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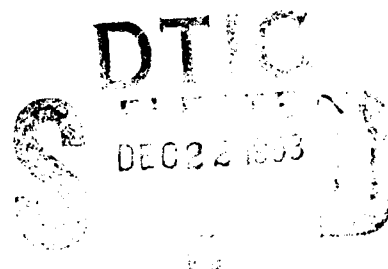


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1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

October 1993



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1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

(CRC Project No. CM-124-90)

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DTIC QUALITY CONTROL

October 1993

Automotive Vehicle Fuel, Lubricant, and Equipment Research Committee
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ABSTRACT

A CRC cooperative program was conducted to determine the difference in octane requirements between technical raters and "customers" (the general driving public). The tests were conducted in two phases, with the second being a repeat of the first to verify the results obtained. The trained raters used the CRC E-15 procedure to determine the octane requirement of the vehicles while the customers' perception and objection to knock were determined through the use of a questionnaire. The customers' responses (perception and objection level) were based upon audible knock, acceleration performance, and after-run on a series of full-boiling-range customer/rater unleaded (FBRCU) reference fuels. Data were analyzed from 168 1988-1991 model-year vehicles, with 126 of these tested in Phase II. The results showed that the customers' objections and perceptions were overwhelmingly based on knock, rather than acceleration performance or after-run. Two general methods, a population comparison and a delta analysis, were used to estimate the difference between customer and rater octane requirements. In the first method, the data were analyzed by comparing satisfaction curves for the technical and customer octane requirements (population comparison). In the second method, a distribution of deltas was developed by directly determining the difference between technical and customer octane requirements for each vehicle. The difference between the technical and customer octane requirement at the mid-point satisfaction level was 3.8 $(R+M)/2$ octane numbers using the population comparison and 4.1 $(R+M)/2$ octane numbers using the distribution of delta analysis. The differences are lower than the corresponding results in the 1975 and 1978 CRC studies. The statistical analysis of the database also showed that the difference between customer objection and perception levels were generally small (less than or equal to 1 $(R+M)/2$ octane number). The differences in the octane distribution curves for Phases I and II were negligible, thus Phase II verified the results of Phase I. Knock sensors were found to have significant effect on the difference between the technical and customer ratings; this effect may be due to a decrease in customer awareness when knock sensors were present. This study and the previous studies found the customer/rater deltas to increase as the technical ratings increase.

I. Introduction

The differences between octane requirements measured by trained raters and the octane level at which customers perceive knock have always generated considerable interest. Two previous CRC programs were conducted in 1975⁽¹⁾ and 1978⁽²⁾ to evaluate the customer octane response compared with that of a trained rater. Since that time, many changes have taken place with automobiles and automotive technology. With the introduction of fuel-injected vehicles, customer expectations of automobile performance have become higher. The current program was initiated in 1990 to provide an update to the earlier data developed. Customers were asked directly about fuel reaction in their vehicles by a questionnaire. Testing was conducted using the CRC E-15⁽³⁾ procedure and a special reference fuel series to determine vehicle octane requirements. A second phase of this program was conducted to verify the results obtained in Phase I.

Data from 168 vehicles were analyzed in the program. The eleven participating laboratories are listed in Appendix A. A list of the members of the Analysis Panel is included in Appendix B. The program proposal is outlined in Appendix C.

II. Summary and Conclusions

The following are the main findings of this work:

- A comparison of the satisfaction curves for customers and for raters (Population Approach) indicates that the difference between customer objection levels and technical ratings is 3.8 (R+M)/2 octane numbers at the midpoint satisfaction level.
- The population approach indicates a difference between customer perception and the technical rating of 3.1 (R+M)/2 octane numbers at the midpoint satisfaction level.
- An analysis of the distribution of the differences between customer objection level and the technical rating for individual vehicles (Delta Approach) found a median difference of 4.1 (R+M)/2 octane numbers.
- The Delta Approach indicates a median difference between the customer perception level and the technical rating of 3.2 (R+M)/2 octane numbers.
- Using both analysis approaches, the difference between customer perception and customer objection was less than 1 (R+M)/2 octane number, indicating that when the customer perceives a problem, it is usually objectionable.
- The Phase II results confirmed the results of Phase I.

- The presence of knock sensors had little or no effect on the technical rating, but tended to reduce the customer objection to knock. This resulted in a 1.6 (R+M)/2 octane number increase in the difference between the technical and customer ratings of knock-sensor vehicles relative to those without knock sensors.
- This and previous studies found that the customer/rater deltas increase as the technical ratings increase.
- The differences between the technical rating and both the customer objection and perception levels have decreased relative to previous studies.

III. Program Description

The objective of this program was to conduct a cooperative test to determine the difference between octane requirements determined by trained raters and octane requirements determined by "customers". The trained raters determined the octane requirements based on audible knock, using the CRC E-15 procedure. Through response to a questionnaire, the customer perception and objection levels were determined based upon audible knock, after-run, and acceleration performance.

The program was started in the late summer and early fall of 1990 and continued until early 1992. The test portion of the program was originally targeted for completion by the end of June 1991, but time constraints within several participating companies forced the testing period to be extended.

The testing was conducted in two phases. Phase I began with trained-rater measurements of the octane number requirement of each vehicle. After these ratings, the fuel tank was emptied and refilled with test gasoline of the same octane number as the rater's octane number requirement of the vehicle. The customer was then asked to drive the vehicle for a minimum of one tankful or a minimum of one week on this fuel.

After this period, but prior to receiving another tank of fuel, the customer was contacted and asked the questions on the Gasoline Evaluation Questionnaire, shown in Appendix C. The interviewer was instructed to obtain unprompted responses to the questions. Based on the customer's responses, the next test fuel was selected. In general, the procedure was to change the octane quality of the tank fuel until the customer objection and perception requirements were defined. A chart illustrating the sequence of vehicle tank fillings is shown in Appendix C.

The customer knock-perception octane number requirement was defined as the highest octane number fuel on which the customer indicated knocking or pinging. The customer knock-objection was defined by the octane number requirement at which the customer objected to the knock or pinging which was reported. Phase II of the program started with an additional trained rater measurement of octane number requirement for each vehicle; the customer knock-perception and knock-objection octane number requirements were then determined in the same manner as Phase I.

IV. Test Fuels

A full-boiling-range customer/rater unleaded reference fuel series (FBRCU) was used for this study. The specifications for these fuels are similar to those used in the 1989/1990 CRC Octane Number Requirement Survey FBRCU reference fuel series. A "keep-clean" level of a port-fuel-injector additive was included to maintain the vehicle's fuel-injector performance throughout the program. The sensitivity of the FBRCU fuel series is similar to the average sensitivity of commercially available fuels. The Reid vapor pressure was at a nominal 9-psi level. The 50 percent evaporated temperature specification was more restrictive than used in the 1989/1990 octane rating fuels to minimize cold-start and warmup driveability problems during the testing period. The limiting specifications can be found in Appendix C.

Three fuels were used as the basis for preparing the blends. The blends were a product of two of the three following octane levels.

	<u>Research</u>	<u>Motor</u>
Low Octane Number Fuel	75.6	71.6
Intermediate Octane Number Fuel	91.6	82.8
High Octane Number Fuel	103.0	92.0

The fuels were blended in increments of 1.0 Research octane number (RON) from 76 to 103 octane number. The corresponding Motor octane numbers (MON) ranged from 72.1 up to 91.5.

The base fuels were submitted to the Fuel Acceptance Panel for approval. Appendix D contains inspection data on the three base fuels and the blends.

V. Test Vehicles

Data were analyzed from a total of 168 1988-1991 model-year vehicles in Phase I, with 126 of these tested in Phase II. Although 1988-1990 model years were targeted, three 1991 vehicles were included. The vehicle mileage ranged from 6,580 miles up to 75,430 miles with an average mileage of 31,207 miles. The actual distribution of odometer readings at the start of the test is shown in Figure 1. The test fleet is described in Appendix E.

The test fleet included 117 (70 percent) passenger cars and 51 (30 percent) light-duty trucks and vans. There were 46 (27 percent) imported vehicles and 72 (43 percent) knock-sensor-equipped vehicles. Vehicles were tested in approximate proportion to their sales. Table 1 shows the vehicle statistics for the vehicles tested in Phase I; the Phase II test fleet was a subset of the Phase I fleet.

VI. Customers

Customers were obtained for this program by offering free gasoline to employees of the participating laboratories or to local residents. Participation was restricted to persons not familiar with, nor directly associated with, octane quality testing. All participants were required to be the principal driver of the vehicle being tested. Efforts were made to select participants that did not typically make only extremely long or extremely short trips.

A distribution of genders and ages that generally represent US drivers was sought. The actual gender breakdown was 70 percent male and 30 percent female. Ages ranged from 22 to 69 years, with a median of 39 years. Customer data are included in Appendix E.

VII. Discussion of Results

A. Data Classifications

A listing of the individual vehicle octane number requirements (ONR) is presented in Appendix F. The data were separated into the following classifications:

1. Rater E-15 Maximum ONR - The greater of the full-and part-throttle requirements for all vehicles as determined by the trained raters utilizing the E-15 technique.
2. Customer Perception ONR - Highest octane levels at which customers perceived, but did not object to, knock, degradation in acceleration performance, or engine after-run.
3. Customer Objection ONR - Highest octane levels at which customers objected to and/or switched fuel because of knock, degradation in acceleration performance, or engine after-run.

B. Data Treatment

The test data for a given customer are summarized on an observation sheet. Information about the customer and the customer's vehicle are contained on the front side and weekly test data on the back side. The customer/vehicle data are listed in Appendix E. The weekly data are listed in Appendix F.

The following procedure was used in interpreting the weekly data to obtain comparisons of customer versus trained-rater octane number requirements for customer vehicles.

1. If the observation sheet weekly data indicated both test phases had been run, indicate the week which begins Phase II. Analyze the two phases separately as indicated in the following steps.
2. Independently for each of the three malfunctions taken into account on the observation sheet (knock, after-run, poor acceleration), record the octane number of the highest octane test fuel for which an objection was recorded. If no objection was recorded and the vehicle was run on an 80 RON test fuel or lower, record an "L" as the objection level. If an objection was registered when the vehicle was run on the highest octane test fuel available, record an "H". Otherwise, record nothing for the objection level.
3. A customer may have perceived one or more of the three kinds of knock-related malfunctions without objection. In this case, determine the perceived requirement as in Step 2 if no objection level for the malfunction has been recorded. If an objection level has been established, record the perceived level as equal to the objection level, unless the highest perceived level is higher than the objection level. If it is, record the highest perceived level.
4. Record the rater octane number requirement which is closest in time to the week corresponding to the highest octane fuel for which an objection was recorded. If no objection was recorded, use the week corresponding to the perception level. If only "L's" were recorded, use the week with the lowest octane fuel.
5. Record the octane number of the highest and lowest test fuels used during the test phase.
6. The customer objection level is defined as the highest objection level of the three individual malfunctions. The customer perception level is defined as the highest perception level of the three individual malfunctions.

These rules were sufficiently restrictive that a computer program was written to assign rater and customer requirements and write the results to a data file. The computer had only to be instructed as to the week the Phase II testing began.

In preparation of satisfaction distributions of rater, customer objection, or customer perception octane number requirements, the "L" requirements were assigned an octane number below that of the lowest test fuel (75 RON). In preparation of frequency distributions of the difference between rater and customer objection or perception octane number requirements, an "L" was replaced by the octane number less one of the lowest fuel on which the given vehicle was tested during the given test phase. This provides a conservative estimate for such observations, as the actual observation (had one been made) could not have been any higher and could well have been lower.

The sample size analyzed varied for the various subsets since some customers did not register an objection or perception and the test phase selection of test fuels did not qualify for the assignment of an "L".

C. Data Analysis Approaches

Two approaches were used to estimate the difference between customer and rater octane requirements. The first, the population comparison approach, used a modification of the "N+1 Approach" that was used in the 1975 and 1978 programs. The second, the delta analysis approach, used the difference between customer and rater octane requirement for each vehicle. It should be noted that octane distributions are not sales-weighted, as they are in the annual CRC Octane Number Requirement Surveys.

1. Population Analysis

The difference between customer and rater observations was determined by generating satisfaction curves (similar to those in the annual CRC Octane Number Requirement Survey) for each group. This approach has the advantages of relating the customer observations to technical observations in the same format as used in the annual Survey and of including all data (including those customers that did not perceive any octane-related problems); it has the disadvantage of being limited by how well the small population tested represents the overall vehicle population.

Generation of the satisfaction curves used an N+1 approach applied to half intervals. With this approach, the octane number requirements are first arranged in increasing order. Vehicle observations at the same octane number are treated as a group; the cumulative frequency for each group is one-half the incremental frequency for the group added to the sum of the incremental frequencies of all the groups at lower octanes. The percent satisfaction for each group is then the cumulative frequency divided by the total number of vehicles +1 x 100.

2. Delta Analysis

The difference between the rater and customer objection and perception levels (deltas) was calculated for each vehicle. There were fourteen vehicles which did not have a customer objection or perception on the lowest fuel tested. These vehicles were assigned an objection and perception level one octane number below the octane of lowest fuel tested. These deltas were used to develop frequency distributions.

D. Phase I

The E-15 procedure does not encompass all driving conditions that can be experienced by the customer. In addition, the temperature and humidity are limited to relatively narrow ranges in the E-15 procedure, whereas the driver may see many different ambient conditions that can affect engine ONR. This probably explains why almost 10 percent of the customers in this program had objection/perception levels at or above the trained rater ONR, and would apply to each of the population curves. Conversely, there is 10 percent of the customers with objection/perception levels 10 or more octane numbers lower than the trained rater ONR.

1. Population Analysis

The $(R+M)/2$ octane distribution curves for the rater and customer objection levels are shown in Figure 2. The midpoint satisfaction level was 87.0 for the trained rater and 83.2 for customer objection. Figure 3 shows the $(R+M)/2$ octane distribution curves for the rater and customer perception levels. At the midpoint satisfaction level, the technical ONR stays the same at 87.0, while the customer perception level was 0.7 octane numbers higher than the customer objection level at 83.9. Table 2 summarizes the rater ONR and the customer objection and perception levels at the midpoint satisfaction level for $(R+M)/2$, RON, and MON.

The difference between the $(R+M)/2$ ONR of raters and customers from their individual distribution populations at the midpoint satisfaction level was 3.8 for rater-customer objection and 3.1 for rater-customer perception. Table 2 shows these differences for $(R+M)/2$, RON, and MON for rater-customer objection and rater-customer perception levels. The complete $(R+M)/2$, RON, and MON frequency distributions for the rater ONR, the customer objection level, and customer perception level (for Phase I) are listed in Appendix G, Tables G-1 through G-3, respectively.

2. Delta Analysis

Figure 4 shows the comparison of the difference between $(R+M)/2$ ONR for the rater and customer objection level for Phase I. The median delta $(R+M)/2$ ONR is 4.1. Table 3 shows these delta differences for $(R+M)/2$, RON, and MON for rater-customer objection and rater-customer perception levels. The complete $(R+M)/2$, RON, and MON delta analysis distribution for the rater-ONR customer-objection levels are shown in Table G-4, and for rater customer perception levels in Table G-5.

E. Phase II

1. Population Analysis

The $(R+M)/2$ octane requirement distribution curves in the rater and customer objection levels are shown in Figure 5. The midpoint satisfaction level was 87.4 for the trained rater and 82.7 for customer objection. Figure 6 shows the $(R+M)/2$ octane distribution curves for the rater and customer perception levels. At the midpoint satisfaction level, the technical ONR stays the same at 87.4, while the customer perception level was 0.6 octane numbers higher than the customer objection level at 83.3. Table 4 summarizes the rater ONR and the customer objection and perception levels at the midpoint satisfaction for $(R+M)/2$, RON, and MON.

The difference between the $(R+M)/2$ ONR of raters and customers from their individual distribution populations at the midpoint satisfaction level was 4.7 in rater-customer objection and 4.1 in rater-customer perception. Table 4 shows these differences for $(R+M)/2$, RON, and MON for rater-customer objections and rater-customer perception levels. The complete $(R+M)/2$, RON and MON frequency distributions for the rater ONR, the customer objection level, and customer perception level (for Phase II) are listed in Appendix G, Tables G-6 through G-8.

2. Delta Analysis

Figure 7 shows the comparison of the difference between the $(R+M)/2$ ONR for the rater and customer objection level for Phase II. The median delta $(R+M)/2$ ONR is 4.3. Table 5 shows these delta differences for $(R+M)/2$, RON, and MON for rater-customer objection and rater-customer perception levels. The complete $(R+M)/2$, RON, and MON delta analysis distribution for the rater ONR customer-objection levels are shown in Table G-9 and for rater customer perception levels in Table G-10.

F. Comparison Between Phase I and Phase II

Figure 8 shows the rater octane requirements for Phase I and Phase II (R+M)/2 data. The data points follow the same trend and overlay in some cases. Figure 9 shows the customer objection requirements for the (R+M)/2 data. Figure 10 shows the distribution of the deltas for Phases I and II. The data track each other up to the midpoint level, but diverge at the higher levels. All of the Phase II results tend to confirm the results obtained in Phase I.

G. Comparison of Customer Objection and Perception Levels

The (R+M)/2 ONR distribution curves for the customer objection and perception levels for Phases I and II are shown in Figures 11 and 12, respectively. The differences between the technical and customer objection level and between the technical and customer perception level for Phases I and II are shown in Figures 13 and 14, respectively. The customer perception levels were generally less than one octane number different than the customer objection levels.

H. Knock Versus Acceleration Performance and Engine After-run

An objection and perception ONR was recorded for each classification (knock, acceleration performance, and engine after-run) of customer response during both phases of the testing.

