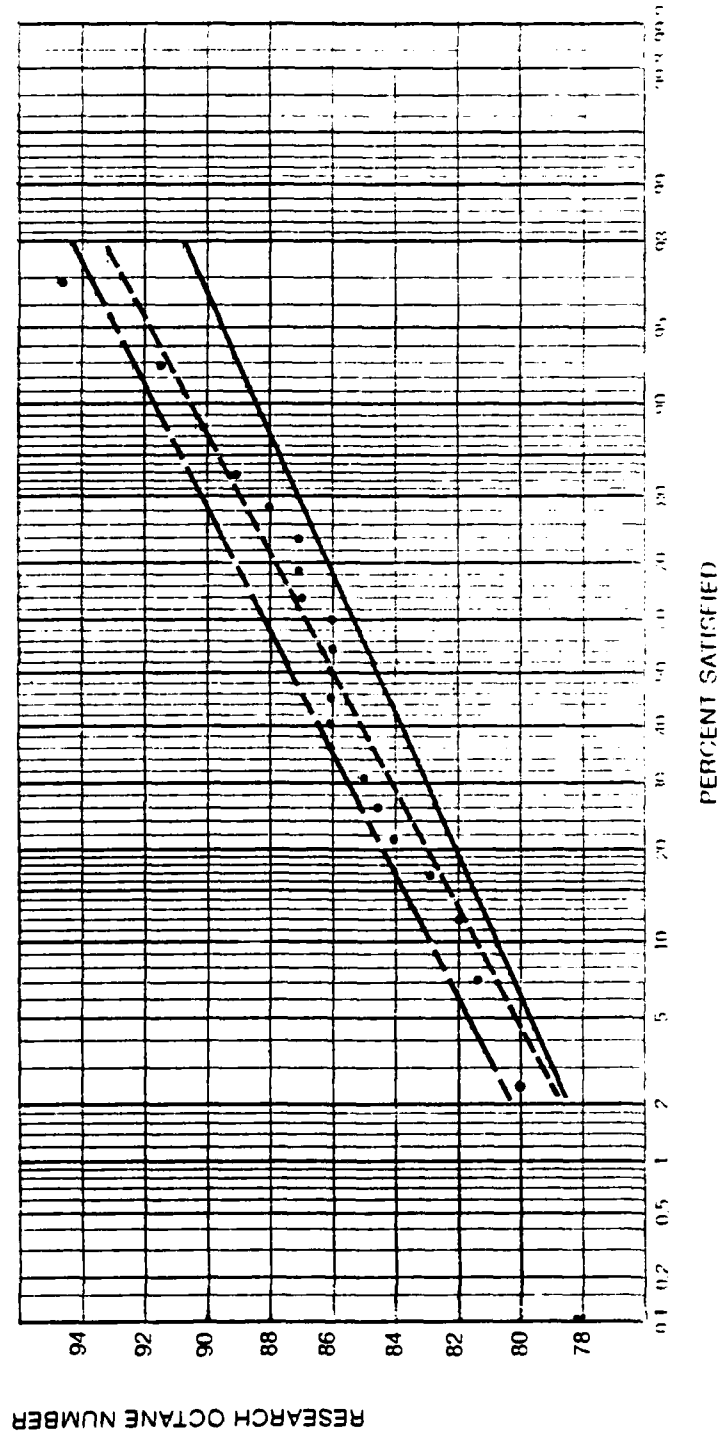


FIGURE 13
DISTRIBUTION OF
MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL NIJ 244

— PR FUEL 12 CARS
- - - FBRU FUEL 12 CARS
- . - FBRU FUEL 12 CARS

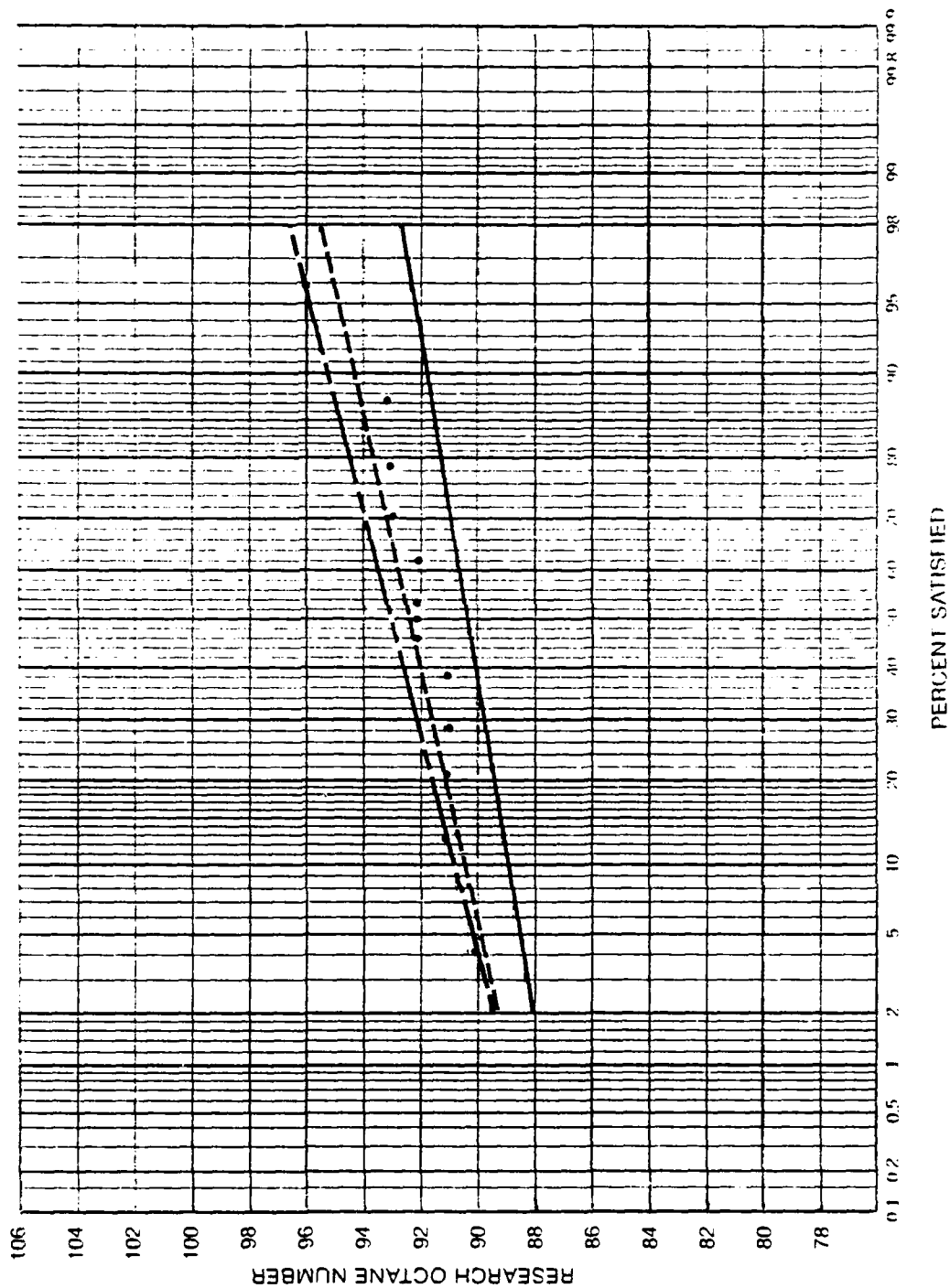


FIGURE 14
DISTRIBUTION OF
MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL OCA 242/MCA 242

PR FUEL	14	CARS
FBRU FUEL	14	CARS
FBRSU FUEL	14	CARS

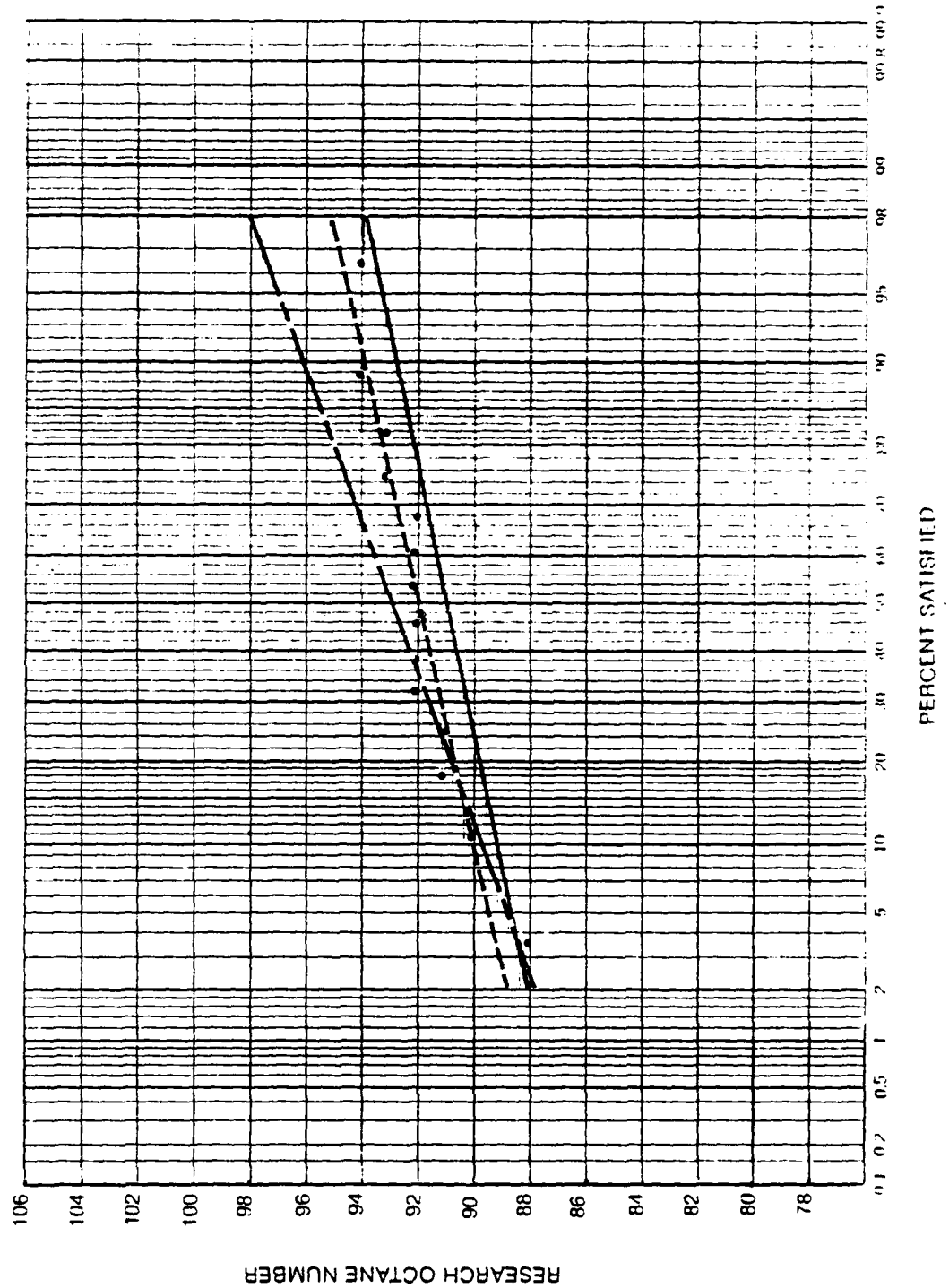


FIGURE 15
DISTRIBUTION OF
MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL O V250/ M V250

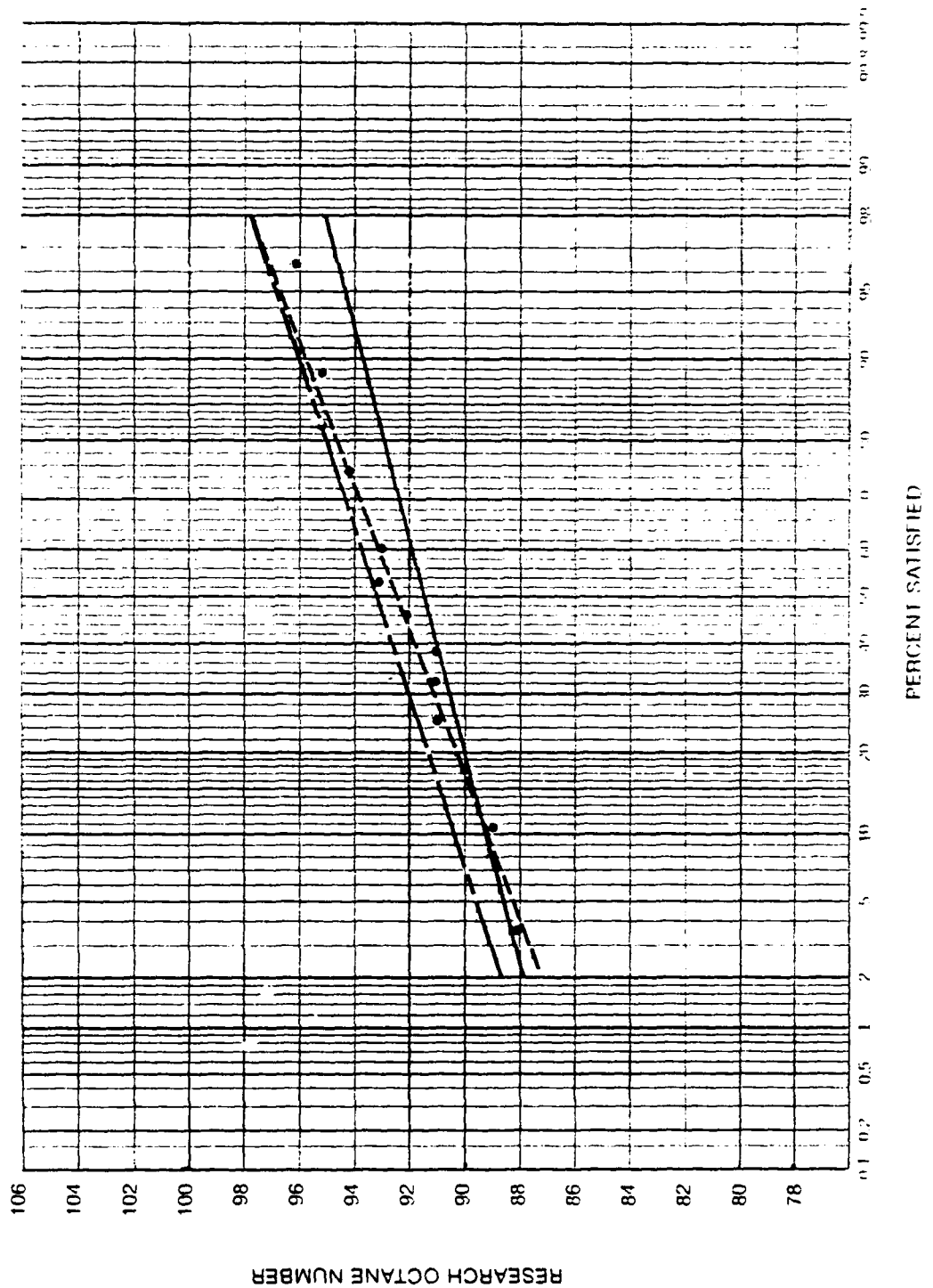


FIGURE 16
DISTRIBUTION OF
MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL PC 137/KC 137/ DC 137

PR FUEL	15	CARS
FBRU FUEL	15	CARS
FBRSU FUEL	15	CARS

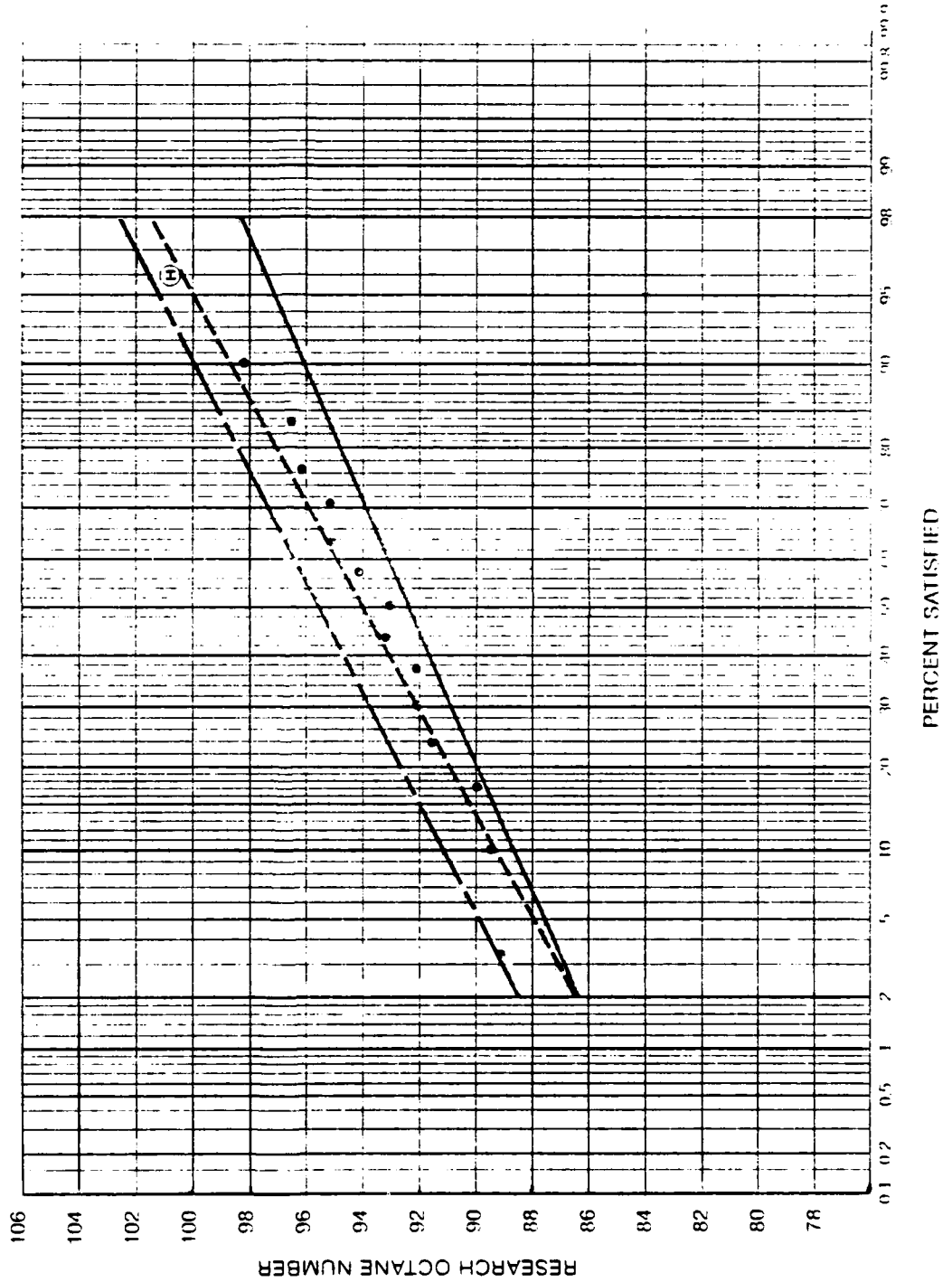


FIGURE 17
ENGINE SPEEDS FOR MAXIMUM AND PART-THROTTLE OCTANE
NUMBER REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES

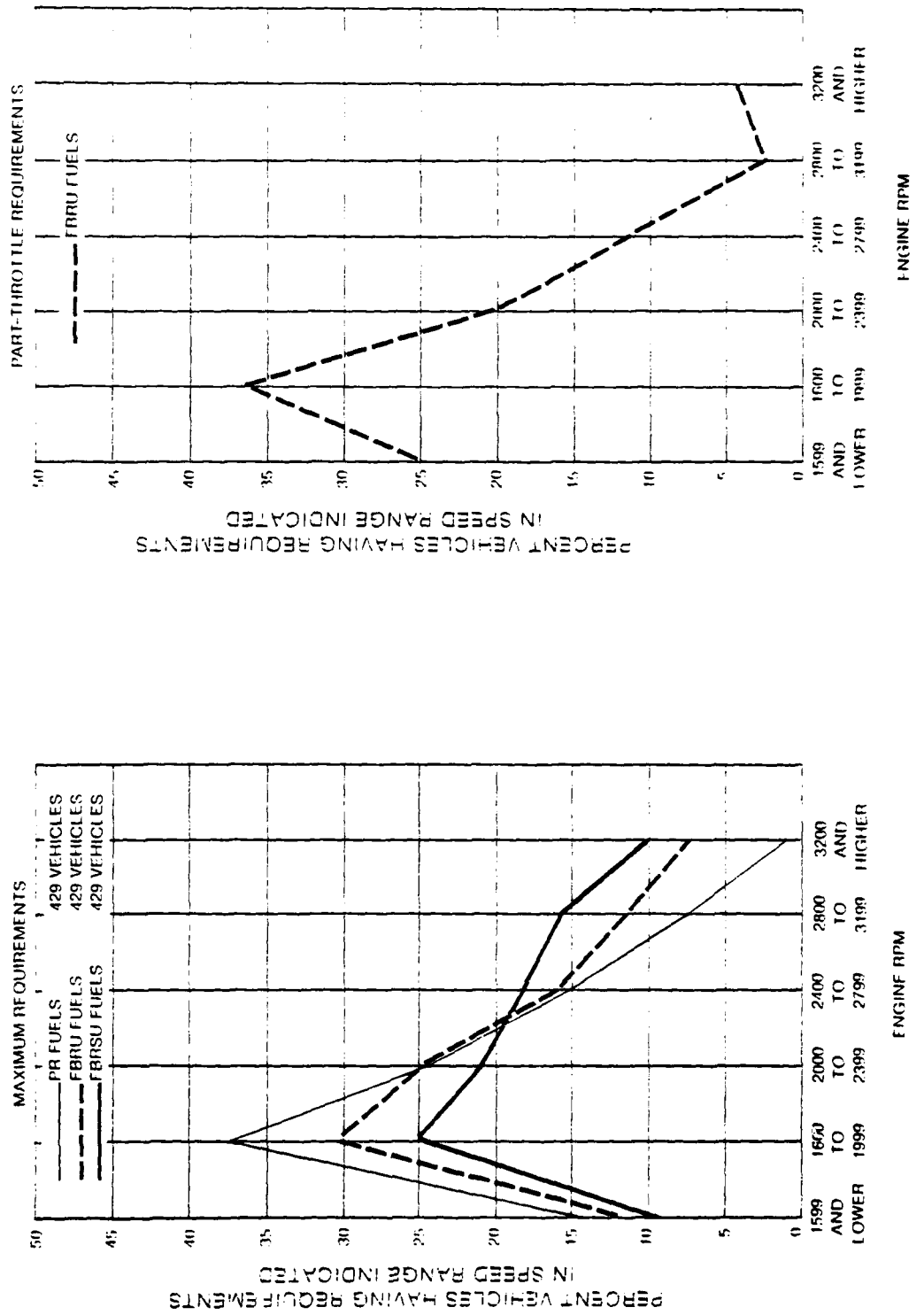


FIGURE 18a
DISTRIBUTION OF PART-THROTTLE FBRU
RON REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES
(389 VEHICLES)

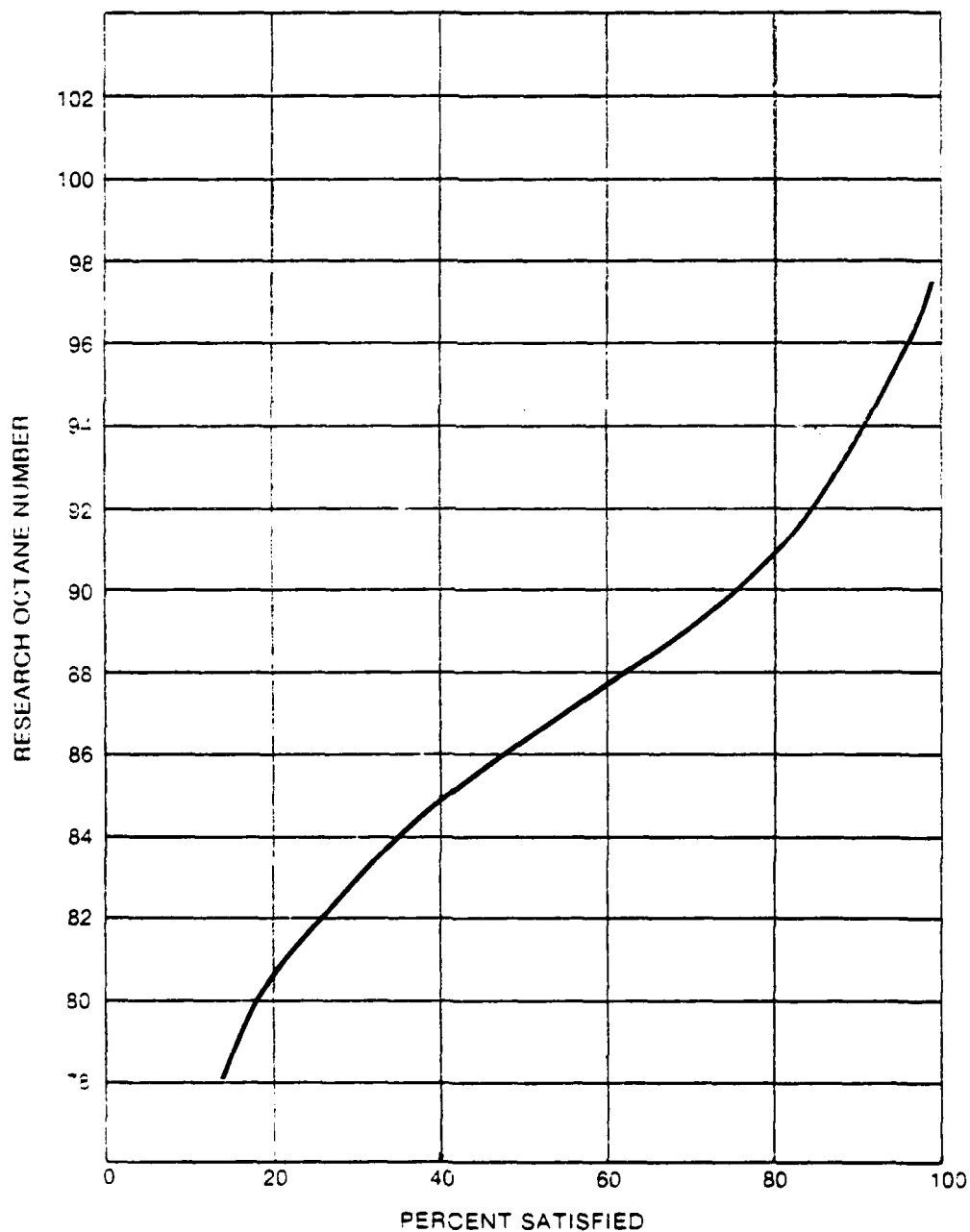


FIGURE 18b
DISTRIBUTION OF PART-THROTTLE
FBRU RON REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES
(389 VEHICLES)

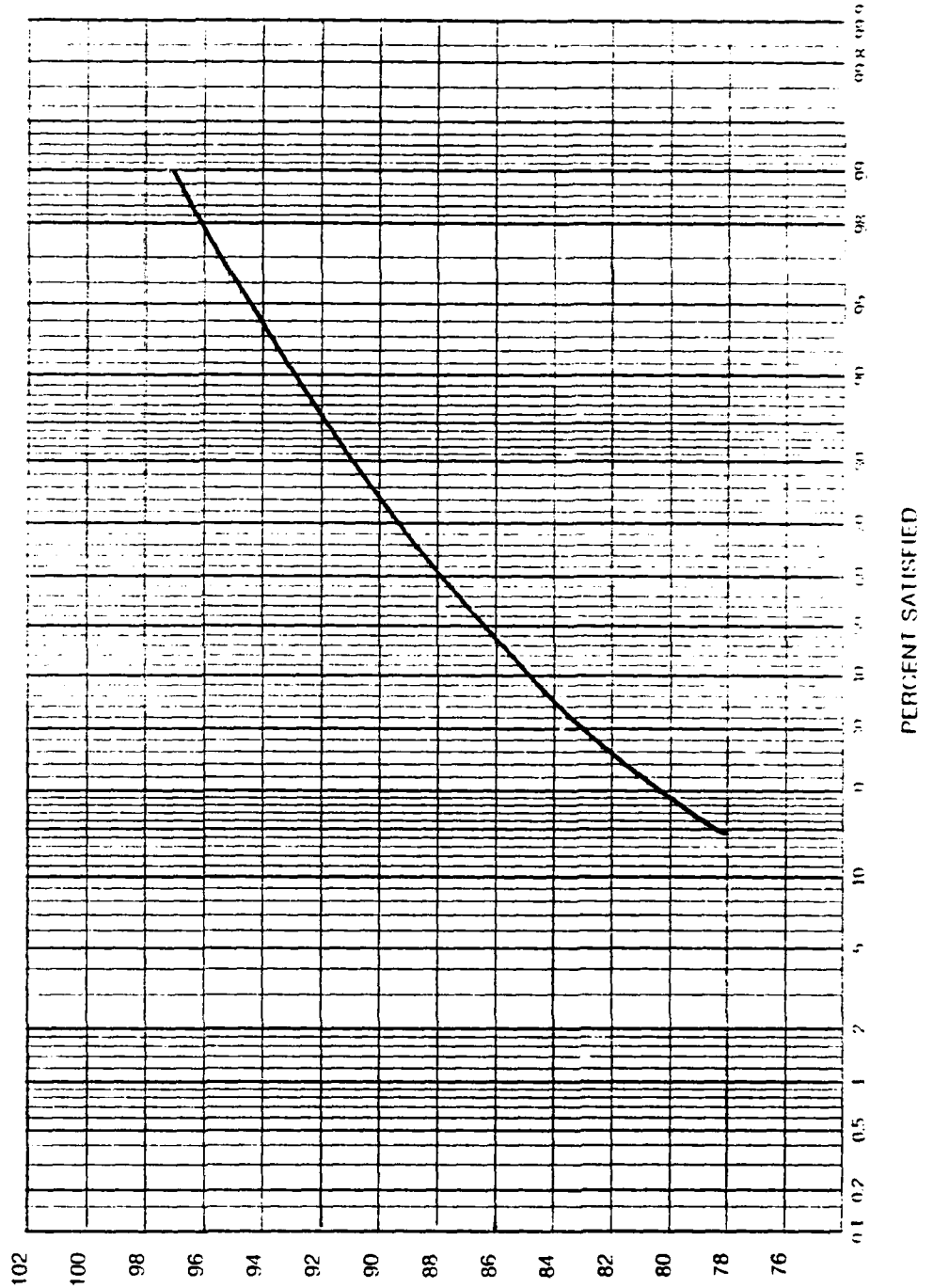


FIGURE 19a
DISTRIBUTION OF PART-THROTTLE FBRU
RON REQUIREMENTS
1980 U.S. VEHICLES
(312 VEHICLES)

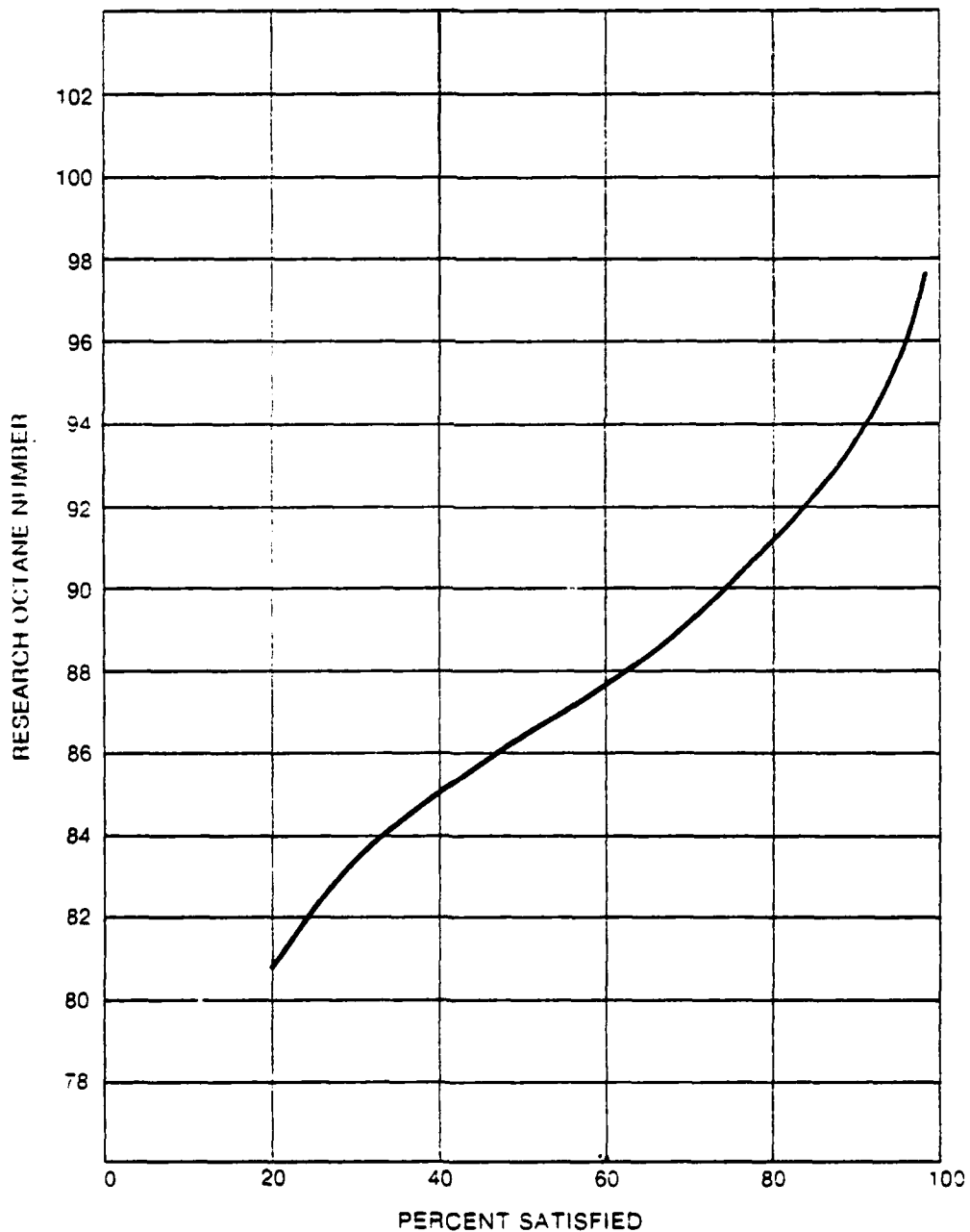


FIGURE 19b
DISTRIBUTION OF
PART-THROTTLE FRRU RON REQUIREMENTS
1980 U.S. VEHICLES
(312 VEHICLES)

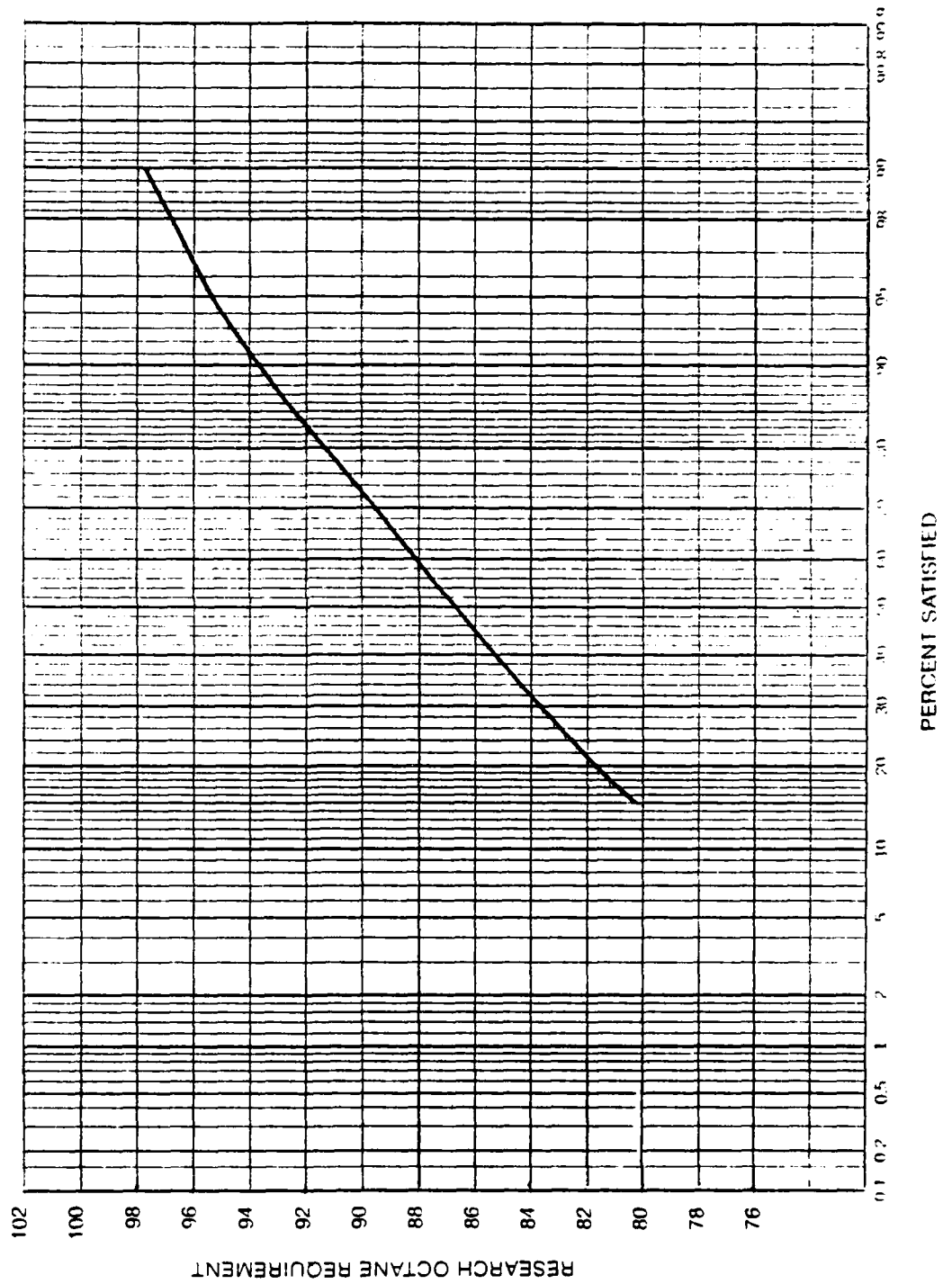


FIGURE 20a
DISTRIBUTION OF
PART-THROTTLE FBRU RON REQUIREMENTS
1980 IMPORTED VEHICLES
(77 VEHICLES)

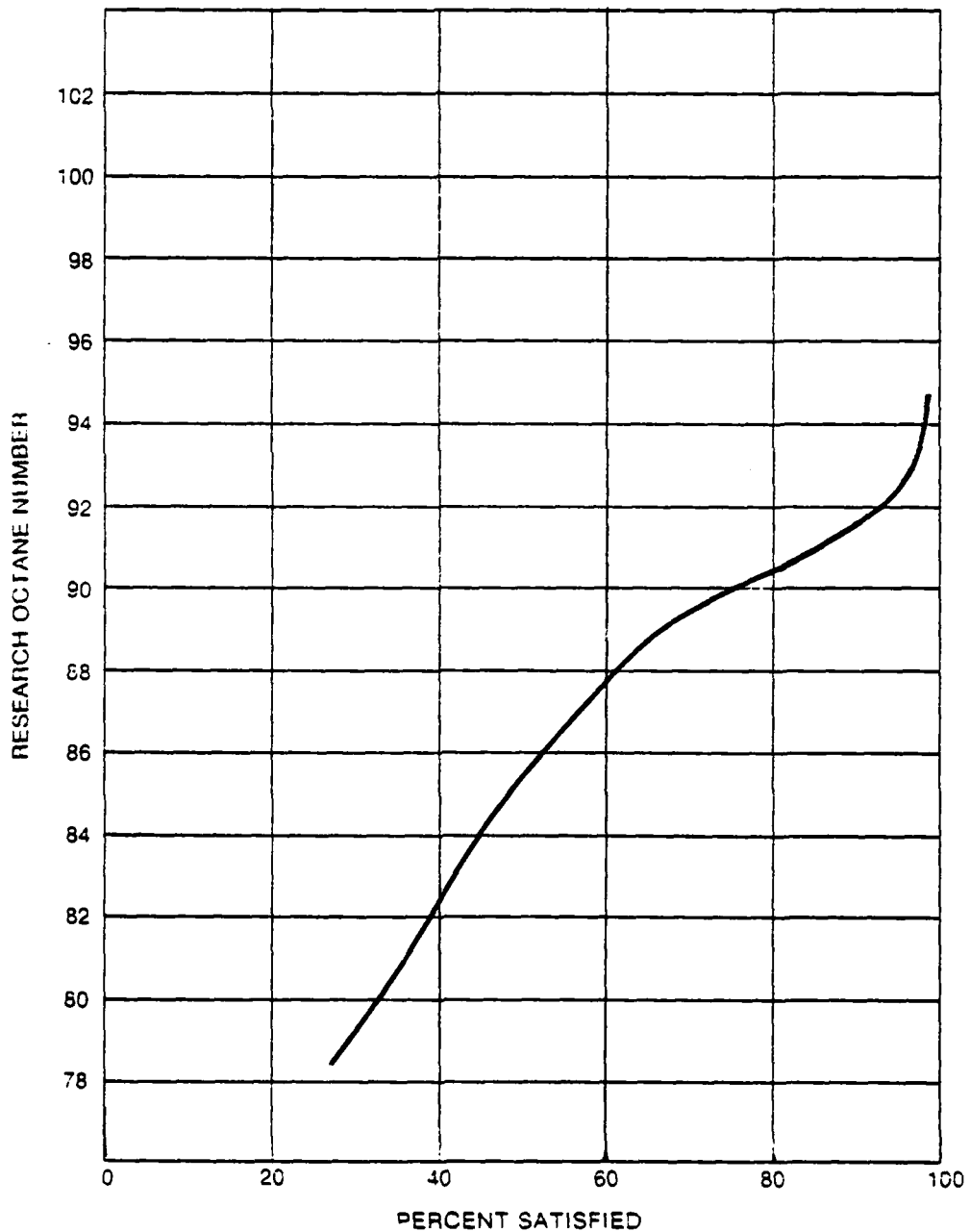


FIGURE 20b
DISTRIBUTION OF
PART-THROTTLE FBRU RON REQUIREMENTS
1980 IMPORTED VEHICLES
(77 VEHICLES)

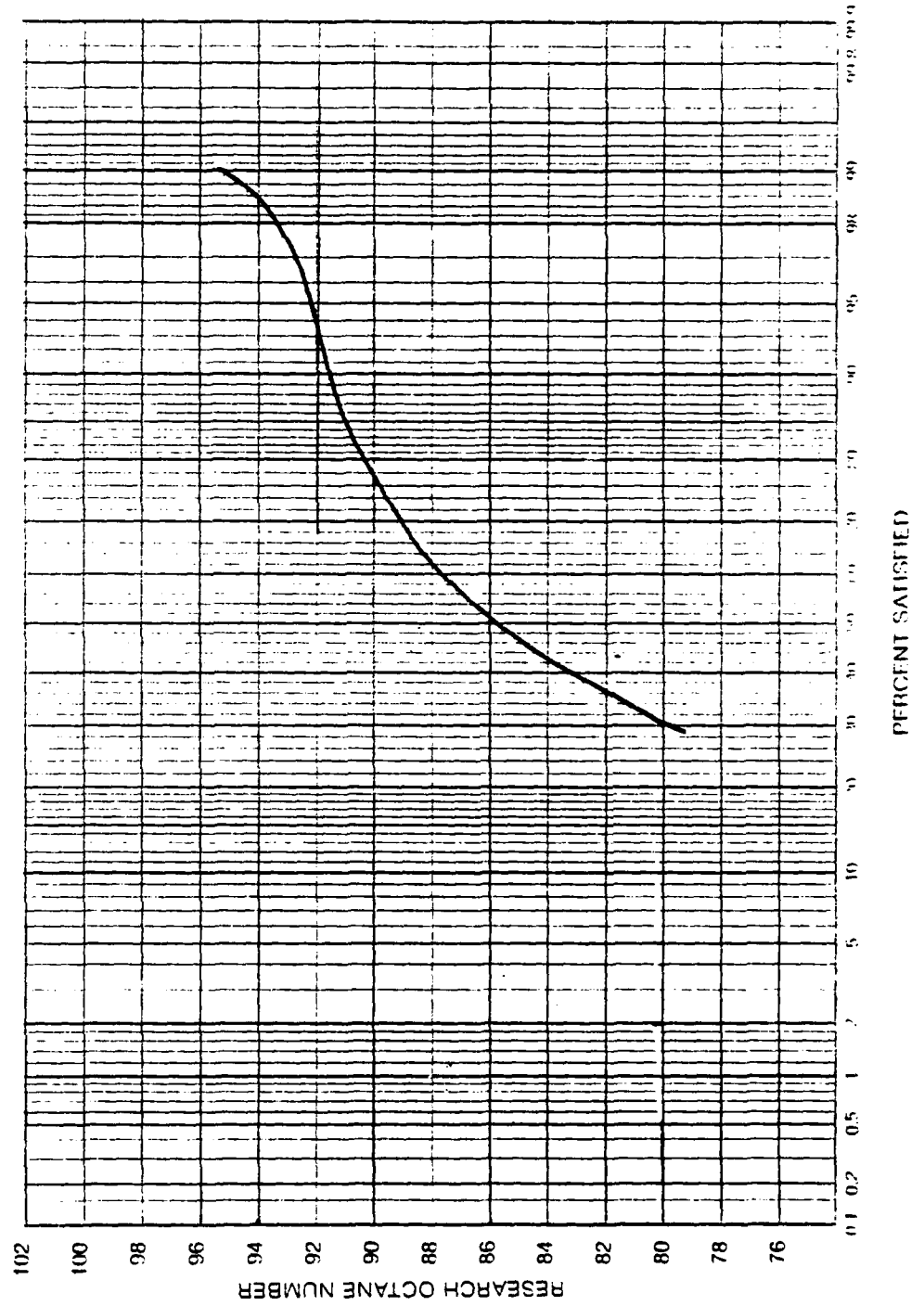


FIGURE 21
COMPARISON OF MAXIMUM FBRU RON REQUIREMENTS
WITH PART-THROTTLE REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES (429 VEHICLES)

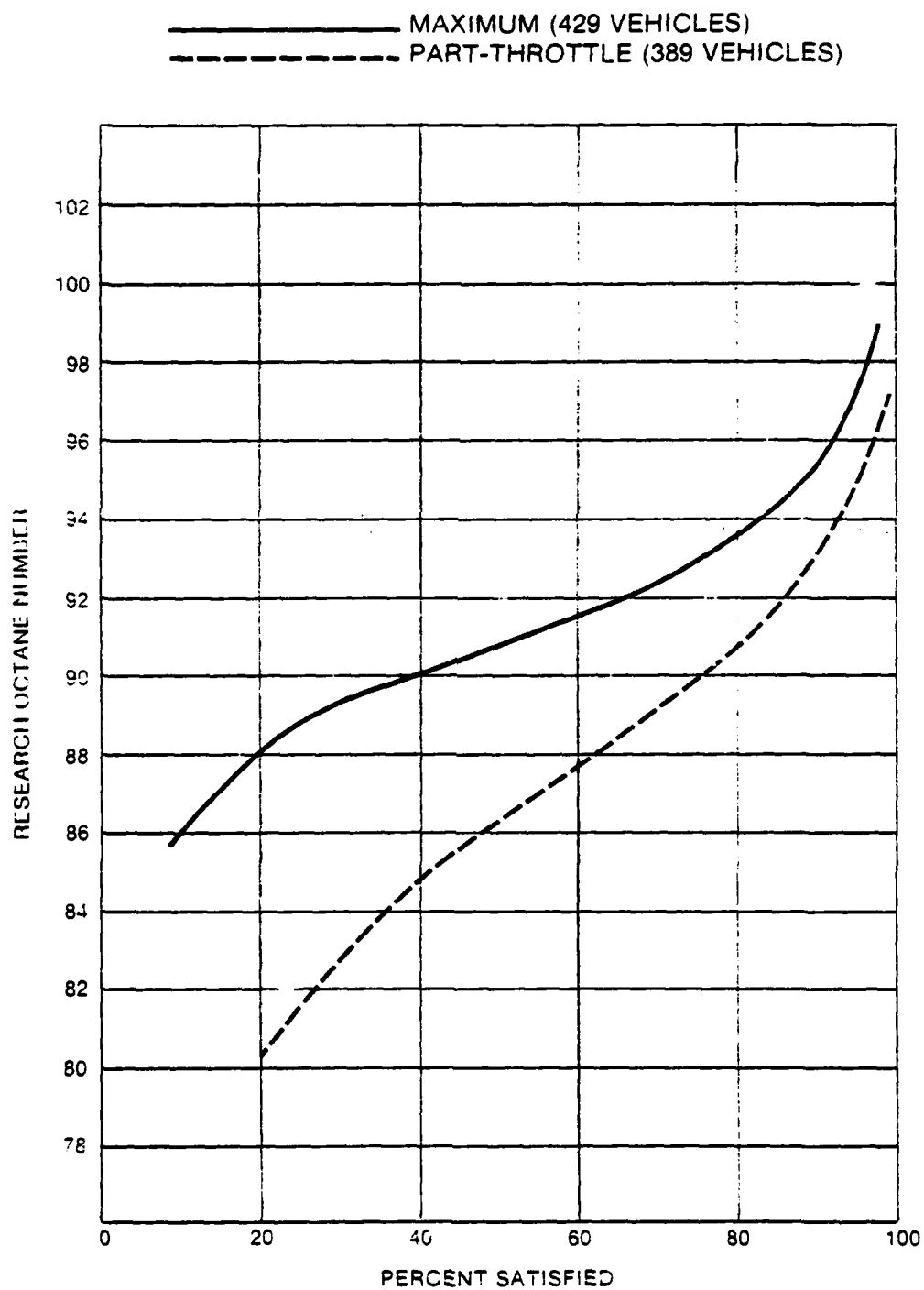


FIGURE 22
COMPARISON OF
PART-THROTTLE FBRU RON REQUIREMENTS
1980 AND 1979 U.S. AND IMPORTED VEHICLES

———— 1980 SURVEY 389 VEHICLES
----- 1979 SURVEY 453 VEHICLES

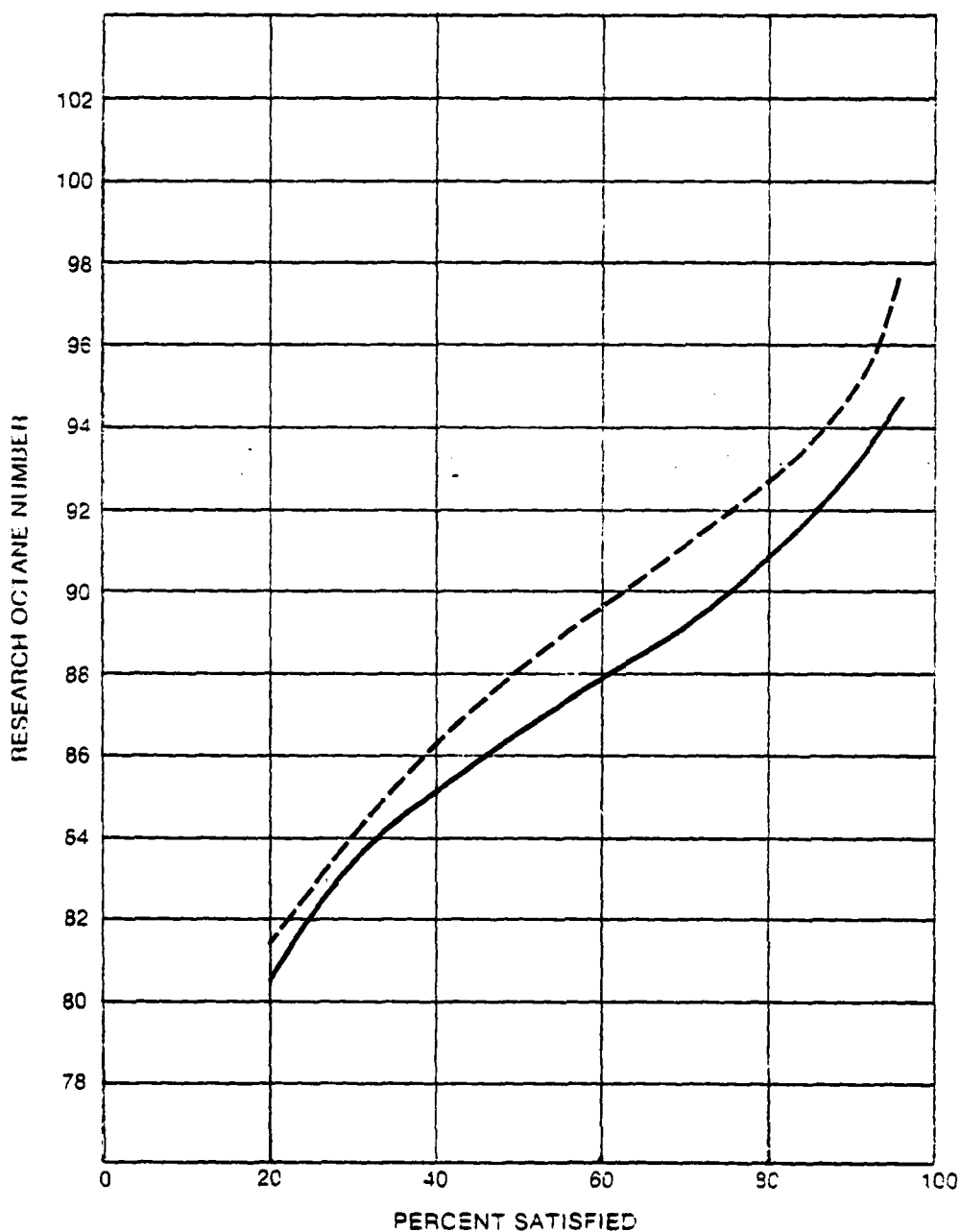
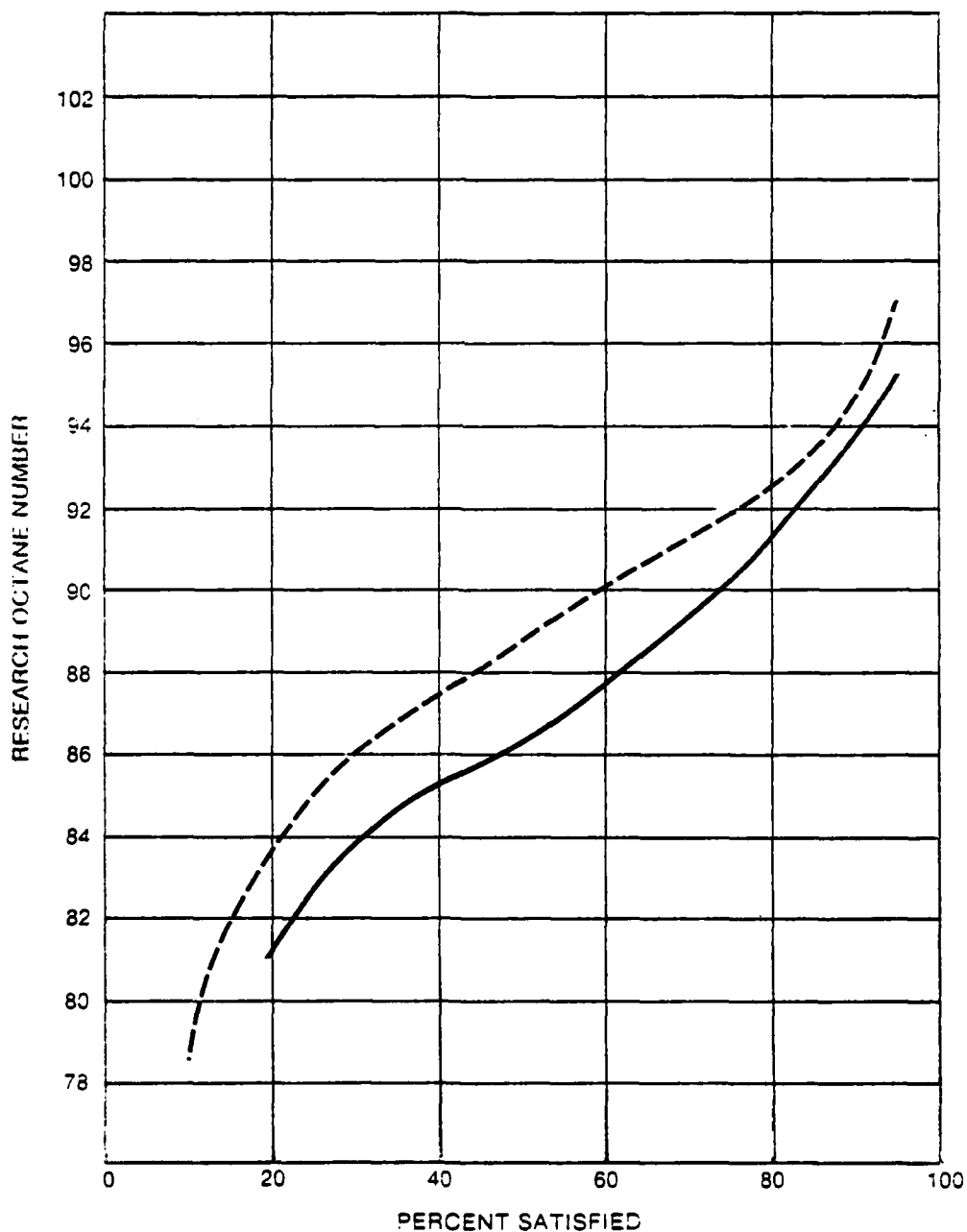


FIGURE 23
COMPARISON OF PART-THROTTLE
FBRU RON REQUIREMENTS
1980 AND 1979 U.S. VEHICLES

———— 1980 SURVEY: 312 VEHICLES
----- 1979 SURVEY: 398 VEHICLES



A P P E N D I X A

PARTICIPATING LABORATORIES

PARTICIPATING LABORATORIESEASTERN AREA

E. I. Du Pont de Nemours and Company, Inc.
Wilmington, Delaware

Exxon Research and Engineering Company
Linden, New Jersey

Gulf Research and Development Company
Pittsburgh, Pennsylvania

Mobil Research and Development Corporation
Paulsboro, New Jersey

Sun Company
Marcus Hook, Pennsylvania

Texaco Inc.
Beacon, New York

EAST CENTRAL AREA

Ethyl Corporation
Detroit, Michigan

Ford Motor Company
Dearborn, Michigan

General Motors Corporation
Warren, Michigan

Standard Oil Company (Ohio)
Cleveland, Ohio

WESTERN AREA

Chevron Research Company
Richmond, California

Union Oil Company of California
Brea, California

WEST CENTRAL AREA

Amoco Oil Company
Naperville, Illinois

Atlantic Richfield Company
Harvey, Illinois

Phillips Petroleum Company
Bartlesville, Oklahoma

Shell Development Company
Houston, Texas

Universal Oil Products
Des Plaines, Illinois

A P P E N D I X B

MEMBERSHIP: 1980 ANALYSIS PANEL

1980 CRC OCTANE NUMBER REQUIREMENT SURVEY

(CRC Project No. CM-123-80)

1980 Analysis Panel

D. P. Barnard, Leader	Standard Oil Company (Ohio)
J. L. Borzone	Mobil Research and Development Corporation
W. J. Brown	Ethyl Corporation
E. S. Corner	Consultant
N. D. Esau	Amoco Oil Company
D. W. Hall	Chevron Research Company
J. D. Rogers, Jr.	E. I. Du Pont de Nemours and Company, Inc.
K. R. Schaper	Gulf Research and Development Company
A. G. Swavely	Ashland Oil, Inc.
R. A. Wirth	Sun Company
T. Wusz	Union Oil Company of California

A P P E N D I X C

PROGRAM

AD-A113 734

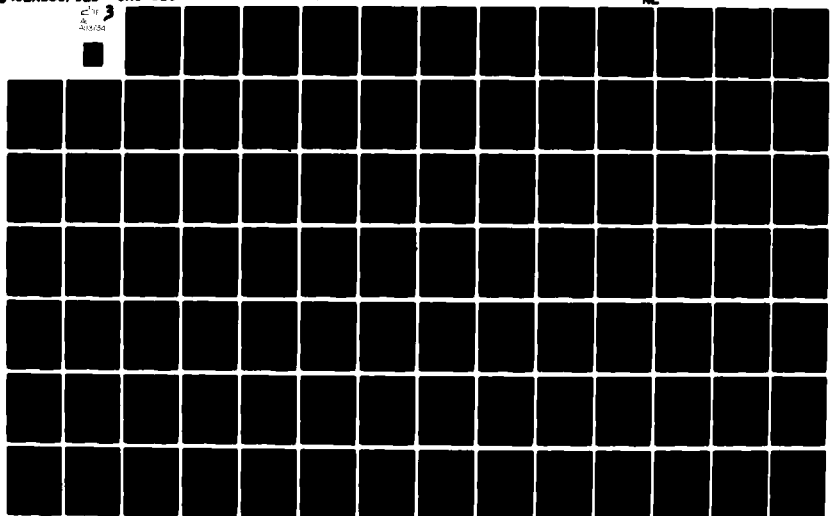
COORDINATING RESEARCH COUNCIL INC ATLANTA GA
1980 CRC OCTANE NUMBER REQUIREMENT SURVEY.(U)
JAN 81
CRC-819

F/O 21/4

UNCLASSIFIED

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APPENDIX C

PROGRAM
for the
1980 CRC OCTANE REQUIREMENT SURVEY

CRC Project No. CM-123-80

Revised

March, 1980

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1980 Full-Boiling Range Reference Fuels

INDEX OF ATTACHMENTS

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ATTACHMENT 2 - Technique for Determination of
Octane Number Requirements of
Light Duty Vehicles

I. INTRODUCTION

The 1980 program of the CRC-Motor Octane Number Requirement Survey Group will consist of a survey of the octane number requirements of 1980 model domestic and imported vehicles. For the purposes of this program, the designation "passenger vehicles" will include passenger cars and light-duty (<8500 lb/3856 kg GVW) pickup trucks, and vans. Approximately 450 vehicles will be tested. Most of these vehicles will be sampled in proportion to their relative production or import volume, to provide data from which to estimate the distribution of octane number requirements for the 1980 model vehicle population in the United States. In addition, select models of special interest will be tested in sufficient numbers to estimate their requirement distributions.

Knocking characteristics will be investigated with three series of reference fuels. Tank fuel knock will also be evaluated. Maximum octane requirements, regardless of throttle opening, will be established for each vehicle using high sensitivity unleaded full-boiling range reference (FBRSU) fuels, average sensitivity unleaded full-boiling range reference (FBRU) fuels and primary reference (PR) fuels. The sensitivity of the FBRU series is similar to average unleaded commercial fuels currently marketed.