The hierarchy of customer requirement classification was established as knock, engine after-run and acceleration performance. In each case, the customer octane requirement was defined by the maximum of the classification requirements. In the cases when the classification requirements were equal, the above hierarchy established the reported maximum classification ONR. A breakdown of the classifications for the customer ONR for Phase I and Phase II is given in Table 6. Engine knock accounted for nearly all of the objected and perceived customer ONR for both of the testing phases. Engine after-run was almost nonexistent at defining maximum customer ONR. Acceleration performance differences were perceived by customers in Phases I and II; however, customer objection to acceleration performance was at a very low level.

I. Deltas Versus Various Factors

At the 95 percent confidence level, driver gender, engine type, vehicle type, vehicle weight, odometer reading, compression ratio, engine displacement, and age of the driver do not have a significant effect on the difference between trained-rater octane requirements and customer-observed requirements.

A regression analysis indicates that the difference between knock-sensor and non-knock-sensor vehicles was significant at the 98 percent confidence level. On average, the delta was 1.6 octane numbers greater for knock-sensor vehicles. Figure 15 shows that there is essentially no difference between the technical rating distributions for the knock-sensor and non-knock-sensor vehicles. Figure 16 shows that there was a difference in the customer objection rating between knock-sensor and non-knock-sensor vehicles. The technical rater knows the vehicle has the knock sensor and rates the vehicle according to the E-15 procedure designed to handle ONR appropriately. In contrast, the customer is not as sensitive as the trained rater and, in most cases, does not perceive knock until after the knock sensor has retarded the spark.

The data plotted in Figures 15 and 16 were also analyzed separately for knock-sensor and non-knock-sensor-equipped vehicles by the population analysis method. The midpoint satisfaction levels were 87.1 and 86.8 $(R+M)/2$ for knock-sensor and non-knock-sensor vehicles, respectively, for the trained raters. The corresponding customer objection levels were 82.4 and 83.8 $(R+M)/2$. Table 7 summarizes the rater ONR and the customer objection levels at the midpoint satisfaction level for $(R+M)/2$, RON, and MON.

The differences between the $(R+M)/2$ ONR of raters and customers from their individual distribution populations at the midpoint satisfaction level was 4.7 for knock-sensor vehicles and 3.0 for non-knock-sensor vehicles for rater-customer objection (this compares with 3.8 for the two groups combined, as discussed previously). The difference of 1.7 $(R+M)/2$ ONR between the two groups compares well with the average value of 1.6 determined by the regression. Table 2 shows these differences for $(R+M)/2$, RON, and MON for rater-customer objection.

J. Relationship Between Customer, Rater, and Delta Observations

Figure 17 plots customer objection versus technical rating for the 168 observations in Phase I. The regression line is plotted through these data which indicates a significant relationship with a very low R^2 value. While this regression directly relates customer and rater observations, it is also related to the delta analysis. For reference, the one-to-one line is also plotted in Figure 17. If there were no difference between customer and rater (if the delta were zero), the regression line would overlay the one-to-one line. A constant delta would parallel the one-to-one line with a fixed offset. The fact that the regression line diverges from the one-to-one line as the technical ONR increases indicates a relationship between the delta and the technical ONR. This relationship has been observed in the previous programs. The individual points in Figure 17 have been marked to indicate whether the vehicle was equipped with a knock sensor. The knock-sensor and non-knock-sensor groups are fairly similarly distributed over the range of rater octane number requirements. Therefore, the regression does not appear to be the result of a maldistribution of either of the two vehicle groups.

K. Comparison With Previous Programs

Similar customer/rater programs were performed in 1975⁽¹⁾ and 1978⁽²⁾. Both of these programs were conducted over shorter time frames and included somewhat more vehicles (197 and 248 in 1975 and 1978, respectively).

In order to compare the current population results with prior results, the current population results have been compared with the N+1 Approach results from 1975 and 1978 at the 50 percent satisfaction level. In addition, since RON was primarily used for analyses of previous studies, RON values are used for the current results for consistency with the older work. The results are shown below:

	<u>1990</u>	<u>1978</u>	<u>1975</u>
Technical Rating - Customer Objection	4.7	5.6	7.0
Technical Rating - Customer Perception	3.9	5.0	-

Although there was some expectation that the difference between the technical and customer ratings would increase due to advances in engine control (knock sensors) and vehicle noise control, the differences have, in fact, decreased. This may be due to changes in the customer population, which appears to have higher expectations for the behavior of their vehicles.

The decrease in the difference between technical and customer ratings is even more dramatic when it is recalled that the older studies tested only non-knock-sensor-equipped vehicles. The rater-customer objection difference for the current study is only 3.8 RON.

L. Comparison with 1989 Octane Number Requirement Survey Data

Figure 18 provides a comparison of Phase I rater (R+M)/2 requirements with the total vehicle data on FBRU fuel for the 1989 CRC Octane Number Requirement Survey.⁽⁴⁾ The delta between the curves is approximately 2.0 octane numbers at the midpoint, and remains fairly close to this level throughout the entire range; this difference is significant at the 95 percent confidence level. The customer/rater data curve may be higher for several reasons: (1) the average mileage of the vehicles in the customer rater program was 31,207 miles compared with the average mileage of 12,773 miles in the 1989 CRC Octane Number Requirement Survey (as vehicles accumulate miles, their octane requirements tend to increase); (2) the 1989 CRC Octane Number Requirement Survey data were sales-weighted while the customer/rater data were not; (3) the 1989 CRC Octane Number Requirement Survey data represent approximately 40 percent of the vehicles represented in the customer/rater program - the bulk of the data came from the 1988 and 1990 model years. These three items may all contribute to the two octane-number delta.

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2. Coordinating Research Council, Inc., "1978 CRC Customer Versus Rater Octane Number Requirement Survey," CRC Report No. 514, April 1980.
3. Coordinating Research Council, Inc., "1990 CRC Octane Number Requirement Survey," CRC Report No. 575, July 1991.
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TABLES
AND
FIGURES

TABLE 1

VEHICLE STATISTICS

	<u>Vehicles</u>	<u>Cars</u>	<u>Trucks</u>
Number	168	117	51
Knock Sensors	72	47	25
Air Conditioned	156	111	45
Turbo-charged	2	1	1
Super-charged	1	1	0
Average Displacement, liters	3.0	2.6	3.9
Average Compression Ratio	9.0	9.0	9.0
Average Odometer, miles	31,207	31,974	29,428

MODEL YEAR

<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
46	68	51	3

ENGINE TYPE

<u>V8</u>	<u>V6</u>	<u>L6</u>	<u>L4</u>
19	77	4	68

FUEL SYSTEM

<u>PFI</u>	<u>TBI</u>	<u>4V</u>	<u>2V</u>	<u>1V</u>
115	48	2	2	1

TRANSMISSION

<u>A4</u>	<u>A3</u>	<u>M5</u>	<u>M4</u>
93	32	41	2

TABLE 2

Midpoint Satisfaction Levels and
Customer Versus Technical Differences
(Population Approach - Phase I)

		Rater Minus <u>(R+M)/2 Customer</u>	RON	Rater Minus <u>Customer</u>	MON	Rater Minus <u>Customer</u>
Technical (Rater)	87.0		91.3		82.7	
Customer (Objection)	83.2	3.8	86.6	4.7	79.8	2.9
Customer (Perception)	83.9	3.1	87.4	3.9	80.3	2.4

TABLE 3

Population Midpoints

(Delta Analysis - Phase I)

	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>
Rater-Customer (Objection)	4.1	5.0	3.2
Rater-Customer (Perception)	3.1	3.7	2.4

TABLE 4

Midpoint Satisfaction Levels and
Customer Versus Technical Differences
(Population Approach - Phase II)

	<u>(R+M)/2</u>	<u>Rater</u> <u>Minus</u> <u>Customer</u>	<u>RON</u>	<u>Rater</u> <u>Minus.</u> <u>Customer</u>	<u>MON</u>	<u>Rater</u> <u>Minus</u> <u>Customer</u>
Technical (Rater)	87.4		91.8		83.0	
Customer (Objection)	82.7	4.7	86.0	5.8	79.4	3.6
Customer (Perception)	83.3	4.1	86.7	5.1	79.9	3.1

TABLE 5

Population Midpoints
(Delta Analysis - Phase II)

	<u>(R+M)/2</u>	<u>RON</u>	<u>MON</u>
Rater-Customer (Objection)	4.3	5.2	3.5
Rater-Customer (Perception)	3.5	4.5	2.9

TABLE 6

Breakdown of Classifications for Customer
Octane Number Requirements

<u>Limiting</u> <u>Malfunction</u>	<u>Phase I</u>	
	<u>Objection</u>	<u>Perception</u>
Knock	142 (97.9)	145 (87.4)
After-Run	1 (0.7)	3 (1.8)
Accel	2 (1.4)	18 (10.8)
TOTAL	145 (100)	166 (100)

<u>Limiting</u> <u>Malfunction</u>	<u>Phase II</u>	
	<u>Objection</u>	<u>Perception</u>
Knock	104 (99)	114 (93.4)
After-Run	0 (0)	0 (0)
Accel	1 (1)	8 (6.6)
TOTAL	105 (100)	122 (100)

NOTE: Percentage of total responses are in parentheses.

TABLE 7

Midpoint Satisfaction Levels and
Customer Versus Technical Differences
By Knock Sensor Classification
(Population Approach - Phase I)

<u>Knock Sensor</u>						
	<u>(R+M)/2</u>	<u>Rater Minus Customer</u>	<u>RON</u>	<u>Rater Minus Customer</u>	<u>MON</u>	<u>Rater Minus Customer</u>
Technical (Rater)	87.1		91.4		82.8	
Customer (Objection)	82.4	4.7	85.6	5.8	79.2	3.6
<u>Non-Knock Sensor</u>						
Technical (Rater)	86.8		91.1		82.5	
Customer (Objection)	83.8	3.0	87.3	3.8	80.3	2.2