Maximum part-throttle octane requirements will be completely defined with FBRU reference fuels.

Octane requirements throughout the speed range will be obtained with PR fuels only. After-run characteristics will be observed on tank fuel.

II. GEOGRAPHICAL AREAS

As in previous years, the 1980 survey will be conducted on a nationwide basis. The country has been divided into four geographical areas. Participants located in New York, New Jersey, Delaware and Pennsylvania have been included in the Eastern area; those located in Ohio, Michigan and Kentucky comprise the East Central area; those in Illinois, Texas and Oklahoma comprise the West Central area; and California participants make up the Western area. A coordinator has been appointed for each area as follows:

Eastern Area	- S. Antika
East Central Area	- D. P. Barnard
West Central Area	- L. J. Olejnik
Western Area	- T. Wusz

The area coordinators will contact their area participants periodically regarding the progress of the survey. To expedite this, it is suggested that participants send copies of all correspondence concerning the survey to the area coordinators. This program outlines the survey in broad terms. If more detailed information is desired, it is suggested that the participant contact his area coordinator.

III. VEHICLES

A total of approximately 450 vehicles will be tested in the 1980 Survey. By requesting each participating laboratory to test 25 vehicles and assuming 18 participants, the 450-vehicle total is obtained. These will be divided into two groups: (1) the statistical group, sampled in proportion to U.S. car model production or import volume, and (2) select models of special interest. Approximately 20 of each of these select models will be tested to provide an estimate of the octane requirement distribution for each model. Some of these 20 vehicles will be those already included in the statistical group and the remainder will be additional vehicles added to the program.

The desired number of vehicles to be tested in each category is as follows:

Statistical group	400
Additional select model group	<u>50</u>
Total	450

A detailed breakdown of the specific models and the number of each model to be tested will be circulated to the participants in May, 1980, after an estimate of vehicle model production has been obtained. If a participant wishes to begin work before that date, he can test select models with certainty that at least one of each model will be assigned to him. Design specifications for select models to be tested in the 1980 Survey are shown below. Selection of these vehicles has been based on new or modified design characteristics that might have a significant effect on octane number requirements and high sales volume which allows individual treatment without additional testing.

Model	Displ.	No. Cyl.	No. Carb. Bbls.	Comp. Ratio	Net HP	Trans.	Type
Oldsmobile	307(5.0)	V-8	4	7.9	150	Automatic	
Chevrolet	229(3.8)	V-6	2	8.6	115	Automatic	
Pontiac	151(2.5)	L-4	2	8.2	86	Automatic	
Chevrolet	173(2.8)	V-6	2	8.5	115	Automatic	
Ford/Mercury Lincoln/TBird	302(5.0)	V-8	2	8.4	134	Automatic	FIOD
Fairmont/Zephyr	255(4.2)	V-8	2	8.8	119	Automatic	
Volare/Aspen/ Cordoba/Diplomat/Mirada	225(3.7)	L-6	1	8.4	90	Automatic	
Cord/Volare/Aspen (FED)	318(5.2)	V-8	2	8.5	120	Automatic	

Wherever possible, specific vehicle assignments to individual participating laboratories will be made in a pattern which tends to minimize data bias. This will be accomplished by apportioning cars of a given model among the four geographical areas, and subsequently among the laboratories within each area, in order to minimize the effect of non-random factors on the results of the survey.

IV. FUELS

A. Full-Boiling Range Reference Fuels

Two full-boiling range reference fuel series will be used to define the vehicle octane number requirements. The two series will be unleaded and of varying sensitivity. One series will be comparable to the average sensitivity of unleaded commercial fuels (FBRU); the other series (FBRSU) will be about two numbers higher in sensitivity than the FBRU fuels. The Research Octane Number (RON) range for both fuel series is 77 to 101.

The two series will be blended in increments of two RON up to 84 and one RON above 84 from three base fuels for each series. The base fuels are compounded from normal refinery gasoline components. Limiting specifications for each base fuel for both series are shown in Table I.

Research and Motor ratings will be determined for incremental blends of each fuel series by all participants to provide data for establishment of blending curves. The average ratings and blending curves will be circulated to all participants.

B. Primary Reference Fuels

Blends of ASTM-grade isooctane and normal heptane will be prepared in two octane number increments from 76 to 82 and one octane number increments from 82 to 100.

C. Tank Gasoline

Research and Motor octane ratings will be obtained only on gasoline samples from the tank of vehicles with owner questionnaire (Attachment 1). Owners' questionnaire should be deleted when,

- a. the vehicle does not have a regular driver
- b. the ignition timing had to be reset.

V. TEST TECHNIQUE

All tests are to be conducted using the technique entitled, "Technique for Determination of Octane Number Requirements of Light Duty Vehicles" (CRC Designation E-15-80). A copy of this technique is included as Attachment 2 to this program. Octane number requirement investigations are to be conducted in all vehicles under level road conditions. Any vehicle obviously in poor mechanical condition or with malfunctioning emission control devices should not be considered for test work. The vehicles should have a minimum of 6000 deposit miles (9656 km) and preferably be privately owned and operated. Vehicles previously used for road octane rating must not be employed in this survey.

Data should be reported on each vehicle tested even though knock was not encountered on any of the fuels.

The order in which the fuels are to be tested is as follows:

1. Tank fuel, 2. FBRSU, 3. FBRU, 4. PR.

VI. DATA FORMS

The test results on each vehicle will be reported on data form (DFMF-11-1180) and work form (DFMF-12-1180). Copies of these forms will be mailed to all participants from the CRC office with instructions for their use printed on the forms. Additional instructions are included in each test technique.

VII. REPORTING RESULTS

A consolidated data report form (DFMF-15-1180) and speed range summary form (DFMF-25-1180) will also be provided by CRC. The consolidated report forms and standard data forms for each vehicle tested should be submitted to the Coordinating Research Council, Inc., 219 Perimeter Center Parkway, Atlanta, Georgia 30346, as soon as possible but not later than October 31, 1980.

TABLE I

PROPOSED LIMITING SPECIFICATIONS FOR 1980 FULL-BOILING RANGE REFERENCE FUELS*

Inspection Tests	Unleaded Average Sensitivity Reference Fuels (FBRU)		Unleaded High Sensitivity Reference Fuel (FHRU)		Unleaded High Sensitivity Reference Fuel (FHRU)	
	RMFD 326	RMFD 327	RMFD 328	RMFD 329	RMFD 330	RMFD 331
ASTM Distillation, °F (°C)						
IDP	90 (32.2)	90	90	90	90	90
10% Evap.	115-158 (46.1-70.0)	115-158	115-158	115-158	115-158	115-158
30% Evap.	150-190 (65.6-87.8)	150-190	150-190	150-190	150-190	150-190
50% Evap.	195-250 (90.6-121.1)	195-250	195-250	195-250	195-250	195-250
70% Evap.	230-300 (110.0-148.9)	230-300	230-300	230-300	230-300	230-300
90% Evap.	285-374 (140.6-190.0)	285-374	285-374	285-374	285-374	285-374
End Point, Max.	437 (225)	437	437	437	437	437
RVP, psi (KPa)	7-9 (48-62)	7-9	7-9	7-9	7-9	7-9
Lead, g/gal (g/l)	<0.03 (<0.008)	<0.03	<0.03	<0.03	<0.03	<0.03
Oxidation Stability, minutes, minimum	1440	1440	1440	1440	1440	1440
Hydrocarbon Type,						
Vol %	To be determined by inspection and reported					
Aromatics**						
Olefins						
Saturates						
Octane Number	77±1	90±1	101±1	77±1	90±1	101±1
Research Sensitivity***	4±.5	7.7±.5	11±.5	6.0±.5	9.7±.5	13±.5
Color	Clear	Green	Red	Yellow	Deep Purple	Light Blue

All fuels to contain minimum 5 PTB of a 100% active antioxidant. No manganese added.

* To be compounded from normal refinery components

** 1% maximum Benzene or legal

*** Sensitivities are shown for the mean Research Octane Number.

Minimum of two units sensitivity difference between corresponding fuels of each series.

OWNER'S QUESTIONNAIRE
CRC OCTANE NUMBER REQUIREMENT SURVEY

OWNER:

Your vehicle is being tested for fuel octane number requirements by a Coordinating Research Council activity. To help analyze the data, we would like the person who has recently been driving the vehicle to answer the following questions:

1. Has any engine knock (ping) been encountered recently?

☐ Yes ☐ Occasionally
☐ No ☐ Frequently

2. If "Yes" was it during any of these conditions?

☐ Low Speed ☐ Hill Climbing ☐ Normal Acceleration
☐ High Speed ☐ Towing Trailer ☐ Maximum Acceleration

3. Did you consider the knock (ping) objectionable?

☐ Yes ☐ No

4. Did the knock (ping) occur on the fuel that is now in the tank?

☐ Yes ☐ No

5. Does the engine continue to run after the key is turned off?

☐ Yes ☐ No

6. If "Yes," did you consider the engine running with the key off objectionable?

☐ Yes ☐ No

Vehicle Make _____ License No. _____

Vehicle Identification No. _____

TECHNIQUE FOR DETERMINATION
OF OCTANE NUMBER REQUIREMENTS
OF LIGHT DUTY VEHICLES

(CRC Designation E-15-80)

Revised

February, 1980

TECHNIQUE FOR DETERMINATION
OF OCTANE NUMBER REQUIREMENTS
OF LIGHT DUTY VEHICLES

(CRC Designation E-15-80)

A. GENERAL

The technique provides for the determination of octane number requirements of a vehicle in terms of borderline spark knock and surface ignition knock, regardless of throttle position, on two series of full-boiling range reference fuels as well as on primary reference fuels. It also provides octane requirements throughout the speed range on primary reference fuels.

Spark knock, surface ignition and after-run characteristics of tank fuel will also be determined.

B. DEFINITION OF TERMS

1. The following definitions of knock were approved by the CFR and CLR Committees on June 8, 1954, and will be used in this technique. Knock is the noise associated with autoignition* of a portion of the fuel-air mixture ahead of the advancing flame front. The flame front is pre-supposed to be moving at normal velocity. With this definition the source of the normal flame front is immaterial -- it may be the result of surface ignition or spark ignition.

- a. Spark Knock: A knock which is recurrent and repeatable in terms of audibility. It is controllable by the spark advance; advancing the spark increases the knock intensity and retarding the spark reduces the intensity. This definition does not include surface ignition knock.
- b. Surface Ignition Knock: Knock which has been preceded by a surface ignition. It is not controllable by spark advance.** It may or may not be recurrent and repeatable.

* Autoignition: The spontaneous ignition and the resulting very rapid reaction of a portion or all of the fuel-air mixture. The flame speed is many, many times greater than that which follows normal spark ignition. There is no time reference for autoignition.

** For the purpose of this program, it is not intended that surface ignition knock be identified by manipulation of the spark advance.

Attachment 2

2. The following definitions of knock intensity were specifically adopted for use in this technique:
 - a. No Knock: This means no spark knock or surface ignition knock.
 - b. Borderline Knock: This means spark knock of lowest audible intensity, recurrent surface ignition knock of borderline intensity, or infrequent (three or less) surface ignition knocks regardless of intensity.
 - c. Above Borderline Knock: This means greater than borderline spark knock, recurrent surface ignition knock greater than borderline intensity, or frequent (four or more) surface ignition knocks regardless of intensity.
 - d. After-Run: The engine continues to operate after the ignition is turned off.

3. Definition of Accelerations

Accelerations are made at maximum-throttle and part-throttle conditions which are defined below:

- a. Maximum-Throttle: The throttle is depressed and regulated throughout the acceleration to maintain the critical maximum throttle position. Maximum throttle will constitute the throttle position from detent to 2 inches Hg (6.7 KPa) above detent manifold vacuum. (This could be in highest gear or passing gear for automatic transmissions.) The detent manifold vacuum obtainable on a given model is determined by the transmission characteristics.
- b. Part-Throttle: The throttle is depressed and regulated throughout the acceleration to maintain a desired, constant critical manifold vacuum. Part-throttle will constitute the throttle position from 2 inches Hg (6.7 KPa) above detent vacuum up to the highest road load vacuum. For vehicles with converter clutch transmissions, part-throttle will constitute the throttle position from 1 inch Hg (3.4 KPa) above the minimum vacuum for converter clutch application up to the highest road load vacuum.

C. VEHICLE PREPARATION

The following vehicle preparation steps should be completed before any octane tests are run. Detailed procedures for each adjustment can be found in the manufacturers' shop manuals.

1. Record vehicle identification number and emission control type, Federal, Altitude or California. Fill in heading on data sheet DFMF-11-1180. Ford emission calibration numbers are to be recorded.

2. Inspect all vacuum lines and air pump hoses for appropriate connections. Also, check to see if PCV valve, distributor vacuum delay valve, EGR valve and heated inlet air mechanism are functioning. Engine must be warmed up for these checks.
3. Record engine idle speed and observe anti-dieseling solenoid operation. Adjust to manufacturers' recommended specifications as specified on the under-hood decal.
4. Observe and record basic spark timing at recommended engine speed. Adjust to manufacturers' recommended setting as specified on the under-hood decal.
5. Crankcase oil, radiator coolant, automatic transmission fluid, and battery fluid levels shall be maintained as recommended by the manufacturer.
6. A calibrated tachometer graduated in 100 rpm (or smaller) increments and capable of indicating engine speed from 0-5000 rpm shall be installed on each vehicle.
7. One calibrated vacuum gage, graduated in one-half inch of mercury (or smaller) increments and capable of indicating vacuum from 0-24 inches of mercury (0-81 KPa) shall be connected to the intake manifold.
8. An auxiliary fuel system shall be provided to supply test fuels to the engine. Caution shall be taken to avoid placing auxiliary fuel lines in locations which promote vapor lock. If vehicles with carbureted engines have tank return fuel lines, this return line should be blocked off. Disconnect line from fuel tank to evaporation control system canister. Instructions for fuel handling with fuel injection systems is shown in the Appendix.
9. For vehicles with owner questionnaire completed, a sample of the tank gasoline shall be withdrawn for determination of Research and Motor method octane number ratings.

D. TEST PROCEDURE

1. Engine Warm-Up

- a. To stabilize engine temperatures, a minimum of ten miles of warm-up is required. The test vehicle should be operated at 55 mph (88 kph) in top gear with a minimum of full-throttle operation.
- b. During the warm-up period, the general mechanical condition of the vehicle should be checked to insure satisfactory and safe operation during test work.

2. Fuel Change-Over

Caution: Because of the installation of catalytic devices on these vehicles, permanent damage may result if the engine runs lean or stalls. Therefore, change-over from one fuel to another must be accomplished without running the carburetor or fuel injection system dry. Fuel handling procedures for vehicles equipped with fuel injection systems are explained in the Appendix.

To eliminate contamination of the new fuel with residual amounts of the previous fuel, flush system twice with new fuel.

After fuel change-over, make one maximum-throttle acceleration before beginning Vehicle Rating Procedure.

3. Details of Observations

a. Operating Conditions

All octane number requirements will be determined under level road acceleration conditions. Vehicles with manual transmission should not be tested in overdrive gear. Vehicles equipped with free wheeling or overdrive units shall be tested with this unit (free wheeling or overdrive) locked out of operation. Automatic transmissions shall be run in "Drive". Test accelerations will be made as described below under 3d in highest drive gear.

Tests will be conducted on moderately dry days preferably at ambient temperatures above 60°F (15.5°C). Tests should not be conducted during periods of high humidity such as prevail when rain is threatening or during or immediately after a rain storm. Laboratories with control capabilities should target for 70°F (21°C) air temperature and 50 grains of water per pound (7.14 gm/kg) of dry air whenever possible.

Air conditioned vehicles will be tested with air conditioner turned ON. (Normal setting, low fan.)

b. Order of Fuel Testing

- | | |
|----------|------------|
| 1. Tank | 3. FBRU |
| 2. FBRSU | 4. Primary |

c. Determination of Knock Intensity

Octane requirements will be established by evaluating the occurrence of knock in terms of knock intensity: "N" for none, "B" for borderline, and "A" for above borderline. Establishment of representative knock intensity for a given fuel will be accomplished with the fewest number of accelerations possible. As defined below, the first two duplicating accelerations are sufficient with "N" and "B" knock intensity.

Attachment 2

<u>Number of Accelerations</u>			<u>Representative Rating</u>
<u>1</u>	<u>2</u>	<u>3</u>	
N	N	-	N
N	B	N	N
N	B	B	B
B	N	B	B
B	B	-	B
B	A	-	A
A	-	-	A

All subsequent accelerations will normally be discontinued when "A" knock intensity is experienced and testing continued with a higher octane number fuel in that series. An exception will be made if "A" knock is experienced on the highest octane fuel which knocks in the engine. In this case, it may be necessary to run additional accelerations to determine the speed of maximum knock intensity. If "A" knock is experienced at initiation of acceleration, as limited by transmission characteristics, this speed will be considered the speed of maximum knock. Otherwise, the midpoint between knock-in and knock-out will be considered the speed of maximum knock. When establishing knock-in and knock-out, back off on the throttle between points to eliminate "A" knock. Tip-in knock should be ignored.

d. Determination of Maximum Octane Requirement

Tests should be run to 60 mph (97 kph) unless required to terminate at 55 mph (88 kph) because of legal speed limits.

1. Vehicle Operating Procedure (for driver)

- a. For establishment of transmission characteristics, obtain top gear downshift engine rpm and manifold vacuum at 25, 35, 45 and 55 mph (40, 56, 72, 88 kph) by movement of the throttle through the detent position. Record both engine rpm and manifold vacuum at the downshift point for each speed. The vehicle brakes may be applied lightly if necessary to maintain vehicle speed. In addition, for transmissions with converter clutches determine the minimum vacuum and minimum road speed for converter clutch application. Record on data sheet.
- b. For maximum throttle requirements in highest gear accelerate at the critical maximum throttle position from the minimum obtainable speed as determined in (a)* up to 60 mph (97 kph). To obtain critical maximum throttle position, move the throttle from detent to 2 inches Hg (6.7 KPa) vacuum above detent while accelerating. For vehicles with converter clutch transmissions perform this acceleration with the converter clutch applied and released. Find the throttle position for the maximum knock intensity. If transmission downshifts abort and start acceleration again.

* Starting speed for accelerations on manual transmission vehicles should be the lowest speed from which the vehicle will accelerate smoothly.

Attachment 2

- c. For maximum throttle requirements in passing gear for vehicles with automatic transmissions, accelerate from 10 mph (16 kph) below the starting speed for highest gear acceleration up to 60 mph (97 kph). When available, set shift gear selector to passing gear.
- d. For those vehicles with vacuum delay devices, to stabilize vacuum advance before starting each part-throttle acceleration, operate at road load for 40 seconds at the speed from which the acceleration is to begin.
- e. For part-throttle requirements, accelerate in highest gear at constant critical manifold vacuum from minimum obtainable speed to 60 mph (97 kph) or until vehicle ceases to accelerate. To obtain critical part-throttle vacuum, operate at road load for 40 seconds at 25, 35, 45, and 55 mph (40, 56, 72 and 88 kph). At each speed move the throttle from the highest road load vacuum, down to 2 inches Hg (6.7 KPa) above detent manifold vacuum (1 inch Hg (3.4 KPa) above the minimum vacuum for converter clutch application) in from 3 to 5 seconds. In this range, find a manifold vacuum for maximum knock intensity to use as the critical vacuum for all subsequent part-throttle accelerations. The vehicle brakes may be applied lightly if necessary, to maintain vehicle speed.

f. Determination of After-Run Characteristics

Determination of the occurrence of after-run will be evaluated on tank fuel. Following the engine warm-up, moderately brake the vehicle to a stop (foot off throttle) and place automatic transmission vehicles in park position, manual transmission vehicles in neutral. Air conditioner must be left off. Immediately turn key to the "OFF" position. Note on the data sheet if after-run occurs.

2. Vehicle Rating Procedure (for rater)

Knock rating should be performed while in a normal seated position (head above instrument panel) with floor mats in place.

Step 1 - Using an estimated non-knocking fuel in a given fuel series, investigate for incidence of knock under conditions as described in 3d (1) (b), and 3d (1) (c) above.

Step 2 - If no knock occurs, go to a lower octane number blend in that series and repeat Step 1.

Attachment 2

- Step 3 - If knock occurs at one or more of the operating conditions in Step 1, then continue investigation at the critical condition(s) with higher octane blends until highest octane fuel giving knock is determined within one octane number or one blend. Record maximum knock intensity on all fuels and speed of maximum knock intensity on highest octane fuel that knocks.
- Step 4 - Using the lowest octane blend that did not knock in Step 3, investigate for incidence of part-throttle knock as described in 3d (1) (e).
- Step 5 - If no knock occurs with FBRU Fuel, investigate for knock with lower octane fuels until maximum part-throttle requirement is defined down to the limit of the lowest octane fuel available. If no knock occurs with PRF and FBRU fuels, further investigations are not required with these fuels at part-throttle.

The rating procedure is given in arrow diagram form on page 16.

e. Tank Fuel Observations on Vehicles with Owner's Questionnaire

Investigate for maximum-throttle and part-throttle knock as detailed in Item 3d (1). Define maximum knock intensity as per Item 3c. Record maximum knock intensity, speed of maximum knock intensity and manifold vacuum at each operating condition. Determine after-run characteristics as described in Item 3d (1) (f).

f. Octane Number Requirement Over Speed Range

Octane requirements over the speed range will be obtained on primary reference fuels only using throttle position for maximum requirements. These will be established by recording the knock-in and knock-out points during maximum requirement acceleration with each incremental fuel investigated. It may be necessary to test one or two additional lower octane fuels to describe the knocking characteristics over the speed range. Accelerate at maximum throttle from minimum obtainable speed as determined in 3d (1) (a) up to 3500 rpm if necessary in order to define requirements. These should be run to 60 mph (97 kph) unless required to terminate at 55 mph (88 kph) because of legal speed limits. If 3500 rpm cannot be attained in top gear, accelerations shall be discontinued and resumed in the next highest gear from 500 rpm below the engine speed at which top gear accelerations were determined.

When "A" knock is experienced, continue the acceleration but back off on the throttle to maintain "B" knock until just prior to the knock-out point.

Attachment 2

E. INTERPRETATION OF DATA

The data will be recorded on data sheet (DFMF-11-1180). Maximum octane requirements for all reference fuels shall be determined as follows:

1. If the knock intensity of the highest fuel giving knock is borderline, the requirement shall be reported as the octane number of that fuel.
2. If the knock intensity of the highest fuel giving knock is above borderline, the requirement shall be reported as one-half the difference between the fuel giving knock and the next highest fuel.

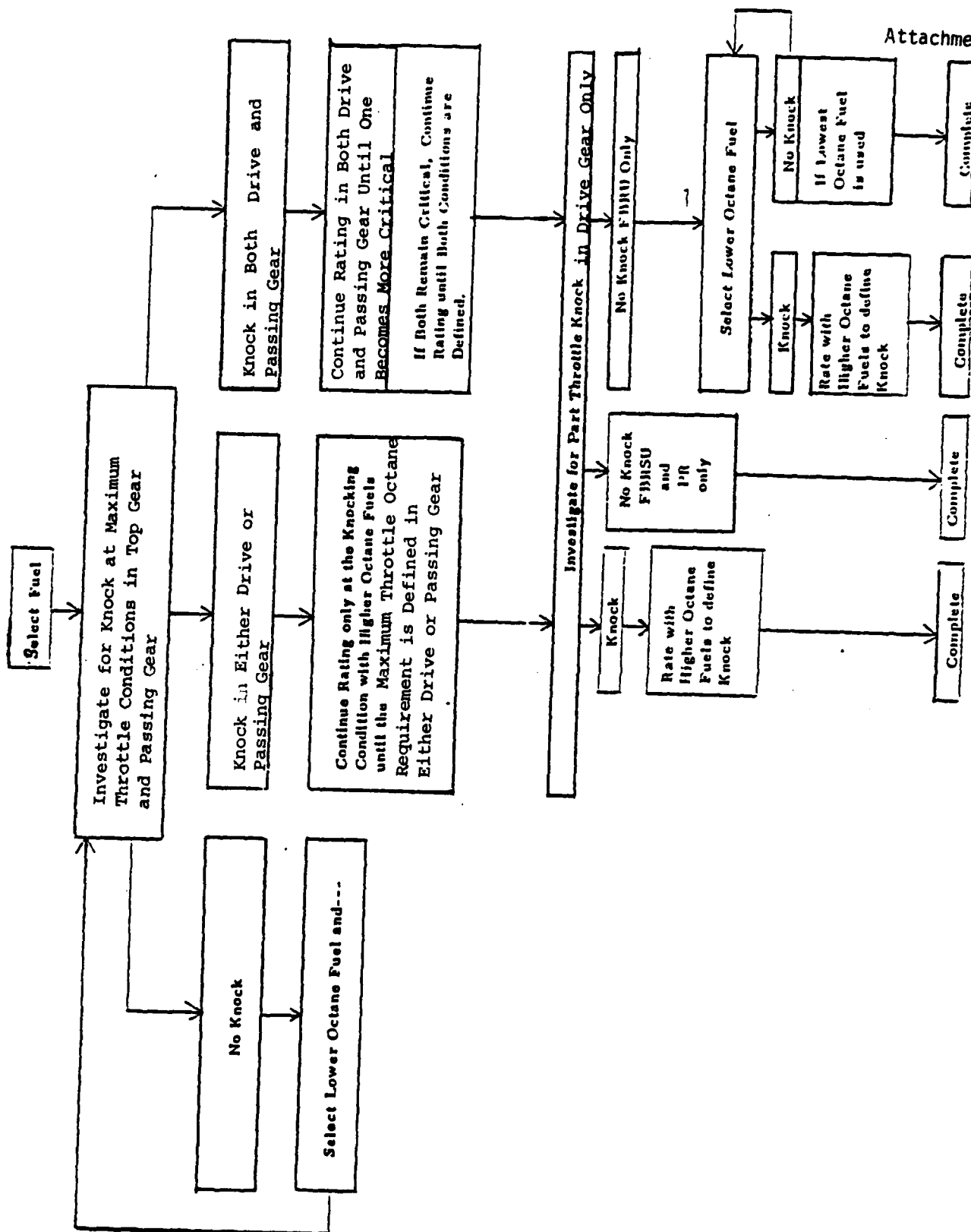
Speed range data shall be reported on data sheet (DFMF-11-1180) as the engine speed of knock-in and knock-out for the octane number of the primary reference fuel tested.

When transferring data to the summary report form, record "no" data as well as "yes" data.

Record data on all fuels tested, even though knock was not encountered. When transferring data to the summary report form (DFMF-15-1180), record results on all fuel series for each throttle condition investigated. Use proper letter designation (see footnotes on summary sheet) to designate requirements outside of the reference fuel limits.

Requirements for the various engine speeds will be determined by fitting a smooth curve through the knock-in and knock-out points on work form (DFMF-12-1180). Primary reference fuel requirements at various engine speeds should be reported to the nearest one-half octane number and recorded on the speed range summary sheets (DFMF-25-1180).

It is important that the vehicle identification number (VIN) of each vehicle tested be recorded on all data and summary sheets to provide a means of cross-indexing.



APPENDIX
CRC E-15-80

PROCEDURE FOR SETTING UP VEHICLES AND HANDLING
REFERENCE FUELS ON VEHICLES EQUIPPED WITH FUEL INJECTION

1. To run octane requirements on fuel injected vehicles it is necessary to run an external fuel line to the inlet of the vehicle fuel injection pump.
2. The fuel return line from the engine to the fuel tank must be disconnected after the fuel pressure regulator (in engine compartment) and before the fuel tank. An auxiliary line long enough to reach the cans must be added to the fuel return line.
3. Make certain that the fuel tank connections are plugged, this means both the normal fuel pump inlet line and the normal fuel return line connection. On vehicles with an in-tank booster pump, this pump must be shut off so it cannot run during the time the vehicle is operating on the external fuel system. If this pump is not disconnected, it will be destroyed.
4. An electric fuel pump (Bendix type acceptable) must be used to draw fuel from the reference fuel can to supply the fuel injection pump on the vehicle. Caution must be exercised to keep the fuel line between the reference fuel cans and the vehicle fuel injection pump full of fuel. If very much air gets into this line, the fuel injection system will become air bound and it is difficult to get the air out of the system.
5. Once the fuel injection pump line and return line have been disconnected, all subsequent operations must be done from an external fuel source.
6. It is possible to use three-way valves in the fuel line between the fuel pump and the fuel tank and between the return line and the fuel tank. When used, the operator must change the return line valve to the auxiliary fuel system while the engine is shut down, to avoid building up excessive pressure in the return line which could damage both the fuel pressure regulator and injection pump.
7. When changing from one reference fuel to another, the following steps must be followed:
 - a. Put fuel inlet line in reference fuel tank with the return line going to a slop fuel can. Do not keep fuel inlet line out of the fuel can any longer than is necessary to move it from one can to the next. DO NOT RUN OUT OF FUEL.

Attachment 2

- b. Observe the fuel stream in the fuel return line. As soon as a steady flow of fuel is observed, move the fuel return line to an empty one-quart can (0.946 l). Allow one quart (0.946 l) of fuel to flow into this can before inserting the return line into the chosen reference fuel can. This operation should take about 60 seconds.
- c. When going to the next reference fuel, it will be necessary to repeat Steps a and b.

The fuel injection pumps on most vehicles pump between 30 and 50 gallons (114-189 l/h) of fuel per hour. Therefore, Steps a and b should be followed very closely or there will be gross reference fuel contamination or you will use a lot more reference fuel than is required to run each test. If Steps a and b are followed exactly you will be discarding to slop about two quarts (1.892 l) of reference fuel each time you change reference fuels. The two quarts (1.892 l) to slop will be at least as much fuel as is consumed to get the reference fuel rating.

A P P E N D I X D

DATA ON 1980 FULL-BOILING RANGE REFERENCE FUELS

TABLE D-I

1980 UNLEADED AVERAGE SENSITIVITY FULL-BOILINGRANGE REFERENCE FUEL SERIES (FBRU)

<u>Research Octane No.</u>	<u>Blending Data Composition, Volume Percent</u>			<u>Motor Octane No.</u>
	<u>RMFD-326-80</u>	<u>RMFD-327-80</u>	<u>RMFD-328-80</u>	
78	96	4		74.5
80	81	19		75.9
82	65	35		77.5
84	49	51		78.9
85	40	60		79.7
86	32	68		80.4
87	24	76		81.0
88	15	85		81.7
89	7	93		82.3
90		98	2	83.0
91		89	11	83.6
92		81	19	84.2
93		72	28	84.8
94		63	37	85.5
95		54	46	86.1
96		45	55	86.7
97		36	64	87.3
98		26	74	88.1
99		17	83	88.8
100		7	93	89.6
101 (100.7)		-	100	90.3

TABLE D-II

1980 UNLEADED HIGH SENSITIVITY FULL-BOILING RANGEREFERENCE FUEL SERIES (FBRSU)

<u>Research Octane No.</u>	<u>Blending Data Composition, Volume Percent</u>			<u>Motor Octane No.</u>
	<u>RMFD-329-80</u>	<u>RMFD-330-80</u>	<u>RMFD-331-80</u>	
78	90	10		72.5
80	76	24		74.1
82	62	38		75.6
84	49	51		77.0
85	42	58		77.7
86	35	65		78.4
87	28	72		79.0
88	21	79		79.6
89	14	86		80.1
90	7	93		80.6
91		98	2	81.2
92		90	10	81.8
93		80	20	82.4
94		71	29	83.0
95		61	39	83.5
96		51	49	84.1
97		41	59	84.7
98		29	71	85.4
99		18	82	86.3
100		6	94	87.3
101 (100.5)			100	87.9

TABLE D-III

SENSITIVITIES OF 1980 FULL-BOILINGRANGE REFERENCE FUELS

<u>RON</u>	<u>FBRU</u>	<u>FBRSU</u>
78	3.5	5.5
80	4.1	5.9
82	4.5	6.4
84	5.1	7.0
85	5.3	7.3
86	5.6	7.6
87	6.0	8.0
88	6.3	8.4
89	6.7	8.9
90	7.0	9.4
91	7.4	9.8
92	7.8	10.2
93	8.2	10.6
94	8.5	11.0
95	8.9	11.5
96	9.3	11.9
97	9.7	12.3
98	9.9	12.6
99	10.2	12.7
100	10.4	12.7
101	(10.4)	(12.6)

TABLE D-IV

COMPARISON OF 1979 AND 1980 FUEL SENSITIVITIES

<u>Research Octane No.</u>	<u>FBRU</u>			<u>FBRSU</u>		
	<u>1980</u>	<u>1979</u>	<u>Difference</u>	<u>1980</u>	<u>1979</u>	<u>Difference</u>
78	3.5	3.8	-0.3	5.5	5.4	0.1
80	4.1	4.4	-0.3	5.9	6.3	-0.4
82	4.5	5.0	-0.5	6.4	6.8	-0.4
84	5.1	5.7	-0.6	7.0	7.4	-0.4
85	5.3	6.2	-0.9	7.3	7.6	-0.3
86	5.6	6.4	-0.8	7.6	8.0	-0.4
87	6.0	7.0	-1.0	8.0	8.4	-0.4
88	6.3	7.4	-0.9	8.4	8.7	-0.3
89	6.7	7.9	-1.2	8.9	9.0	-0.1
90	7.0	8.3	-1.3	9.4	9.5	-0.1
91	7.4	8.8	-1.4	9.8	9.8	0.0
92	7.8	9.2	-1.4	10.2	10.2	0.0
93	8.2	9.6	-1.4	10.6	10.6	0.0
94	8.5	9.8	-1.3	11.0	11.0	0.0
95	8.9	10.2	-1.3	11.5	11.2	0.3
96	9.3	10.4	-1.1	11.9	11.6	0.3
97	9.7	10.6	-0.9	12.3	11.7	0.6
98	9.9	10.9	-1.0	12.6	11.9	0.7
99	10.2	11.0	-0.8	12.7	11.9	0.8
100	10.4	11.2	-0.8	12.7	12.0	0.7
101	10.4	11.4	-1.0	12.6	12.2	0.4

TABLE D-V

FUEL INSPECTIONS1980 UNLEADED AVERAGE SENSITIVITY REFERENCE FUELS (FBRU)

<u>ASTM D-86</u>	<u>RMFD 326</u>	<u>RMFD 327</u>	<u>RMFD 328</u>
Distillation, °F			
1BP	106	106	114
10% Evap.	138	138	156
30% Evap.	182	164	198
50% Evap.	219	202	238
70% Evap.	243	256	257
90% Evap.	318	344	296
End Point	404	436	360
Gravity, °API	66.6	60.6	51.2
RVP, psi	8.0	7.1	6.9
Lead, g/gal.	0.009	0.015	0.013
Oxidation Stability, hr.	>24	>24	>24
<u>Hydrocarbon Type, Vol. %</u>			
Aromatics	12.7	18.2	50.8
Olefins	10.6	11.1	1.6
Saturates	76.7	70.7	47.6
Research Octane Number	77.1	89.9	100.9
Motor Octane Number	73.1	82.1	90.0
Sensitivity	4.0	7.8	10.9
Color	Clear	Green	Red

TABLE D-V
(Continued)

FUEL INSPECTIONS

1980 UNLEADED HIGH SENSITIVITY REFERENCE FUELS (FBRSU)

<u>ASTM D-86</u>	<u>RMFD 329</u>	<u>RMFD 330</u>	<u>RMFD 331</u>
Distillation, °F			
1BP	100	90	104
10% Evap.	146	124	152
30% Evap.	203	159	204
50% Evap.	262	214	240
70% Evap.	308	248	257
90% Evap.	388	353	294
End Point	420	430	398
Gravity, °API	53.1	63.5	46.2
RVP, psi	9.3	9.0	6.9
Lead, g/gal.	0.009	0.017	0.014
Oxidation Stability, hr.	>24	>24	>24
<u>Hydrocarbon Type, Vol. %</u>			
Aromatics	36.0	23.8	59.8
Olefins	18.2	26.5	12.4
Saturates	45.8	49.7	27.8
Research Octane Number	77.3	90.8	100.6
Motor Octane Number	71.2	80.9	87.7
Sensitivity	6.1	9.9	12.9
Color	Yellow	Purple	Blue

A P P E N D I X E

1980 OCTANE NUMBER REQUIREMENT SURVEY DATA

G L O S S A R Y

Emission Certification:	C	California
	F	Federal
	B	Both California and Altitude
Knock Sensor:	Y	Yes
	N	No
Transmission:	A	Automatic
	M	Manual
Air Conditioner:	Y	Yes
	N	No
Spark Advance:	+	Before Top Center
	-	After Top Center
Test Fuel:	1	Tank Fuel
	2	FBRU
	3	FBRU
	4	PR
Gear:	D	Drive, Automatic Transmissions
	P	Passing Gear, Automatic Transmissions
	1-5	Manual Transmissions
Octane Number Requirements: (expressed as Research O.N.)	L	Less than lowest available O.N. for FBRU and FBRU fuels and less than 76 for PR fuels
	H	Higher than highest available O.N. for FBRU and FBRU fuels and higher than 100 O.N. for PR fuels
Noise Type:	K	Spark knock only
	S	Surface ignition knock only
	B	Both K and S

Tank FuelOwner Report

Knock:	Y	Yes
	N	No
Objectionable:	Y	Yes
	N	No
After-Run:	Y	Yes
	N	No

Rater Report

Noise Intensity:	N	None
	B	Borderline
	A	Above borderline
Throttle:	M	If knock at maximum throttle
	MV	Manifold vacuum if knock at part-throttle
After-Run:	Y	Yes
	N	No

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION	
ORS LAB VEHICLE NO NO CODE	T E R M A C N T S C.R.	SPARK ADVANCE A I AS AS RCD TST MILES	HUM L	BARO	IMP	MAX PART THR	MAX FULL THR	OWNER	RATER
197 28 RA F16	F A 8.2	Y - 3 - 3 12026	82 29.24	138 3	L	78.5 K D 2700 1.0 1	80.0 K D 2200 1.0	N	N
192 28 RA F16	F A 8.2	Y + 5 + 3 26165	73 29.40	95 3	2	80.0 K D 2200 1.0	85.0 K P 2750 1.0	N	N
20 22 RA F16M	F M 8.2	Y - 3 - 3 5436	70 29.50	50 3	L	81.0 K 4 2400 0.0 1	83.0 K 4 2600 0.0	N	N
134 29 RA F16M	F M 8.2	N + 3 + 3 8552	68 30.24	55 3	L	80.0 K 4 2500	82.0 K 4 2500	N	N
158 44 RA F16M	F M 8.2	Y - 3 - 3 10535	69 29.54	63 3	88.0 K 4 1800 3	90.0 K 4 2200 1.0 1	91.0 K 4 2200 1.0	91.9 A3.3 R K 4 M	2250 N
372 26 RA F16M	F M 8.2	Y -15 + 3 18023	93 29.88	128 3	78.0 K 4 2100 2	83.0 K 4 2000 0.3 1	85.0 K 4 2100 0.3	93.4 84.3 N	N
80 6 DC 137	F A 8.4	Y +10 +12 11900	79 29.81	121 3	82.0 K D 1400 3	93.0 K D 1500 0.6 1	94.0 K D 1400 0.6	92.4 84.1 A K D M	1550 N
195 28 DC 137	F A 8.4	Y +12 +12 8102	84 29.28	142 3	89.0 K D 1350 0.2 1	89.0 K D 1350 0.2	89.0 K D 1300 0.2	N	N

MODEL DESCRIPTION										WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
T SPARK ADVANCE										F T G		N T G				K N T G			
A I AS AS ODOM										Y E		Y E				U O R			
RCD TST MILES										OCT P A		OCT P A				OCT NO			
T S C.R.										NO E R RPM		NO E R RPM				RES MOT			
HUM L										MV		MV				N T G			
												</							

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
OBS LAH VEHICLE NO NO CODE	T	E R M A C N T S C.R.	SPARK ADVANCE	I A S AS ODOM AMB RCD TST MILES TMP BARO HUM L	MAX PART THR	T G Y E P A NO E R RPM MV	MAX FULL THR	OWNER	N T G I Y E M N P A P T F R X M V RPM N	PATER
369 26 G6 460	F A 8.2	Y +18	16534	107 29.98	115 3	83.0 K D 1550	3	88.0 K D 1950 0.5 1 88.0 K D 1975 0.5 86.0 K D 1900 0.5	91.7 83.4 N	N
9 22 HLA 238	F A 8.0	Y +13	16580	70 29.27	51 3	84.5 K D 1800	3	92.5 K D 1900 1.5 1 94.5 K D 2000 1.3 90.0 K D 1900 1.5	A K D M	2150 N
35 4 HLV 225	F A 8.2	N +12	5880	80 29.12	60 3	87.0 K D 1400	5	91.0 K P 2300 1.2 1 N 92.0 K P 3550 1.2 90.0 K D 2250 1.2	N 92.2 83.5 B K D M	2400 N
298 7 HLV 225	F A 8.2	Y +12	7249	70 30.11	51 3	90.0 K D 2300	2	90.0 K D 2300 2.0 1 N 90.0 K D 2600 2.0 87.0 K P 2800 1.0	N 92.2 82.5 N	N
325 3 HLV 225	F A 8.2	Y +12	9874	76 29.87	75 3	91.0 K D 2200	3	91.0 K D 2700 0.7 1 94.0 K D 2700 0.7 89.0 K D 2700 0.7	N	N
343 46 HLV 225	C A 8.2	Y +12	9199	76 29.50	70 3	92.0 K D 2300 1.0 1 92.0 K D 2100 1.0 90.0 K D 2400 1.0			N	N
349 46 HLV 225	C A 8.2	Y +12	8470	77 29.20	74 3	80.0 K D 1900	4	91.0 K P 2250 1.0 1 92.0 K P 2400 1.0 88.0 K P 2150 1.0	A K P M	2200 N
128 29 HLS 225	F A 8.2	Y +10	9824	70 29.69	68 3	85.0 K D 1900	5	91.0 K D 2300 2.5 1 N 92.0 K D 2100 2.5 88.0 K D 2100 2.5	N 91.2 84.0 N	N

[illegible]

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
					MAX PART THR			OWNER		
					MAX FULL THR			RATER		

MODEL DESCRIPTION										WEATHER		OCTANE NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION	
T SPARK ADVANCE										F T G		N T G		K N		WATER	
E R A										U Y F		T G		F N A		N T G	
M A I AS AS ODOM AMR										E OCT P A		Y E		U O R		I Y E M	
C N R C D TST MILES TMP BARO HUM L										NO E P RPM		OCT P A		E C B U		N P A A P T	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T E R X M V R P M	
T S C.R. R										NO E P RPM		NO E R RPM		L K J N		R F S M O T T	

MODEL DESCRIPTION										WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
T SPARK ADVANCE												MAX PART THR		MAX FULL THR		OWNER		RATFR	
E R A										F		N T G		F N A		K N T G			
M A										U		Y E		U O R		J Y F M			
C N I AS AS ODOM AMR										E OCT P A		OCT P A		E C H U		OCT NO J Y F M			
T S C.R. R PCD TST MILES TMP BARO HUM L NO E R RPM MV										OCT P A		NO E R RPM		L K J N		RES MOT T F R X M V R P M N			

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION	
OHS LAH VEHICLE NO NO CODE	T E R M A C N T S C.R.	SPARK ADVANCE A I AS R RCD TST MILES	HARD HUM L	TEMP TMP	AMBIENT AMB	MAX PART THH	MAX FULL THH	OWNER	RATER		
427 41 KL 217	C A 8.2	Y +10 +10	531A	66	30.04	64 3	88.0 K D 2500 90.0 K D 2600 87.0 K D 2700	1		R K D	2 2200 Y
66 6 KL 217M	F M 8.2	N +13 +12	10A17	82	29.80	110 3	94.0 K 4 2200 2 98.0 K 4 2200 2 90.0 K 4 2100 0.8	1 Y N Y	94.3 A 3.7 A K 4	2 2200 N	
171 5 KL 217M	F M 8.2	N +10 +12	6464	73	29.80	61 3	89.0 K 4 1900 2 91.0 K 4 1800 2 89.0 K 4 1800 0.4				2
282 7 KL 217M	F M 8.2	N +12 +12	11200	67	29.94	58 3	94.0 K 4 2400 2 96.0 K 4 2300 2 91.0 K 4 2100 0.6	Y	91.2 A 3.3 N		Y
12 22 KC 137	F A 8.4	Y +10 +12	12796	70	29.4A	50 3	83.0 K D 1350 2 89.5 K D 1550 0.3 1 91.0 K D 1550 0.3 89.0 K D 1550 0.3			N	Y
106 6 KC 137	F A 8.4	N +12 +12	8265	69	30.05	64 3	95.0 K D 1600 3 97.0 K D 1500 1.2 94.5 K D 1500 1.2	Y	94.3 A 3.7 A K D M	1400 U	
142 29 KC 137	F A 8.4	Y +12 +12	12533	70	29.80	54 3	95.0 K D 1200 10 99.0 K D 1300 0.5 1 99.0 K D 1300 0.5 95.5 K D 1300 0.5		91.4 A 4.0 A K D M	10 1200 N	
167 5 KC 137	F A 8.4	Y +14 +12	6206	75	30.10	60 3	82.0 K D 1600 8 92.0 K P 2000 1.5 1 96.0 K D 2400 1.5 91.0 K P 1900 1.5	N	97.4 A 7.3 N		N

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
						</							

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
OBS NO	LAH VEHICLE CODE	T E R M A C N S C.R. R	SPARK ADVANCE I A S ODOM AMR R C D 1ST MILES TMP BARO HUM L	WIND DIRECTION WIND SPEED WIND GUST	MAX PART THR	MAX FULL THR	OWNER	RATER	OCT NO	RES	MOT	T E R X M V	N																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

MODEL DESCRIPTION										WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION						
T E R M A C N T S C.R. NO NO										SPARK ADVANCE A I AS AS R C D T S T M I L E S T M P B A R O		F U E H U M L		MAX PART THR		MAX FULL THR		OWNER		RATER		
												N T G Y F P A O C T N O E R R P M M V		N T G Y E P A O C T N O E R R P M M V		K F N A U O O R E C R U L K J N		N T G I Y E M N P A A P T T E R X M V R P M N				
102	6	LIA	238	F A 8.0	Y + 8 + 8	8850	74	29.93	68	3	97.0	K D 2050	3	100.0	K U 2200	2.0	I Y N N	94.7	83.8	A K D M	2000	N
									2						H	K D 2200	2.0					
									4						96.0	K D 2100	2.0					
140	29	LIA	238	F A 8.0	Y +15 +15	15820	70	29.81	52	3	87.0	K D 1800	3	93.0	K P 1900	1.0	1	92.1	83.4	A K P M	1800	N
									2						96.5	K P 3300	1.0					
									4						91.0	K P 1900	1.0					
144	29	LIA	238	F A 8.0	Y +15 +15	9821	70	30.17	52	3	90.0	K D 1750	4	94.0	K P 1700	1.5	1	91.8	84.0	A K D M	1750	N
									2						96.0	K P 1700	1.5					
									4						90.0	K P 1700	1.5					
154	44	LIA	238	B A 8.0	Y +15 +15	4462	80	29.34	83	3	96.0	K D 1400	8	95.0	K D 1700	2.0	1	91.2	83.4	R K D M	1900	N
									2						97.0	K D 1800	2.0					
									4						94.0	K D 1700	2.0					
168	5	LIA	238	F A 8.0	Y +15 +15	10819	75	30.07	68	3	89.0	K D 1500	10	93.0	K P 2700	1.5	1	91.6	83.1	A K D M	2000	N
									2						96.0	K D 1900	1.1					
									4						90.0	K D 1800	1.1					
207	28	LIA	238	F A 8.0	Y +15 +15	16191	66	29.20	86	3	92.0	K P 3300	1.0	1	92.0	K P 3300	1.0	1				
									2						95.0	K P 3200	1.0					
									4						91.0	K P 1800	1.0					
351	46	LIA	238	F A 8.0	Y + 5 + 5	7953	74	29.10	56	3	80.0	K P 1300	4	94.0	K D 1250	1.5	1					
									2						94.0	K D 1250	1.5					
									4						92.0	K D 1250	1.5					
361	26	LIA	238	F A 8.0	Y +13 +15	5480	99	29.98	114	3	87.0	K D 1500	3	93.0	K D 1750	0.8	1	98.3	87.0	N		
									2						96.0	K D 1650	0.8					
									4						92.0	K D 1600	0.8					

[illegible]

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION			
T E R M A C N T S C.R.		SPARK ADVANCE A I AS R RCD IST MILES		HUM L		F U E HUM L		N T G Y E OCT P A NO E R RPM		OWNER		RATE	
OPS LAM VEHICLE NO NO CODE													
232	23 L4 441	F A 8.0	Y +14 +15 6809	57 28.89	46 3	84.0 K D 2100	3	91.0 K P 2600 0.8 1 94.0 K P 2600 0.8 88.0 K P 2300 0.8	K F N A U O R E C B U L K J N	N N T G I Y F M N P A A P T T F R X M V R P H N			
377	26 L4 441	F A 8.0	Y +15 +15 12519	70 30.10	40 3	86.0 K D 2550	3	98.0 K P 3250 0.5 1 101.0 K P 3500 0.5 90.0 K P 2750 0.5		98.2 86.3 A K P M			3200 N
91	6 ML 223	F A 9.0	N + 6 + 6 18670	70 30.22	96 3	84.0 K D 2500	4	88.0 K D 2800 1.6 1 89.0 K D 2750 1.6 88.0 K D 2700 1.6		94.5 83.7			N
338	46 ML 223	F A 9.0	Y + 6 + 6 17006	76 29.60	42 3	82.0 K D 2300	3	89.0 K D 2550 1.0 1 90.0 K D 2550 1.0 88.0 K D 2400 1.0			N		N
63	6 MCA 133	F A 8.6	Y +11 +10 8355	79 29.98	93 3	92.0 K D 2300	4	95.0 K P 2800 2.0 1 96.0 K P 2300 1.2 94.0 K P 3000 2.2		94.8 83.4 A K P M			2500 N
84	6 MCA 133	F A 8.6	Y + 8 +10 15880	72 29.96	75 3	85.0 K D 2200	3	92.0 K P 2400 1.5 1 94.0 K P 2500 1.2 90.0 K P 2500 1.5		93.3 83.4			N
248	32 MCA 133	F A 8.6	Y +10 +10 5911	85 29.53	60 3	85.0 K D 2200	4	92.0 K D 2100 96.5 K P 3650 90.0 K P 2000	1 N	92.6 83.3 R K D M			2400 N
253	32 MCA 133	F A 8.6	Y +10 +10 11815	85 29.29	60 3			89.0 K P 2100 89.0 K P 3100 87.0 K P 2100	1 N Y	94.4 84.4 N			N

OHS LAH VEHICLE NO CODE	MODEL DESCRIPTION	WEATHER	OCTANE			NUMBER			REQUIREMENT DATA			TANK FUEL INFORMATION					
			MAX PART			THR			MAX FULL			OWNER					
			N			T G			N			K					
F U E L			F U E L			F U E L			F U E L			F U E L			F U E L		
I AS ODOM			I AS ODOM			I AS ODOM			I AS ODOM			I AS ODOM			I AS ODOM		
R CD TST MILES			R CD TST MILES			R CD TST MILES			R CD TST MILES			R CD TST MILES			R CD TST MILES		
HUM L			HUM L			HUM L			HUM L			HUM L			HUM L		
MUM L			MUM L			MUM L			MUM L			MUM L			MUM L		
NO E R RPM			NO E R RPM			NO E R RPM			NO E R RPM			NO E R RPM			NO E R RPM		
MV			MV			MV			MV			MV			MV		
OCT P A			OCT P A			OCT P A			OCT P A			OCT P A			OCT P A		
Y E			Y E			Y E			Y E			Y E			Y E		
T G			T G			T G			T G			T G			T G		
N			N			N			N			N			N		
85.0 K D 2000			85.0 K D 2000			85.0 K D 2000			85.0 K D 2000			85.0 K D 2000			85.0 K D 2000		
65 3			65 3			65 3			65 3			65 3			65 3		
2			2			2			2			2			2		
4			4			4			4			4			4		
87 29.30			87 29.30			87 29.30			87 29.30			87 29.30			87 29.30		
7689			7689			7689			7689			7689			7689		
Y +10 +10			Y +10 +10			Y +10 +10			Y +10 +10			Y +10 +10			Y +10 +10		
F A 8.6			F A 8.6			F A 8.6			F A 8.6			F A 8.6			F A 8.6		
255 32 MCA 133			255 32 MCA 133			255 32 MCA 133			255 32 MCA 133			255 32 MCA 133			255 32 MCA 133		
80 29.76			80 29.76			80 29.76			80 29.76			80 29.76			80 29.76		
54 3			54 3			54 3			54 3			54 3			54 3		
2			2			2			2			2			2		
4			4			4			4			4			4		
90.0 K D 2300 1.5			90.0 K D 2300 1.5			90.0 K D 2300 1.5			90.0 K D 2300 1.5			90.0 K D 2300 1.5			90.0 K D 2300 1.5		
95.0 K D 2400 1.5			95.0 K D 2400 1.5			95.0 K D 2400 1.5			95.0 K D 2400 1.5			95.0 K D 2400 1.5			95.0 K D 2400 1.5		
93.0 K D 2450 1.5			93.0 K D 2450 1.5			93.0 K D 2450 1.5			93.0 K D 2450 1.5			93.0 K D 2450 1.5			93.0 K D 2450 1.5		
92.0 K P 1925 0.5 1			92.0 K P 1925 0.5 1			92.0 K P 1925 0.5 1			92.0 K P 1925 0.5 1			92.0 K P 1925 0.5 1			92.0 K P 1925 0.5 1		
95.0 K P 1950 0.5			95.0 K P 1950 0.5			95.0 K P 1950 0.5			95.0 K P 1950 0.5			95.0 K P 1950 0.5			95.0 K P 1950 0.5		
88.0 K P 1950 0.5			88.0 K P 1950 0.5			88.0 K P 1950 0.5			88.0 K P 1950 0.5			88.0 K P 1950 0.5			88.0 K P 1950 0.5		
92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500		
93.0 K 4 2400			93.0 K 4 2400			93.0 K 4 2400			93.0 K 4 2400			93.0 K 4 2400			93.0 K 4 2400		
92.0 K 4 1450			92.0 K 4 1450			92.0 K 4 1450			92.0 K 4 1450			92.0 K 4 1450			92.0 K 4 1450		
92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500		
92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500		
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92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500		
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92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500			92.0 K 4 1500					

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MODEL DESCRIPTION				WEATHER		OCTANE NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION	
MODEL		DESCRIPTION		WEATHER		OCTANE NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION	
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MODEL		DESCRIPTION		WEATHER		OCTANE NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION	
MODEL		DESCRIPTION</									

MODEL DESCRIPTION				WEATHER		OCTANE		NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION					
T ER MA CN TS C.R.		SPARK ADVANCE		HUM BARO TMP AMB		F U E		N T G Y E O C T P A N O E R R P H M V		MAX PART THR		MAX FULL THR		OWNER		WATER	
		A I AS AS RCD TST MILES				OCT P A N O E R R P H M V		OCT P A N O E R R P H M V		OCT P A N O E R R P H M V		OCT P A N O E R R P H M V		OCT P A N O E R R P H M V		OCT P A N O E R R P H M V	
299	8 NL9 216	F A 8.6	N +18 +18 14998	80 29.89 100 3	84.0 K D 2600 5	88.0 K D 2950 2.0 88.0 K D 2950 2.0 84.0 K D 2900 2.0				Y N N	92.7 84.0 R K D M			3150 N			
47	4 NL9 216	F A 8.6	N +18 +18 6333	70 29.08 80 3	L	84.0 K D 3100 1.5 85.0 K D 3000 1.5 82.0 K D 2950 1.5				N	94.3 86.7 N						
92	6 NL9 216	F A 8.6	Y +18 +18 16070	86 30.00 121 3	80.0 K D 3250 3	95.0 K P 4300 2.0 98.0 K P 4300 2.0 87.0 K P 3450 1.5					92.8 83.1						
146	29 NL9 216	F A 8.6	Y +18 +18 11107	70 30.01 42 3	L	90.0 K D 3100 1.5 93.0 K D 3100 1.5 86.0 K D 2800 1.5					91.3 83.7 N						
321	3 NL9 216	F A 8.6	N +18 +18 8390	89 30.04 108 3	L	89.0 K D 3100 1.7 93.0 K D 3100 1.7 85.0 K D 3100 1.7				N	97.3 85.7 N						
354	26 NL9 216	F A 8.6	Y +18 +18 11696	94 29.90 119 3	84.0 K D 3725 3	93.0 K D 3800 0.4 97.0 K D 3800 0.4 86.0 K D 3800 0.4					92.0 82.3 A K D M			3700 N			
14	22 NL9 216M	F M 8.6	N +12 +12 9476	70 29.54 50 3	88.0 K 4 950 2	90.0 K 4 1750 0.0 91.0 K 4 1950 0.0 90.0 K 4 1400 0.0					R K 4 M			1600 N			
77	4 NL9 216M	F M 8.6	N +12 +12 11875	71 29.92 78 3	93.0 K 4 2550 2	93.0 K 4 1800 0.2 96.0 K 4 1700 0.2 95.0 K 4 1600 0.2				N	95.0 83.7 A K 4 M			2100 N			

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
ONS LAH VEHICLE NO NO CODE	T E R M A C N	SPARK ADVANCE A	I AS AS 000M R RCD TST MILES	AMP TMP BARO HUM L	F U E	N T G Y E O C T P A N O E R H P M M V	MAX PART THR	MAX FULL THR	OWNER	RATE
131 29 NLQ 216M	F M R.6	N +12 +12 11324	70 30.18	58 3	L	86.5 K 4 1900 0.5 1 N	91.5 83.2 N	N		
				2		90.0 K 4 2000 0.5				
				4		82.0 K 4 2200 0.5				
239 23 NLQ 216M	F M R.6	Y +11 +12 6639	66 28.85	78 3	85.0 K 4 1500 2	90.0 K 3 1700 0.1 1				
				2		92.0 K 3 1700 0.1				
				4		90.0 K 3 1600 0.1				
271 7 NLQ 216M	F M R.6	Y +12 +12 6767	70 30.11	50 3	89.0 K 4 2700 2	89.0 K 4 2700 1.2 1 Y Y N	94.2 84.5 R K 4 M			
				2		89.0 K 4 2600 1.2				
				4		88.0 K 4 2100 1.2				
348 46 NLQ 216M	F M R.6	Y +12 +12 14670	78 29.60	86 3	L	89.0 K 4 1600 1.0 1				
				2		91.0 K 4 1700 1.0				
				4		88.0 K 4 1900 1.0				
421 41 NLQ 216M	C M R.6	N +12 +12 12311	70 29.97	52 3	91.0 K 4 1600 2	90.0 K 4 2050 1				
				2		92.0 K 4 2850				
				4		90.0 K 4 2150				
17 22 NC5 225	F A R.2	Y +10 +10 23003	70 29.45	50 3	L	82.5 K P 3150 0.4 1				
				2		88.5 K P 3400 0.4				
				4		82.0 K P 3100 0.4				
28 4 NC5 225	C A R.2	Y +6 +6 8924	85 29.08	102 3	85.0 K 0 1800 6	90.0 K 0 2500 1.0 1 N	91.3 83.9 N			
				2		91.0 K 0 2250 1.0				
				4		86.0 K 0 2400 1.0				
55 4 NC5 225	F A R.2	N +10 +10 18349	67 29.27	66 3	L	89.0 K P 2650 1.5 1 N	92.7 83.9 N			
				2		92.0 K P 2400 1.5				
				4		87.0 K P 2700 1.5				

MODEL	DESCRIPTION	WEATHER	OCTANE			NUMBER			REQUIREMENT DATA			TANK FUEL INFORMATION		
			MAX PART THR			MAX FULL THR			OWNER			RATER		
OHS LAH VEHICLE NO NO CODE	T E R M A C N T S C.R. R I A S R C D T S T MILES	SPARK ADVANCE	F U E	T G Y E	OCT P A	NO E R RPM	MV	N	T G Y E	OCT P A	NO E R RPM	F N A U O O R C B U L K J N	OCT NO	I Y F M N P A A P T M O T T E R X M V R P M
9A 6 NCS 225	F A 8.2 Y +10 +10 17018	71 30.07	58 3	86.0 K D 2250	4	93.0 K P 2800 1.5	1	N	94.8 A 3.7 A K P M	3000 N				
			2			96.0 K P 2900 1.5								
			4			90.0 K P 2600 1.5								
169 29 NCS 225	F A 8.2 Y +10 +10 36375	69 30.32	38 3	87.0 K D 1900	4	94.0 K D 2100 1.5	1	N	92.3 A 3.8 A K D M	2100 N				
			2			95.0 K D 2100								
			4			89.0 K D 2050								
155 44 NCS 225	F A 8.2 Y +10 +10 6404	72 29.59	67 3	88.0 K D 2200	4	93.0 K D 2600 1.5	1	N	90.0 A 2.9 A K D M	2700 N				
			2			95.0 K D 2800 1.5								
			4			90.0 K D 2600 1.5								
169 5 NCS 225	F A 8.2 N +10 +10 12874	75 30.30	62 3	L		91.0 K P 3000 0.8	1	N	91.8 A 3.2 A K P M	3000 N				
			2			94.0 K P 3200 0.8								
			4			90.0 K P 2500 0.8								
223 23 NCS 225	F A 8.2 Y +10 +10 12468	68 29.19	74 3	82.0 K D 2100	3	91.0 K P 2200 0.8	1	N	8 K P M	2200 N				
			2			93.0 K P 2200 0.8								
			4			90.0 K P 2200 0.8								
270 7 NCS 225	F A 8.2 Y +11 +10 15481	80 29.94	76 3	91.0 K D 2400	2	93.0 K P 2900 0.7	1	Y Y N	92.5 A 3.0	N				
			2			95.0 K P 2800 0.7								
			4			89.0 K P 2800 0.7								
297 7 NCS 225	F A 8.2 Y +10 +10 20920	76 30.07	64 3	96.0 K D 2500	2	98.0 K P 3400 0.9	1	Y Y Y	92.2 A 3.1 A K P M	3500 Y				
			2			98.0 K D 2700 1.0								
			4			92.0 K D 2800 1.0								
10A 8 NCS 225	F A 8.2 Y +10 +10 27801	80 29.62	89 3	L		84.0 K D 2150 2.0	1	N	92.7 A 3.1 A N	N				
			2			84.0 K D 2150 2.0								
			4			84.0 K D 2300 2.0								

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MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION	
OHS LAH VEHICLE NO NO	CODE	T S C.R. R	CD TST MILES	AMP	HUM	MAX PART THR		MAX FULL THR		OWNER	DATE
						N	T G	N	T G		
						F	T G	F	T G	K	N
						U	Y E	U	Y E	O D R	O C T N O
						E	O C T P A	O C T P A	O C T P A	E C H U	I Y E M
						L	N O E R P M	N O E R P M	N O E R P M	L K J N	M O T T F R X M V R P M

[illegible]