Figure 1
DISTRIBUTION OF ODOMETER MILEAGE FOR CUSTOMER VEHICLES

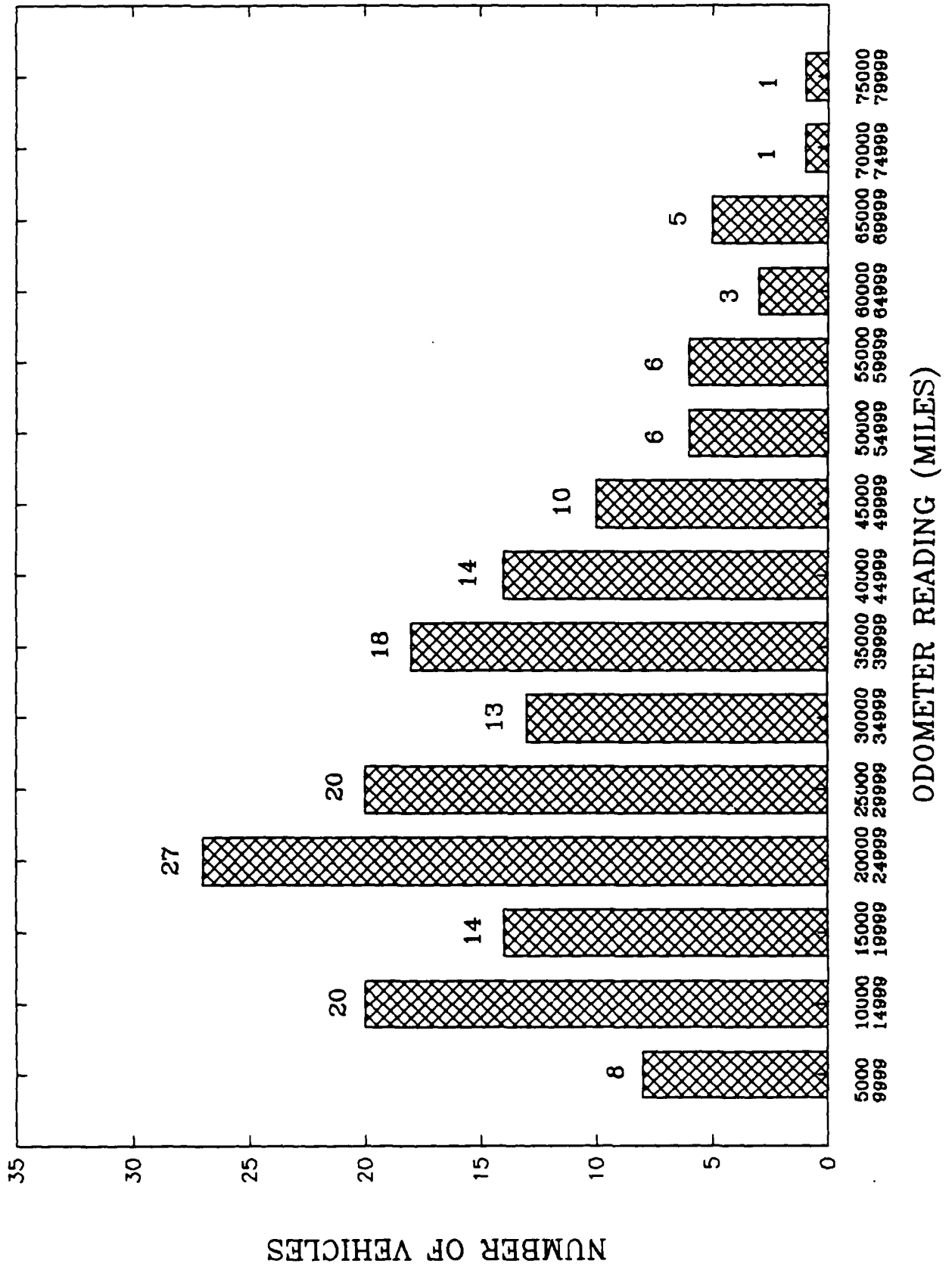


Figure 2
DISTRIBUTIONS OF CUSTOMER/RATER (R+M)/2 OCTANE NUMBER REQUIREMENTS
Phase I

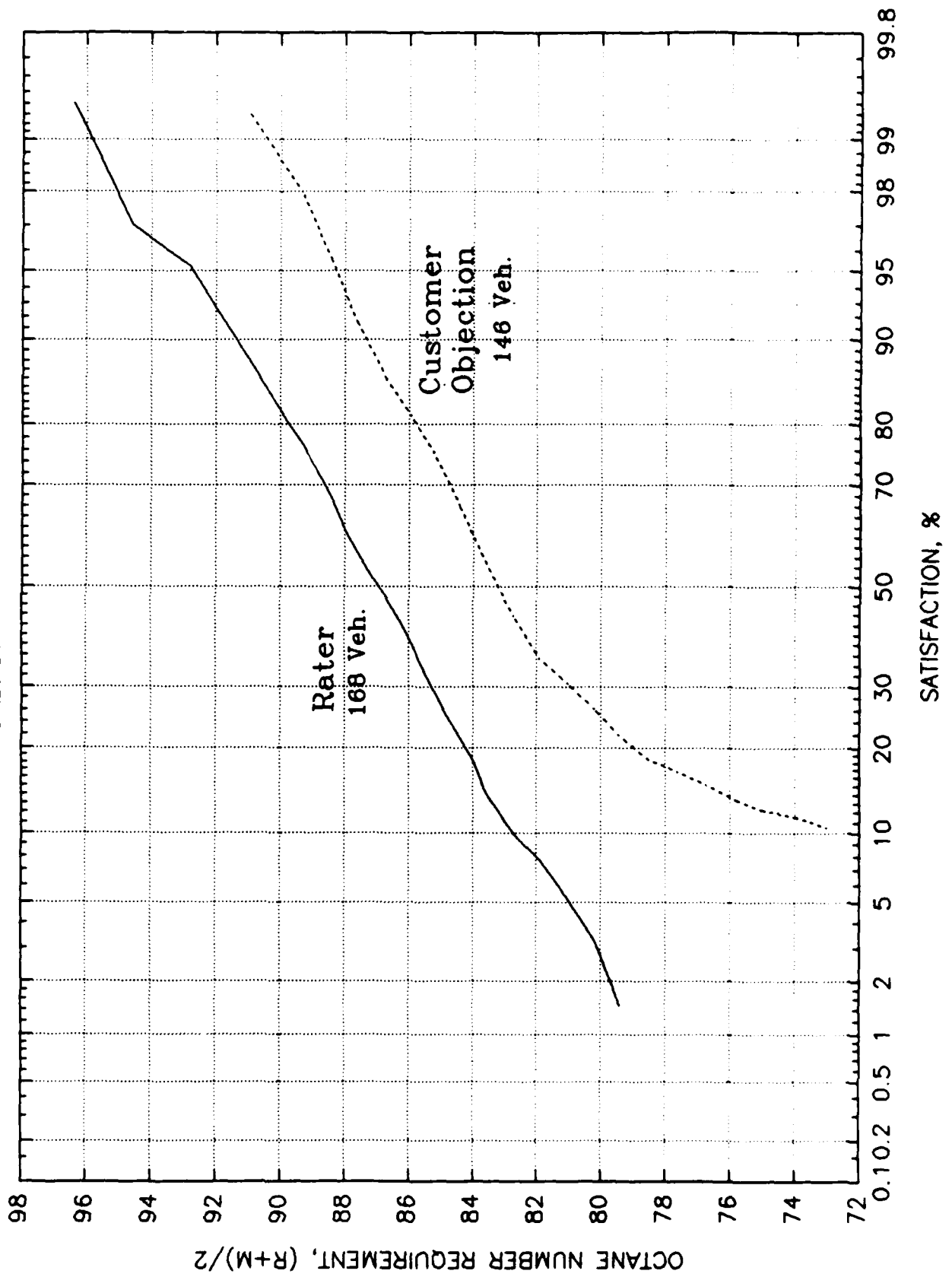


Figure 3
DISTRIBUTIONS OF CUSTOMER/RATER (R+M)/2 OCTANE NUMBER REQUIREMENTS
Phase I

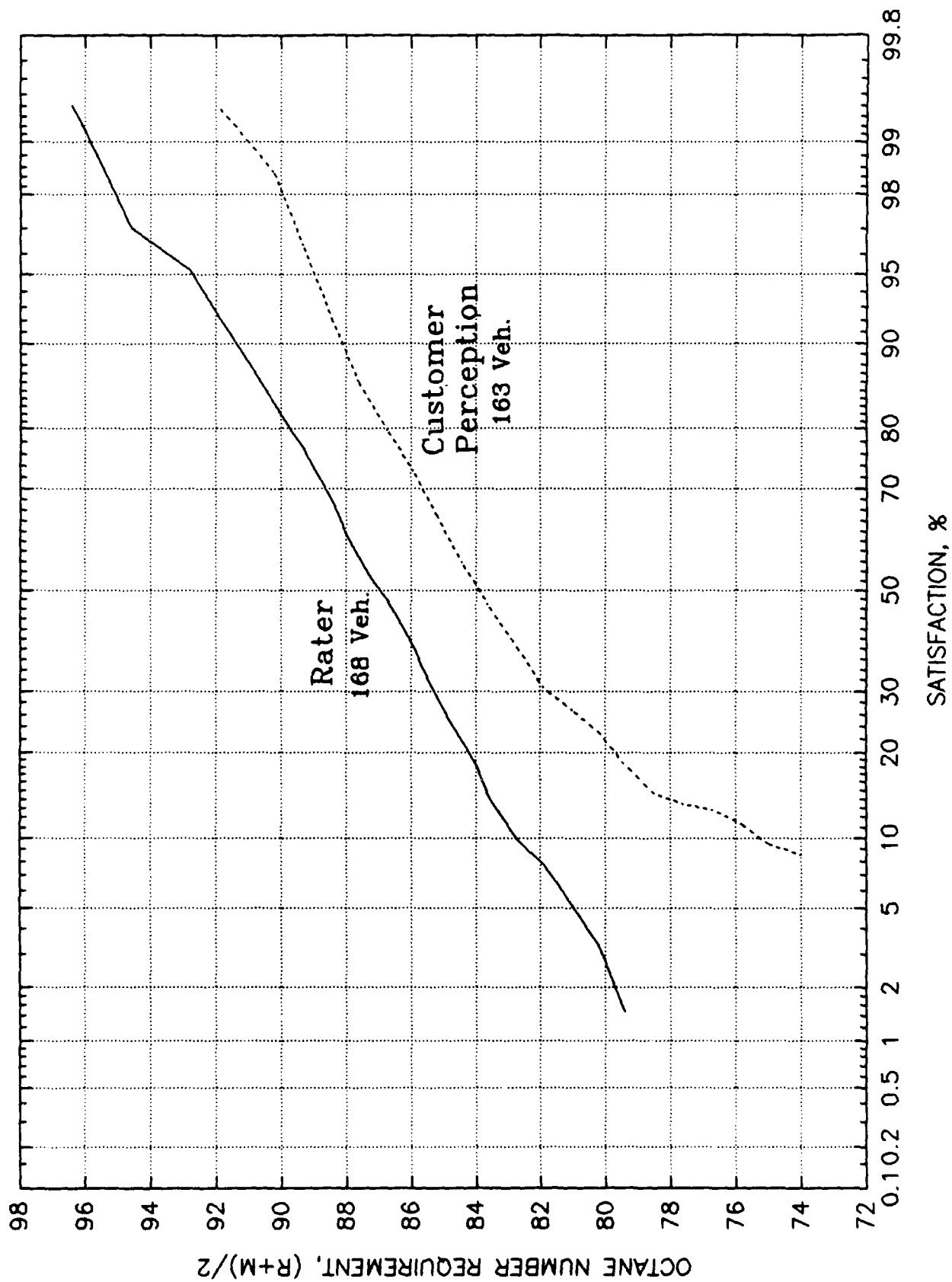


Figure 4
DELTA (R+M)/2, (RATER - CUSTOMER OBJECTION) OCTANE NUMBER REQUIREMENT

Phase I

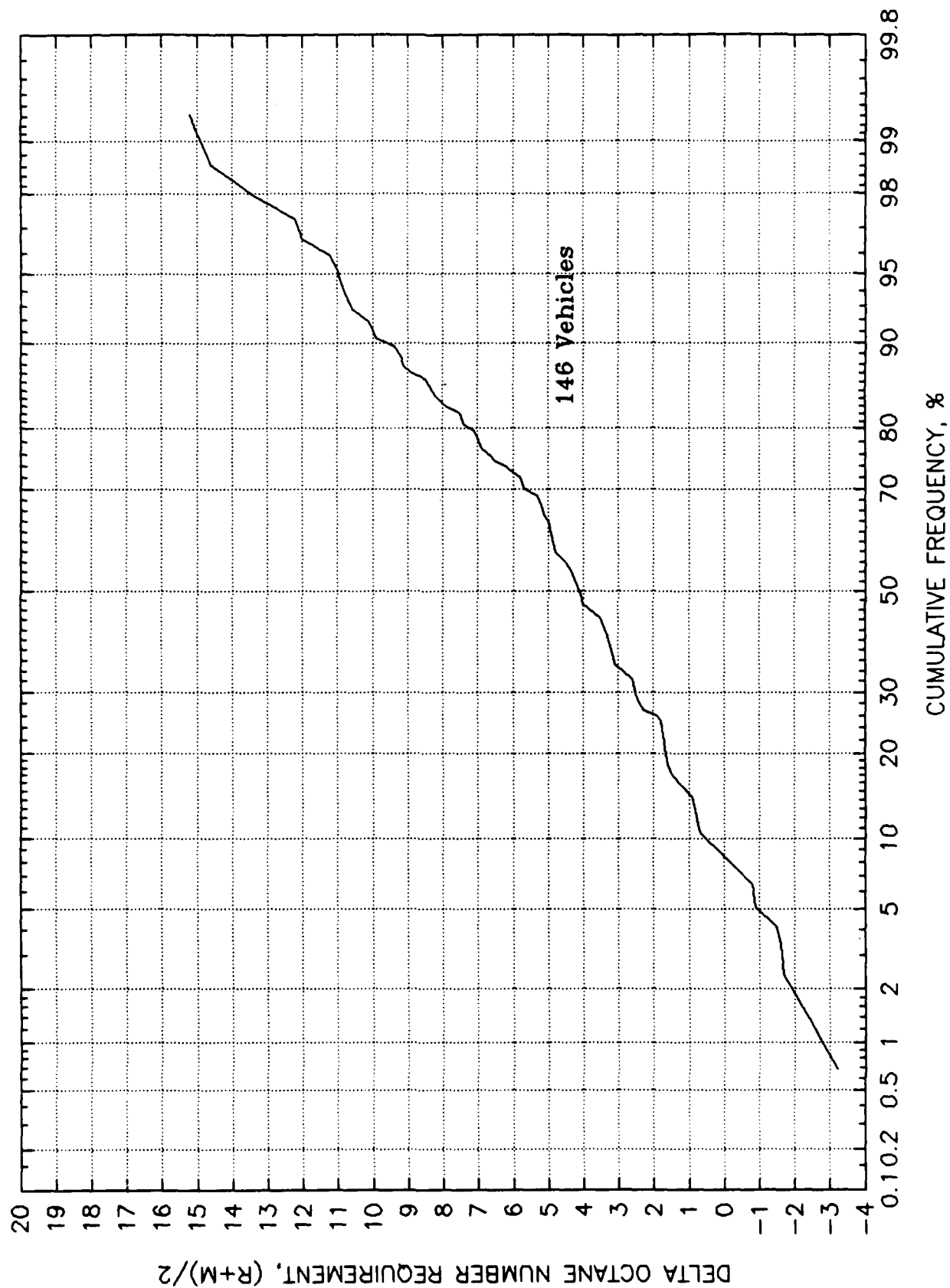


Figure 5
DISTRIBUTIONS OF CUSTOMER/RATER (R+M)/2 OCTANE NUMBER REQUIREMENTS
Phase II

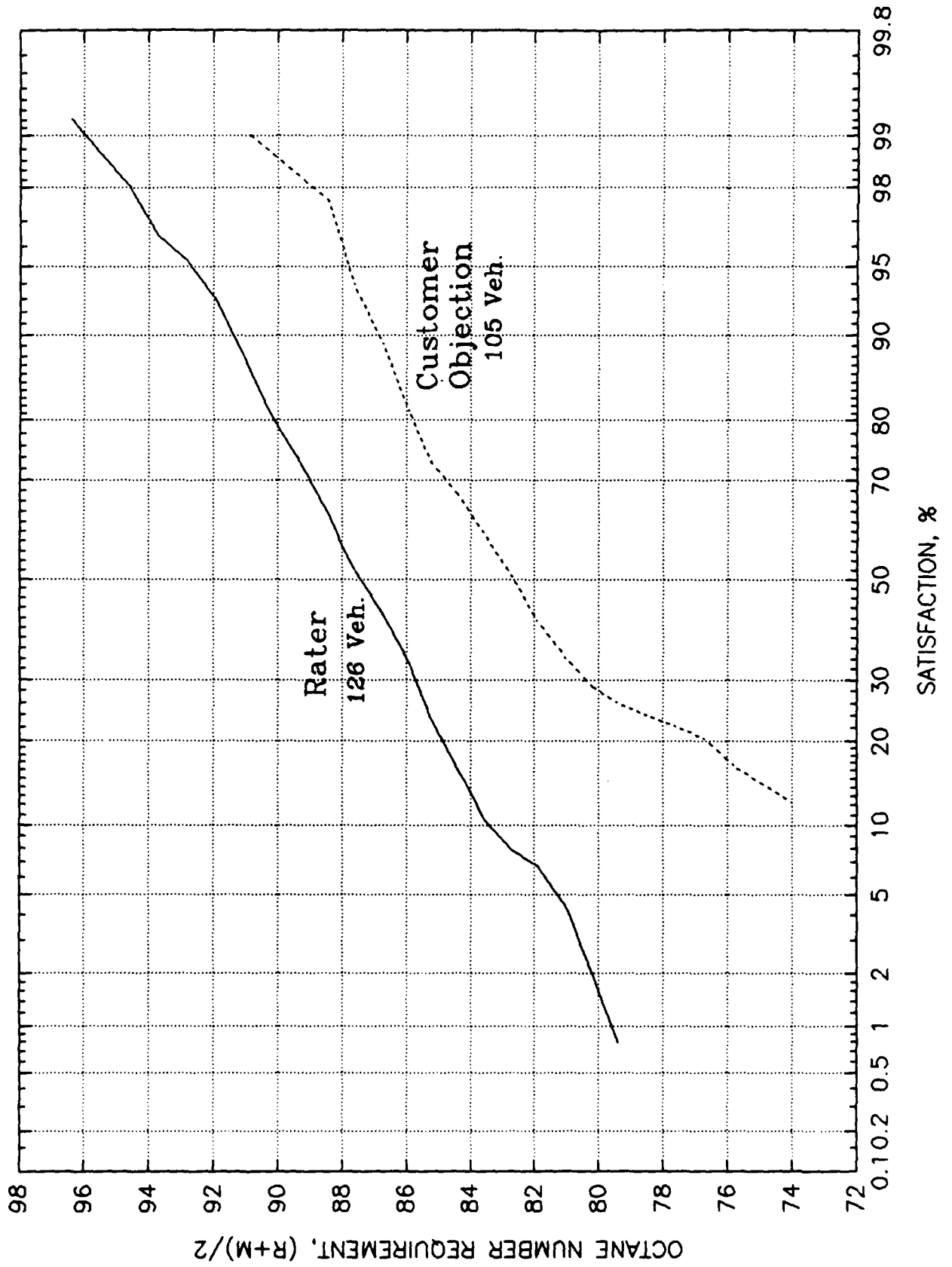


Figure 6
DISTRIBUTIONS OF CUSTOMER/RATER (R+M)/2 OCTANE NUMBER REQUIREMENTS
Phase II

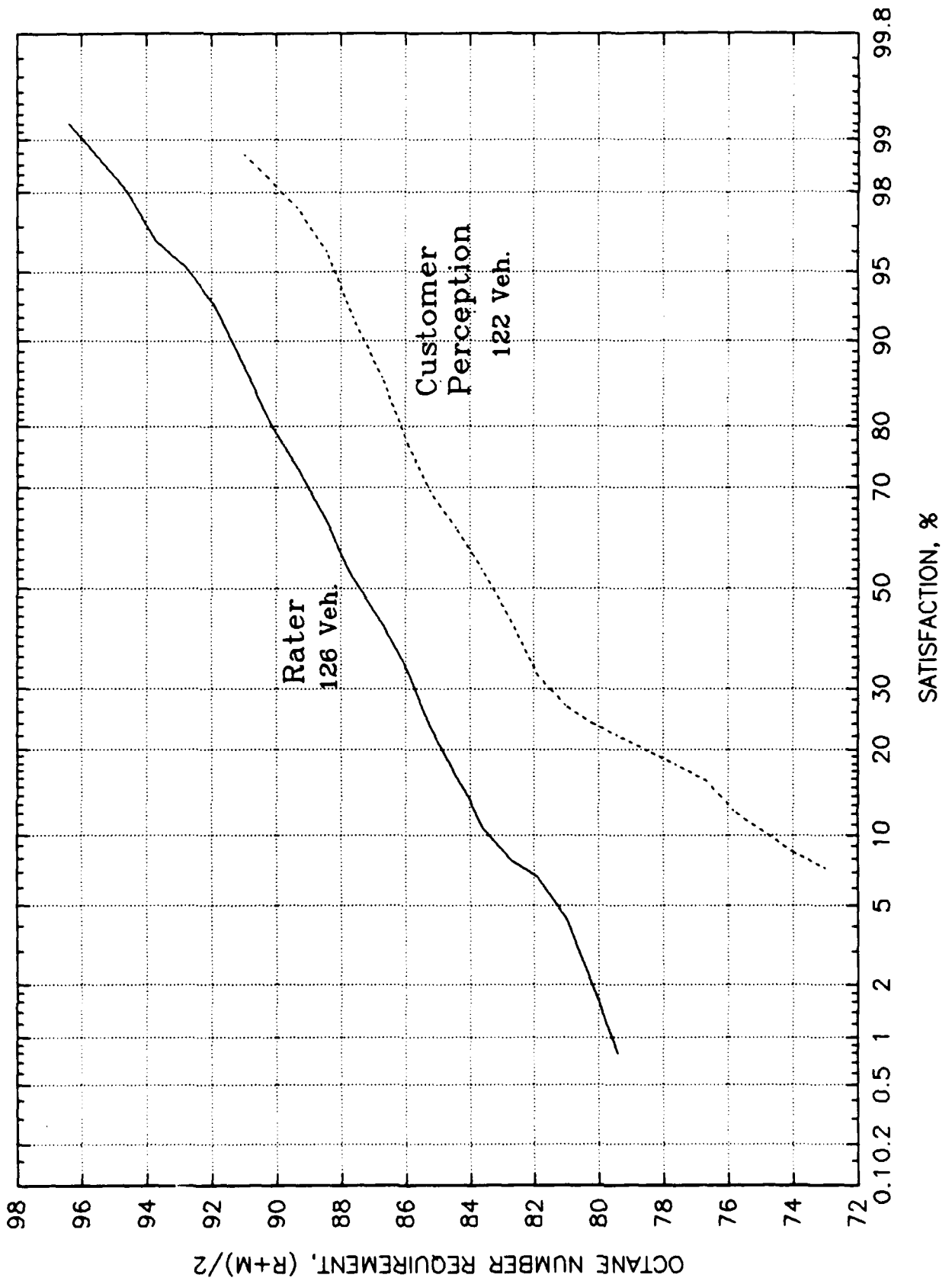
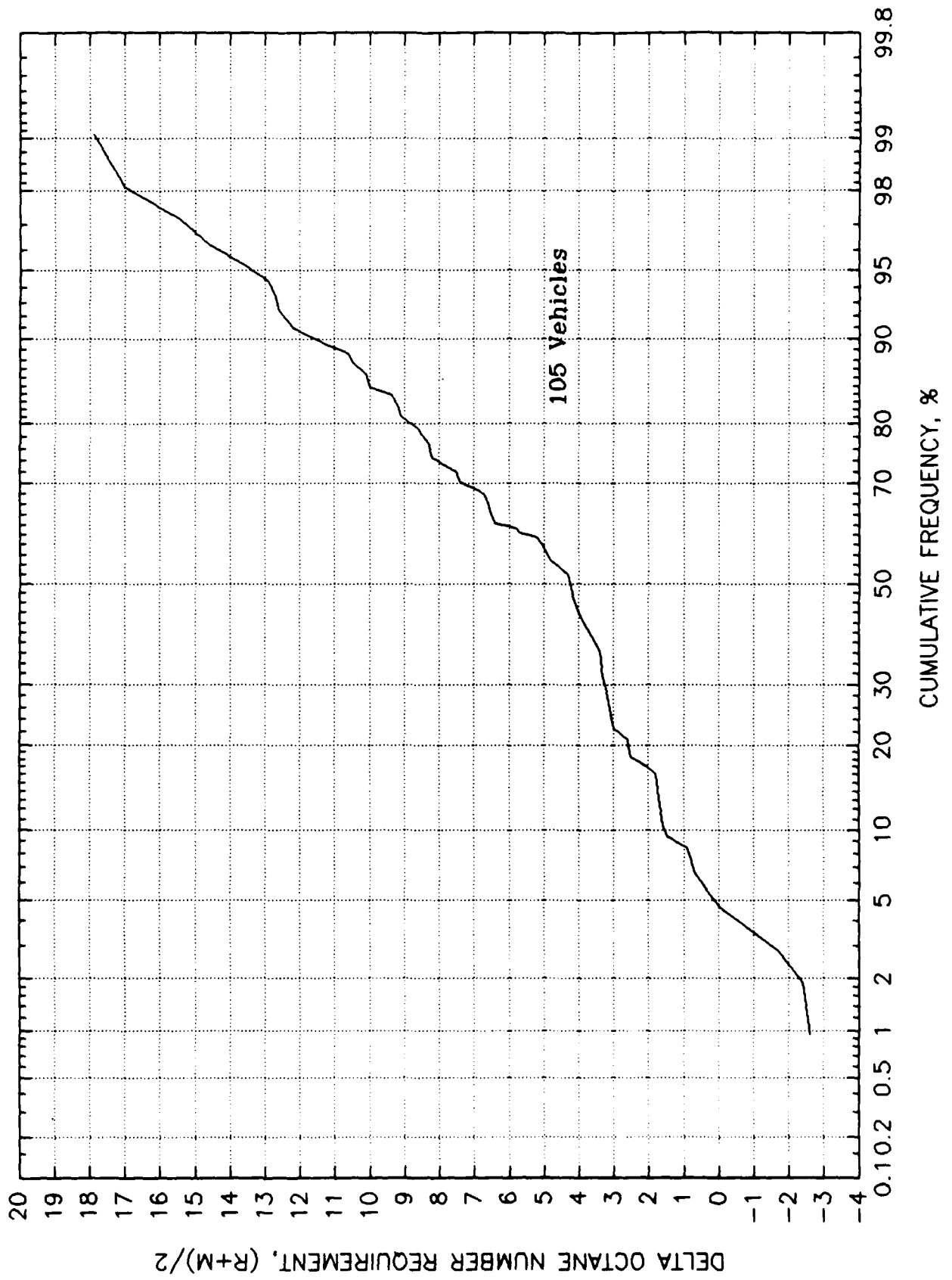


Figure 7
Phase II
DELTA (R+M)/2, (RATER - CUSTOMER OBJECTION) OCTANE NUMBER REQUIREMENT



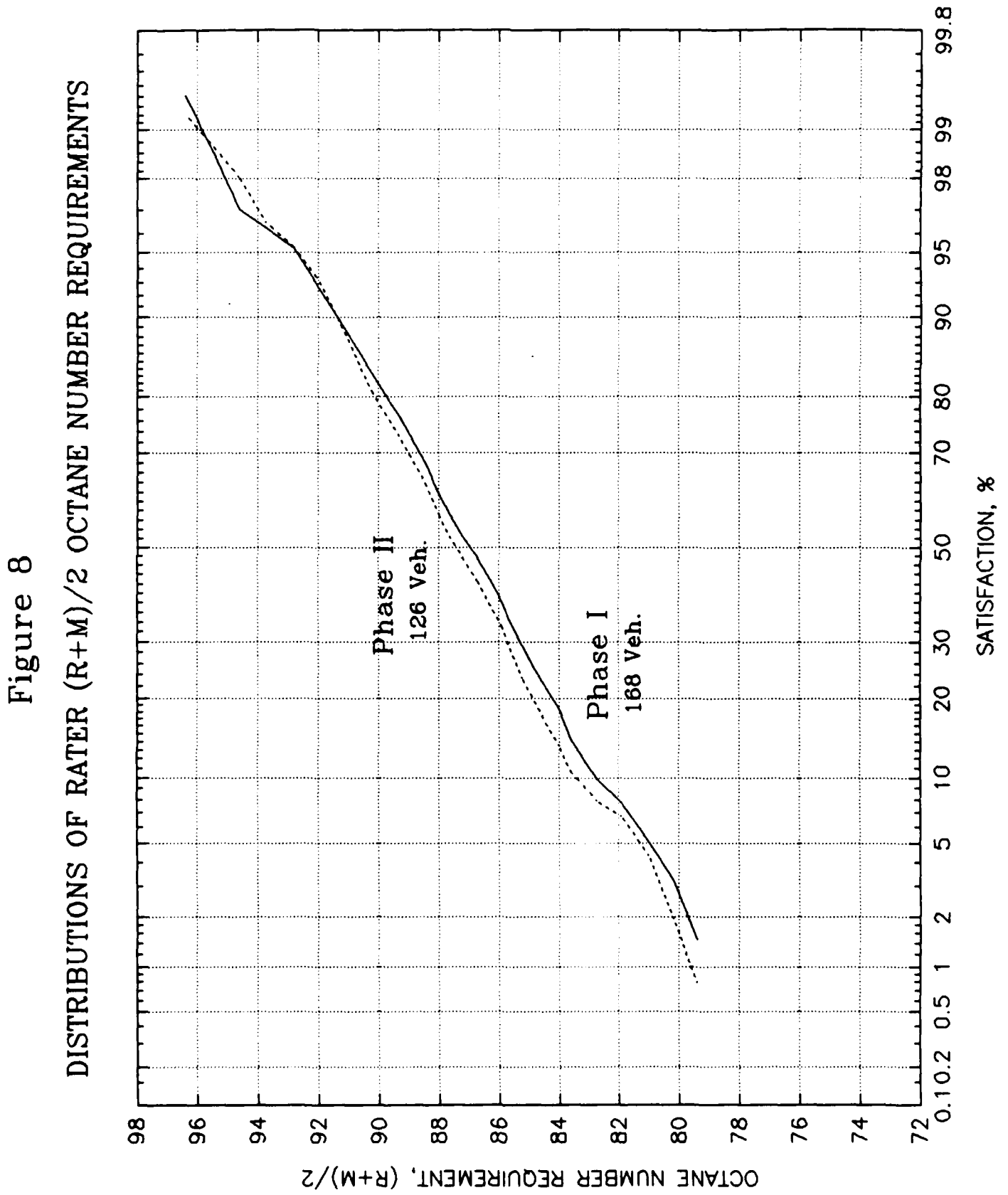


Figure 9

DISTRIBUTIONS OF CUSTOMER OBJECTION (R+M)/2 OCTANE NUMBER REQUIREMENTS

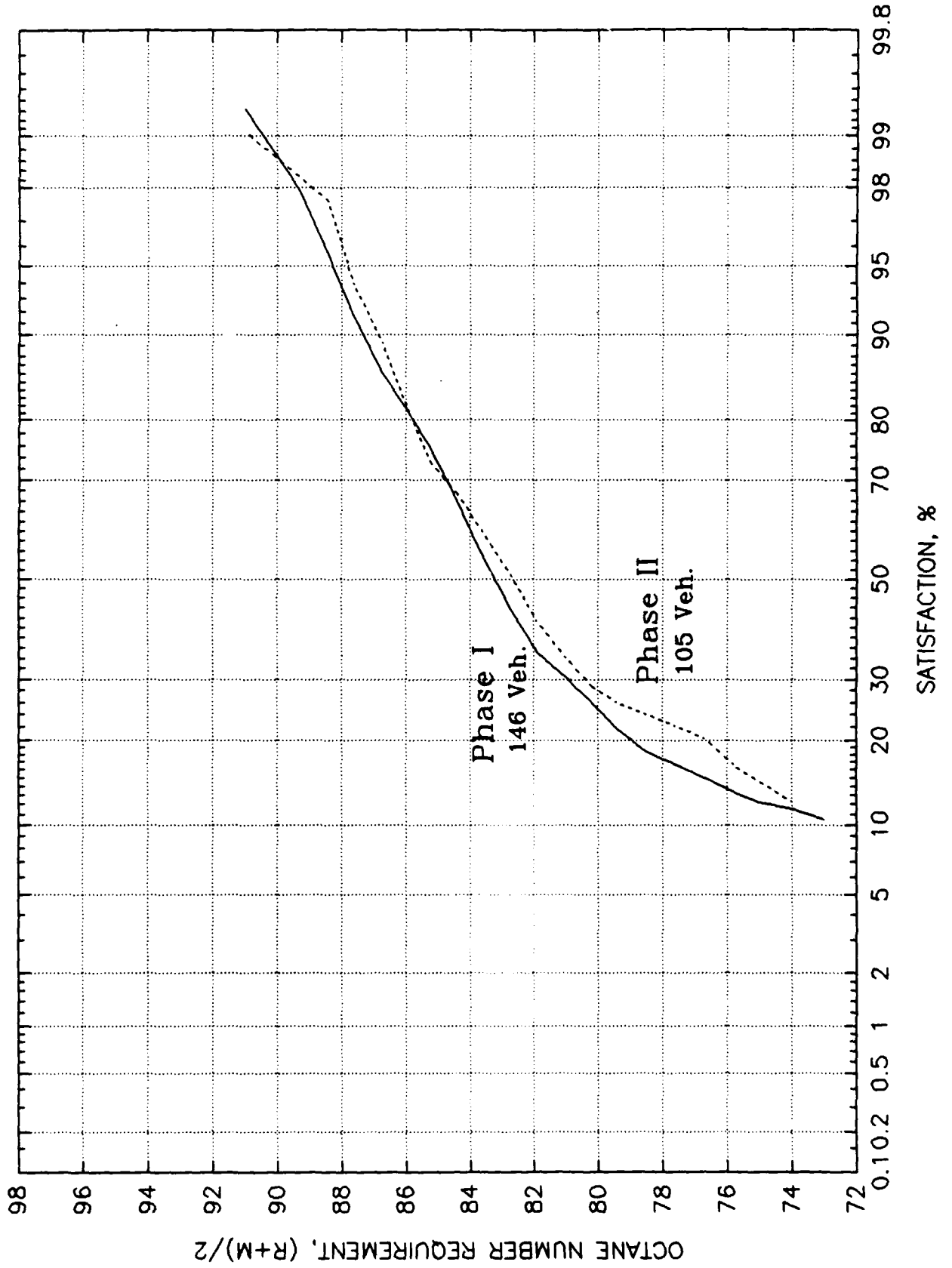


Figure 10

DELTA (R+M)/2, (RATER - CUSTOMER OBJECTION) OCTANE NUMBER REQUIREMENT

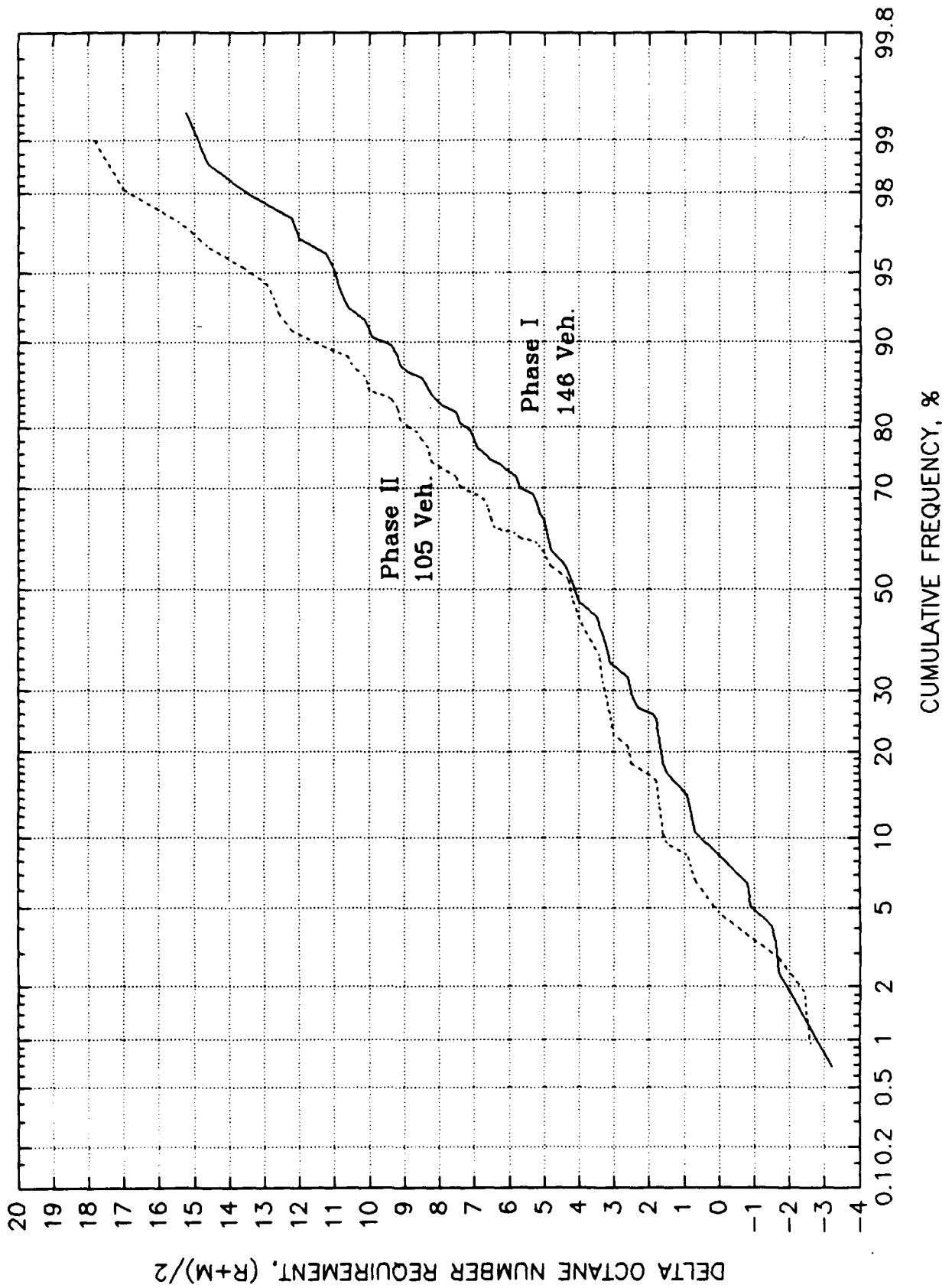


Figure 11
DISTRIBUTIONS OF CUSTOMER OBJECTION AND PERCEPTION
(R+M)/2 OCTANE NUMBER REQUIREMENT
Phase I

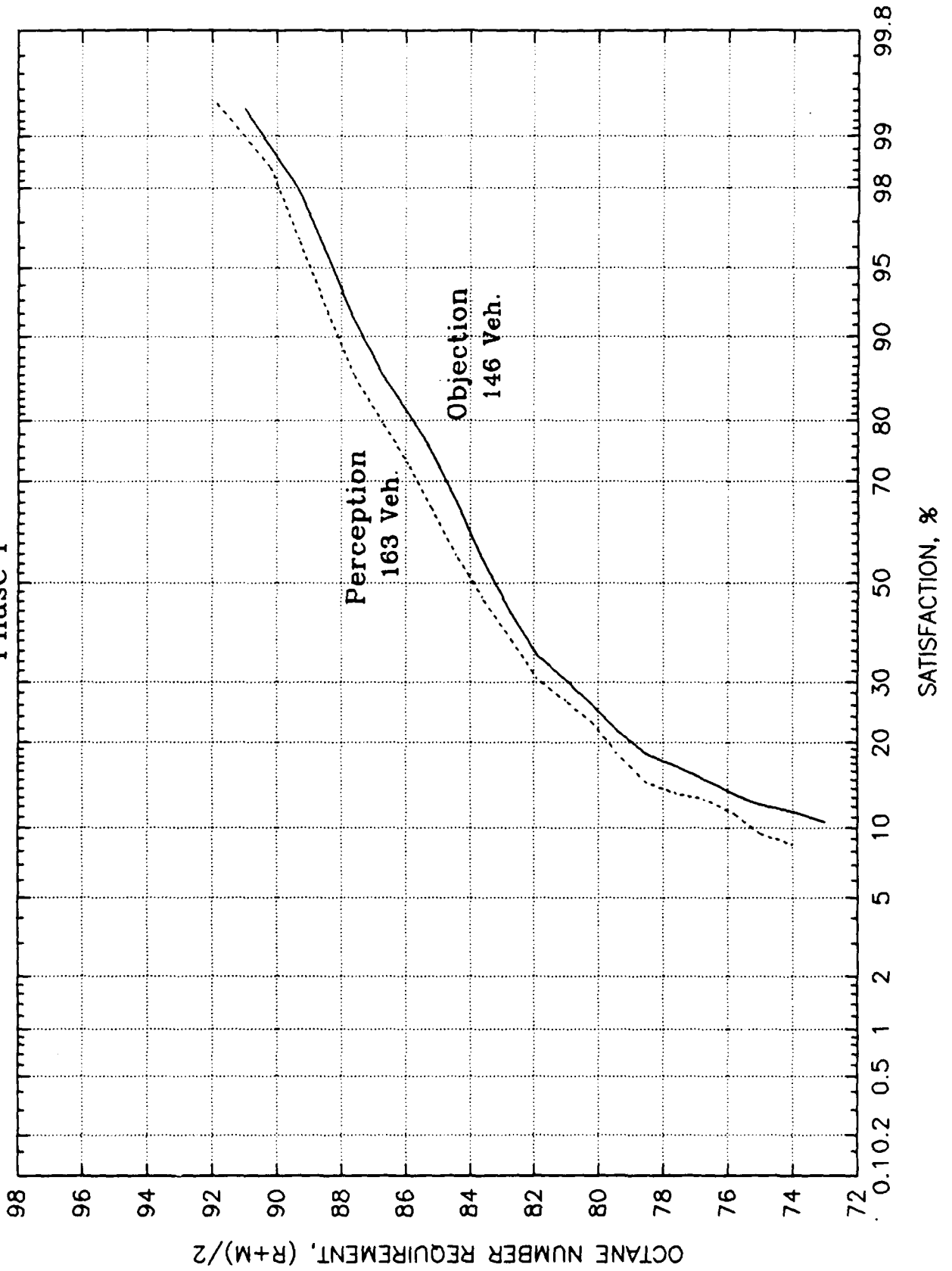


Figure 12
DISTRIBUTIONS OF CUSTOMER OBJECTION AND PERCEPTION
(R+M)/2 OCTANE NUMBER REQUIREMENT
Phase II

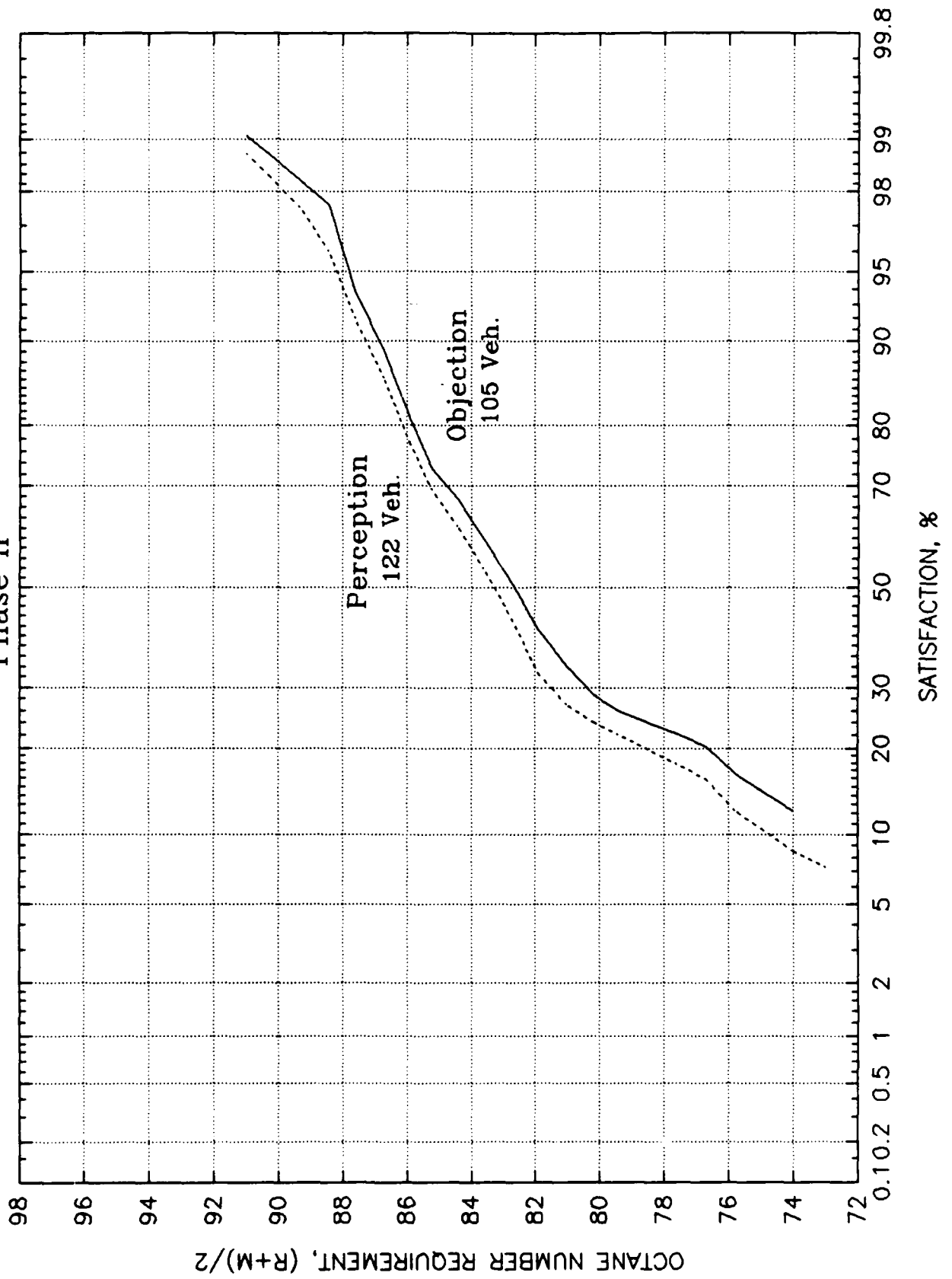