MODEL	DESCRIPTION	WEATHER	OCTANE NUMBER			REQUIREMENT DATA			TANK FUEL INFORMATION		
			MAX PART THR			MAX FULL THR			OWNER		
			N			N			K		
ORS LAY VEHICLE NO NO CODE	T E R M A C N T S C.R.	SPARK ADVANCE A I AS R RCU TST MILES TMP RARO	F U E HIM L	T G Y E P A NO E R RPM	M V	O C T P A NO E R PPM	M V	M V	F N U O R E C B U L K J N	A O C T NO R E S	N T G I Y E M N P A A P T M O T T F R X M V R P M N
331 46 NIJ 244	F A 8.3	Y + 4 + 4 12293 78 29.55	58 3	86.0 K D 1700	4	91.0 K D 1750 1.5 1					1750 N
			2			91.0 K D 1750 1.5					
			4			89.0 K D 1650 1.5					
334 46 NIJ 244	F A 8.3	Y + 4 + 4 12960 74 29.70	88 3	88.0 K D 1650	4	93.0 K D 1650 1.5 1					1700 N
			2			92.0 K D 1650 1.5					
			4			91.0 K D 1650 1.5					
336 46 NIJ 244	F A 8.3	Y + 4 + 4 12611 76 29.61	42 3	86.0 K D 1800	4	93.0 K D 1800 1.5 1					1950 N
			2			93.0 K D 1900 1.5					
			4			90.0 K D 1850 1.5					
344 46 NIJ 244	F A 8.3	Y + 4 + 4 10194 78 29.66	49 3	84.0 K D 1900	4	91.0 K D 1900 1.5 1					1850 N
			2			90.0 K D 1900 1.5					
			4			89.0 K D 1900 1.5					
345 46 NIJ 244	F A 8.3	Y + 4 + 4 17262 74 29.63	74 3	88.0 K D 1750	4	93.0 K D 1700 1.0 1					1700 N
			2			93.0 K D 1700 1.0					
			4			91.0 K D 1700 1.0					
347 46 NIJ 244	F A 8.3	Y + 4 + 4 8612 78 29.26	76 3	89.0 K D 1800	3	96.0 K D 1900 1.0 1					1800 N
			2			96.0 K D 1900 1.0					
			4			92.0 K D 1800 1.0					
57 4 NIK 238	F A 8.6	Y +10 +10 11064 73 29.40	47 3	89.0 K D 1300	6	91.0 K D 1800 1.5 1 N				93.3 A3.9 N	N
			2			94.0 K D 2050 1.5					
			4			90.0 K D 1800 1.5					
111 6 NIK 238	F A 8.6	Y +10 +10 18980 73 29.97	86 3	87.0 K D 2000	3	89.0 K D 2000 2.0 1				93.0 A3.9	N
			2			90.0 K D 1900 2.0					
			4			89.0 K D 1800 1.8					

MODEL DESCRIPTION										WEATHER		OCTANE				NUMBER				REQUIREMENT DATA				TANK FUEL INFORMATION																				
T SPARK ADVANCE										F		N		T G		Y F		OCT P A		NO E R RPM		MV		MAX FULL		THR		OWNER		RATFR														
E R A										U		Y		Y E		OCT P A		NO E R RPM		MV		MAX FULL		THR		K		N T G																
M A										E		Y		Y E		OCT P A		NO E R RPM		MV		MAX FULL		THR		U O O R		I Y E M																
C N I A S ODDM AMR										L		N		N		OCT P A		NO E R RPM		MV		MAX FULL		THR		E C H U		N P A A P T																
T S C.P. R RCD TST MILES TMP HARO HUM										H		N		N		OCT P A		NO E R RPM		MV		MAX FULL		THR		L K J N		W E S M O T T E R X M V R P M N																
OHS LAH VEHICLE										H		N		N		OCT P A		NO E R RPM		MV		MAX FULL		THR		K		N T G																
NO NO CODE										H		N		N		OCT P A		NO E R RPM		MV		MAX FULL		THR		L K J N		W E S M O T T E R X M V R P M N																
206	28	NIK	238	F	A	8.6	Y	+10	+10	15921	64	29.44	71	3	90.0	K	D	1700	2	91.0	K	P	3400	0.3	1	94.0	K	D	1900	0.5	1	Y	Y	N	91.7	A	2.5	A	K	D	M	2200	N	
210	28	NIK	238	F	A	8.6	Y	+10	+10	20498	64	29.50	76	3	92.0	K	D	1800	2	93.0	K	P	3400	0.3	1	95.0	K	D	2050	0.5	1	Y	Y	N	91.7	A	2.5	A	K	D	M	2200	N	
221	23	NIK	238	F	A	8.6	Y	+8	+10	7046	73	29.23	67	3	88.0	K	D	1200	4	92.0	K	D	1700	1.0	1	93.0	K	D	1200	2.6	1	Y	Y	N	91.7	A	2.5	A	K	D	M	1700	N	
241	23	NIK	238	F	A	8.6	Y	+10	+10	8393	65		3	85.0	K	D	1600	3	90.0	K	D	1800	1.0	1	91.0	K	D	1800	1.0	1	Y	Y	N	91.7	A	2.5	A	K	D	M	1700	N		
300	8	NIK	238	F	A	8.6	Y	+10	+10	15299	80	29.90	69	3	84.0	K	D	1450	6	88.0	K	D	1800	2.0	1	90.0	K	D	1800	2.0	1	Y	Y	N	91.7	A	2.5	A	K	D	M	1700	N	
323	3	NIK	238	F	A	8.6	Y	+10	+10	8925	75	30.12	67	3	90.0	K	D	2100	3	92.0	K	P	3200	1.7	1	95.0	K	P	3200	1.7	1	Y	Y	N	91.7	A	2.5	A	K	D	M	1700	N	
375	26	NIK	238	F	A	8.6	Y	+10	+10	7186	81	30.02	57	3	84.0	K	D	1600	3	90.0	K	D	1775	0.6	1	93.0	K	P	3550	0.4	1	Y	Y	N	91.7	A	2.5	A	K	D	M	1700	N	
228	23	NIK	238	F	A	8.0	Y	+16	+15	13459	70	29.02	58	3	80.0	K	D	1600	4	94.0	K	P	2800	1.4	1	100.0	K	P	2800	1.4	1	Y	Y	N	91.7	A	2.5	A	K	D	M	1700	N	

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
ORS LAH VEHICLE NO NO CODE	T E R M A	SPARK ADVANCE A	I AS AS ODOM AMB R RCD TST MILES TMP HARD HUM L	MAX PART THR	MAX FULL THR	OWNER	WATER			
236 23 NSR 457	F A 8.2	Y • 6 • 6	7642 50 28.99	54 3	87.0 K D 1400 3.0 1 90.0 K D 1500 3.0 87.0 K D 1400 3.0	4	89.0 K D 1400 3.0 1 90.0 K D 1500 3.0 87.0 K D 1400 3.0	N	N	N
132 29 NA 218	F A 8.0	Y • 13 • 13	12709 70 30.18	59 3	84.0 K D 1700 7	2	89.0 K D 2000 1.5 1 90.0 K D 1900 1.5 86.0 K D 1800 1.5	92.1	83.7	N
14 22 NH 450	F A 8.6	Y • 4 • 4	9572 70 29.45	50 3	93.0 K D 1200 3	2	95.0 K P 1900 0.8 1 96.0 K P 1950 0.8 93.0 K P 1800 1.0	A	K D M	1800 N
204 28 NH 450	F A 8.6	Y • 4 • 4	17130 66 29.57	64 3	93.0 K D 1050 3	2	94.0 K P 2500 1.0 1 97.0 K D 1150 3 92.0 K D 1000 3	A	K P M	2750 N
370 26 NH 450	F A 8.6	Y • 4 • 4	6574 89 29.98	134 3	83.0 K D 1350 4	2	95.0 K P 1800 0.7 1 98.0 K P 1825 0.4 92.0 K P 1750 0.7	98.2	86.4	N
100 6 NJ 244	F A 8.3	Y • 2 • 2	15830 69 30.11	60 3	89.0 K D 1700 3	2	90.0 K D 1800 1.8 1 91.0 K D 1800 1.8 90.0 K D 1700 1.8	94.6	83.7	N
108 6 NJ 244	F A 8.3	Y • 4 • 4	17360 68 29.76	80 3	80.0 K D 1700 4	2	90.0 K D 1700 2.0 1 90.0 K D 1900 2.0 88.0 K D 1700 1.5	92.0	83.4	Y
124 29 NJ 244	F A 8.3	Y • 6 • 6	9106 70 30.07	64 3	84.0 K D 1750 5	2	89.0 K D 1900 1.0 1 N 90.0 K D 1950 1.0 84.5 K D 1650 1.0	92.0	83.8	N

OHS LAH VEHICLE NO NO CODE	MODEL DESCRIPTION	WEATHER	OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
			MAX PART THR	MAX FULL THR	OWNER	HATER				
	T ER MA CN TS C.R.	SPARK ADVANCE A I AS AS ODOM AMR RCD TST MILES TMP HARO	N TG YF OCT PA NO E RPM	N TG YE OCT PA NO E RPM	K FN A U O O R E C B U L K J N	N N T G I Y E M N P A A P T M O T Y E R X M V H P M				
179 5 NK 238	F A 8.6	Y +10 +10 5107 73 30.30	54 3 2 4	90.0 K D 1100 R 95.0 K D 1100 R 90.0 K P 1500 1.5	1 N N N	93.2 R 3.2 R K D	A 1000 N			
227 23 NK 238	F A 8.6	Y +10 +10 8305 58 29.08	66 3 2 4	89.0 K D 1800 1.3 I 90.0 K P 1900 0.6 89.0 K P 1800 0.6	1 N		N			
233 23 NK 238	F A 8.6	Y +10 +10 15684 54 29.08	38 3 2 4	90.0 K P 1900 0.5 I 92.0 K P 1900 0.5 90.0 K P 1800 0.5	N		N			
320 3 NK 238	F A 8.6	Y +10 +10 6494 84 30.10	57 3 2 4	87.0 K D 2400 1.0 I 88.0 K D 2400 1.0 86.0 K D 2400 1.0	N		N			
391 47 NK 238	C A 8.6	Y +12 +10 13100 70 29.66	50 3 2 4	90.0 K D 2000 1.0 I 92.0 K D 1850 1.0 90.0 K D 1850 1.0	1 Y N Y		N			
256 32 OL 223	F A 9.0	N +19 +17 9047 85 29.10	68 3 2 4	85.0 K P 3000 88.0 K P 4000 85.0 K D 3100	1 N Y		N			
264 32 OL 223	F A 9.0	Y + 8 + 6 7918 86 29.54	64 3 2 4	89.0 K D 3000 90.0 K D 3000 87.0 K D 2850	1 N Y		N			
259 32 OL 223M	F M 9.0	N + 2 + 6 6986 85 29.55	62 3 2 4	90.0 K 4 1600 90.0 K 4 1900 89.0 K 4 1600	1 N N		N			

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
ORS LAM VEHICLE NO NO CODE	T E R M A C N	SPARK ADVANCE A I AS AS ODOM RCD TST MILES TMP BARO HUM L	MAX PART THR	MAX FULL THR	OWNER	RATER	N T G Y E P A NO E R RPM MV	OCT NO RES MOT T E R X M V RPM	N T G Y F M P A A P T T E R X M V RPM	N
267 32 OL 223M	F M 9.0	Y + 4 + 6 31177 85 29.45	64 3	90.0 K 4 1600	3	95.0 K 4 1600	95.0 K 4 1700	95.0 K 4 1600	1 N Y	N
30 4 OCA 133	F A 8.6	N +10 +10 5545 80 29.08	63 3	86.0 K 0 2350	5	88.0 K P 2300 1.9	91.0 K P 2450 1.9	86.0 K P 2250 1.9	1 N	N
165 5 OCA 133	F A 8.6	Y +14 +10 4641 72 30.24	63 3	82.0 K 0 2000	4	89.0 K P 2200 1.1	93.0 K 0 2300 1.4	90.0 K P 2000 1.1	1 N	N
319 3 OCA 133	F A 8.6	Y +10 +10 6840 79 29.97	75 3	L	2	96.0 K P 2500 1.5	96.0 K P 2500 1.5	92.0 K P 2500 1.5	1 Y N N	2500 N
389 47 OCA 133	C A 8.6	Y + 6 +10 13216 70 29.75	50 3	L	2	91.0 K P 3350 1.5	96.5 K P 2250 1.5	89.5 K P 2250 1.5		
29 4 OCA 223	F A 9.0	N + 6 + 6 5728 82 29.16	58 3	82.0 K 0 2200	5	90.0 K P 3700 1.7	91.0 K P 3300 1.7	89.0 K 0 3000 1.7	1 N	N
58 30 OCA 223	F A 9.0	N + 6 + 6 6199 71 29.52	58 3		2	87.5 K 0 2830 2.0	89.5 K 0 2830 2.0	85.5 K 0 2780 2.0	1 Y N N	91.5 A3.7 N
61 30 OCA 223	F A 9.0	Y + 4 + 4 4404 49 29.42	62 3		2	94.5 K 0 2900 1.5	97.0 K 0 3010 1.0	95.0 K 0 2360 2.0	1 Y Y	90.9 A1.4 A K 0 M
			4		4					2500 N

ORS LAH VEHICLE NO NO CODE	MODEL DESCRIPTION	WEATHER	OCTANE			NUMBER			REQUIREMENT DATA			TANK FUEL INFORMATION												
			MAX PART			THR			MAX FULL			OWNER												
			N			T G			N			K												
			F	T G	Y E							F N A	O C T NO	O C T NO	N T G	A								
			U	Y E								U O O R			I Y E M	R								
			E	O C T P A								E C R U			N P A A P T	U								
			H U M L	N O E R R P M	M V							L K J N	RES	MOT	T E R X M V	R P M N								
52	4 OCA 223M	F M 9.0	N + 6 + 6	10039	79	20.08	112	3	80.0	K 4	1400	3	90.0	K 4	1500	0.5	1	N	91.1	83.5	R K 4	M	1300	N

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER		REQUIREMENT DATA		TANK FUEL INFORMATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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200 28 OCA 242	F A 8.8	Y + 6 + 6	16958	77	29.44	110	3	87.0 K D 1700	3	88.0 K P 1800	0.5	1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												</

OHS LAB VEHICLE NO NO CODE	MODEL DESCRIPTION	WEATHER	OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
			MAX PART THR		MAX FULL THR		OWNER	RATER		
			N	T G	N	T G		N	T G	A
			F	U	F	U	F N A	OCT NO	I Y E M	R
			E	OCT P A	OCT P A	Y E	U O U R		N P A A P T	U
			HUM L	NO E R RPM	NO E R RPM	MV	E C R U	RES	MOT	T F R X M V RPM
							L K J N			
340 46 OCA 242	F A 8.8 Y + 6 + 6 17374 75 29.4A 41 3	91.5 K D 1700 3	94.0 K D 1750 1.0 1	95.5 K D 1750 1.0	93.0 K D 1750 1.0					1750 N
359 26 OCA 242	F A 8.8 Y + 4 + 6 8076 93 29.8A 195 3	90.0 K D 1700 3	93.0 K D 1775 0.7 1	94.0 K D 1750 0.7	91.5 K P 1775 0.3			98.3 86.8 N		N
280 7 OCR 141	F A 8.6 Y + 10 + 10 6917 70 30.20 54 3	96.0 K D 2000 3	96.0 K D 2300 1.5 1	97.0 K D 2300 1.5	91.0 K D 2300 1.5					3 2400 N
244 32 OI 242	F A 8.8 Y + 2 + 6 12727 85 29.42 67 3	90.0 K D 6	93.0 K D	94.0 K D	93.0 K D 1850					N
366 26 OI 242	F A 8.8 Y + 3 + 6 17326 79 30.03 107 3	86.0 K D 1775 3	92.0 K P 1750 0.2 1	95.0 K P 1700 0.2	92.0 K P 1725 0.2			91.6 82.8 A K P M		1700 N
423 41 OI V242	F A 8.8 Y 0 + 6 18478 76 30.10 66 3	94.0 K D 1700 3	93.0 K D 1800	94.0 K D 1800	93.0 K D 1800					1850 N
43 4 OI 250	F A 8.4 Y + 10 + 10 9505 70 29.20 71 3	90.0 K D 1300 4	91.0 K D 1250 1.5 1	92.0 K D 1300 1.5	88.0 K D 1300 1.5					1250 N
242 32 OI 250	F A 8.4 Y + 8 + 8 12000 85 29.34 69 3	93.0 K D 1900 4	94.0 K D 2000	97.0 K D 2000	91.0 K D 1950					N

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FULL INFORMATION			
ORC NO	LAH VEHICLE CODE	T E R M A C N T S C.R.	SPARK ADVANCE A	I AS R RCD TST MILES	AMB TMP HARD	HUM L	F U E	N T G Y E O C T P A N O E R P M	MAX PART THP	MAX FULL THP	OWNER	RATER
420	41 01 V250	C A 8.4	Y + 8 + 8	13805	67 30.32	50 3	2	91.0 K D 1950 3.0 1	4	92.0 K D 1950 3.0	N	N
						4		91.0 K D 1925 3.0				
44	4 0 V250	F A 8.4	Y + 5 + 5	11977	67 29.24	45 3	2	91.0 K D 2100 1.6 1	4	92.0 K D 2000 1.6	N	N
						4		90.0 K P 1600 3.0				
114	6 0 V250	F A 8.4	Y + 6 + 6	8275	69 29.88	76 3	2	88.0 K D 2100 1.8 1	4	89.0 K D 1800 1.8	93.2 83.1	N
						4		88.0 K D 2100 1.8				
164	5 0 V250	F A 8.4	Y + 6 + 6	6836	71 30.30	56 3	2	91.0 K D 2000 1.5 1	4	92.0 K D 2000 1.5	N	1900 N
						4		91.0 K P 1900 1.0				
189	28 0 V250	F A 8.4	Y + 8 + 8	14950	78 29.35	120 3	2	94.0 K D 900 2.5 1	4	93.0 K D 900 2.5	R K D M	3 1000 N
						4		94.0 K D 900 2.5				
193	28 0 V250	F A 8.4	Y + 8 + 8	16790	73 29.40	95 3	2	94.0 K D 1000 2.5 1	4	94.0 K D 1050 2.5	N	1000 N
						4		91.0 K D 900 2.5				
212	28 0 V250	F A 8.4	Y + 8 + 8	17419	54 29.48	47 3	2	93.0 K D 2800 3.0 1	4	94.0 K D 900 3.0	A K D M	900 N
						4		81.0 K P 1150 3.0				
251	32 0 V250	F A 8.4	Y + 12 + 6	6489	85 29.18	68 3	2	89.0 K P 1800	4	90.0 K D 1950	N	N
						4		90.0 K P 1750				

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
OHS LAR VEHICLE NO NO CODE	T E R M A C N T S C.R.	SPARK ADVANCE A I AS AS ODOM RCD TST MILES TMP BARO HUM L	MAX PART THR	N T G Y E OCT P A NO E R RPM	MAX FULL THR	N T G Y E OCT P A NO E R RPM	OWNER	RATFR		
273 7 0 V250	F A R.4	Y * 5 * 6 12275 70 30.08 48 3	93.0 K D 2000	2	95.0 K D 2100 1.5 1 95.0 K D 2100 1.5 93.0 K D 2200 1.5	92.5 R4.2				N
276 7 0 V250	F A R.4	Y * 6 * 6 7440 80 30.26 58 3	94.0 K D 2000	2	96.0 K D 1900 1.3 1 Y N N 96.0 K D 1900 1.3 93.0 K D 1900 1.3	93.0 R3.8 A K P M				2 1600 N
361 7 6 0 V250	F A R.4	Y * 8 * 8 9932 96 30.02 116 3	93.0 K D 1150	3	90.0 K D 1250 0.9 1	98.3 R6.8 N				N
404 3 0 V250	F A R.4	Y * 6 * 6 17229 63 30.65 10 3	86.0 K D 1500	3	95.0 K D 1800 1.0 1 Y N N 85.0 K D 1500 3 94.0 K D 1800 1.0	91.8 R3.2 A K D M				1800 N
296 7 0 W V250	F A R.3	Y * 10 * 10 24141 70 29.92 50 3	94.0 K D 1350	10	94.0 K P 2350 1.6 1 Y Y N 97.0 K P 1600 1.6 93.0 K D 1400 1.1	92.2 R2.1 A K P M				3600 N
394 47 0 W V250	C A R.3	Y * 10 * 10 10250 70 29.65 50 3	95.0 K D 2500	3	95.0 K D 2350 1.0 1 Y Y N 98.5 K P 3150 1.5 91.0 K D 1750 1.0	A K P M				2750 N
31 4 PL 217	F A R.2	Y * 8 * 12 5402 74 29.07 103 3	L		82.0 K D 2400 1.5 1 N 84.0 K P 2550 1.5 82.0 K P 2500 1.5	94.6 R3.3 N				N
112 4 PL 217	F A R.2	N * 12 * 12 14000 74 29.99 85 3	89.0 K D 2300	4	93.0 K D 2700 1.2 1 N 97.0 K D 2850 1.2 87.0 K D 2500 1.2	94.8 R4.6 A K D M				2700 N

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
OHS LAH VEHICLE NO NO CODE	T E R M A C N T S C.P.	SPARK ADVANCE A I AS AS ODUM R RCD TST MILES R RCD TST MILES	HIM L	HARO	T F U E L	N T G Y E P A O C T N O	M V R P M	M V R P M	O W N E R	R A T E R
390 47 PL 217	C A 8.2	Y + 5 + 5 12960	50 3	70 29.70	3	83.0 K D 1900	3	88.0 K D 2000 1.0 1	N	N
			2					90.0 K D 2000 1.0		
			4					89.0 K D 2100 1.0		
393 47 PL 217	C A 8.2	Y + 12 + 10 6800	50 3	70 29.74	3	82.0 K D 1900	3	86.0 K D 2150 1.0 1		
			2					88.0 K D 2600 1.0		
			4					83.0 K D 2350 1.0		
400 47 PL 217	C A 8.2	Y + 8 + 10 7000	40 3	70 29.30	3	83.0 K D 2000	3	84.5 K D 2950 1.0 1		
			2					86.0 K D 2950 1.0		
			4					83.0 K D 2500 1.0		
417 41 PL 217	C A 8.2	Y + 14 + 10 7631	62 3	67 30.00	3			90.0 K D 2700 2.5 1	N	N
			2					91.0 K D 2400 2.5		
			4					90.0 K D 2600 2.5		
10 22 PL 217M	F M 8.2	N + 12 + 12 7300	50 3	70 29.17	3	79.0 K 4 2200	3	82.0 K 4 1800 0.1 1	N	N
			2					83.0 K 4 1900 0.1		
			4					82.0 K 4 2050 0.1		
70 6 PL 217M	F M 8.2	Y + 12 + 12 11639	102 3	83 30.09	2	90.0 K 4 1800	2	89.0 K 4 1900 0.4 1	N	N
			2					92.0 K 3 2100 0.6		
			4					88.0 K 4 2000 0.4		
81 6 PL 217M	F M 8.2	Y + 12 + 12 14610	70 30.12		3	88.0 K 4 1800	3	89.0 K 4 1900 0.6 1	N	N
			2					91.0 K 4 2200 0.6		
			4					88.0 K 4 1800 0.6		
174 5 PL 217M	F M 8.2	N + 12 + 12 9156	54 3	71 29.96	2	87.0 K 4 2200	2	89.0 K 4 2100 0.6 1	N	N
			2					93.0 K 4 2000 0.6		
			4					87.0 K 4 1900 0.6		

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
T SPARK ADVANCE					MAX PART THR			OWNER		
E R A					MAX FULL THR			PATER		
M A										
I AS										
R CD										
T S C.R.										
MILES										
TMP										
HARO										
HUM										
L										
NO E R PPM										
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MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION					
T E R M A C N T S C.R. CODE				SPARK ADVANCE		HUM L		MAX PART THR		MAX FULL THR		OWNER		RATER	
				A	AS	ODOM	AMR	F	U	N	T G	F N	A	K	N
OPS LAH VEHICLE				I AS		R HCD TST MILES		NO E P A		OCT P A		U O D R		OCT NO	
NO NO				R		TMP HARO		NO E P RPM		NO E R RPM		E C H U		N P A A P T	
												L K J N		RES MDT	
177	5	NTCH	450	F A 8.6	Y + 5 + 5	14570	74 29.93	63 3	82.0 K D 1700	6	92.0 K P 1900 2.0	1 N	N	93.2	83.4 N

[illegible]

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			

[illegible]

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
						MAX PART THR		MAX FULL THR		OWNER		RATER	

MODEL DESCRIPTION		WEATHER		OCTANE NUMBER REQUIREMENT DATA		TANK FUEL INFORMATION	
ORS LAB VEHICLE NO NO CODE	T E R M A C N	SPARK ADVANCE A I AS AS RCD TST MILES IMP BARO HUM L	MAX PART THR	MAX FULL THR	OWNER	RATER	
59 30 J 318M	F M 8.0	N + 2 + 2 4903 62 29.08 95 3	L	L	1 N N 91.1 83.8 N	N	N
75 6 J 318M	F M 8.0	N + 4 + 4 13900 78 29.82 110 3	L	L	1 N N 93.5 83.6 N	N	N
83 6 J 318M	F M 8.	N 0 0 12160 72 29.89 98 3	L	L	1 N N 94.3 84.5 N	N	N
115 6 J 318M	F M 8.0	Y 0 0 7940 79 30.08 75 3	L	L	1 N N 93.4 83.6 N	N	N
151 29 J 318M	F M 8.0	N + 2 + 2 6907 70 30.18 48 3	L	L	1 N N 91.8 83.5 N	N	N
357 26 J 318M	F M 8.0	Y 0 0 8466 94 29.96 119 3	L	L	98.2 86.9 N	N	N
378 47 J 318M	C M 8.0	Y + 1 0 6820 70 29.55 50 3	L	L	81.0 K 4 1350 1.0 1	N	N
79 6 0 216M	F M 8.5	N + 10 + 10 15841 78 29.81 121 3	L	L	95.4 84.2 N	N	N

MODEL DESCRIPTION										WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION																
T SPARK ADVANCE										F T G		N		MAX PART THP		MAX FULL THP		OWNER		RATER												
E R M A A I AS AS ODOM AMB										F U Y E		N				K F N A		N T G														
C N I AS AS ODOM AMB										E U Y E						U O O R		O C T N D		J Y E M												
T S C.R. R RCD TST MILES TMP HARO HUM L										NO E P RPM		MV NO E R RPM		MV NO E R RPM		L K J N		P E S M O T		T E R X M V R P M												
392 47 Q 216M										C M 8.5	N + 7 + 8	5937	70	29.72	50	3	82.0	K 4	3450	3	91.0	K 4	3400	1.0	1							
															2																	
															4																	
418 41 Q 216M										C M 8.5	N + 8 + 8	6655	68	30.40	66	3	90.0	K 4	2800		1	N	92.9	82.0	R K 4	M	2050	N				
															2																	
															4																	
23 22 QD 216M										F M 9.0	N + 10 + 8	14519	70	29.21	50	3	82.0	K 4	2250	2	85.5	K 4	1500	0.2	1		N					
															2																	
															4																	
178 5 QD 216M										F M 9.0	Y + 8 + 8	5595	74	29.85	57	3	91.0	K 4	1000	2	92.0	K 4	1000	0.9	1	N	92.6	82.3	R K 4	M	1000	N
															2																	
															4																	
104 6 T 215										F A 8.7	Y + 5 + 5	10633	68	30.03	50	3	84.0	K D	3000	4	89.0	K D	3200	1.8	1		94.5	84.0	A K D	M	3200	N
															2																	
															4																	
289 7 T 215M										F M 8.7	N + 8 + 5	10473	65	30.09	57	3	90.0	K 5	1600	2	92.0	K 5	2250	0.6	1	Y	Y	N	91.4	83.8		N
															2																	
															4																	
382 47 T 215M										C M 8.7	Y + 10 + 5	8161	70	29.62	50	3	81.0	K 4	1750	2	84.5	K 4	1650	0.4	1							
															2																	
															4																	
3 22 T 218										F A 9.0	Y + 10 + 10	6460	70	29.28	50	3	L														N	
															2																	
															4																	

[illegible]

MODEL DESCRIPTION										WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION			
SPARK ADVANCE												MAX PART THP		MAX FULL THP		OWNER		RATER	
T ER M A C N I AS A3 ODOM AMR T S C.R. R RCD TST MILES IMP BARO H/M L										F U E		N T G Y E		K F N A U O D R E C H U		N T G I Y F M			
										OCT P A		NO E R PPM MV		NO E R PPM MV		OCT NO		RES MOT T E R K M V R P M N	
ORS LAH VEHICLE NO NO CODE																			
425 41 T 21A	C A 9.0	Y +10 +10	6533	74	30.10	54	3					90.0 K D 2950 91.0 K D 2950 89.0 K D 3050	1				N	N	
87 6 T 21AM	F M 9.0	N +10 +10	10810	71	29.95	83	3	L				89.0 K 4 2400 1.2 93.0 K 3 3800 1.0 89.0 K 4 2400 1.2	1	N	95.2	84.1	N	N	
322 3 T 21AM	F M 9.0	N +10 +10	7750	84	30.04	111	3	L				88.0 K 4 2000 1.2 89.0 K 4 2000 1.2 88.0 K 4 2000 1.2	1	N	92.5	83.2	N	N	
381 47 T 21AM	C M 9.0	Y +10 +10	8955	70	29.58	50	3					85.5 K 4 2750 0.2 85.5 K 4 2750 0.2 85.5 K 4 2350 0.2	1				N	N	
7 22 T 222	F A 8.4	Y + 8 + 8	5862	71	29.30	50	3	L				85.5 K D 2200 1.7 90.0 K P 3400 1.2 85.0 K D 2100 1.7	1				N	N	
157 44 T 222	F A 8.4	Y + 8 + 8	5897	70	29.76	61	3					91.0 K D 2800 1.5 92.0 K D 2900 1.5 90.0 K D 2700 1.5	1		91.8	83.2	R K D M	2900	
358 26 T 222	F A 8.4	Y + 8 + 8	7361	94	29.90	126	3					95.0 K D 2300 0.8 99.0 K D 3900 0.8 92.0 K D 2050 0.8	1		98.2	86.9	A K P M	3900 N	
388 47 T 222	C A 8.4	Y + 8 + 8	5251	70	29.80	50	3	L				90.0 K D 2150 1.1 93.0 K D 3400 1.1 87.0 K D 2200 1.1	1	N	92.8	83.8	N	N	

[illegible]