Figure 13
DELTA (RATER - CUSTOMER OBJECTION) & (RATER - CUSTOMER PERCEPTION)
(R+M)/2 OCTANE NUMBER REQUIREMENT

Phase I

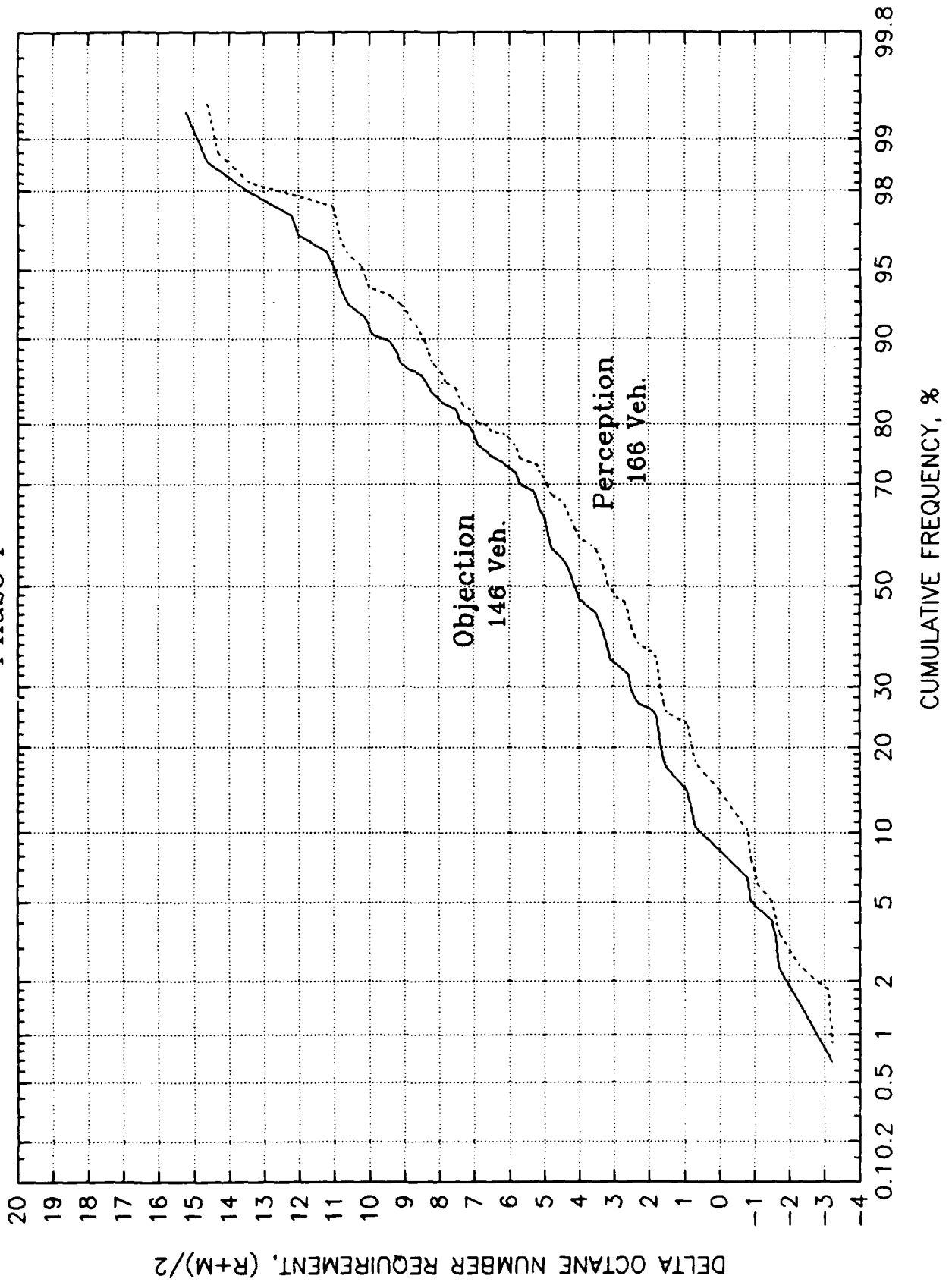


Figure 14
DELTA (RATER - CUSTOMER OBJECTION) & (RATER - CUSTOMER PERCEPTION)
(R+M)/2 OCTANE NUMBER REQUIREMENT
Phase II

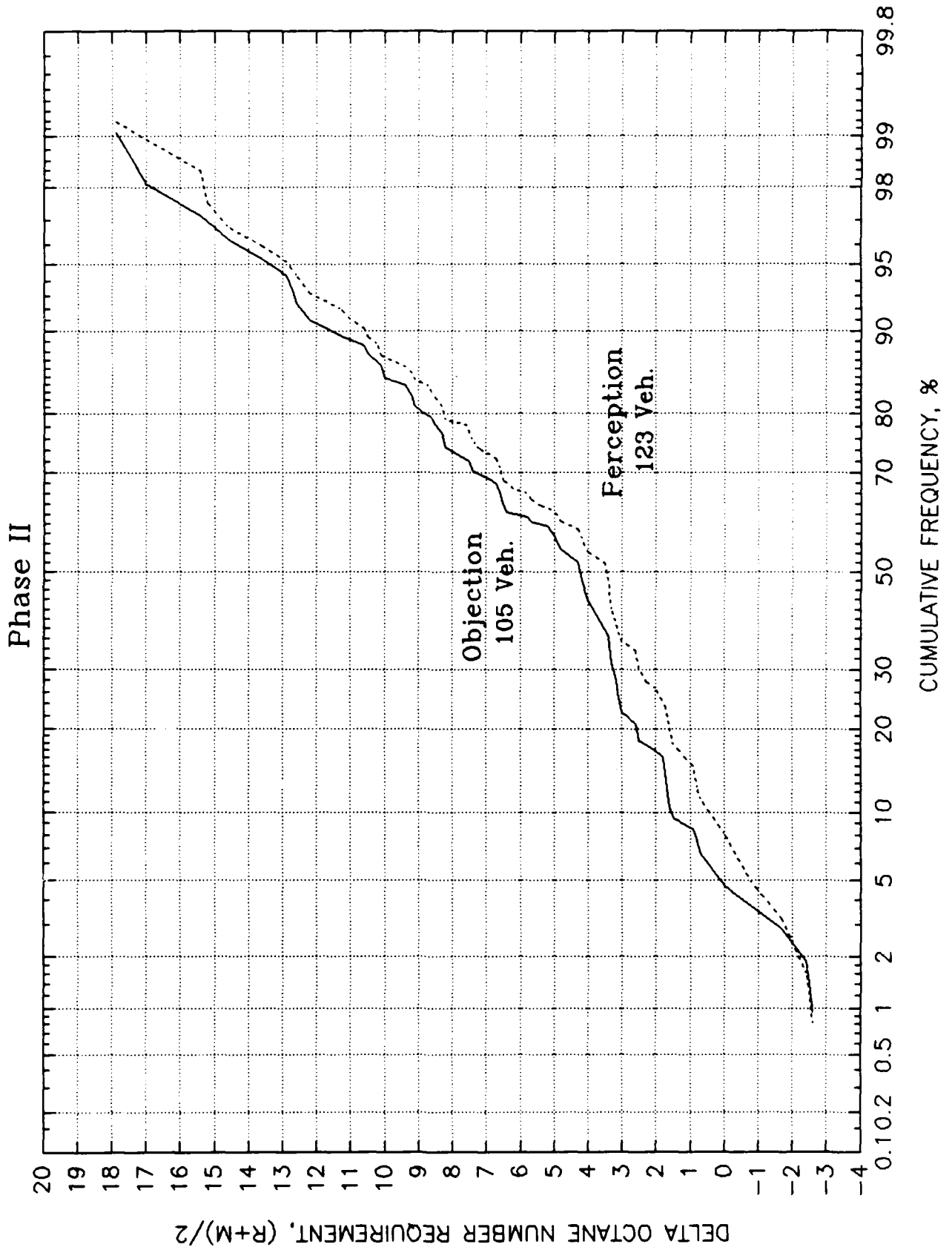


Figure 15
COMPARISON OF KNOCK AND NON-KNOCK SENSOR VEHICLES
DISTRIBUTIONS OF RATER (R+M)/2 OCTANE NUMBER REQUIREMENTS - PHASE I

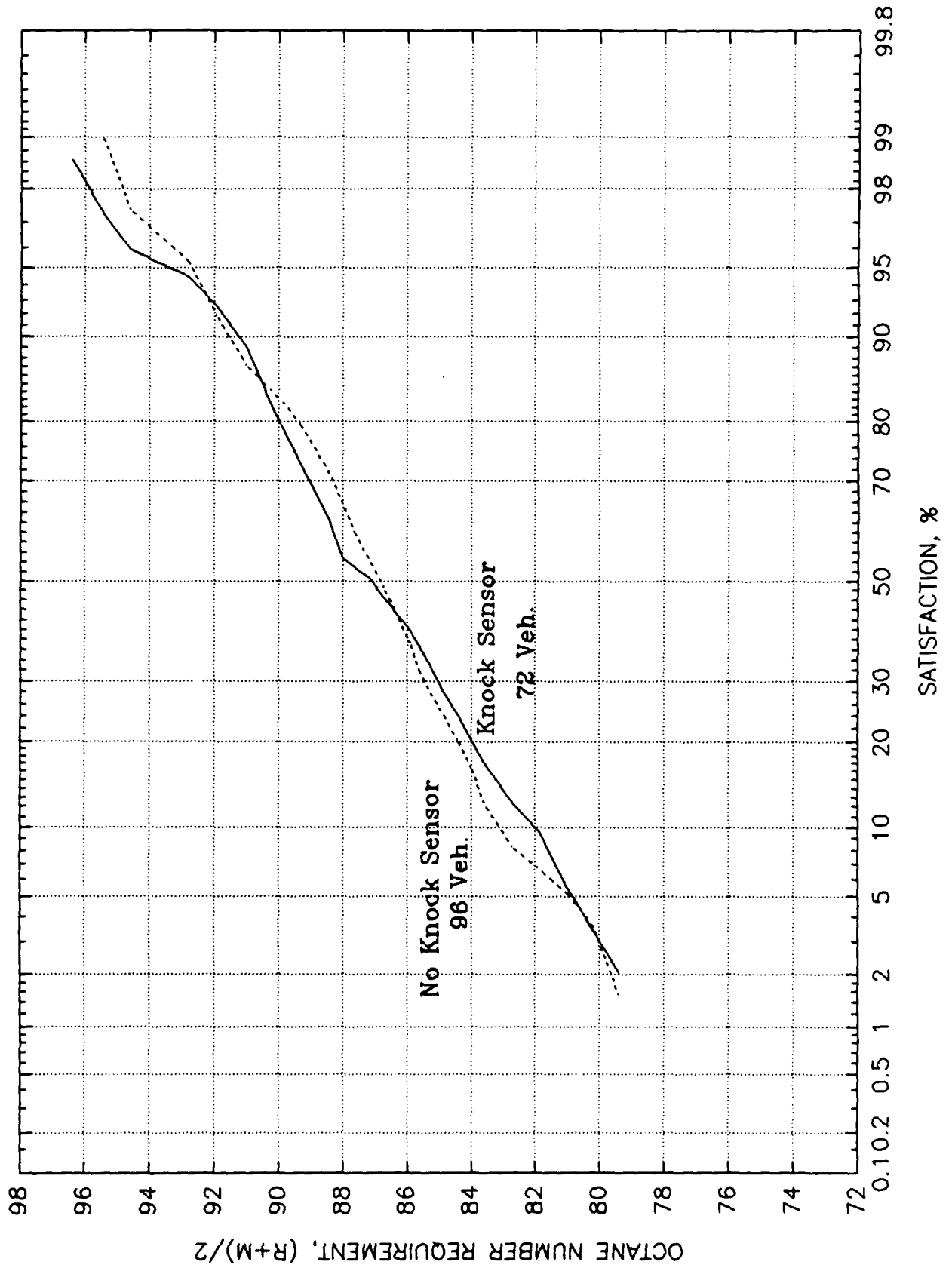


Figure 16
COMPARISON OF KNOCK AND NON-KNOCK SENSOR VEHICLES
DISTRIBUTIONS OF CUSTOMER OBJECTION (R+M)/2 OCTANE NUMBER REQUIREMENTS - PHASE I