MODEL DESCRIPTION			WEATHER		OCTANE NUMBER REQUIREMENT DATA			TANK FUEL INFORMATION		
OBS LAH VEHICLE NO CODE	T E R M A C N T S	SPARK ADVANCE A I AS R C D T S T M I L E S	H A R O T M P H A R O	M I L E S	MAX PART THR	MAX FULL THR	OWNER	RATER		
42R 41 Z 220M	C M 8.6	Y + 5 + 5	7040	69 30.06	64 3	89.0 K 4 3300 92.0 K 4 3000 88.0 K 4 2400	1 N N 91.7 82.6 R K 4 M		3200 N	
26 22 CT 120M	F M 8.5	N + 5 + 5	12990	70 29.43	50 3	85.5 K 4 1550 0.8 1 86.0 K 4 2100 0.8 85.0 K 4 1150 0.6			N	
385 47 ET 220M	C M 8.5	Y + 11 + 12	9945	70 29.54	50 3	86.0 K 4 1550 8 91.0 K 4 3250 1.2 1 95.0 K 4 3400 1.2 88.0 K 4 1850 1.2				
291 7 TT 222M	F M 8.4	N + 8 + 8	7282	71 29.98	51 3	90.0 K 4 2400 2 94.0 K 3 3500 1.1 1 Y 95.0 K 4 2000 1.1 90.0 K 4 2400 1.1	N 93.6 82.9 A K 3 M		3600 N	
424 41 TT 222M	C M 8.4	N + 8 + 8	11714	68 30.06	64 3	92.0 K 4 1900 2 92.0 K 4 1900 2 92.0 K 4 1900 2	1 Y Y N 91.9 83.6 R K 4 M		2 2650 N	
800 30 RA 115M	F M 8.0	N 0 0	36	40 29.20	66 3	79.0 K 4 2300 1.0 1 79.0 K 4 2350 1.0 79.0 K 4 2380 1.0			N	
801 30 11A 238	F A 8.0	Y + 15 + 15	1716	56 29.06	72 3	90.5 K 0 2080 2.0 1 N 91.5 K 0 2100 2.0 88.0 K 0 2100 2.0	N 92.3 83.0 N		N	
802 30 11F 243	F A 7.5	Y + 21 + 20	1462	80 29.25	92 3	87.5 K 0 1860 1.7 1 N 89.5 K 0 1900 1.7 85.5 K 0 1780 1.7	N 91.9 83.9 N		N	

OBS LAH VEHICLE NO NO CODE	MODEL DESCRIPTION	WEATHER	OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION					
			MAX PART THR		MAX FULL THR		OWNER		RATE			
			N	T G	N	T G	K	N	N	T G		
101 5 V F28	F A R.6	Y +10 +10 10067 74 30.00	54 3	87.0 K 0 2200	R	87.0 K P 2200	1.0 1	N	96.6	85.7	N	
			2	96.0 K 0 2100	R	87.0 K P 2500	1.0					
			4			84.0 K P 2200	1.0					
68 W 216M	F M 8.6	N +12 +12 11555 85 30.00 122 3	3	91.0 K 4 1700	4	90.0 K 4 1700	0.4 1	N	Y	94.2	84.7	N
			2	94.0 K 4 1900	4	90.0 K 4 1850	0.4					
			4			91.0 K 4 1600	0.4					
405 41 W 216M	C M 8.6	N +12 +12 20411 68 30.10	54 3	90.0 K 4 1400	2	89.0 K 4 2050	1				N	
			2	91.0 K 4 1400	2	90.0 K 4 2550						
			4	90.0 K 4 1400	2	89.0 K 4 2600						
97 6 Z 214M	F M 8.6	N + 5 + 5 10892 72 30.18 102 3	L			84.0 K 4 2000	1.5 1	N	N	94.3	83.8	N
			2			81.0 K 4 2500	1.5					
			4			84.0 K 4 1900	1.5					
135 29 Z 214M	F M 8.6	N + 8 + 8 9988 69 30.25	56 3	L		87.5 K 4 2100	0.5 1	N	N	91.4	83.6	N
			2			90.0 K 4 2150	0.5					
			4			82.0 K 4 2200	0.5					
293 7 7 214M	F M 8.6	N + 5 + 5 4676 70 30.56	50 3	84.0 K 5 2750	2	88.0 K 4 1900	0.9 1	N	Y	92.6	84.2	N
			2			89.0 K 5 1900	0.8					
			4			88.0 K 5 1750	0.8					
384 47 Z 220M	C M 8.6	Y + 5 + 5 9201 70 29.56	50 3	88.0 K 4 1550	3	89.5 K 4 1750	0.6 1	N	N	92.8	83.1	N
			2			89.5 K 4 2500	0.6					
			4			88.0 K 4 1850	0.6					
411 41 7 220M	C M 8.6	Y + 6 + 6 10041 67 29.86	54 3	91.0 K 4 1400	3	91.0 K 4 2375	1	N	N	92.9	82.0	8 4 M 3 2150 N
			2			94.0 K 4 2300						
			4			90.0 K 4 2300						

MODEL DESCRIPTION				WEATHER		OCTANE NUMBER REQUIREMENT DATA				TANK FUEL INFORMATION							
T		SPARK ADVANCE		MILES		TEMP		HUMIDITY		MAX PART THR		MAX FULL THR		OWNER		RATER	
FR	MA	A	I	AS	AS	ODOM	AWR	U	F	T	G	N	T	G	K	F	N
CN	I	AS	AS	ODOM	AWR	U	F	U	F	T	G	N	T	G	K	F	N
T S C.R.	R	RCD	TST	MILES	MP	BARO	HUM	L	E	OCT	P	A	OCT	P	A	E	C
NO	NO	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE	CODE
803	30	11F	243	F	A	7.5	Y	18	2885	62	29.04	75	3	89.5	K	D	1730
					</												

A P P E N D I X F

SPEED RANGE DATA

APPENDIX F

Primary Reference Fuel Speed Range Octane Number Requirement

Primary reference fuel octane number requirements were determined at one to eleven of the specified engine speeds on 337 vehicles (Table F-I). Speed range data were analyzed for the six select models, totaling 79 cars, and are plotted in Figures F.1 through F.6 for the mean (50% satisfaction level). For 21 cars in the select model category, the speed range data were either missing or insufficient for analysis. The select model calculated data are given in Table F-II.

[illegible]

TABLE F-I
(Continued)

URS NO	LAH NO	VEHICLE CODE	T E R	M A	C N	T S	C.P.	H	RCU	TST	MILES	AMB IMP	HARD	MUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM										
															1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
															A I AS AS R RCU TST MILES										
166	5	HCS 225	F	A	8.2	Y	+	9	+	4	12637	75	29.90	56					83.5	85.0	84.5	83.5	83.0	82.0	
127	29	HC7 228	F	A	8.5	Y	+	2	+	2	10173	70	29.67	67					90.0	88.5	86.0	85.0			
376	26	HFA 238	F	A	8.0	Y	+	12	+	15	6242	82	29.74	132				84.0	90.0	89.0	84.0	81.0	80.0		
313	8	HFW 449	F	A	8.1	Y	+	12	+	12	18307	80	29.93	37							85.0	87.0	86.0		
160	44	HIA 238	F	A	8.0	Y	+	14	+	15	6791	93	29.51	57					94.3	94.5	92.0				
4	22	HIK 238	F	A	8.6	Y	+	10	+	10	11031	71	29.36	50				91.0	88.0	87.0	86.0	83.5	82.0	81.0	
326	3	HIK 238	F	A	8.6	Y	+	10	+	10	10327	80	29.76	78					90.0	90.0	89.0	88.0	86.5	85.0	
324	3	HIV 449	F	A	8.1	Y	+	12	+	12	11838	75	30.12	67							87.0	87.0	86.0	84.0	
287	7	HA 238	F	A	8.0	Y	+	15	+	15	6733	70	29.90	50			83.0	85.5	88.0	88.8	87.2	86.0	85.0	84.2	
374	26	HW 449	F	A	8.1	Y	+	12	+	12	10046	81	30.14	57					91.0	90.0	89.5	88.5	87.5	86.5	
386	47	ICS 225	C	A	8.2	Y	+	10	+	10	10025	70	29.68	50				84.0	89.0	87.5	86.0	78.5	76.0	L	
130	29	IC7 228	F	A	8.5	Y	+	2	+	2	11202	70	29.70	65					89.0	88.5	87.5	86.5	85.5	85.0	
303	8	IC7 228	F	A	8.5	N	+	2	+	2	6101	84	29.60	88					80.0	81.5	86.0	85.0			
294	7	IC7 228M	F	M	8.5	Y	+	4	+	4	9324	48	30.13	30			80.0	86.8	88.8	89.7	89.0	87.1	85.5	84.0	
2	22	IIA 238	F	A	8.0	Y	+	15	+	15	7052	70	29.34	50					85.0	83.0	82.5	86.0	79.0		
34	4	IIA 238	F	A	8.0	N	+	15	+	15	12180	89	29.06	120				86.0	88.0	88.0	87.0	86.0	85.5	84.5	
56	4	IIA 238	F	A	8.0	N	+	13	+	15	11429	70	29.18	52				91.0	91.5	92.0	92.0	91.0	89.5	88.5	
159	44	IIA 238	F	A	8.0	Y	+	15	+	15	14070	74	29.38	73							86.0				
161	44	IIA 238	F	A	8.0	Y	+	15	+	15	14501	68	29.51	56					86.0	88.5	86.0				
199	28	IIA 238	F	A	8.0	Y	+	15	+	15	16675	82	29.44	102				87.5	89.5	90.5	90.0	88.5	87.5	86.0	
277	7	IIA 238	F	A	8.0	Y	+	12	+	15	15413	72	30.26	51				90.0	92.0	91.9	91.1	90.1	89.1	88.0	
5	22	IIF 243	F	A	7.5	Y	+	20	+	20	17071	70	29.21	50				89.5	88.0	86.0	85.0	83.5			

TABLE F-I
(Continued)[illegible]

TABLE F-I
(Continued)

OHS NO	LAH CODE	VEHICLE	T M A	F R	Y	SPARK ADVANCE			AMB TST	HARO	HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS. AT RPM												
						A	I	AS				AS	ODOM	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
310	8	LC5 225	F A 8.2	Y	+10	+10	10491	80	30.06	50			82.0	84.0	87.5									
316	3	LC5 225	F A 8.2	Y	+24	+10	24451	76	30.07	52			85.0	85.0	84.8	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
53	4	LC7 228	F A 8.5	N	+8	+8	6499	67	29.13	62			77.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	77.5	77.0	77.0	77.0
60	30	LC7 228	F A 8.5	Y	+6	+6	9038	52	29.34	68			81.0	85.0	80.0									
154	44	LC7 228	F A 8.5	Y	+8	+8	19280	80	29.63	95			82.0	84.5	82.0									
186	28	LC7 228	F A 8.5	Y	+8	+8	17497	82	29.24	138			L	L	L	L	L	L	L	L	L	L	L	L
284	7	LC7 228	F A 8.5	Y	+2	+2	5100	74	29.73	80			80.0	83.6	84.3	84.0	83.1	82.4	81.6					
305	8	LC7 228	F A 8.5	Y	+2	+2	6224	85	30.21	71			80.0	84.5	85.0									
1	22	LIA 238	F A 8.0	Y	+15	+15	10285	70	29.44	51			90.0	88.0	85.0	83.5	81.5	80.0	78.0					
32	4	LIA 238	F A 8.0	Y	+15	+15	11861	88	29.15	109			86.0	87.5	88.0	87.0	85.5	84.5	83.5	82.5	81.5			
140	29	LIA 238	F A 8.0	Y	+15	+15	15820	70	29.81	52			91.0	90.5	89.0	87.5	86.0	85.0	84.5					
144	29	LIA 238	F A 8.0	Y	+15	+15	9821	70	30.17	52			90.0	89.5	87.5	86.5	86.0	85.0	84.5					
156	44	LIA 238	B A 8.0	Y	+15	+15	4662	80	29.34	83			94.5											
168	5	LIA 238	F A 8.0	Y	+15	+15	10819	75	30.07	68			89.5	88.5	87.0	86.0	85.0							
207	28	LIA 238	F A 8.0	Y	+15	+15	16191	66	29.20	86			87.0	87.5	89.0	91.0	90.0	85.0	87.0	85.5	84.5	83.0		
351	46	LIA 238	F A 8.0	Y	+5	+5	7953	74	29.10	56			85.5	88.5	90.0	90.0	87.5	85.5	84.5					
363	26	LIA 238	F A 8.0	Y	+13	+15	5980	99	29.98	114			90.0	91.0	89.0	86.5	83.0	81.0	79.5					
403	47	LIA 238	C A 8.0	Y	+12	+15	13281	70	29.68	50			86.0	86.5	87.5	88.5	92.0	89.0	87.0	84.5	78.0			
309	8	LIA 449	F A 8.1	Y	+12	+12	18431	80	29.71	64			90.0	88.5	87.0									
190	28	L4 441	F A 8.0	Y	+15	+15	12490	78	29.31	120			85.5	87.0	89.0	91.5	92.5	91.5	90.0	88.5	88.0			
202	28	L4 441	F A 8.0	Y	+13	+15	16185	61	29.44	107			83.5	86.5	89.0	90.0	90.2	90.0	89.0	88.0	87.0			
377	26	L4 441	F A 8.0	Y	+15	+15	12519	70	30.10	40			84.0	88.5	90.0	90.0	90.0	87.5	86.5	85.5				

TABLE F-1
(Continued)

OBS LAH VEHICLE NO NO CODE	T E R M A C N T S	C.R.	A I R	SPARK ADVANCE AS TST	ODOM MILES	AMR IMP	BARO HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM													
								1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500			
338 46 MI 223	F	A	9.0	Y	+	6	+	6	17006	76	29.60	42		87.5	88.0	86.0	85.0				
248 32 MCA 133	F	A	8.6	Y	+	10	+	10	5911	85	29.53	60		90.0	90.0	89.0	88.6	88.1			
253 32 MCA 133	F	A	8.6	Y	+	10	+	10	11815	85	29.29	60		87.0	86.7						
255 32 MCA 133	F	A	8.6	Y	+	10	+	10	7589	87	29.30	65		95.0	94.8						
312 8 MCA 133	F	A	8.6	Y	+	10	+	10	13166	80	29.76	54									
364 26 MCA 133	F	A	8.6	Y	+	5	+	7	11813	86	30.00	114									
243 32 MCA 223M	F	M	9.0	Y	+	6	+	6	5921	85	29.38	64		90.8	92.0	91.7	90.8	90.0			
314 8 MCA 223M	F	M	9.0	N	+	6	+	6	5606	80	30.10	37									
262 32 MCA 242	F	A	8.8	Y	+	2	+	6	11111	85	29.41	69									
261 32 MCA 141	F	A	8.6	Y	+	12	+	10	12954	85	29.20	60									
204 28 MI 242	F	A	8.8	Y	+	6	+	6	19869	68	29.55	87		87.0	90.0	91.0	89.5	87.0	85.0	79.0	83.0
266 32 MI 242	F	A	8.8	Y	+	6	+	6	14947	86	29.42	62			94.9	95.0	92.7				
281 7 MI 242	F	A	8.8	Y	+	0	+	6	14570	71	30.20	51		87.0	89.5	91.0	92.0	91.8			
245 32 MI 250	F	A	8.4	Y	+	10	+	10	17085	85	29.50	64		90.0	90.0	90.0	89.9	89.0			
246 32 M V250	F	A	8.4	Y	+	6	+	6	9011	85	29.44	66			90.0	89.0					
260 32 M V250	F	A	8.4	Y	+	6	+	6	7954	85	29.35	69			90.2	91.0	86.9	86.0	85.3		
307 8 M V250	F	A	8.4	Y	+	6	+	6	13643	80	29.80	73			84.0	88.5	85.0				
143 29 MW V258	F	A	8.3	Y	+	12	+	12	14997	70	30.20	54		92.0	92.0	91.5	91.0	90.5	90.0	89.5	89.0
254 32 MW V258	F	A	8.3	Y	+	10	+	10	5569	85	29.46	60		91.0	91.0	90.8	90.4	90.1			
315 8 MW V258S	F	A	8.3	Y	+	10	+	10	7466	80	30.05	54		84.5	86.0	85.0	84.0				
14 22 NLV 225	F	A	8.2	N	+	12	+	12	10121	70	29.52	50									
42 4 NLV 225	F	A	8.2	N	+	16	+	12	8420	73	29.28	96									

TABLE F-I
(Continued)

OHS IAH VEHICLE NO NO CODE	T E M M A C N T S C.R.	SPARK ADVANCE A I AS AS R RCD TST MILES	AMR TMP HBARO HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS. AT RPM											
				1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500	
2204 28 NL0 216	F A 8.6	Y +14 +14	16062 62 29.45 66			79.5	80.5	81.0	82.0	83.0	84.0	85.0	86.5	88.5	
2215 28 NL0 216	F A 8.6	Y +14 +14	18136 52 29.38 40					82.0	83.5	85.0	86.2	86.2	85.8	85.0	
2299 8 NL0 216	F A 8.6	N +14 +14	14998 80 29.89 100								83.0	84.0	82.0	80.5	
47 4 NL0 216	F A 8.6	N +14 +14	6333 70 29.08 80							78.0	81.5	82.0	81.5	80.5	
144 29 NL0 216	F A 8.6	Y +14 +14	11107 70 30.01 42								84.0	84.0	84.0	83.5	
321 3 NL0 216	F A 8.6	N +14 +14	8390 89 30.04 108										85.0	84.5	
356 26 NL0 216	F A 8.6	Y +14 +14	11696 94 29.90 119							82.0	85.0	86.0	85.5	84.5	
14 22 NL0 216M	F M 8.6	N +12 +12	9476 70 29.54 50	85.5	87.0	84.5	87.5	86.5	86.0	85.0	84.5	84.0	83.0	82.0	
131 29 NL0 216M	F M 8.6	N +12 +12	11326 70 30.18 58							82.0	82.0	80.5	79.5	77.5	
271 7 NL0 216M	F M 8.6	Y +12 +12	6767 70 30.11 50		84.0	84.8	86.0	87.6	88.8	86.8	85.7	84.9	84.4	84.1	
348 46 NL0 216M	F M 8.6	Y +12 +12	14670 78 29.60 86			85.5	86.5	88.0	86.5	86.0	85.5	85.0	84.5	84.0	
421 41 NL0 216M	C M 8.6	N +12 +12	12311 70 29.97 52					90.0	90.0	89.8	88.8	87.3	85.4		
17 22 NC5 225	F A 8.2	Y +10 +10	23003 70 29.45 50						76.0	78.0	79.5	82.0	81.5	80.0	
28 4 NC5 225	C A 8.2	Y + 6 + 6	8924 85 29.08 102				84.5	85.0	86.0	86.0	85.0	84.0	83.0	81.0	
55 4 NC5 225	F A 8.2	N +10 +10	18349 67 29.27 66					85.0	86.5	87.0	87.0	87.0	86.5	85.5	
149 29 NC5 225	F A 8.2	Y +10 +10	36375 69 30.32 38					88.5	89.0	88.5	87.5	86.5	85.0	84.0	
155 44 NC5 225	F A 8.2	Y +10 +10	6404 72 29.59 67				94.5			90.0	89.5				
270 7 NC5 225	F A 8.2	Y +11 +10	15481 80 29.94 76				86.2	87.2	88.1	89.0	89.8	90.7	91.8	91.6	
297 7 NC5 225	F A 8.2	Y +10 +10	20920 76 30.07 64							89.7	91.6	91.1	89.5	88.0	
308 8 NC5 225	F A 8.2	Y +10 +10	27401 80 29.62 89												
314 3 NC5 225	F A 8.2	N +10 +10	11427 78 30.32 62					80.0	84.0	82.0			92.0	90.5	
355 26 NC5 225	F A 8.2	Y +10 +10	19158 96 29.93 103						88.5	90.0	87.5	86.5	83.5	82.0	

TABLE F-1
(Continued)

ORS NO	LAH CODE	VEHICLE	T E R M A C N	S C R	SPARK ADVANCE				HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM														
					I A	R C D	T S T	M I L E S		O D O M	A M R	H A R O												
													1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500	
387	47	NC5 225	C A	R.2	Y	+10	+10	8026	70	29.79	50	82.0	82.5	84.0	86.0	92.0	92.0	87.0	85.5	84.0	83.0	82.0		
150	29	NC5 225M	F M	R.2	N	+10	+10	7493	68	30.30	40		82.0	86.0	85.0	84.5	83.5	83.0	82.0					
163	5	NC5 225M	F M	R.2	Y	+10	+10	4972	72	30.22	51	92.0	90.0	90.0	89.5	89.0	88.5	88.0	87.0	86.5				
19	22	NC7 228	F A	R.5	N	+2	+2	5384	70	29.36	50					79.0	83.0	82.0	80.0	79.0	78.0			
38	4	NC7 228	F A	R.5	Y	+8	+8	15933	82	29.33	128		80.0	81.5	83.0	82.5	81.5	81.0	80.5	80.0	79.5			
148	29	NC7 228	F A	R.5	Y	+2	+2	14442	68	30.34	36					86.0	85.0	83.5	82.5	81.0	80.0			
295	7	NC7 228	F A	R.5	Y	+8	+8	10282	70	30.02	80					81.0	85.5	86.0	84.8	83.4	82.2			
317	3	NC7 228	F A	R.5	Y	+8	+8	6537	75	30.12	67							82.0	81.5	80.0	78.0			
354	26	NC7 228	F A	R.5	Y	+6	+6	29057	88	30.01	136				81.0	84.0	87.0	85.0	82.5	81.0	79.0			
383	47	NC7 228	C A	R.5	Y	+6	+6	26030	70	29.84	50				80.0	77.5	76.0	74.5						
396	47	NC7 228	C A	R.5	Y	+6	+6	6188	70	29.80	50				84.0	84.0	84.0	83.0	82.0	81.0	80.0			
18	22	NC7 228M	F M	R.5	Y	+4	+4	5985	70	29.49	50	86.5	85.0	84.5	84.0	83.0	82.5	81.0	79.0	77.5	76.0	L		
429	41	NFH 450	C A	R.6	Y	+20	+4	15516	71	29.95	51				91.0	86.0								
123	29	NFL 457	F A	R.2	Y	+6	+6	9271	70	30.07	66				88.0	88.0	84.0							
398	47	NIA 238	C A	R.0	Y	+16	+15	9550	70	29.64	58	82.0	83.5	85.0	86.5	88.0	87.5	86.0	84.5					
406	41	NIH 450	C A	R.6	Y	+6	+4	7033	72	30.02	58			90.0	91.4	92.0								
203	28	NIJ 244	F A	R.3	Y	+4	+4	16261	81	29.45	122	86.0	88.5	91.0	91.0	90.0	88.0	86.0	84.5	83.0				
209	20	NIJ 244	F A	R.3	Y	+4	+4	19565	66	29.20	86				86.5	87.5	89.8	87.2	86.5	85.5	85.2	85.0		
285	7	NIJ 244	F A	R.3	Y	+3	+4	10647	70	29.92	51				82.5	85.0	88.0	86.2	84.8	83.0				
331	46	NIJ 244	F A	R.3	Y	+4	+4	12293	78	29.55	58				88.0	89.0	88.0	86.0	84.5					
336	46	NIJ 244	F A	R.3	Y	+4	+4	12460	74	29.70	88				91.0	89.5	87.5	86.5	85.5	85.0				
336	46	NIJ 244	F A	R.3	Y	+4	+4	12611	76	29.61	42				89.5	89.0	87.5							

TABLE F-1
(Continued)

OHS NO	LAH CODE	T M A	E R	SPARK ADVANCE	T C.S.R.	I R	AS TST	AS MILES	AMH IMP	HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM										
											1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
344	46	N I J	244	F A 8.3	Y + 4 + 4	10194	74	29.66	49					89.0	89.0	87.5	86.5				
345	46	N I J	244	F A 8.3	Y + 4 + 4	17262	74	29.63	74					91.0	89.0	87.5	87.0	86.5			
57	4	N I K	234	F A 8.6	Y + 10 + 10	11064	73	29.40	47					88.0	90.0	89.5	88.5	87.5	87.0	86.5	86.0
204	28	N I K	238	F A 8.6	Y + 10 + 10	15921	64	29.44	71					89.0	91.5	90.5	89.0	88.0	86.5	85.0	84.0
210	28	N I K	238	F A 8.6	Y + 10 + 10	20498	64	29.50	76					90.0	91.5	92.5	91.5	90.0	89.0	88.0	87.5
300	8	N I K	238	F A 8.6	Y + 10 + 10	15299	80	29.90	69					88.0	87.0	84.0					
323	3	N I K	238	F A 8.6	Y + 10 + 10	8425	75	30.12	67												89.0
374	26	N I K	238	F A 8.6	Y + 10 + 10	7186	81	30.02	57						89.5	89.5	89.0	88.0	88.0	88.0	88.0
132	29	N A	238	F A 8.0	Y + 13 + 13	12709	70	30.18	59						86.0	86.0	84.5	82.5			
14	22	N H	450	F A 8.6	Y + 4 + 4	9572	70	29.45	50			92.0	92.5	93.0	92.0	88.0	87.0	86.5	86.0		
205	28	N H	450	F A 8.6	Y + 4 + 4	17130	66	29.57	64			85.0	89.0	90.5	90.0	89.5	88.5	88.0	87.0	86.0	
170	26	N H	450	F A 8.6	Y + 4 + 4	6574	89	29.98	134				89.0	92.0	92.0	91.0	90.0	89.5	88.5	87.5	87.0
124	29	N J	244	F A 8.3	Y + 6 + 6	9306	70	30.07	64					84.5	84.0	82.0	81.0	80.0			
278	7	N J	244	F A 8.3	Y + 4 + 4	9448	70	30.25	50					87.0	89.4	90.0	87.3	85.8	84.7	84.0	
292	7	N J	244	F A 8.3	Y + 8 + 4	6311	70	30.20	50					84.2	85.6	87.0	88.2	89.5	90.3	88.6	86.8
301	8	N J	244	F A 8.3	Y + 4 + 4	19749	80	30.11	54					86.0	87.5	86.5					
13	22	N K	238	F A 8.6	Y + 10 + 10	18438	71	29.45	50					88.5	87.5	86.5	85.0	83.5	81.5	80.5	
39	4	N K	238	F A 8.6	Y + 10 + 10	5973	87	29.18	114					87.5	88.5	89.0	88.0	87.0	86.5	85.5	84.5
49	4	N K	238	F A 8.6	Y + 10 + 10	12600	78	28.50	52					85.0	86.0	85.5	84.5	83.0	82.0	81.0	80.0
320	3	N K	238	F A 8.6	Y + 10 + 10	6494	84	30.10	57									86.0	85.0	83.0	80.5
191	47	N K	238	C A 8.6	Y + 12 + 10	13100	70	29.66	50			80.0	83.0	86.0	90.0	90.0	88.0	86.0	84.5	83.0	82.5
254	32	0 L	223	F A 9.0	N + 19 + 17	9047	85	29.10	68									84.0	84.5	84.5	84.0

TABLE F-1
(Continued)

OHS NO	LAH CODE	T M A C N	S C.R.	SPARK ADVANCE A	I R	AS RCD	AS TST	OUM MILES	AMR THP	HMR HMM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS. AT RPM												
											1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500		
264	32 OL 223	F	A	9.0	Y	+	8	+	6	7918	86	29.54	64			83.5	84.5	85.9	87.0	87.0			
259	32 OL 223M	F	M	9.0	N	+	2	+	6	6986	85	29.55	62	89.0	88.9	87.7	87.0						
267	32 OL 223M	F	M	9.0	Y	+	4	+	6	31177	85	29.45	64	94.1	94.9	95.0	92.8						
30	4 OCA 133	F	A	8.6	N	+	10	+	10	5545	80	29.08	63	84.5	85.5	86.0	86.0	86.0	85.5	85.0	84.5	84.0	
310	3 OCA 133	F	A	8.6	Y	+	10	+	10	6840	79	29.97	75					92.0	87.5	85.0	83.5	82.0	
189	47 OCA 133	C	A	8.6	Y	+	6	+	10	13216	70	29.75	50	82.0	83.5	89.0	89.0	89.0	87.5	84.0	81.5	80.0	
29	4 OCA 223	F	A	9.0	N	+	6	+	6	5728	82	29.16	58		86.5	87.0	87.5	88.0	88.5	89.0	88.5	88.0	
58	30 OCA 223	F	A	9.0	N	+	6	+	6	6199	71	29.52	58					83.0	85.5	83.0			
61	30 OCA 223	F	A	9.0	Y	+	4	+	4	4404	49	29.42	62				94.0	94.5	90.5				
198	28 OCA 223	F	A	9.0	Y	+	6	+	6	17255	80	29.46	111			83.0	87.0	89.0	86.5	84.5	83.0	82.0	
213	28 OCA 223	F	A	9.0	Y	+	6	+	6	18557	60	29.34	69	78.0	81.0	84.0	85.2	86.0	86.5	86.0	84.0	83.0	
269	32 OCA 223	F	A	9.0	Y	+	17	+	17	7380	85	29.15	69				77.0	80.7	82.0	82.0	80.2		
275	7 OCA 223	F	A	9.0	N	+	3	+	6	8360	70	30.21	66					88.3	87.9	87.0	86.0	86.0	
342	46 OCA 223	F	A	9.0	Y	+	6	+	6	11208	86	29.79	36				80.5	83.0	84.0	82.5	80.5		
353	26 OCA 223	F	A	9.0	Y	+	6	+	6	10154	91	30.00	122			85.5	87.0	89.0	91.0	89.0	88.0	85.0	
52	4 OCA 223M	F	M	9.0	N	+	6	+	6	10039	79	29.08	112	84.0	86.5	88.0	87.0	86.0	84.5	84.0	83.0	81.5	81.0
261	32 OCA 223M	F	M	9.0	Y	+	6	+	6	8069	85	29.09	62	87.4	89.4	90.0	90.0						
196	28 OCA 1223	F	A	9.0	Y	+	10	+	10	8256	78	29.49	87			85.0	86.0	89.0	91.5	90.5	89.0	87.5	86.5
37	4 OCA 242	C	A	8.8	Y	+	6	+	6	5675	83	29.32	100	88.0	89.0	90.0	90.0	89.5	89.0	88.5	88.0	87.5	87.0
184	5 OCA 242	F	A	8.8	Y	+	6	+	6	9377	74	30.27	52			91.0	92.0	91.5	90.0	89.0	88.0	87.0	86.0
200	28 OCA 242	F	A	8.8	Y	+	6	+	6	16958	77	29.44	110			87.0	88.5	86.0	84.5	83.5	82.5	82.0	81.5
247	32 OCA 242	F	A	8.8	Y	+	4	+	6	5956	85	29.32	64			91.7	89.0						

NO-A113 734

COORDINATING RESEARCH COUNCIL INC ATLANTA GA
1980 CRC OCTANE NUMBER REQUIREMENT SURVEY. (U)

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TABLE F-1
(Continued)

OHS LAH VEHICLE NO CODE	T E R M A	C N T S	C.R.	SPARK ADVANCE		AMR IMP	HARD	HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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				I H	AS RCD				AS TST	ODOM MILES	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
250 32 OCA 242	F A 8.8	Y	3	6	11606	85	29.44	60				91.0	90.0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

TABLE F-1
(Continued)