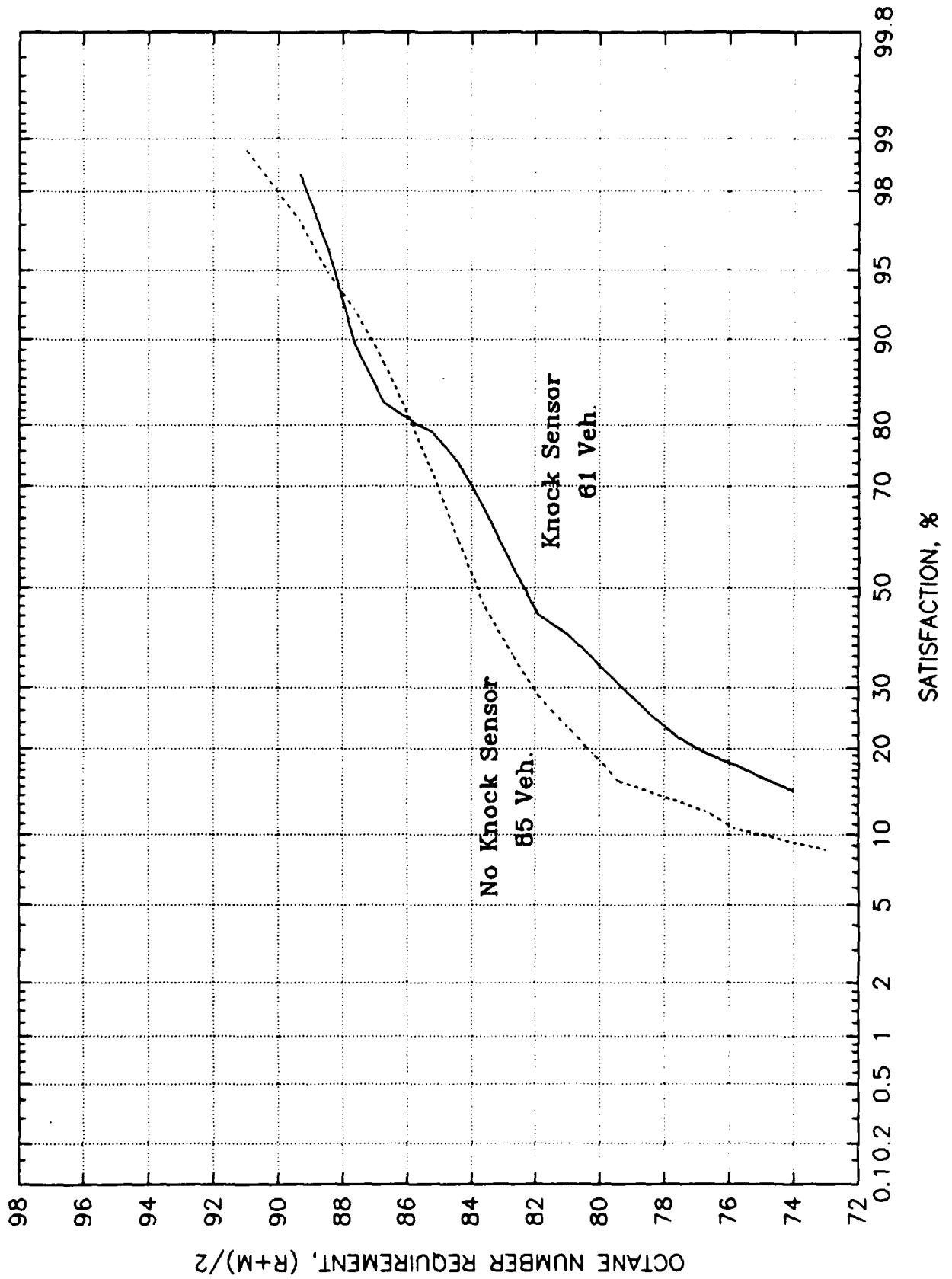
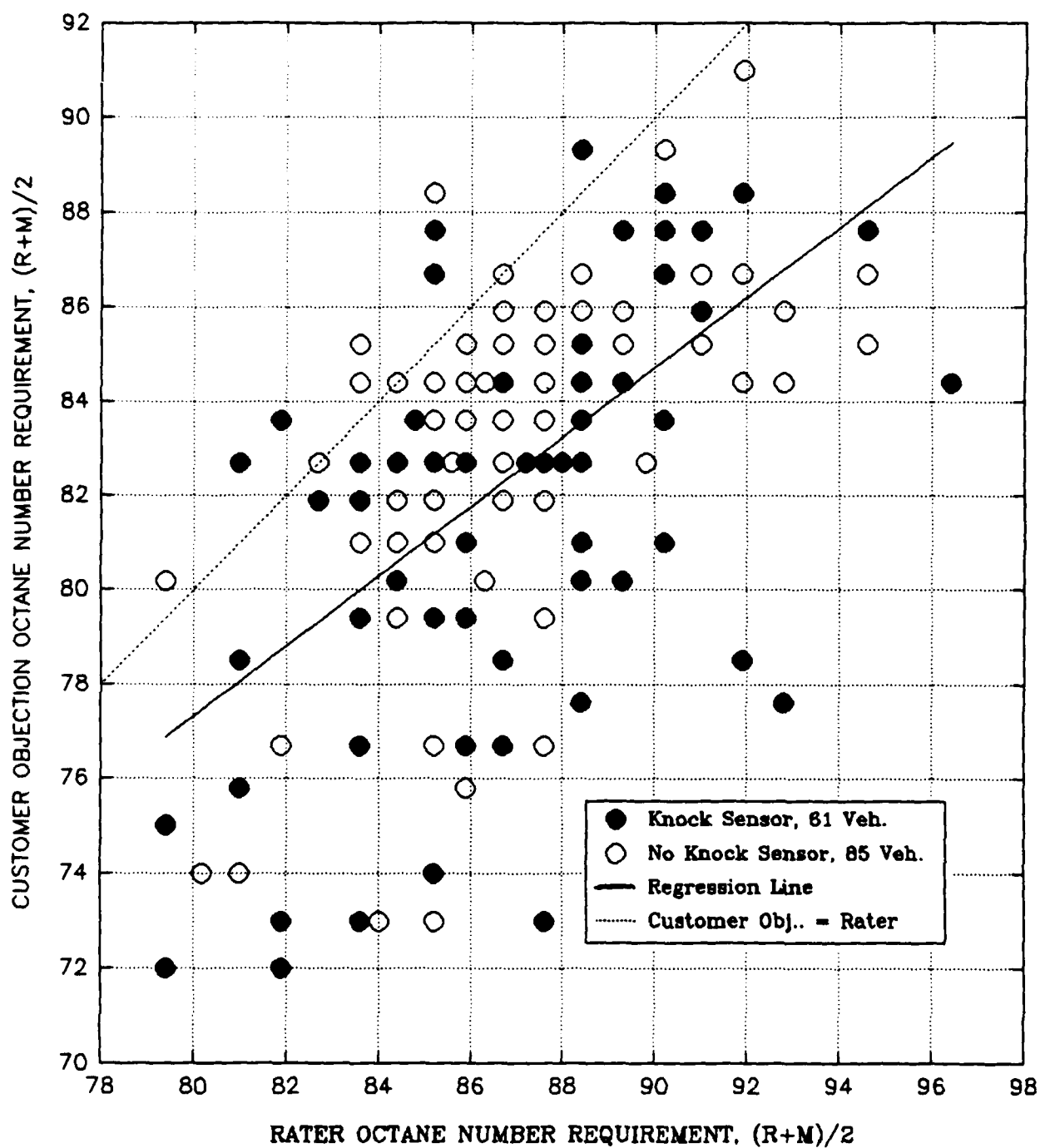


Figure 17

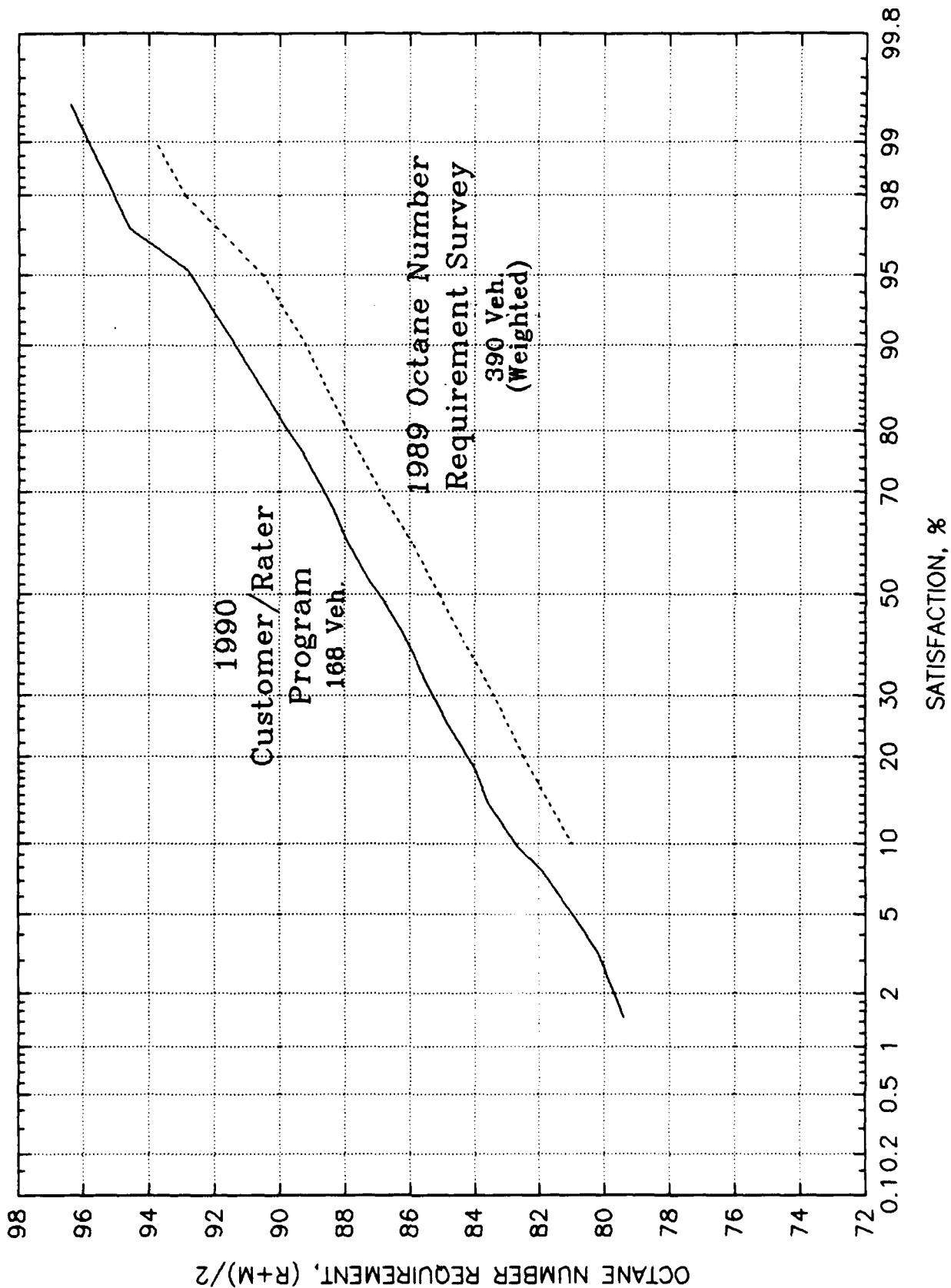
RATER VS CUSTOMER OBJECTION
 $(R+M)/2$ OCTANE NUMBER REQUIREMENT
 Phase I



NOTE: Some points represent more than one piece of data.

Figure 18

COMPARISON OF PHASE I RATER (R+M)/2 OCTANE NUMBER REQUIREMENTS WITH
1989 OCTANE NUMBER REQUIREMENT SURVEY FOR FBRU FUEL AND TOTAL VEHICLES



APPENDIX A

PARTICIPATING COMPANIES

APPENDIX A

PARTICIPATING COMPANIES

Amoco Oil Company
BP Oil Company
Chevron Research and Technology Company
Exxon Research and Engineering Company
Mobil Research and Development Corporation
Phillips Petroleum Company
Shell Canada
Shell Development Company
Sun Refining and Marketing Company
Texaco Inc
Unocal Corporation

f

APPENDIX B

ANALYSIS PANEL MEMBERSHIP

Analysis Panel Membership

<u>Name</u>	<u>Affiliation</u>
J. P. Uihlein, Leader	BP Oil Company
W. F. Biller	Consultant
C. J. Bonés	Mobil Research and Development Corp.
R. A. Bouffard	Exxon Research and Engineering Co.
C. T. Siambekos	Amoco Oil Company
T. Wusz	Unocal Corporation

APPENDIX C

PROGRAM PROPOSAL

C-1

COORDINATING RESEARCH COUNCIL
INCORPORATED

219 PERIMETER CENTER PARKWAY
ATLANTA, GEORGIA 30346
(404) 396-3400

**1990 CRC CUSTOMER VERSUS RATER
OCTANE NUMBER REQUIREMENT PROGRAM**

CRC PROJECT NO. CM-124-90

MARCH 1990

OBJECTIVE

Two previous CRC programs were conducted (1975 and 1978) to evaluate the customer octane response compared with that of a trained rater. Since that time, many changes have taken place with automobiles and automotive technology.

The objective of this program is to conduct a cooperative test to determine the difference between octane requirements determined by trained observers and octane requirements determined by "customers." The trained observers will determine the octane requirements based on audible knock, using the CRC E-15-90 procedure. Through response to a questionnaire, the customer perception and objection levels will be determined based upon audible knock, afterrun, acceleration performance, and vehicle operability.

TIMING

The program is to be conducted in the late summer and early fall of 1990 and continued in the spring and summer of 1991. The target starting date is August 15, 1990, with the summer/fall session ending before mid November and the spring/summer session starting after April 1, 1991. These dates are suggested to avoid using fuels with a Reid vapor pressure of 9 pounds during inappropriate weather. The test portion of the program should be targeted for completion by the end of June 1991.

FUELS

A full-boiling-range customer unleaded (FBRCU) reference fuel will be used for this study. Specifications for this fuel are similar to those for the 1989/1990 CRC Octane Number Requirement Survey FBRCU reference fuels. A "keep-clean" level of a port-fuel-injector additive has been included to maintain the vehicle's fuel-injector performance throughout the program. The sensitivity of this FBRCU fuel is similar to the average sensitivity of commercially available fuels, while the Reid vapor pressure is at a nominal 9-pound level, and a more restrictive 50 percent distillation temperature specification has been applied.

Three fuels will be used as bases for blends. Blends will be a product of any two of the three following octane levels; 75, 91, and 104. Fuels will be blended in increments of 1.0 (Research octane number) from 75 to 104 octane number.

Base fuels will be submitted to the Fuel Acceptance Panel for approval. Table 1 contains information on the three base fuel specifications.

VEHICLES

Vehicles studied in this program will be 1988, 1989, and 1990 model-year cars and light trucks. They shall have accumulated a minimum of 12,000 miles, in normal customer service, and be in good mechanical condition. They shall also have an octane number requirement of between 86 and 100 Research octane numbers as measured by trained raters using the specified test fuels. Each vehicle shall have a single principal driver.

A 200-vehicle program is considered as a minimum and can be accomplished by each participating laboratory testing 20 vehicles. It is recommended that test vehicles be distributed about as follows:

- One-third of vehicles per model-year
- One-half of vehicles equipped with knock sensors
- One-third light trucks
- One-fourth import vehicles
- Domestic vehicles should be chosen in proportion to their sales

"CUSTOMERS"

"Customers" should include a good distribution of both men and women over the age of 18 years, generally representative of US drivers. There should also be a good distribution of age among the "customers." "Customers" should not be familiar with, nor directly associated with, octane quality testing. "Customers" should be told that they are involved in a test of different gasolines. A sample form letter has been prepared for this purpose, and is given in Attachment 1.

Care should be taken to select cooperative "customers" willing to participate fully in the program, and who are the principal drivers of the vehicles being tested. In order to ensure a good mix of driving conditions, "customers" routinely driving extremely long trips (predominantly expressway driving) and extremely short trips should not be included in the test. "Customers" should be normally available to the test site, and fuel their vehicle one to two times per week.

DATA FORMS AND REPORTING RESULTS

Data forms and instructions for reporting results will be distributed to the participants prior to the program. Sample forms and questionnaires are given in Attachment 1.

TEST PROCEDURE

"Customers" should be told that principal drivers of late-model vehicles are being sought to determine how they evaluate different gasolines in their own vehicles under typical driving conditions. A sample notice to "customers" is shown on page 7.

In an initial interview, the potential "customers" will be asked questions regarding their vehicle description and their personal background. A sample questionnaire for this purpose is shown on pages 9 and 10. These questions are considered necessary; others may be needed at individual test sites. The "customers" who are tentatively selected to participate in the program will then be sent a letter of introduction and explanation of the program. A sample letter is shown on page 11. The final customer/vehicle selection will include consideration of the vehicle's mechanical condition and octane number requirement.

The first phase of the program will be started by having trained raters determine the octane requirement of each vehicle using a modified version of the CRC E-15-90 procedure (Attachment 2) with the FBRCU series of reference fuels designated for this program. This will become the first test fuel if the vehicle meets program requirements. Modifications to the E-15-90 procedure will include using only one rating fuel series, and part-throttle octane requirements will be determined within the range of test fuels.

Once the vehicle is accepted, its fuel tank will be drained, flushed twice with about two gallons each of the first test fuel, and then filled with the first test fuel. The "customer" will drive the vehicle for about one week or a minimum of one tankful. An interviewer will ask a series of questions of the customer to determine his perception of the vehicle's operation for each test fuel. This interview is to be done twice for each test fuel, by either telephone or direct (face-to-face) contact: once about midway through the tankful, and the second time just prior to refueling. Interviewer questions, which are shown on the Gasoline Evaluation Questionnaire (shown on pages 13 through 17), will be asked. The "customer" will be asked only those questions appearing on the questionnaire.

The fuel tank will be drained and flushed between each successive tank-fill of different octane fuel. Successive tank-fills will be reduced in two octane number steps until the "customer" indicates objectionable vehicle performance. This can be objectionable knock, poor acceleration, engine afterrun, or driveability. Objectionable is defined as the point where the "customer" would act to correct the problem. The tank fuel will then be increased in one octane number increments until the problem is imperceptible to the "customer." The diagram in Table 2 shows the order of tank-filling. If the "customer" perceives knock at a higher octane number than his objection level, a tank fuel one octane number above that perception fuel should also be tested. The test fuel sequence procedure is carried out until the "customer" objection level is determined. After the "customer" objection level is determined, an E-15 rating will be made. This E-15 rating will determine the starting fuel for the next test sequence which will be repeated per Table 2 until the "customer" objection level is again obtained. A final E-15 rating will then be obtained. If the customer finds the gasoline to be objectionable at a level two octane numbers higher than the E-15 rating, an engineer/scientist should evaluate the customer's responses before continuing further testing.

The fuel-dispensing schedule described above should be modified if a "customer" responds at any time that he has bought commercial fuel. In such a case, he should be given the same fuel for one additional week (or tankful). Responses given for the first week should be discarded when the results are analyzed.

TABLE 1

LIMITING SPECIFICATIONS FOR 1990 CUSTOMER/RATER REFERENCE FUELS*

Inspection Tests	Unleaded Average Sensitivity Reference Fuels (FBRU)(C)		
	RMFD 374	RMFD 375	RMFD 376
ASTM Distillation, °F(°C)			
IBP, Min.	90 (32.2)	90	90
10% Evap.	115-158 (46.1- 70.0)	115-158	115-158
30% Evap.	150-185 (65.6- 85.0)	150-185	150-185
50% Evap.	195-225 (90.6-107.2)	195-225	195-225
70% Evap.	230-280 (110.0-137.8)	230-280	230-280
90% Evap.	285-374 (140.6-190.0)	285-374	285-374
End Point, Max.	437 (225)	437	437
RVP, psi (KPa)	7-9 (48-62)	7-9	7-9
Lead, g/gal (g/l)	<0.03 (<0.008)	<0.03	<0.03
Oxidation Stability, Minutes, Min.	1440	1440	1440
Hydrocarbon Type, Vol. %			
Aromatics, Max.**	20	35	55
Olefins, Max.	20	15	10
Saturates	Remainder	Remainder	Remainder
Octane Number			
Research	75 ± 1	91 ± 1	104 ± 1
Motor	72 ± 1	82 ± 1	92 ± 1
Color	Blue	Green	Red

Note: All fuels to contain minimum 5 PTB of a 100% active antioxidant and 10 PTB of corrosion inhibitor, and keep-clean level of PFI additive as specified by CRC.

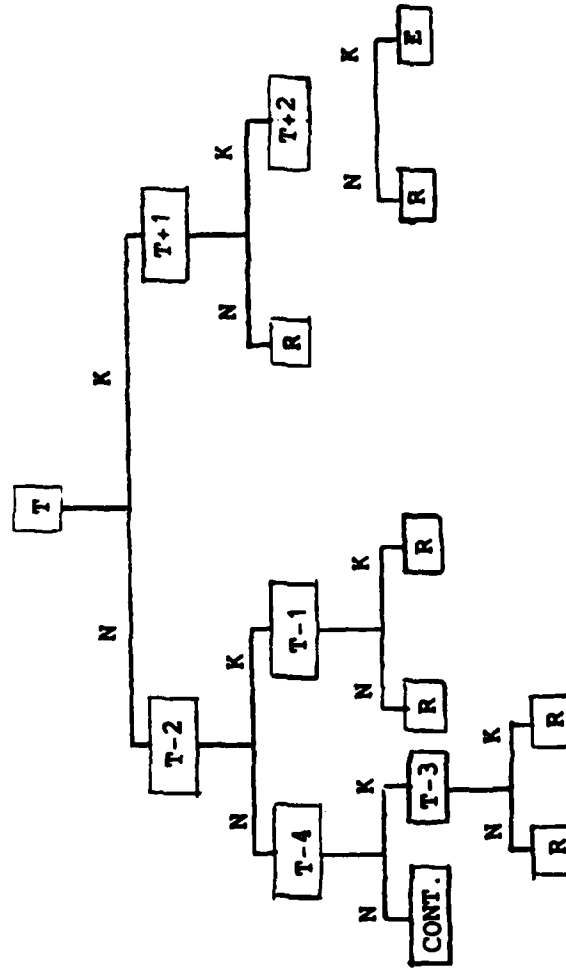
No manganese added.

Confirmation of product quality of fuel blends to be approved by a six-laboratory CRC Fuel Acceptance Panel prior to drumming.

* To be compounded from normal refinery components. Oxygenates are not to be used as fuel components.

** 1% maximum Benzene or legal.

TABLE 2
TEST FUEL SEQUENCE
KNOCK-SENSOR-EQUIPPED VEHICLE



T = High Borderline Octane Number Requirement
 N = No objectionable behavior
 K = Objectionable behavior
 R = Redetermine Octane Number Requirement
 E = Evaluate Customer objection
 Cont. = Continue downward in two octane increment

(Sample notice to "customers")

Selected Participants Will Be Supplied

Ten Tank Fills (Minimum) of Gasoline

F R E E

(If you are the principal
driver of a 1988, 1989, or
1990 automobile with 12,000 or
more miles on the odometer)

The _____ Laboratories needs
participants for a three-month fuel study. We would like to determine how you
rate the operation of your car with a variety of gasolines. We will supply
the test gasoline and also test your car three times during the study.

If you are interested in participating, please contact _____

_____ for more information.

INITIAL INTERVIEW QUESTIONNAIRE

By telephone or personal interview, obtain the following information:

Vehicle year, make and model _____

Number of cylinders _____

Engine displacement _____

VIN Number _____

Air Conditioned (Yes or No) _____

Transmission _____

Odometer Miles _____

Make sure emission controls are as-received from manufacturer.

Has engine had any major overhaul (Yes or No) _____

Would you be able to fuel your car at _____ for a 10-week
period (Yes or No) _____

Would you agree to have any anticipated tune-up work done either before
of after the entire test program (Yes or No) _____

How many miles per week do you drive _____

How frequently do you fuel up _____

Principal driver's name _____

Address _____

Telephone Numbers: Home _____ During
Day _____

INITIAL INTERVIEW QUESTIONNAIRE - (Continued)

Sex _____

Age _____

Occupation _____

Is car driven to work daily by the principal driver _____

If car and driver are acceptable to participate,

assign car number _____

By _____ Date _____

(Sample letter to acknowledge
"Customer's" participation in the program)

Dear _____,

Thank you for your interest in participating in our fuel study. The program in which you will be participating is part of a 200-car cooperative study by the Coordinating Research Council. _____ Laboratory is cooperating by arranging for 20 car tests. The purpose of the program is to determine how you (the principal driver of a car) rate the performance of different gasolines. We want you to do this in your own car under typical driving conditions.

During the test, we will give you tank fills of gasoline as needed. Your evaluation of each gasoline will be tabulated by your telephone answers to a prepared questionnaire. Your car will also be tested at our laboratory at the start, during, and end of the program. This will be a one-day test during which time we will provide a loaner car for your use if required. The target starting date is August 15, 1990. Since it will take some time to get all cars started on test, we will call you to arrange for a specific date.

Thank you again for your willingness to help out.

Very truly yours,

GASOLINE EVALUATION QUESTIONNAIRE

Lab No. _____, Vehicle No. _____, Fuel No. _____

Driver's Name _____, Tel. No. _____

Interviewer _____, Date _____

This is _____ of _____ calling about
the gasoline evaluation test. Is this _____?
(Drivers Name)

() Yes (Proceed)

() No (Ask for participant and start again)

- 1) Did you buy any gasoline since your car was last fueled by us?

() Yes (Ask) How many gallons? _____

() No (Proceed)

- 2) What, if any, mechanical work did you have done on your car during the past week?

() None () Body work () Engine (Explain) _____

() Tune Up () Other: _____

- 3) Since you last brought your car in, what kind of driving have you been doing? Has it been?

() Mostly around town () Mostly highway () Mixed

- 4) How was your car's operation this week? Was it?

() Satisfactory, or

() Unsatisfactory

- 5) Was there anything unusual?

() Yes

() No

- 6) a. Did your car start okay?

() Yes

() No

What day did this occur? _____

What time of day did this occur? _____

What was the approximate temperature? _____

Was it particularly humid or particularly dry?

- ☐ Neither
- ☐ Humid
- ☐ Dry

Was the engine

- ☐ cold
- ☐ hot

Was this problem objectionable?

- ☐ Yes
- ☐ No

Would you take any action to correct this problem?

- ☐ Yes
- ☐ No

If so, what action would you take? _____

b. Did your car stall?

- ☐ No
- ☐ Yes

What day did this occur? _____

What time of day did this occur? _____

What was the approximate temperature? _____

Was it particularly humid or particularly dry?

- ☐ Neither
- ☐ Humid
- ☐ Dry

Did stalling occur

- ☐ immediately after starting
- ☐ when put in gear
- ☐ while driving

Was this problem objectionable?

- ☐ Yes
- ☐ No

Would you take any action to correct this problem?

- ☐ Yes
- ☐ No

If so, what action would you take? _____

c. Did your car hesitate or stumble while driving?

- ☐ No
- ☐ Yes

What day did this occur? _____

What time of day did this occur? _____

What was the approximate temperature? _____

Was it particularly humid or particularly dry?

- ☐ Neither
- ☐ Humid
- ☐ Dry

Was the engine

- ☐ cold
- ☐ hot

Did this occur during

- ☐ light acceleration
- ☐ heavy acceleration

About what speed did this occur? _____

Did this happen

- ☐ once
- ☐ occasionally
- ☐ frequently

Was the problem objectionable?

- ☐ Yes
- ☐ No

Would you take any action to correct this problem?

- ☐ Yes
- ☐ No

If so, what action would you take? _____

d. How was your car's acceleration?

- ☐ Satisfactory
- ☐ Unsatisfactory

What day did this occur? _____

What time of day did this occur? _____

What was the approximate temperature? _____

Was it particularly humid or particularly dry?

- ☐ Neither
- ☐ Humid
- ☐ Dry

Did this occur

- ☐ during light acceleration
- ☐ during heavy acceleration
- ☐ from a stop
- ☐ during passing another car
- ☐ merging into traffic
- ☐ other

Was this problem objectionable?

- ☐ Yes
- ☐ No

Would you take any action to correct this problem?

- ☐ Yes
- ☐ No

If so, what action would you take? _____

e. Did you hear any knock or ping?

- ☐ No
- ☐ Yes

What day did this occur? _____

What time of day did this occur? _____

What was the approximate temperature? _____

Was it particularly humid or particularly dry?

- ☐ Neither
- ☐ Humid
- ☐ Dry

During which of the following types of operation did it occur?

- ☐ light acceleration
- ☐ heavy acceleration
- ☐ cruising at low speed
- ☐ cruising at high speed
- ☐ climbing hills
- ☐ pulling a trailer
- ☐ idle
- ☐ other

About what speed did this occur? _____

Was the engine

- ☐ cold
- ☐ hot

Was the problem objectionable?

- ☐ Yes
- ☐ No

Would you take any action to correct this problem?

- ☐ Yes
- ☐ No

If so, what action would you take? _____

f. Did the engine continue to run after turning it off?

- ☐ No
- ☐ Yes

What day did this occur? _____

What time of day did this occur? _____

What was the approximate temperature? _____

Was it particularly humid or particularly dry?

- ☐ Neither
- ☐ Humid
- ☐ Dry

Did it occur after

- ☐ long trips
- ☐ short trips

Was this problem objectionable?

- ☐ Yes
- ☐ No

Would you take any action to correct this problem?

- ☐ Yes
- ☐ No

If so, what action would you take? _____

7) Would you prefer this gasoline to the previous tankful?

- ☐ Yes
- ☐ No
- ☐ Indifferent

Thank you very much.

APPENDIX D

FUELS

TABLE D-1

SUPPLIERS' FUEL INSPECTIONS1990/1991 FBRCU FUELS

	Low-Octane	Intermediate-	High-Octane
	Base Blend	Octane	Base Blend
	RMFD	Base Blend	Base Blend
	RMFD	RMFD	RMFD
	374-90/91	375-90/91	376-90/91
<u>Laboratory Inspection</u>			
Distillation, °F			
IBP	103	93	98
10% Evap.	141	126	134
30% Evap.	182	155	177
50% Evap.	206	202	228
70% Evap.	230	275	249
90% Evap.	334	354	288
End Point	428	431	379
RVP, psi	7.6	8.4	8.3
Lead, g/gal.	0.000	0.000	0.001
Oxidation Stab., min.	1440+	1440+	1440+
<u>Hydrocarbon Type, Vol. %</u>			
Aromatics	14.5	30.1	43.9
Olefins	8.6	9.7	1.0
Saturates	76.9	60.2	55.1
Research Octane Number	75.1	91.7	104.0
Motor Octane Number	72.0	82.6	92.1
Sensitivity	3.1	9.1	11.9

TABLE D-2

OCTANE NUMBERS AND COMPOSITIONS FOR 1990/1991 FERCU FUELS

Research Octane Number	Composition Volume Percent			Motor Octane Number	Sensitivity
	RMFD 374-90/91	RMFD 375-90/91	RMFD 376-90/91		
76	96.9	3.1	---	72.1	3.9
77	91.3	8.7	---	72.9	4.1
78	85.6	14.4	---	73.7	4.3
79	79.8	20.2	---	74.5	4.5
80	73.9	26.1	---	75.2	4.8
81	68.0	32.0	---	76.0	5.0
82	62.0	38.0	---	76.7	5.3
83	55.9	44.1	---	77.4	5.6
84	49.7	50.3	---	78.1	5.9
85	43.5	56.6	---	78.8	6.2
86	37.2	62.8	---	79.4	6.6
87	30.6	69.2	---	80.1	6.9
88	24.4	75.6	---	80.7	7.3
89	17.8	82.2	---	81.3	7.7
90	11.2	88.8	---	81.8	8.2
91	4.6	95.4	---	82.4	8.6
92	---	96.7	3.3	83.2	8.8
93	---	88.6	11.4	83.9	9.1
94	---	80.4	19.6	84.6	9.4
95	---	72.1	27.9	85.3	9.7
96	---	63.8	36.2	86.1	9.9
97	---	55.4	44.8	86.8	10.2
98	---	46.8	53.2	87.6	10.4
99	---	38.2	61.8	88.4	10.6
100	---	29.5	70.5	89.1	10.9
101	---	20.7	79.3	89.9	11.1
102	---	11.9	88.1	90.7	11.3
103	---	2.9	97.1	91.5	11.5

TABLE D-3

1990/1991 FBRCU FUELS

<u>Percent in Blend</u>			<u>Laboratory</u>	
<u>RMFD</u>	<u>RMFD</u>	<u>RMFD</u>	<u>Octane Rating</u>	
<u>374-90/91</u>	<u>375-90/91</u>	<u>376-90/91</u>	<u>Research</u>	<u>Motor</u>
100	---	---	75.6	71.6
80	20	---	78.9	74.4
60	40	---	82.2	77.0
40	60	---	85.7	79.2
20	80	---	88.7	81.0
	100	---	91.6	82.8
	80	20	94.0	84.8
	60	40	96.6	86.5
	40	60	98.9	88.0
	20	80	101.2	90.0
		100	103.0	92.0

APPENDIX E

**DESCRIPTION OF VEHICLE TEST FLEET
AND CUSTOMERS**

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT-PROGRM

CUSTOMER/VEHICLE DATA

Make	Model	Customer Model			Knock		Air/Fuel		Disp.	C.R.	Trans	A/C	Odometer
		Age	Sex	Year	Eng.	Sensor	System						
ACURA	INTEGRA	31	M	88	L4	Y	P		1.6	9.5	M5	Y	40,999
ACURA	INTEGRA	26	M	89	L4	N	P		1.6	9.5	M5	Y	22,772
ACURA	LEGEND	46	M	88	V6	N	P		2.7	9.0	A4	Y	54,229
ACURA	LEGEND	52	M	90	V6	N	P		2.7	9.0	A4	Y	17,340
ACURA	LEGEND		M	88	V6	N	P		2.7	9.0	M5	Y	48,138
BUICK	LESABRE	63	M	89	V6	Y	P		3.8	8.5	A4	Y	21,255
BUICK	REGAL LIMITED		M	90	V6	Y	P		3.1	8.9	A4	Y	24,536
BUICK	SKYLARK		M	89	L4	Y	P		2.3	9.5	A3	Y	20,107
CADILLAC	SEDAN DEVILLE	46	M	88	V8	N	T		4.5	9.0	A4	Y	53,798
CHEVROLET	1500 PICKUP	27	M	90	V8	Y	T		5.7	9.1	A4	Y	11,500
CHEVROLET	2500 PICKUP	30	F	88	V8	Y	T		5.7	9.1	A4	N	37,183
CHEVROLET	ASTRO VAN	47	M	89	V6	Y	T		4.3	9.3	A4	Y	
CHEVROLET	BERETTA	26	M	90	L4	Y	P		2.5	9.0	M5	Y	27,126
CHEVROLET	C1500 PICKUP		M	89	V8	Y	T		5.7	9.1	A4	Y	27,674
CHEVROLET	CAMARO		F	88	V6	Y	P		2.8	8.9	A4	Y	17,586
CHEVROLET	CAPRICE	50	F	88	V8	Y	4		5.0	8.0	A4	Y	27,336
CHEVROLET	CAPRICE	63	M	90	V8	Y	T		5.0	9.2	A4	Y	10,685
CHEVROLET	CAVALIER		M	88	L4	N	T		2.0	9.0	A3	Y	64,000
CHEVROLET	CAVALIER	33	M	89	L4	N	T		2.0	9.0	A3	Y	24,240
CHEVROLET	CAVALIER		M	90	L4	N	T		2.2	9.0	M5	Y	14,636
CHEVROLET	CAVALIER	31	F	90	V6	Y	P		2.8	8.9	A3	Y	25,694
CHEVROLET	CAVALIER		M	89	L4	N	T		2.0	9.0	M5	N	21,814
CHEVROLET	CELEBRITY	43	F	89	V6	Y	P		2.8	8.9	A4	Y	20,867
CHEVROLET	CELEBRITY	43	M	88	V6	Y	P		2.8	8.9	A3	Y	37,086
CHEVROLET	CORSICA	31	F	90	V6	Y	P		3.1	8.8	A3	Y	8,736
CHEVROLET	CORSICA		M	89	V6	Y	P		2.8	8.9	A3	Y	33,745
CHEVROLET	CORSICA	55	M	90	L4	Y	P		2.8	8.9	M5	Y	12,624
CHEVROLET	G-20 VAN	39	M	89	V8	Y	T		5.7	9.1	A4	Y	39,935
CHEVROLET	LUMINA	39	M	90	V6	Y	T		3.1	9.3	A3	Y	13,150
CHEVROLET	MONTE CARLO	25	F	88	V8	Y	4		5.0	9.3	A4	Y	43,355
CHEVROLET	S-10	57	M	90	V6	Y	T		4.3	9.3	A4	Y	16,451
CHEVROLET	S-10 PICKUP		M	91	V6	Y	T		4.3	9.3	A4	Y	17,392
CHEVROLET	S-10 PICKUP		M	89	V6	Y	T		4.3	9.3	A4	Y	26,390
CHEVROLET	SILVERADO	58	M	89	V8	Y	P		5.7	9.1	A4	Y	27,667
CHEVROLET	SILVERADO		M	88	V8	Y	T		5.7	9.1	A4	Y	48,472
CHEVROLET	SUBURBAN	36	M	89	V8	Y	T		5.7	9.1	A4	Y	20,434
CHEVROLET	SUBURBAN	48	F	90	V8	Y	T		5.7	9.1	A4	Y	22,690
CHRYSLER	DODGE DAKOTA	35	F	90	V6	N	T		3.9	9.2	A4	Y	8,674
CHRYSLER	DYNASTY	39	F	90	V6	Y	P		3.3	8.9	A4	Y	8,707
CHRYSLER	LE BARON	40	F	88	L4	N	T		2.2	9.5	A3	Y	28,761
CHRYSLER	LEBARON	46	F	88	L4	N	T		2.2	9.5	A3	Y	50,826
CHRYSLER	PLYMOUTH LASER	41	M	90	L4	N	P		2.0	9.0	A4	Y	8,697
CHRYSLER	PLYMOUTH VOYAGE	43	M	90	V6	N	P		3.0	8.9	A4	Y	16,206
CHRYSLER	PLYMOUTH VOYAGE	32	F	90	V6	Y	P		3.0	8.9	A4	Y	13,709
DODGE	CARAVAN	34	F	90	V6	N	P		3.0	8.9	A3	Y	12,867
DODGE	CARAVAN	37	M	89	L4	Y	T P		2.5	8.9	A3	Y	25,456
DODGE	CARAVAN		M	89	V6	Y	P		3.0	8.9	A4	Y	30,034
DODGE	CARAVAN	50	M	90	V6	N	P		3.0	8.9	A3	Y	18,930