OBS NO	LAH CODE	T C.N.	M C.R.	SPARK ADVANCE A	I AS	AS	ODOM MILES	HARO	HJM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM									
										1000	1250	1500	1750	2000	2250	2500	2750	3000	3250
404	3 0 V250	F	A	8.4	Y	+	6	+	6	17229	63	30.65	10		94.0	90.0	89.0	86.5	84.0
296	7 0M V258	F	A	8.3	Y	+	10	+	10	24141	70	29.92	50	87.0	88.8	89.5	90.2	91.0	88.4
394	47 0M V258	C	A	8.3	Y	+	10	+	10	10250	70	29.65	50	89.0	89.5	91.0	91.0	90.5	90.0
31	4 PL 217	F	A	8.2	Y	+	8	+	12	5402	74	29.07	103		79.0	81.5	82.0	81.5	80.0
390	47 PL 217	C	A	8.2	Y	+	5	+	5	12960	70	29.70	50		86.0	89.0	87.5	86.0	84.5
393	47 PL 217	C	A	8.2	Y	+	12	+	10	6800	70	29.74	50		82.0	82.0	82.0	82.0	80.0
400	47 PL 217	C	A	8.2	Y	+	8	+	10	7000	70	29.30	40		80.0	82.0	82.0	81.5	78.0
417	41 PL 217	C	A	8.2	Y	+	14	+	10	7631	67	30.00	62			90.0	89.9	87.4	84.5
10	22 PL 217M	F	M	8.2	N	+	12	+	12	7300	70	29.17	50	L	L	77.0	77.5	76.0	L
174	5 PL 217M	F	M	8.2	N	+	12	+	12	9356	71	29.96	54		83.0	86.5	87.0	85.0	83.0
399	47 PL 217M	C	M	8.2	Y	+	8	+	10	10235	70	29.30	50	82.0	84.5	89.0	89.0	85.5	81.5
11	22 PC 137	F	A	8.4	Y	+	12	+	12	5759	70	29.35	50		86.5	90.0	89.5	88.0	85.5
33	4 PC 137	F	A	8.4	N	+	12	+	12	6772	81	29.10	92		92.0	91.5	91.0	90.5	87.0
137	29 PC 137	F	A	8.4	N	+	12	+	12	5024	70	29.65	40		93.0	89.0	87.5	86.5	86.0
272	7 PC 137	F	A	8.4	Y	+	12	+	12	5283	70	30.00	50		82.0	86.5	87.3	87.2	85.5
327	3 PC 137	F	A	8.4	N	+	12	+	12	8276	73	29.77	70		92.0	92.0	94.0	89.0	88.0
328	3 PC 137	F	A	8.4	Y	+	12	+	12	6121	73	29.77	70			93.0	90.5	88.0	86.0
352	26 PC 137	F	A	8.4	Y	+	11	+	10	7517	94	29.80	119		93.0	89.5	86.0	85.0	84.0
333	46 PC 252	F	A	8.5	Y	+	12	+	12	12606	76	29.40	94		85.5	86.0	86.0	85.5	84.5
337	46 PC 252	F	A	8.5	Y	+	12	+	12	20340	78	29.61	59		87.5	90.0	89.5	88.0	86.0
350	46 PC 252	F	A	8.5	Y	+	12	+	12	20550	82	29.77	38			88.0	87.0	86.5	85.0
373	26 P 252	F	A	8.5	Y	+	12	+	12	16231	86	29.92	108		87.0	88.0	86.0	85.0	84.0

TABLE F-1
(Continued)

MORS No	LAH CODE	T S C.R.	E M A	I R	A S	SPARK ADVANCE			AMB TMP	HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM											
						AS RCD	AS TST	ODJ MILES			1000	1250	1500	1750	2000	2250	2500	2750	3000	3500		
24	22	RL	225	F	A	R.3	Y	+12	+12	6902	70	29.09	50				79.0	84.0	87.0	83.5	82.0	80.0
211	28	RL	242	F	A	R.3	Y	+10	+10	19288	59	29.45	62	85.5	90.5	91.5	91.0	90.0	88.5	87.0	85.5	85.0
141	29	RC	242	F	A	R.3	Y	+10	+10	12462	70	29.81	55	92.0	90.5	89.5	89.0					
214	28	RC	242	F	A	R.3	Y	+10	+10	17431	39	29.47	24		84.5	86.0	87.0	88.5	89.5	88.5	87.5	87.5
365	26	RC	242	F	A	R.3	Y	+10	+10	16602	94	30.05	104	94.0	92.5	92.0	89.5	88.0	86.5	85.0	84.0	83.0
201	28	S	F50	F	A	R.4	Y	+20	+20	16296	67	29.45	71	87.0	87.5	88.5	87.5	87.0	85.5	84.0	81.5	79.0
249	32	SW	V258	F	A	R.3	Y	+10	+10	15850	85	29.39	68	89.3	89.6	90.0	91.0	91.0				
268	32	SW	V258S	F	A	R.3	Y	+10	+10	8679	85	29.29	68	90.2	91.5	92.0	91.4					
51	4	NICH	450	F	A	R.6	Y	+4	+4	10070	77	29.33	59	91.5	92.0	92.0	91.5	90.5	89.5	89.0	88.5	88.0
177	5	NICH	450	F	A	R.6	Y	+5	+5	14570	74	29.93	63		90.5	91.0	86.5	85.0	84.0	83.0	82.5	82.0
408	41	NTLD	241	C	A	R.0	N	+8	+10	8456	81	30.13	62		88.0	88.5						
125	29	NTLD	241M	F	M	R.0	N	+6	+6	8493	70	29.96	60	80.0	85.0	79.5	78.0					
283	7	NTLD	241M	F	M	R.0	N	+5	+10	14684	70	30.05	50	84.0	89.7	91.2	91.9	91.5	90.9	89.8	88.3	87.0
27	22	NTLG	250	F	A	R.4	N	+8	+8	7934	70	29.26	50		88.0	87.0	86.0	84.0	82.5	80.0	78.0	
402	47	NTLL	457	C	A	R.2	Y	+12	+8	15050	70	29.76	50		87.0	86.5	85.0	84.5	83.5	82.5	82.0	
407	41	NTLL	457	C	A	R.2	N	+8	+6	5299	72	30.12	72		88.2	89.5	86.5					
362	26	NTML	457	F	A	R.2	Y	+8	+8	12936	92	29.93	124	82.0	85.5	85.0	85.0	83.5	83.0	82.5	82.0	
284	7	NULD	241	F	A	R.0	N	+5	+10	15456	71	30.18	51	84.5	87.7	90.0	91.3	90.8	89.3	88.0	87.2	86.6
265	32	OTM	258	F	A	R.0	Y	+6	+6	16699	85	29.51	67		90.5	90.0	89.0	87.9	86.2	85.8	84.1	
124	29	OTM	149	F	A	R.9	N	+10	+10	13122	70	29.96	48	89.0	93.0	92.0	90.5					
367	26	OTM	250	F	A	R.4	Y	+6	+8	9014	95	29.98	112	85.0	89.0	91.0	88.5	87.5	86.5	86.0	84.5	
257	32	OTM	149	F	A	R.9	N	+15	+10	10482	85	29.14	60			91.0	89.4	87.5				

TABLE F-1
(Continued)

ORS NO	LAH CODE	VEHICLE	T E R M A C N Y S	C.R.	R	TST	MILES	AMB TMP	BARO	HUM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM										
											1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
225R	32	OVH 250	F A	A.4	Y	+10	+10	1263R	85	29.0R	60				84.0	85.4	84.9	84.3	82.0		
409	41	AU F21	C A	A.0	Y	- 3	- 3	4294	73	30.10	66							86.5	88.8	89.0	
21	22	H F16	F A	B.2	Y	- 3	- 3	13649	70	29.39	50				L	L	L	L	L	76.5	L
416	41	H F16M	C M	B.2	Y	0	0	4856	78	29.95	62					88.0	87.7	86.5			
54	4	C 114M	F M	A.8	N	+ 5	+ 5	12700	69	29.17	68										
136	29	E 212M	F M	A.5	N	+10	+10	7853	68	29.90	57						L				
145	29	E 212M	F M	B.5	N	+10	+10	6426	70	30.17	55			78.0	79.0	77.0	76.5	76.0	76.0		
45	4	E 214	F A	A.5	Y	+ 8	+ 8	10092	68	29.22	55			86.0	89.0	90.0	90.0	89.0	88.0	87.0	86.0
380	47	E 214	C A	B.5	N	+ 9	+ 8	9238	70	29.72	50								87.0	87.0	86.5
424	41	E 214	C A	B.5	Y	+ 9	+ 9	7038	47	30.04	60							90.0	87.5	85.9	84.8
185	5	E 214M	F M	B.5	N	+ 8	+ 8	4434	73	30.23	60			87.0	87.0	87.0	85.5	85.0	84.5	84.0	83.5
279	7	E 214M	F M	B.5	N	+ 8	+ 8	5200	83	30.09	61			85.0	86.5	88.0	89.1	90.0	90.0	88.4	85.5
422	41	E 214M	C M	B.5	Y	+ 8	+ 8	9383	74	29.80	54				89.5	88.8	87.5	85.4			
397	47	E 220	C A	A.5	Y	+ 8	+ 6	18830	70	29.63	50			81.0	84.0	86.0	87.0	86.5	82.0		
44	4	E F20M	F M	B.5	Y	+ 8	+ 8	6880	76	29.00	58			88.0	88.0	87.5	87.0	86.5	86.0	85.5	84.5
414	41	E F20M	C M	B.5	Y	+ 6	+ 6	5907	71	30.10	64					91.8	92.6	93.0	92.4	90.0	
180	5	E F28M	F M	B.3	Y	+10	+10	6380	72	30.10	56			85.0	85.0	85.0	85.0	83.5	82.5	82.0	82.0
379	47	E F28M	C M	B.3	Y	+ 8	+10	12103	70	29.66	50			91.0	91.0	91.0	91.0	90.0	89.0	88.0	86.0
290	7	F 215M	F M	B.5	N	+ 5	+ 5	4812	57	30.24	38			82.0	89.0	90.1	88.9	86.8	85.0	83.8	82.0
415	41	F F20M	C M	A.1	Y	+10	+10	4434	80	29.91	64					85.4	86.8	88.3	89.0	89.0	
401	47	J 213M	C M	7.9	Y	+ 2	0	6500	70	29.82	50			89.0	89.0	89.0	88.0	87.5	87.0	86.5	86.0
413	41	J 215M	C M	B.9	Y	0	0	5926	68	30.00	64					84.0	85.8	88.0	90.0	90.0	87.0

TABLE F-1
(Continued)

OHS NO	LAH CODE	VEHICLE	T E R	C N	M A	SPARK ADVANCE			T S	C.R.	R	I	A	S	AS	ODOM MILES	AMB TMP	HARD HARD	HMM	PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM									
						1000	1250	1500												1750	2000	2250	2500	2750	3000	3250	3500		
25	22	J 31A	F	A	B.0	N	+	2	0	7077	70	29.46	50									L	79.0	78.0	77.5	76.5			
50	4	J 11A	F	A	B.0	N	+	4	0	6860	64	29.20	62										77.0	78.0	77.5	L			
59	30	J 31AM	F	M	B.0	N	+	2	+	2	4903	62	29.08	95															
151	29	J 31AM	F	M	B.0	N	+	2	+	2	6907	70	30.18	48															
357	26	J 31AM	F	M	B.0	Y	0	0	8466	94	29.96	119																	
378	47	J 31AM	C	M	B.0	Y	+	1	0	6420	70	29.55	50																
392	47	O 216M	C	M	B.5	N	+	7	+	9	5937	70	29.72	50															
418	41	O 216M	C	M	B.5	N	+	8	+	8	6655	68	30.40	66															
23	22	OD 216M	F	M	B.0	N	+	10	+	8	14519	70	29.21	50															
178	5	OD 216M	F	M	B.0	Y	+	8	+	8	5595	74	29.85	57															
289	7	T 215M	F	M	B.7	N	+	8	+	5	10473	65	30.09	57															
382	47	T 215M	C	M	B.7	Y	+	10	+	5	8161	70	29.62	50															
3	22	T 21A	F	A	B.0	Y	+	10	+	10	6460	70	29.28	50															
147	29	T 21A	F	A	B.0	Y	+	10	+	10	6764	70	30.01	32															
153	44	T 21A	F	A	B.0	Y	+	10	+	10	12102	70	29.85	52															
311	8	T 21A	F	A	B.0	Y	+	10	+	10	15069	80	29.90	41															
346	46	T 21B	F	A	B.0	Y	+	10	+	10	10826	78	29.63	49															
368	26	T 21B	F	A	B.0	Y	+	10	+	10	11190	100	30.00	135															
371	26	T 21B	F	A	B.0	Y	+	9	+	10	9626	87	30.07	144															
425	41	T 21B	C	A	B.0	Y	+	10	+	10	6533	74	30.10	54															
322	3	T 21AM	F	M	B.0	N	+	10	+	10	7750	84	30.04	111															
381	47	T 21AM	C	M	B.0	Y	+	10	+	10	8955	70	29.58	50															

[illegible]

TABLE F-1
(Continued)

OHS NO	LAB CODE	VEHICLE	T		F		M		A		S		PARK		ADVANCE		PRIMARY R.F. OCTANE NUMBER REQUIREMENTS, AT RPM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
			C	N	T	S	C.R.	R	I	A	S	T	MILES	AMB	TMP	BARO	HUM	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
A02	30	IIF	243	F	A	7.5	Y	+21	+20	1862	80	29.25	92																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

TABLE F-II

SPEED RANGE STATISTICAL DATA
1980 SELECT MODELS - 50% SATISFACTION

		Engine RPM										
		1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
NC5 225/HC5 225/ IC5 225/LC5 225	50% Sat.	-	-	-	-	-	-	-	-	-	-	-
	SD	-	-	-	85.5	85.7	86.1	86.7	86.1	85.8	85.4	84.0
	N	-	-	-	4.6	3.4	3.7	3.1	3.5	4.1	3.3	3.3
NC7 228/HC7 228/ IC7 228/LC7 228	50% Sat.	-	-	-	-	-	-	-	-	-	-	-
	SD	-	-	-	-	-	-	-	-	-	-	-
	N	-	-	-	7	11	14	17	15	15	14	14
NIJ 244	50% Sat.	-	-	-	-	83.0	82.1	83.3	82.5	81.7	81.0	79.5
	SD	-	-	-	-	4.2	3.5	3.2	3.2	2.3	2.2	1.7
	N	-	-	-	-	10	15	16	17	12	10	9
OCA 242/MCA 242	50% Sat.	-	-	-	89.4	89.4	88.1	86.6	85.5	84.1	-	-
	SD	-	-	-	1.6	0.7	0.7	0.6	1.0	1.3	-	-
	N	-	-	-	7	8	8	7	7	4	-	-
O V250/M V250	50% Sat.	-	-	-	88.8	89.7	88.5	88.1	86.7	85.5	-	-
	SD	-	-	-	1.3	2.0	2.4	2.0	2.3	3.0	-	-
	N	-	-	-	6	13	10	8	6	4	-	-
PC 137/KC 137/ DC 137	50% Sat.	-	-	-	86.9	88.3	86.7	87.0	86.0	84.5	83.9	-
	SD	-	-	-	2.5	3.8	3.8	3.5	3.1	2.9	3.9	-
	N	-	-	-	7	12	9	9	9	7	4	-
	50% Sat.	-	89.7	89.7	88.8	88.4	87.1	86.1	84.7	83.9	83.4	81.9
	SD	-	3.1	3.9	2.8	3.6	3.2	2.9	3.0	3.4	3.3	3.0
	N	-	5	10	10	11	10	10	8	8	7	7

FIGURE F.1

PRF SPEED RANGE OCTANE NUMBER REQUIREMENTS

1980 Select Models: NC5 225
HC5 225
IC5 225
LC5 225

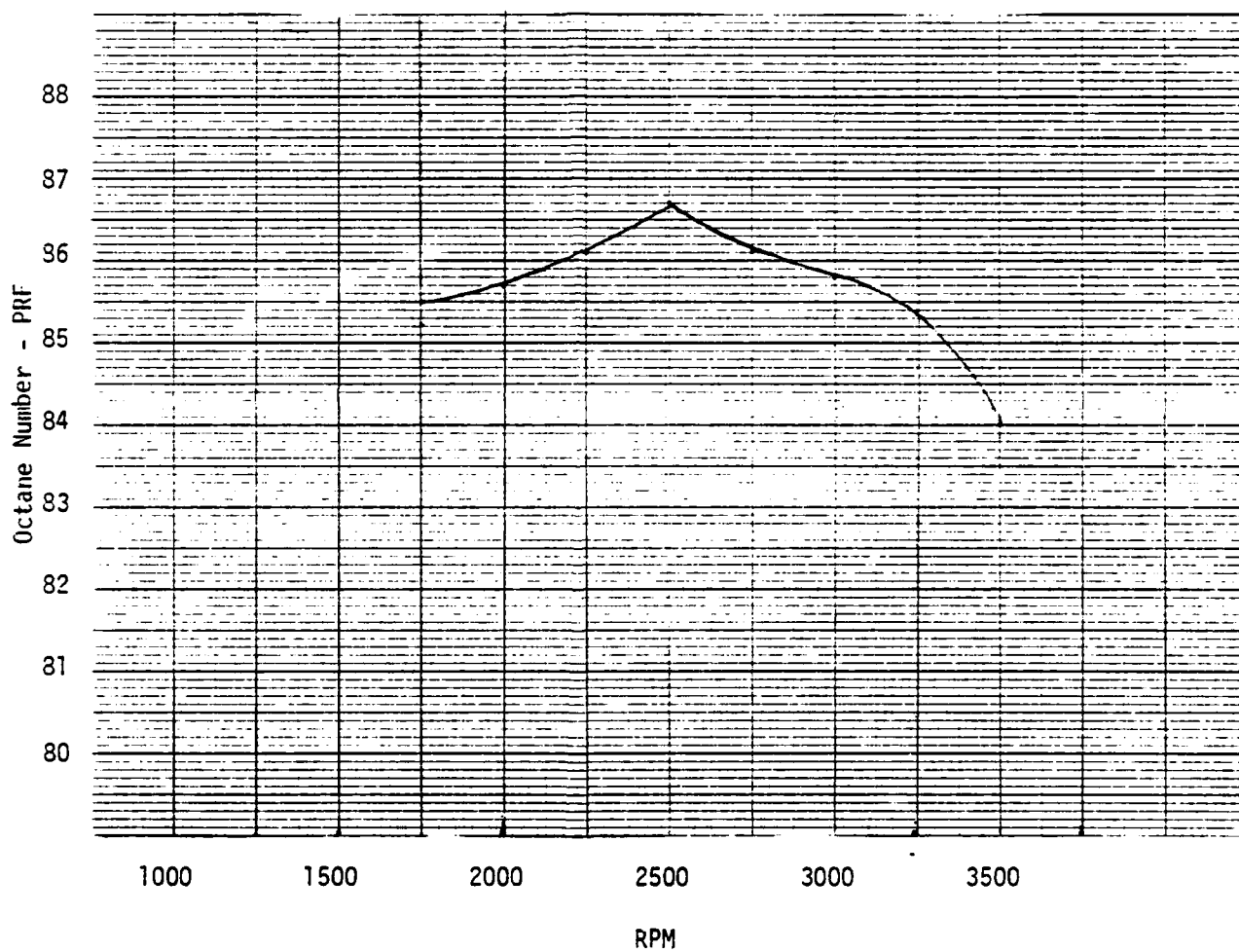


FIGURE F.2

PRF SPEED RANGE OCTANE NUMBER REQUIREMENTS

1980 Select Models: NC7 228
HC7 228
IC7 228
LC7 228

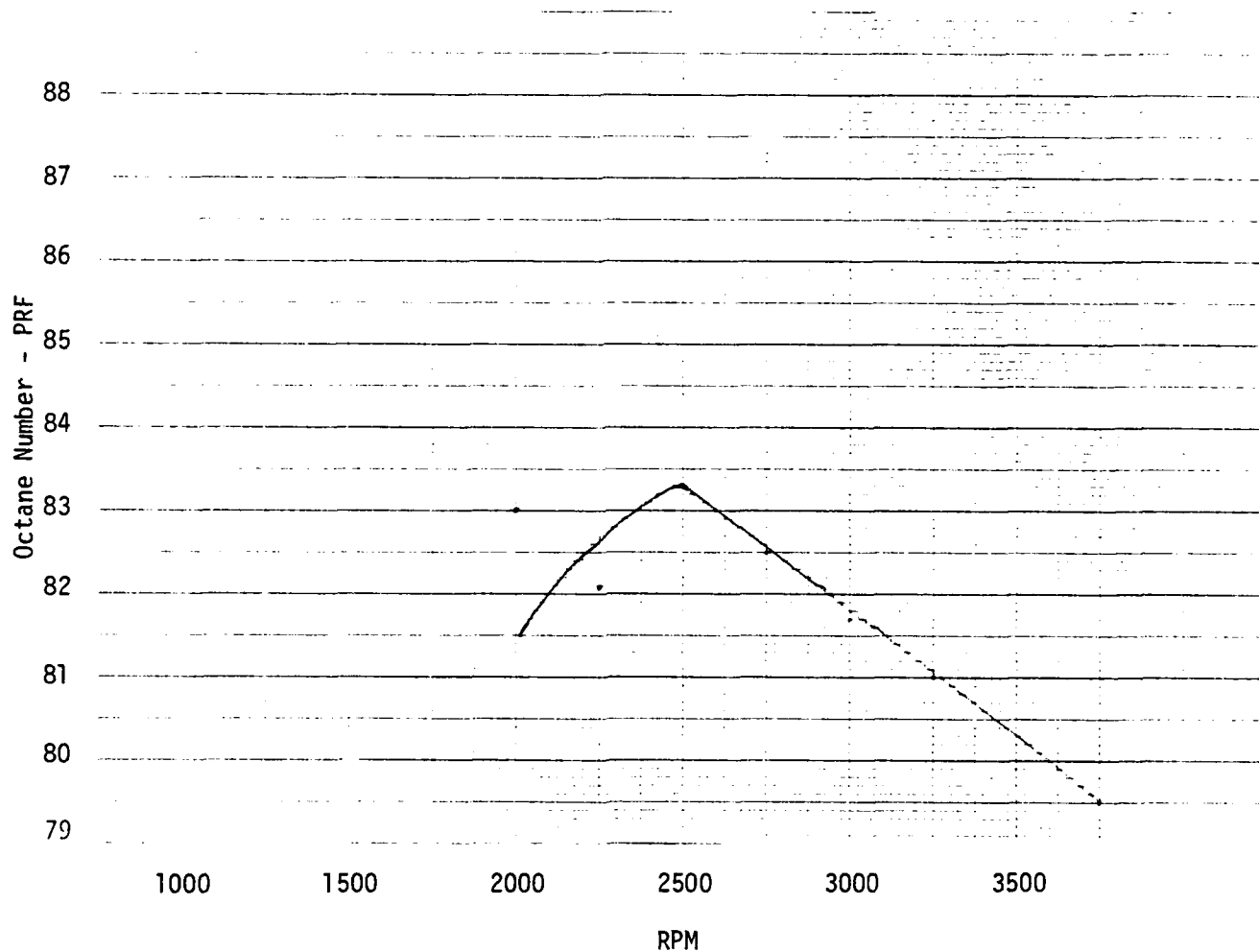


FIGURE F.3

PRF SPEED RANGE OCTANE NUMBER REQUIREMENTS

1980 Select Models: OCA 242
MCA 242

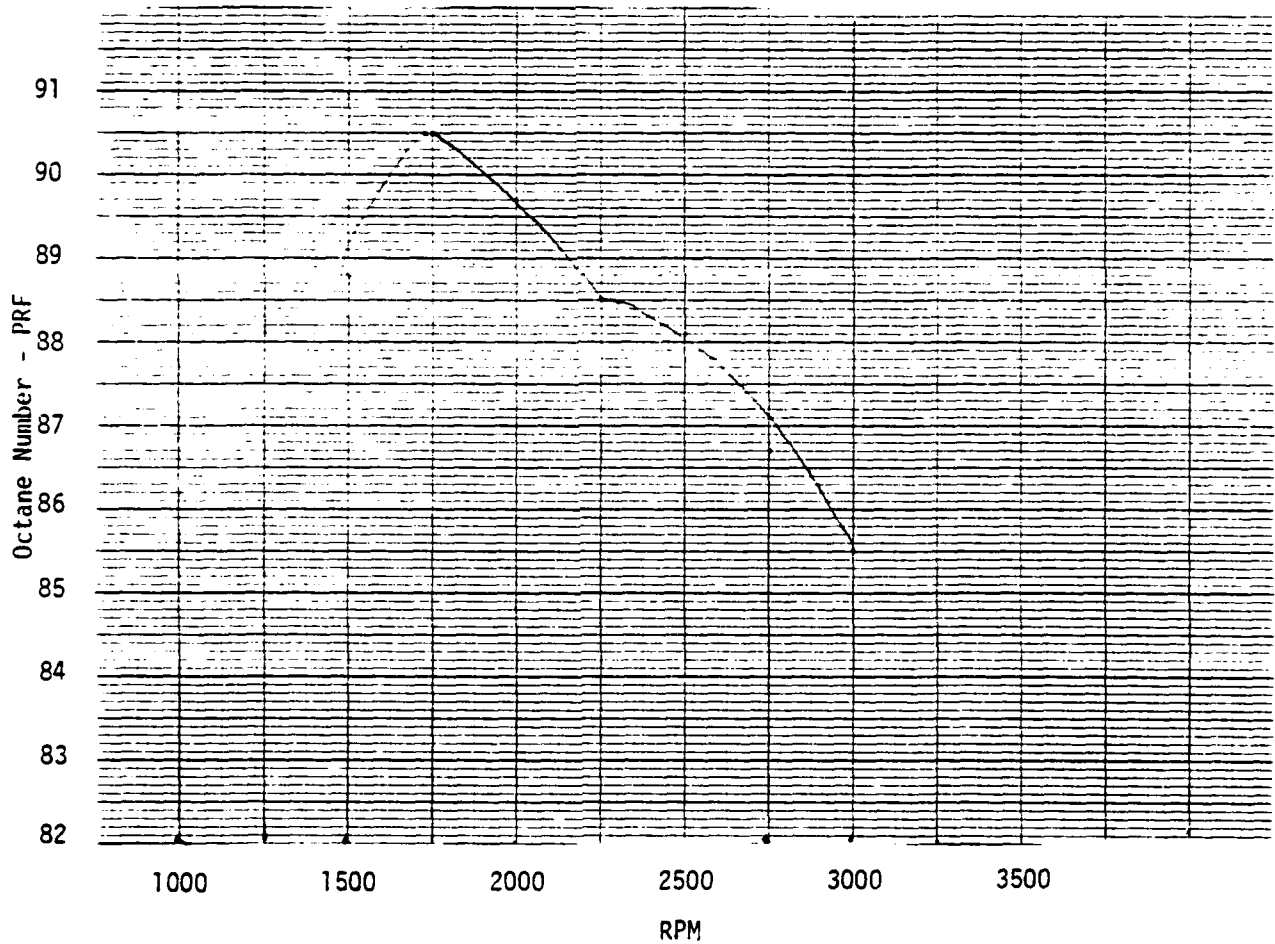


FIGURE F.4

PRF SPEED RANGE OCTANE NUMBER REQUIREMENTS

1980 Select Model: NIJ 244

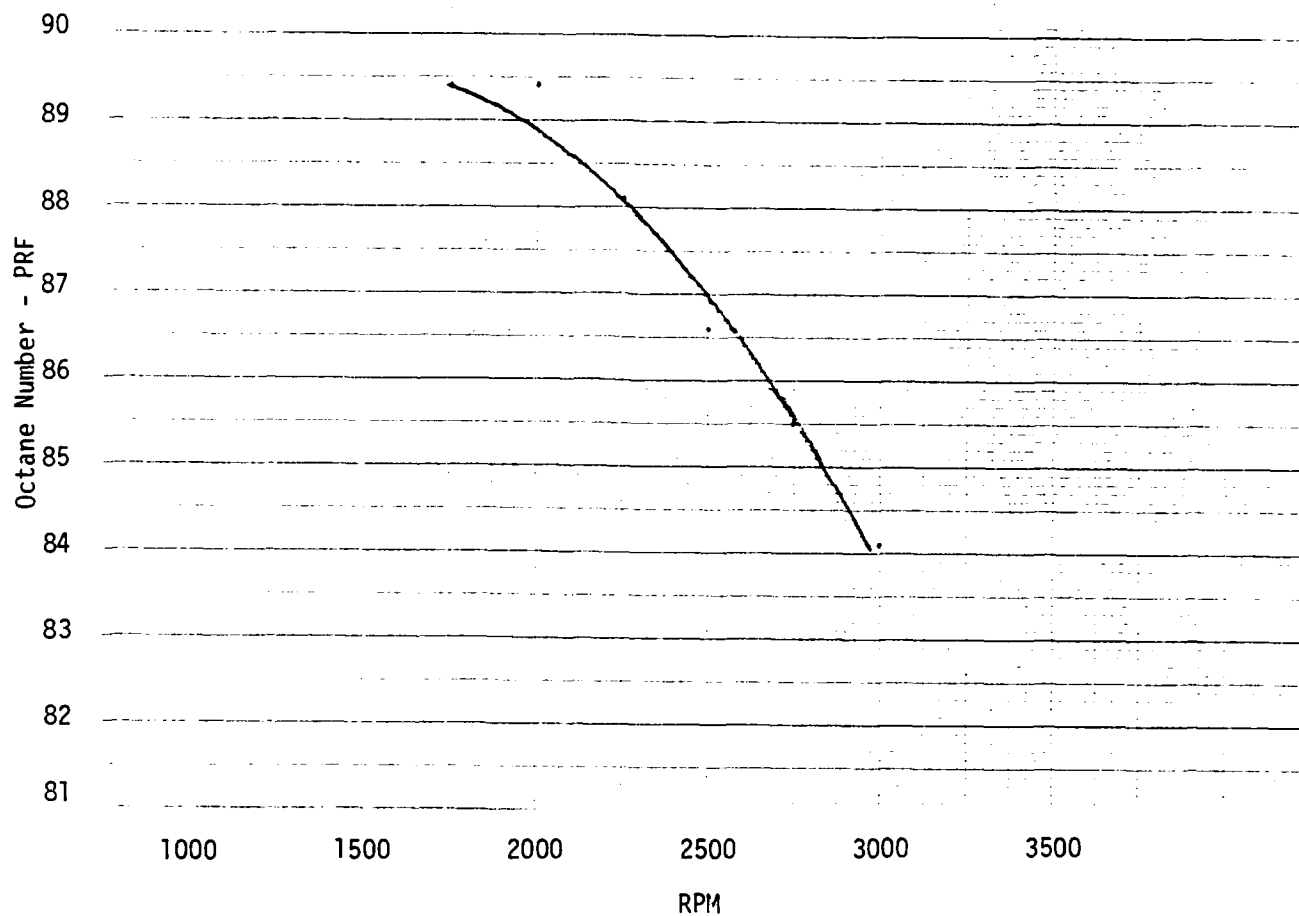


FIGURE F.5

PRF SPEED RANGE OCTANE NUMBER REQUIREMENTS

1980 Select Models: 0 V250
M V250

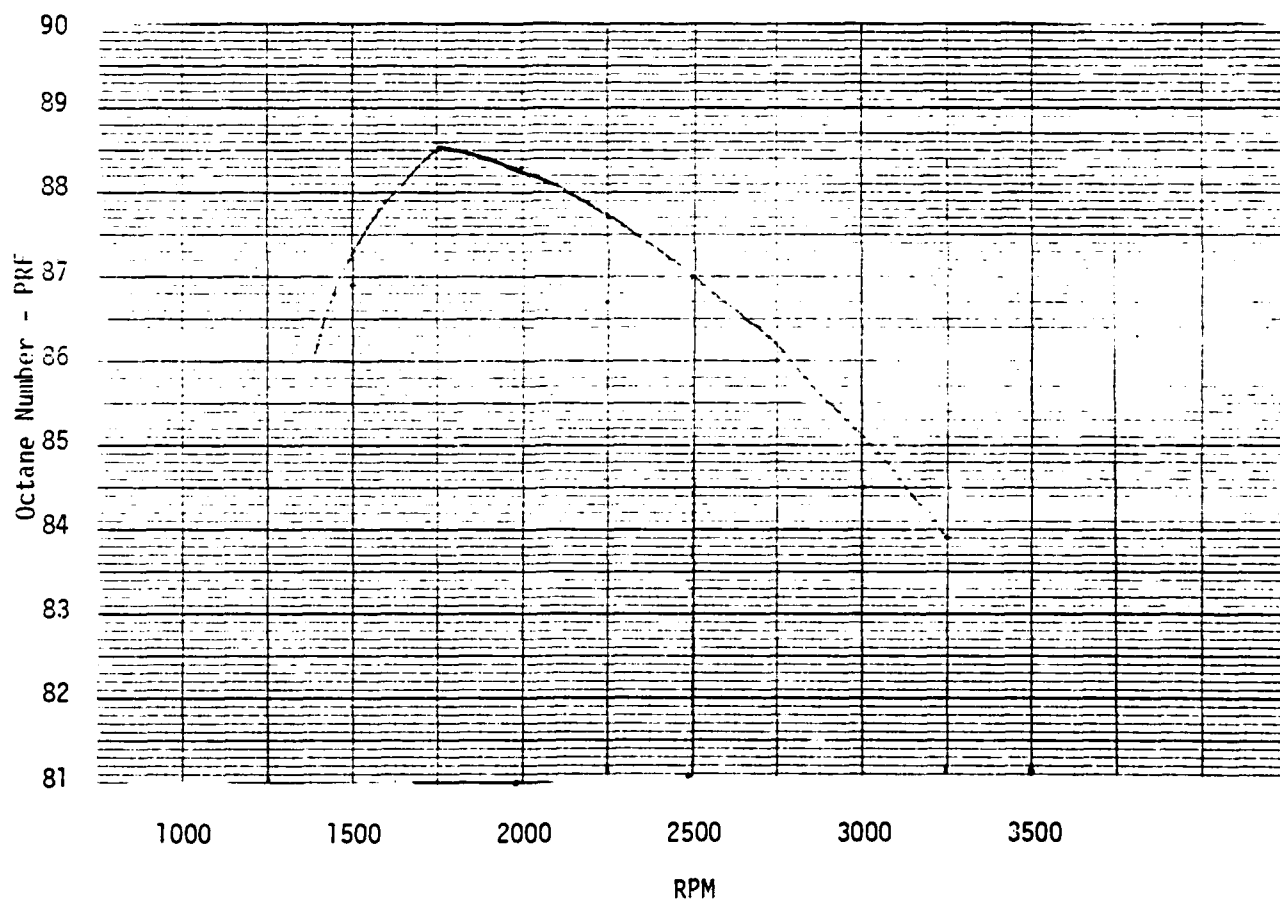
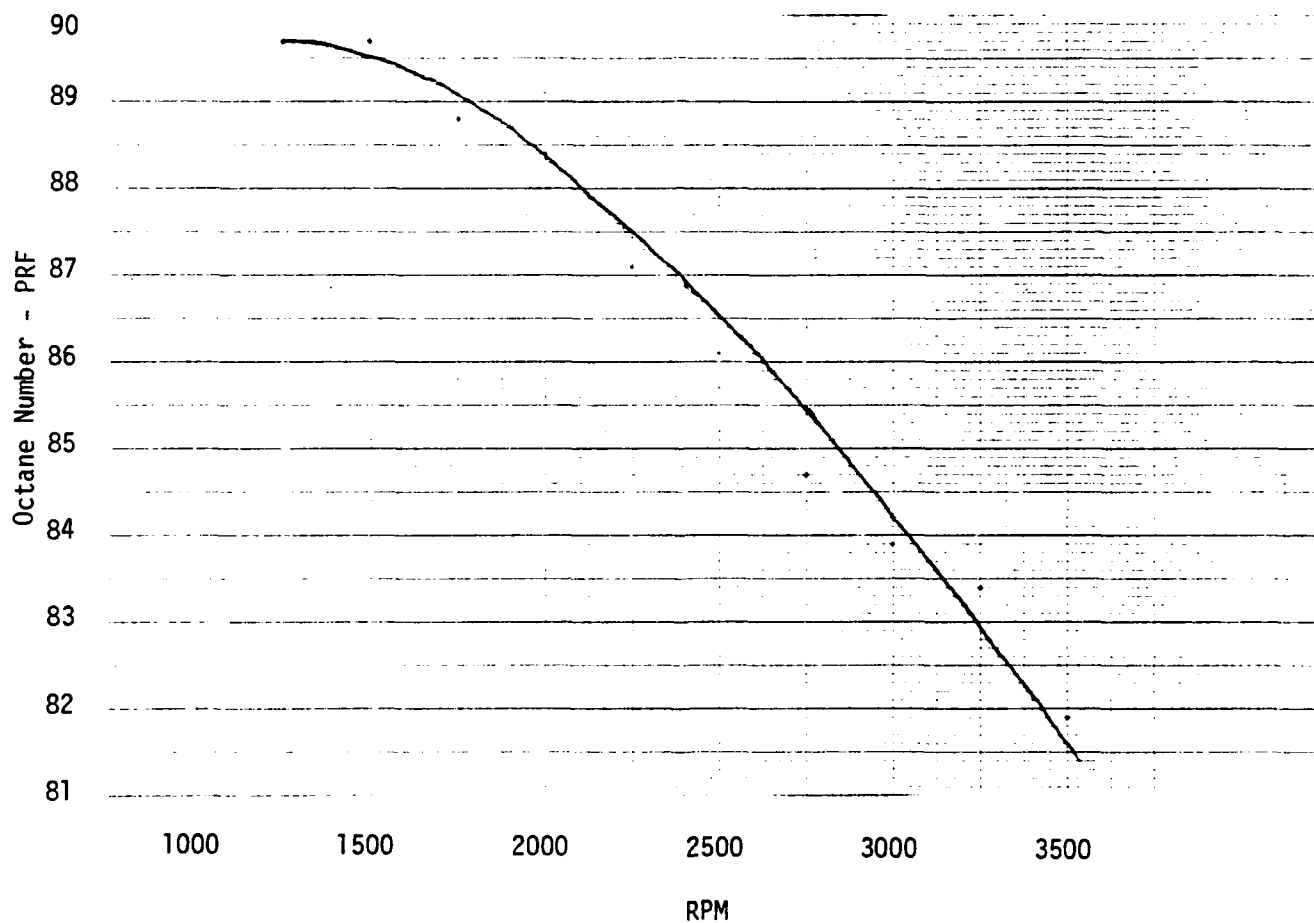


FIGURE F.6

PRF SPEED RANGE OCTANE NUMBER REQUIREMENTS

1980 Select Models: PC 137
KC 137
DC 137



A P P E N D I X G

CONFIDENCE LIMITS OF
OCTANE NUMBER REQUIREMENT DISTRIBUTIONS

CONFIDENCE LIMITS OF OCTANE NUMBER REQUIREMENT DISTRIBUTIONS

Octane number requirements of vehicles presented in this survey are determined at the levels that satisfy certain percentages of specific vehicle populations. In many cases, the recorded octane number requirement is followed by a plus and minus limit, referred to as the confidence interval. These limits give the interval within which the requirement for that satisfaction level would be expected 95% of the time in replicate testing.

At the 50% satisfaction level, the 95% confidence interval is calculated as follows:

$$CI = \pm ts / \sqrt{n}$$

where t = Students t at the proper number of degrees of freedom*

s = Standard deviation, calculated directly from the data or estimated as the difference between the 84.16th and 50th percentiles (assuming normal distribution)

n = Number of vehicles in population.

At other satisfaction levels:

$$CI = \pm ts \sqrt{1/n + k^2/[2(n-1)]}$$

At the 90% satisfaction level, k = 1.2817. For other satisfaction levels, appropriate values for k may be found in the standard statistical tables.

* Distribution of t for probability = 0.05.

Degrees of Freedom**	t	Degrees of Freedom	t
1	12.706	18	2.101
2	4.393	19	2.093
3	3.182	20	1.086
4	2.776	21	2.080
5	2.571	22	2.074
6	2.447	23	2.069
7	2.365	24	2.064
8	2.306	25	2.060
9	2.262	26	2.056
10	2.228	27	2.052
11	2.201	28	2.048
12	2.179	29	2.045
13	2.160	30	2.042
14	2.145	40	2.021
15	2.131	60	2.000
16	2.120	120	1.980
17	2.110	-	1.960

** D.F = (n-1)

TABLE G-I

95% CONFIDENCE LIMITS FOR MAXIMUM REQUIREMENTS

1980 Weighted Vehicle Population Groups

	Fuel	n	t	Std. Dev. (S)		95% Confidence Limits			
				RON	MON	RON		MON	
						50%	90%	50%	90%
U.S. and Imported Vehicles	PR	429	1.96	2.64	2.64	0.25	0.34	0.25	0.34
	FBRU	429	1.96	3.39	2.13	0.32	0.43	0.20	0.27
	FBRSU	429	1.96	3.89	2.24	0.37	0.50	0.21	0.29
U.S. and Imported Cars	PR	407	1.96	2.59	2.59	0.25	0.34	0.25	0.34
	FBRU	407	1.96	3.57	2.24	0.35	0.47	0.22	0.29
	FBRSU	407	1.96	4.10	2.35	0.40	0.54	0.23	0.31
U.S. Vehicles	PR	344	1.96	2.50	2.50	0.26	0.36	0.26	0.36
	FBRU	344	1.96	3.24	2.05	0.34	0.46	0.22	0.29
	FBRSU	344	1.96	3.70	2.15	0.39	0.53	0.23	0.31
U.S. Cars	PR	326	1.96	2.54	2.54	0.28	0.37	0.28	0.37
	FBRU	326	1.96	3.42	2.14	0.37	0.50	0.23	0.31
	FBRSU	326	1.96	3.82	2.20	0.41	0.56	0.24	0.32
Imported Vehicles	PR	85	1.99	2.83	2.83	0.61	0.83	0.61	0.83
	FBRU	85	1.99	3.01	1.90	0.65	0.88	0.41	0.56
	FBRSU	85	1.99	3.33	1.97	0.72	0.97	0.42	0.57

TABLE G-II

95% CONFIDENCE LIMITS FOR FBRU PART-THROTTLE REQUIREMENTS

1980 Weighted Vehicle Population Groups

	<u>n</u>	<u>t</u>	Std. Dev. (S)		95% Confidence Limits			
					RON		MON	
			<u>RON</u>	<u>MON</u>	<u>50%</u>	<u>90%</u>	<u>50%</u>	<u>90%</u>
U.S. and Imported Vehicles	389	1.96	5.36	3.41	0.53	0.72	0.34	0.46
U.S. and Imported Cars	375	1.96	5.04	3.21	0.51	0.69	0.33	0.44
U.S. Vehicles	312	1.96	5.82	3.69	0.65	0.87	0.41	0.55
U.S. Cars	296	1.96	5.36	3.41	0.61	0.82	0.39	0.52
Imported Vehicles	77	1.99	5.02	3.23	1.14	1.54	0.73	0.99

TABLE G-III

95% CONFIDENCE LIMITS FOR MAXIMUM REQUIREMENTS

1980 Select Models

Car Model	Fuel	n	t	Std. Dev. (S)		95% Confidence Limits					
						RON			MON		
				RON	MON	50%	90%		50%	90%	
MC5 225/HC5 225/ IC5 225/LC5 225	PR	24	2.069	2.868	2.868	1.21	1.65		1.21	1.65	
	FBRU	24	2.069	3.747	2.430	1.58	2.16		1.03	1.40	
	FBRSU	24	2.069	3.799	2.297	1.60	2.19		0.97	1.32	
NC7 228/HC7 228/ IC7 228/LC7 228	PR	21	2.086	2.906	2.906	1.32	1.81		1.32	1.81	
	FBRU	21	2.086	3.333	2.268	1.52	2.07		1.03	1.41	
	FBRSU	21	2.086	3.447	2.100	1.57	2.14		0.96	1.30	
NIJ 244	PR	12	2.201	0.985	0.985	0.63	0.86		0.63	0.86	
	FBRU	12	2.201	1.564	0.961	0.99	1.37		0.61	0.84	
	FBRSU	12	2.201	1.658	0.965	1.05	1.45		0.61	0.84	
OCA 242/MCA 242	PR	14	2.160	1.393	1.393	0.80	1.10		0.80	1.10	
	FBRU	14	2.160	1.562	0.978	0.90	1.24		0.56	0.78	
	FBRSU	14	2.160	2.341	1.443	1.35	1.86		0.83	1.14	
O V250/M V250	PR	14	2.160	1.737	1.737	1.00	1.38		1.00	1.38	
	FBRU	14	2.160	2.400	1.505	1.39	1.90		0.87	1.19	
	FBRSU	14	2.160	2.112	1.213	1.22	1.67		0.70	0.96	
PC 137/KC 137/DC 137	PR	15	2.145	2.770	2.770	1.53	2.10		1.53	2.10	
	FBRU	15	2.145	3.474	2.282	1.92	2.64		1.26	1.73	
	FBRSU	15	2.145	3.326	2.101	1.84	2.53		1.16	1.60	

A P P E N D I X H

MAXIMUM OCTANE NUMBER REQUIREMENTS OF SELECT MODELS

TABLE H-I

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

Percent Satisfied	Model: NC5 225/HC5 225/IC5 225/LC5 225					Model: NC7 228/HC7 228/IC7 228/LC7 228				
	PRF O.N.	FBRU		FBRSU		PRF O.N.	FBRU		FBRSU	
		RON	MON	RON	MON		RON	MON	RON	MON
5	83.9	84.9	79.6	87.4	79.1	79.8	80.7	76.7	81.5	75.5
10	85.0	86.3	80.5	88.8	79.9	80.9	81.9	77.5	82.7	76.3
20	86.2	88.0	81.6	90.5	80.9	82.2	83.4	78.5	84.3	77.2
30	87.1	89.1	82.4	91.7	81.6	83.1	84.4	79.2	85.4	77.9
40	87.9	90.2	83.0	92.7	82.3	83.9	85.3	79.8	86.3	78.4
50	88.6	91.1	83.6	93.7	82.8	84.6	86.2	80.4	87.2	79.0
60	89.4	92.1	84.2	94.6	83.4	85.4	87.0	81.0	88.0	79.5
70	90.1	93.1	84.9	95.7	84.0	86.1	87.9	81.6	89.0	80.1
80	91.1	94.3	85.7	96.9	84.8	87.1	89.0	82.3	90.1	80.7
90	92.3	95.9	86.7	98.6	85.8	88.3	90.5	83.3	91.6	81.7
95	93.4	97.3	87.6	99.9	86.6	89.4	91.7	84.1	92.8	82.4

(Continued)

TABLE H-I
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

Percent Satisfied	Model: NIJ 244						Model: OCA 242/MCA 242					
	PRF O.N.	FBRU		FBRSU		PRF O.N.		FBRU		FBRSU		
		RON	MON	RON	MON			RON	MON	RON	MON	
5	88.7	89.5	82.7	90.0	80.6	88.7		89.3	82.5	89.3	80.1	
10	89.1	90.1	83.0	90.6	81.0	89.2		89.9	82.9	90.1	80.7	
20	89.5	90.8	83.4	91.4	81.4	89.8		90.5	83.3	91.2	81.3	
30	89.8	91.3	83.8	91.9	81.7	90.2		91.0	83.6	91.9	81.8	
40	90.1	91.7	84.0	92.3	82.0	90.6		91.5	83.9	92.6	82.1	
50	90.3	92.1	84.3	92.8	82.2	91.0		91.9	84.1	93.1	82.5	
60	90.6	92.5	84.5	93.2	82.5	91.3		92.3	84.4	93.7	82.9	
70	90.8	92.9	84.8	93.6	82.7	91.7		92.7	84.6	94.4	83.3	
80	91.2	93.4	85.1	94.1	83.0	92.1		93.2	84.9	95.1	83.7	
90	91.6	94.1	85.5	94.9	83.5	92.7		93.9	85.4	96.1	84.4	
95	92.0	94.7	85.8	95.5	83.8	93.3		94.4	85.7	97.0	84.9	

(Continued)

TABLE H-1
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

Percent Satisfied	Model: 0 V250/M V250					Model: PC 137/KC 137/DC 137				
	PRF O.N.	FBRU		FBRSU		PRF O.N.	FBRU		FBRSU	
		RON	MON	RON	MON		RON	MON	RON	MON
5	88.5	88.3	81.9	89.5	80.4	87.6	88.1	81.6	89.8	80.4
10	89.1	89.2	82.5	90.3	80.8	88.6	89.3	82.4	91.0	81.1
20	89.9	90.3	83.1	91.2	81.4	89.9	90.8	83.4	92.5	82.1
30	90.4	91.0	83.6	91.9	81.7	90.7	91.9	84.2	93.6	82.7
40	90.9	91.7	84.0	92.5	82.1	91.5	92.9	84.8	94.5	83.3
50	91.4	92.3	84.4	93.0	82.4	92.2	93.8	85.4	95.3	83.8
60	91.8	92.9	84.8	93.5	82.7	92.9	94.6	85.9	96.1	84.4
70	92.3	93.5	85.2	94.1	83.0	93.7	95.6	86.5	97.0	84.9
80	92.8	94.3	85.7	94.8	83.4	94.5	96.7	87.3	98.1	85.6
90	93.6	95.4	86.3	95.7	83.9	95.8	98.2	88.3	99.6	86.5
95	94.2	96.2	86.9	96.5	84.4	96.8	99.5	89.1	100.8	87.3

(Continued)

TABLE H-II

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL NC5 225/HC5 225/IC5 225/LC5 225

i	PRF O.N.	FBRU			FBRSU			% Satisfied
		RON	MON	(R+M)/2	RON	MON	(R+M)/2	
1	82.0	82.5	77.8	80.2	86.0	78.4	82.2	2.08
2	84.0	85.0	79.7	82.4	87.0	79.0	83.0	6.25
3	85.0	86.0	80.4	83.2	88.5	79.8	84.2	10.42
4	85.0	87.0	81.0	84.0	89.0	80.1	84.6	14.58
5	86.0	88.0	81.7	84.8	90.0	80.6	85.3	18.75
6	87.0	89.0	82.3	85.6	90.0	80.6	85.3	22.92
7	87.0	89.0	82.3	85.6	91.0	81.2	86.1	27.08
8	87.0	90.0	83.0	86.5	92.0	81.8	86.9	31.25
9	88.0	90.0	83.0	86.5	93.0	82.4	87.7	35.42
10	89.0	90.0	83.0	86.5	94.0	83.0	88.5	39.58
11	89.0	91.0	83.6	87.3	94.0	83.0	88.5	43.75
12	89.0	91.0	83.6	87.3	95.0	83.5	89.2	47.92
13	89.0	92.0	84.2	88.1	95.0	83.5	89.2	52.08
14	89.0	92.0	84.2	88.1	95.0	83.5	89.2	56.25
15	90.0	93.0	84.8	88.9	95.0	83.5	89.2	60.42
16	90.0	93.0	84.8	88.9	95.0	83.5	89.2	64.58
17	90.0	93.0	84.8	88.9	96.0	84.1	90.0	68.75
18	90.0	93.0	84.8	88.9	96.0	84.1	90.0	72.92
19	90.0	93.0	84.8	88.9	96.0	84.1	90.0	77.08
20	91.0	94.0	85.5	89.8	96.0	84.1	90.0	81.25
21	92.0	94.0	85.5	89.8	97.0	84.7	90.8	85.42
22	92.0	95.0	86.1	90.6	98.0	85.4	91.7	89.58
23	92.5	98.0	88.1	93.0	99.0	86.3	92.6	93.75
24	94.0	98.0	88.1	93.0	101.0	87.9	94.4	97.92
N	24		24			24		
50% ($\bar{x}$)	88.646	91.104	83.629	87.367	93.688	82.838	88.263	
s	2.868	3.747	2.430	3.088	3.799	2.297	3.046	

(Continued)

TABLE H-II
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL NC7 228/HC7 228/IC7 228/LC7 228

i	PRF O.N.	FBRU			FBRSU			% Satisfied
		RON	MON	(R+M)/2	RON	MON	(R+M)/2	
1	78.0	80.0	75.9	78.0	81.0	74.8	77.9	2.38
2	79.0	81.5	77.1	79.3	82.0	75.6	78.8	7.14
3	81.0	82.0	77.5	79.8	84.0	77.0	80.5	11.90
4	82.0	83.0	78.2	80.6	84.0	77.0	80.5	16.67
5	83.0	84.0	78.9	81.4	85.0	77.7	81.4	21.43
6	83.0	84.5	79.3	81.9	85.0	77.7	81.4	26.19
7	84.0	85.0	79.7	82.4	86.0	78.4	82.2	30.95
8	85.0	86.0	80.4	83.2	86.0	78.4	82.2	35.71
9	85.0	86.0	80.4	83.2	86.0	78.4	82.2	40.48
10	85.0	86.0	80.4	83.2	86.0	78.4	82.2	45.24
11	85.0	86.0	80.4	83.2	87.0	79.0	83.0	50.00
12	85.0	86.0	80.4	83.2	87.0	79.0	83.0	54.76
13	85.0	86.0	80.4	83.2	87.0	79.0	83.0	59.52
14	86.0	87.0	81.0	84.0	88.0	79.6	83.8	64.29
15	86.0	87.0	81.0	84.0	88.0	79.6	83.8	69.05
16	86.0	87.0	81.0	84.0	88.0	79.6	83.8	73.81
17	86.0	88.0	81.7	84.8	90.0	80.6	85.3	78.57
18	87.0	89.0	82.3	85.6	91.0	81.2	86.1	83.33
19	87.0	90.0	83.0	86.5	92.0	81.8	86.9	88.10
20	89.0	91.5	83.9	87.7	92.5	82.1	87.3	92.86
21	90.0	94.5	85.8	90.2	95.0	83.5	89.2	97.02
N	21		21					
50% (X)	84.619	86.190	80.414	83.302	87.167	78.971	83.069	
s	2.906	3.333	2.268	2.800	3.447	2.100	2.772	

(Continued)

TABLE H-II
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL NIJ 244

i	PRF O.N.	FBRU			FBRSU			% Satisfied
		RON	MON	(R+M)/2	RON	MON	(R+M)/2	
1	89.0	90.0	83.0	86.5	90.0	80.6	85.3	4.17
2	89.0	91.0	83.6	87.3	91.0	81.2	86.1	12.50
3	89.0	91.0	83.6	87.3	92.0	81.8	86.9	20.83
4	90.0	91.0	83.6	87.3	92.0	81.8	86.9	29.17
5	90.0	91.0	83.6	87.3	92.0	81.8	86.9	37.50
6	90.0	92.0	84.2	88.1	92.0	81.8	86.9	45.83
7	91.0	92.0	84.2	88.1	93.0	82.4	87.7	54.17
8	91.0	92.0	84.2	88.1	93.0	82.4	87.7	62.50
9	91.0	93.0	84.8	88.9	93.0	82.4	87.7	70.83
10	91.0	93.0	84.8	88.9	94.0	83.0	88.5	79.17
11	91.0	93.0	84.8	88.9	95.0	83.5	89.2	87.50
12	92.0	96.0	86.7	91.4	96.0	84.1	90.0	95.83

N	12	12	12	12
50% ($\bar{X}$)	90.333	92.083	84.258	88.171
s	0.985	1.564	0.961	1.263
		92.750	82.233	87.492
		1.658	0.965	1.312

(Continued)

TABLE H-II
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL OCA 242/MCA 242

i	PRF O.N.	FBRU			FBRSU			$\frac{\%}{\text{Satisfied}}$
		RON	MON	$(R+M)/2$	RON	MON	$(R+M)/2$	
1	88.0	88.0	81.7	84.8	89.0	80.1	84.6	3.57
2	89.0	90.0	83.0	86.5	90.0	80.6	85.3	10.71
3	90.0	91.0	83.6	87.3	91.5	81.5	86.5	17.86
4	90.0	91.0	83.6	87.3	93.0	82.4	87.7	25.00
5	90.0	92.0	84.2	88.1	93.0	82.4	87.7	32.14
6	91.0	92.0	84.2	88.1	93.0	82.4	87.7	39.29
7	91.0	92.0	84.2	88.1	93.0	82.4	87.7	46.43
8	91.5	92.0	84.2	88.1	93.0	82.4	87.7	53.57
9	92.0	92.0	84.2	88.1	93.0	82.4	87.7	60.71
10	92.0	92.0	84.2	88.1	93.0	82.4	87.7	67.86
11	92.0	93.0	84.8	88.9	94.0	83.0	88.5	75.00
12	92.0	93.0	84.8	88.9	94.0	83.0	88.5	82.14
13	92.0	94.0	85.5	89.8	95.5	83.8	89.6	89.29
14	93.0	94.0	85.5	89.8	99.0	86.3	92.6	96.43

N 14

14

50% ($\bar{X}$)

90.964

91.857

84.121

87.989

93.143

82.507

87.825

s

1.393

1.562

0.978

1.270

2.341

1.443

1.891

(Continued)

TABLE H-II
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL 0 V250/M V250

i	PRF O.N.	FBRU			FBRSU			% Satisfied
		RON	MON	(R+M)/2	RON	MON	(R+M)/2	
1	88.0	88.0	81.7	84.8	89.0	80.1	84.6	3.57
2	90.0	89.0	82.3	85.6	90.0	80.6	85.3	10.71
3	90.0	90.0	83.0	86.5	91.0	81.2	86.1	17.86
4	90.0	91.0	83.6	87.3	92.0	81.8	86.9	25.00
5	90.0	91.0	83.6	87.3	92.0	81.8	86.9	32.14
6	91.0	91.0	83.6	87.3	92.0	81.8	86.9	39.29
7	91.0	92.0	84.2	88.1	93.0	82.4	87.7	46.43
8	91.0	93.0	84.8	88.9	93.0	82.4	87.7	53.57
9	92.0	93.0	84.8	88.9	94.0	83.0	88.5	60.71
10	92.0	94.0	85.5	89.8	95.0	83.5	89.2	67.86
11	93.0	94.0	85.5	89.8	95.0	83.5	89.2	75.00
12	93.0	95.0	86.1	90.6	95.0	83.5	89.2	82.14
13	94.0	95.0	86.1	90.6	95.0	83.5	89.2	89.29
14	94.0	96.0	86.7	91.4	96.0	84.1	90.0	96.43
N	14		14					
50% ($\bar{X}$)	91.357	92.286	84.393	88.339	93.000	82.371	87.686	
s	1.737	2.400	1.505	1.952	2.112	1.213	1.663	

(Continued)

TABLE H-II
(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL PC 137/KC 137/DC 137

i	PRF O.N.	FBRU			FBRSU			% Satisfied
		RON	MON	(R+M)/2	RON	MON	(R+M)/2	
1	88.0	89.0	82.3	85.6	89.0	80.1	84.6	3.33
2	88.0	89.5	82.6	86.0	91.0	81.2	86.1	10.00
3	89.0	90.0	83.0	86.5	91.5	81.5	86.5	16.67
4	90.5	91.5	83.9	87.7	94.0	83.0	88.5	23.33
5	91.0	92.0	84.2	88.1	94.0	83.0	88.5	30.00
6	91.0	92.0	84.2	88.1	94.0	83.0	88.5	36.67
7	92.0	93.0	84.8	88.9	94.0	83.0	88.5	43.33
8	92.0	93.0	84.8	88.9	96.0	84.1	90.0	50.00
9	93.0	94.0	85.5	89.8	96.0	84.1	90.0	56.67
10	93.0	95.0	86.1	90.6	97.0	84.7	90.8	63.33
11	93.5	95.0	86.1	90.6	97.0	84.7	90.8	70.00
12	94.0	96.0	86.7	91.4	97.0	84.7	90.8	76.67
13	94.5	96.5	87.0	91.8	98.0	85.4	91.7	83.33
14	95.5	98.0	88.1	93.0	99.0	86.3	92.6	90.00
15	98.0	H	H	H	H	H	H	96.67

N	15	15
50% ($\bar{X}$)	92.200	(93.767) (85.353) (89.560) (95.300) (83.820) (89.560)
s	2.770	(3.474) (2.282) (2.877) (3.326) (2.101) (2.711)

A P P E N D I X I

PROCEDURES FOR PLOTTING
OCTANE NUMBER REQUIREMENT DISTRIBUTION DATA

WEIGHTED VEHICLE/CAR POPULATIONS

Weighting factors for each vehicle model were developed from information supplied by the U.S. Vehicle Manufacturers and from information published (Ward's Automotive Reports) for imported vehicles. These weight factors were proportioned to the relative production and/or sales volumes of the vehicles tested.

For any vehicle having octane requirements lower (L) than the lowest octane number fuel available within a given fuel series, a number 0.5 Research/0.4 Motor lower was assigned. Similarly, for any vehicle having octane requirements higher (H) than the highest octane fuel available within a given fuel series, a number 0.5 Research/0.4 Motor higher was assigned.

The weighting factors of each vehicle model were divided by the number of vehicles tested to calculate individual vehicle weight factors. The octane requirements for each vehicle were then arranged in increasing order with the appropriate individual weighting factors. The percent of vehicles at each octane requirement level represents the summation of all vehicle weighting factors before that level, plus one-half the sum of the weighting factors at that level. The individual vehicle weighting factors are adjusted so that the summation of all weighting factors is 100.00 for any vehicle population of interest. The midpoint percentiles are plotted versus octane number requirement on arithmetic probability paper and a distribution curve is drawn through the points. These distributions are then plotted point to point on Cartesian coordinates for figures shown in the survey report.

SELECT CAR MODELS

For individual car models, the octane number requirement distribution curves were plotted by the "Z" method as described in "Statistical Estimation of the Gasoline Octane Number Requirement of New Model Automobiles," C. S. Brinegar and R. R. Miller, Technometrics, Vol. 2, No. 1, February 1960.

The procedure is as follows:

For any cars having octane requirements lower (L) than the lowest octane number fuel available within a given fuel level, a number 0.5 Research/0.4 Motor lower was assigned. Similarly, for individual cars having octane requirements higher (H) than the highest octane fuel available within a given fuel series a number 0.5 Research/0.4 Motor higher was assigned.

Using all observed and estimated octane number values, calculate the mean ($\bar{X}$) and the standard deviation (S) from the data for each car model.

1.

$$\bar{X} = \frac{\sum X_i}{n}$$

$$s = \sqrt{\frac{1}{n-1} \left[\sum X_i^2 - \left(\frac{\sum X_i}{n} \right)^2 \right]}$$

Where X_i = Octane number requirement of the i^{th} car of a given model

n = Number of cars of that model.

2. Estimate octane number requirements at the percentiles of interest from octane number requirement distribution data by

$$\text{O.N.} = \bar{X} + ks$$

where k is selected from normal distribution tables.

Values of k used to calculate percentiles in this report are:

<u>Percentile</u>	<u>k</u>
5	-1.645
10	-1.282
20	-0.842
30	-0.524
40	-0.253
50	0
60	+0.253
70	+0.524
80	+0.842
90	+1.282
95	+1.645

The requirements were arranged in increasing order and plotted on arithmetic probability paper; the percent satisfaction for any car is calculated by the following relationship:

$$\text{Percent satisfied: } i^{\text{th}} \text{ car} = \frac{(i-0.5)}{N} 100$$

where N is the total number of cars tested for a given fuel
and i is an integer having increasing values from 1 to N .

Curves may either be faired through the plotted points or a straight line superimposed using the mean and standard deviation calculated above. From inspection of these curves, revised L and H values may be indicated. If so, new means and standard deviations may be calculated.

A P P E N D I X J

GEAR POSITION FOR
MAXIMUM OCTANE NUMBER REQUIREMENTS

TABLE J-I

GEAR POSITION AT 1980 MAXIMUM OCTANE NUMBER REQUIREMENT

FBRU Fuel

<u>GEAR POSITION</u>	<u>Automatic Transmission</u>		<u>Manual Transmission</u>		<u>All Vehicles</u>	
	<u>No. Vehicles</u>	<u>%</u>	<u>No. Vehicles</u>	<u>%</u>	<u>No. Vehicles</u>	<u>%</u>
<u>Highest</u>						
Full-Throttle	183	55	57	59	240	56
Part-Throttle	12	4	11	11	23	5
Full = Part-Throttle	23	7	14	15	37	8
<u>Passing</u>						
Full-Throttle	99	30	8	8	107	25
<u>Miscellaneous</u>						
Highest PT = Passing FT	5	1	1	1	6	2
Highest PT > Passing FT	3	1	2	2	5	1
Max. Requirement <78	4	1	4	4	8	2
Max. Requirement >102	3	1	0	0	3	1
	332	100	97	100	429	100