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Make	Model	Customer Model			Knock		Air/Fuel		Disp.	C.R.	Trans	A/C	Odometer
		Age	Sex	Year	Eng.	Sensor	System						
DODGE	DAKOTA	35	M	88	V6	N		T	3.9	9.2	M5	Y	65,091
DODGE	DAKOTA	34	M	89	V6	N		T	3.9	9.2	A4	Y	75,430
DODGE	DAKOTA P/U	55	M	88	V6	N		T	5.9	9.2	M5	N	30,933
DODGE	DAYTONA	24	F	89	L4	N		T	2.5	9.0	M5	Y	49,843
DODGE	DYNASTY	47	M	88	V6	N		P	3.0	8.9	A4	Y	30,664
DODGE	DYNASTY	56	M	90	V6	N		P	3.3	8.9	A3	Y	16,000
DODGE	DYNASTY		M	89	V6	N		P	3.0	8.9	A4	Y	57,038
DODGE	DYNASTY	44	M	89	V6	N		P	3.0	8.9	A4	Y	40,580
DODGE	SHADOW	60	M	89	L4	N		T	2.5	8.9	A3	Y	12,100
EAGLE	PREMIER	43	M	90	V6	N		P	3.0	9.3	A4	Y	17,923
FORD	AEROSTAR	48	M	89	V6	N		P	3.0	9.3	A4	Y	38,446
FORD	AEROSTAR	41	M	90	V6	N		P	4.0	9.0	A4	Y	26,770
FORD	AEROSTAR	45	M	90	V6	Y		P	3.0	9.3	A4	Y	40,336
FORD	BRONCO	55	M	89	V8	N		P	5.8	8.8	A3	Y	8,755
FORD	ESCORT	30	F	88	L4	N		T	1.9	9.0	A3	Y	48,179
FORD	ESCORT (SW) SI	54	M	88	L4	N		T	1.9	9.0	A3	Y	51,047
FORD	F-150 PICKUP	52	M	90	V8	N		P	5.0	9.0	A4	Y	19,442
FORD	F-150 PICKUP	31	M	90	V8	Y		P	5.0	9.0	A4	Y	31,343
FORD	F-250 PICKUP	46	M	89	V8	Y		P	5.0	9.0	A4	Y	55,779
FORD	FESTIVA		M	90	L4	N		P	1.3	9.7	M5	Y	31,255
FORD	MUSTANG	27	F	89	V8	Y		P	5.0	9.0	M5	Y	34,121
FORD	MUSTANG	27	F	88	L4	Y		P	2.3	9.5	A4	Y	32,835
FORD	PROBE	47	M	90	L4	N		P	2.2	8.6	A3	Y	20,049
FORD	PROBE	63	M	89	L4	Y	T	P	2.2	7.8	M5	Y	48,300
FORD	RANGER	47	M	89	V6	N		P	2.9	9.0	M5	Y	22,878
FORD	RANGER	30	M	90	V6	N		P	2.9	9.0	M5	Y	24,225
FORD	RANGER	59	M	89	V6	N		P	2.9	9.0	A4	Y	29,505
FORD	RANGER	35	M	89	V6	N		P	2.9	9.0	A4	Y	40,905
FORD	RANGER (PICKUP)	35	M	89	V6	N		P	2.9	9.0	M5	N	40,270
FORD	RANGER XLT		M	89	V6	N		P	2.9	9.0	M5	Y	19,280
FORD	RANGER XLT		M	89	L4	N		P	2.3	9.2	M5	Y	24,232
FORD	T-BIRD		M	91	V8	N		P	5.0	9.0	A4	Y	14,597
FORD	TAURUS	30	M	89	V6	N		P	3.8	9.1	A4	Y	26,500
FORD	TAURUS	58	M	89	V6	N		P	3.8	9.0	A4	Y	41,768
FORD	TAURUS	31	F	89	V6	Y		P	3.0	9.3	A4	Y	46,802
FORD	TAURUS	45	M	88	V6	Y		P	3.0	9.3	A4	Y	42,427
FORD	TAURUS		M	88	V6	N		P	3.0	9.3	A4	Y	29,166
FORD	TAURUS		M	88	V6	N		P	3.8	9.0	A4	Y	37,101
FORD	TAURUS	48	M	89	V6	N		P	3.8	9.0	A4	Y	25,619
FORD	TAURUS		M	88	V6	N		P	3.0	0.0	A4	Y	32,996
FORD	TAURUS SHO	32	M	90	V6	Y		P	3.0	9.8	M5	Y	8,286
FORD	TEMPO	28	M	89	L4	N		P	2.3	9.0	A3	Y	16,615
FORD	TEMPO	25	F	90	L4	N		P	2.3	9.0	A3	Y	6,204
FORD	THUNDERBIRD	57	M	89	V6	N		P	3.8	9.0	A4	Y	
FORD	THUNDERBIRD	47	M	89	V6	N		P	3.8	9.0	A3	Y	30,582
FORD	THUNDERBIRD S-C	63	M	90	V6	Y	S	P	3.8	8.2	A4	Y	13,006
GEO	PRISM	33	F	90	L4	N		P	1.6	10.3	A4	Y	24,860
GEO	STORM GSI	39	M	91	L4	N		P	1.6	9.1	A4	Y	13,775

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Make	Model	Customer Model			Knock		Air/Fuel		Disp.	C.R.	Trans	A/C	Odometer
		Age	Sex	Year	Eng.	Sensor	System	System					
GMC	PICKUP		M	89	V6	Y		T	4.3	9.3	A4	N	21,025
GMC	PICKUP 1500	32	F	89	V8	Y		T	5.7	9.1	A4	Y	21,313
GMC	SAFARI VAN		F	88	V6	Y		T	4.3	9.3	A4	Y	36,668
HONDA	ACCORD	42	F	88	L4	N		P	2.0	9.3	A4	Y	58,000
HONDA	ACCORD	31	M	90	L4	N		P	2.2	8.8	A4	Y	35,240
HONDA	ACCORD	24	F	89	L4	N		2	2.0	9.1	M5	Y	32,040
HONDA	ACCORD LX	52	M	88	L4	N		P	2.0	9.4	M5	Y	35,175
HONDA	ACCORD LX	27	F	90	L4	N		P	2.2	8.8	A4	Y	21,462
HONDA	CIVIC	24	F	90	L4	N		P	1.5	9.2	M5	N	38,153
HONDA	CIVIC...	46	M	89	L4	N		T	1.5	9.2	M5	Y	38,500
HONDA	CIVIC		M	90	L4	N		T	1.5	9.2	M4	N	16,353
HONDA	CRX	27	F	88	L4	N		P	1.6	9.1	M5	Y	67,010
HONDA	PRELUDE	27	M	89	L4	N		P	2.0	9.0	A4	Y	13,444
HONDA	PRELUDE SI	26	M	89	L4	N		P	2.0	9.0	M5	Y	36,229
ISUZU	TROOPER	34	F	88	L4	N		P	2.6	8.3	M5	Y	44,012
JEEP	CHEROKEE	47	M	89	L6	Y		P	4.0	8.8	M5	Y	20,550
JEEP	CHEROKEE	42	M	90	L6	Y		P	4.0	8.8	A4	Y	20,000
JEEP	CHEROKEE	30	M	89	L6	Y		P	4.0	8.8	A4		32,090
JEEP	CHEROKEE	49	M	88	V6	N		P	4.0	8.8	A4	Y	65,896
JEEP	CHEROKEE		M	88	L6	Y		P	4.0	8.8	A4	Y	35,810
LINCOLN	CONTINENTAL		M	89	V6	Y		P	3.8	9.0	A4	Y	37,143
MAZDA	323	24	F	89	L4	N		T	1.6	9.3	M5	Y	43,000
MAZDA	B-2200 PICKUP	27	M	89	L4	N		2	2.2	8.6	M5	N	40,833
MAZDA	MPV	45	F	89	V6	N		P	2.6	8.4	A4	Y	38,780
MERCURY	COUGER		M	89	V6	N		P	3.8	9.0	A4	Y	27,924
MERCURY	SABLE		M	88	V6	Y		P	3.0	9.3	A4	Y	37,890
MERCURY	SABLE	43	M	89	V6	Y		P	3.0	9.3	A4	Y	35,387
MERCURY	SABLE	63	F	88	V6	N		P	3.0	9.3	A4	Y	40,544
NISSAN	240SX		F	89	L4	N		P	2.4	8.6	A4	Y	21,597
NISSAN	MAXIMA	44	F	89	V6	Y		P	3.0	9.0	A4	Y	27,940
NISSAN	MAXIMA		M	88	V6	Y	N	P	3.0	9.0	M5	Y	21,946
NISSAN	PATHFINDER	28	M	90	V6	N		P	3.0	9.0	A4	Y	13,445
NISSAN	PULSAR	29	M	89	L4	N		T	1.6	9.4	M5	Y	69,731
NISSAN	SENTRA	29	M	89	L4	N		P	1.6	9.4	A3	Y	23,148
NISSAN	SENTRA	42	F	90	L4	N		T	1.6	9.4	M4	Y	22,124
NISSAN	SENTRA	40	F	90	L4	N		P	2.4	8.6	A4	Y	11,850
NISSAN	SENTRA	22	F	88	L4	N		T	1.6	9.3	A4	Y	23,840
OLDSMOBILE	CUTLASS CIERA	38	M	90	V6	Y		P	3.3	9.0	A4	Y	6,580
OLDSMOBILE	SILHOUETTE	58	M	90	V6	Y		T	3.1	8.8	A3	Y	14,959
PLYMOUTH	SUNDANCE	61	M	89	L4	N		T	2.2	9.5	A3	Y	42,837
PLYMOUTH	SUNDANCE	22	M	89	L4	N		T	2.5	9.0	M5	Y	23,500
PLYMOUTH	VOYAGER	41	M	89	L4	N		T	2.5	8.9	A4	Y	25,580
PLYMOUTH	VOYAGER	43	M	89	L4	N		T	2.5	8.9	A3	Y	51,040
PONTIAC	6000	56	F	89	V6	N		P	2.8	8.9	A4	Y	13,095
PONTIAC	BONNEVILLE	28	F	89	V6	Y		P	3.8	8.5	A4	Y	19,164
PONTIAC	BONNEVILLE	40	F	90	V6	Y		P	3.8	8.5	A4	Y	12,514
PONTIAC	BONNEVILLE		M	89	V6	Y		P	3.8	8.5	A4	Y	20,241
PONTIAC	FIREBIRD		M	90	V6	Y		P	3.1	8.9	A4	Y	27,601

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Make	Model	Customer Model			Knock		Air/Fuel		Disp.	C.R.	Trans	A/C	Odometer
		Age	Sex	Year	Eng.	Sensor	System						
PONTIAC	GRAND AM	25	M	90	L4	Y	P		2.3	9.5	A3	Y	49,218
PONTIAC	GRAND AM	42	M	90	L4	Y	P		2.3	9.5	A3	Y	12,639
PONTIAC	GRAND AM		M	88	L4	Y	P		2.3	9.5	A3	Y	56,379
PONTIAC	GRAND AM		M	88	L4	N	T		2.5	9.0	M5	Y	57,091
PONTIAC	GRAND PRIX		M	88	V6	Y	P		2.8	8.8	A4	Y	40,875
PONTIAC	GRAND PRIX	33	F	88	V6	Y	P		2.8	8.9	A4	Y	61,175
PONTIAC	GRAND PRIX	28	M	88	V6	Y	P		2.8	8.9	A4	Y	46,067
PONTIAC	GRAND PRIX	32	F	89	V6	Y	P		2.8	8.9	A4	Y	20,579
PONTIAC	LEMANS	40	M	90	L4	N	T		1.6	8.6	M5	N	31,025
PONTIAC	SUNBIRD	22	F	90	L4	N	T		2.0	0.0	M5	Y	12,575
PONTIAC	SUNBIRD	52	F	89	L4	N	T		2.0	8.8	A4	Y	27,484
SUBARU	GL WAGON	43	M	88	L4	N	T		1.8	9.5	M5	N	36,390
SUBRU	LEGACY	69	M	90	L4	Y	P		2.2	9.5	A4	Y	27,666
TOYOTA	CAMRY	23	F	89	L4	Y	P		2.0	9.3	A4	Y	35,000
TOYOTA	CAMRY	39	M	88	L4	N	P		2.0	9.3	A4	Y	67,080
TOYOTA	CAMRY	32	F	88	V6	Y	P		2.5	9.0	A4	Y	48,171
TOYOTA	CAMRY	31	F	88	L4	N	P		2.0	9.3	M5	Y	26,820
TOYOTA	PICKUP	28	M	89	V6	N	P		3.0	9.0	M5	Y	49,100
TOYOTA	TERCEL	37	F	90	L4	N	P		1.5	9.3	A3	Y	15,200
TOYOTA	TERCEL	23	F	89	L4	N	1		1.5	9.3	A3	Y	64,000
VOLKSWAGEN	JETTA GL	48	F	90	L4	Y	P		1.8	10.0	A3	Y	10,838
VOLKSWAGON	FOX	30	M	88	L4	N	P		1.8	9.0	M5	N	72,150
VW	GOLF GL	26	F	88	L4	N	P		1.8	10.0	M5	Y	58,828
VW	GOLF GL		M	88	L4	Y	T		1.8	10.0	M5	Y	52,475

APPENDIX F

INDIVIDUAL VEHICLE OCTANE NUMBER REQUIREMENTS

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
05-01	1	95	-	-	-	-	95.5	3	4,050	0.8				
05-01	2	94	-	-	-	-								
05-01	3	92	-	-	-	-								
05-01	4	90	X	X	-	-								
05-01	5	91	-	-	-	-	96.0	3	3,850	0.8				
05-01	6	96	-	-	-	-								
05-02	1	94	-	-	-	-	94.0	2	2,740	0.6				
05-02	2	92	-	-	-	-								
05-02	3	90	-	-	-	-								
05-02	4	88	X	X	-	-								
05-02	5	89	-	-	-	-								
05-02	6	90	-	-	-	-	90.5	2	2,200	0.6				
05-02	7	90	-	-	-	-								
05-03	1	95	X	-	-	-	95.0	3L	1,800	2.0				
05-03	2	93	X	-	-	-								
05-03	3	91	X	X	-	-								
05-03	4	92	X	-	-	-	95.0	3L	1,700	1.8				
05-03	5	95	-	-	-	-								
05-04	1	93	X	-	-	-	93.0	2	2,200	1.3				
05-04	2	91	X	X	-	-								
05-04	3	92	X	X	-	-								
05-04	4	93	-	-	-	-								
05-04	5	93	X	X	-	-								
05-04	6	94	-	-	-	-	97.0	4L	1,800	0.8				
05-04	7	97	-	-	-	-								
05-05	1	89	-	-	-	-	89.0	3	2,520	0.4				
05-05	2	87	X	X	-	-								
05-05	3	88	X	X	-	-								
05-05	4	89	X	-	-	-	89.0	4	2,600	0.4				
05-05	5	89	-	-	-	-								
05-06	1	95	-	-	-	-	95.0	2	2,300	1.2	95.0	2	2,300	1.2
05-06	2	93	-	-	-	-								
05-06	3	91	-	-	-	-								
05-06	4	89	X	X	-	-								
05-06	5	87	X	X	-	-								
05-06	6	90	X	X	-	-								
05-06	7	91	X	X	-	-								
05-06	8	92	X	X	-	-								
05-06	9	93	-	-	-	-	95.0	3	2,200	1.2				
05-06	10	95	-	-	-	-								
05-06	11	93	-	-	-	-								
05-06	12	91	X	X	-	-								
05-06	13	92	-	-	-	-								
05-06	14	96	-	-	-	-	96.0	3	2,500	1.4				
05-07	1	90	-	-	-	-	90.0	4L	1,820	1.0	89.0	4L	1,670	1.0
05-07	2	88	-	-	-	-								
05-07	3	86	X	X	-	-								
05-07	4	87	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
05-07	5	88	-	-	-	-	90.0	4L	1,860	0.6				
05-07	6	90	-	-	-	-								
05-07	7	88	-	-	-	-								
05-07	8	86	-	-	-	-								
05-07	9	85	-	-	-	-								
05-07	10	84	-	-	-	-								
05-07	11	82	-	-	-	-								
05-07	12	80	-	-	-	-								
05-07	13	90	-	-	-	-	90.0	4L	2,360	0.6				
05-08	1	92	-	-	-	-	92.0	4	2,180	3.0				
05-08	2	90	-	-	-	-								
05-08	3	88	-	-	-	-								
05-08	4	86	-	-	-	-								
05-08	5	84	-	-	-	-								
05-08	6	82	-	-	-	-								
05-08	7	80	-	-	-	-								
05-09	1	95	-	-	-	-	95.0	4L	1,460	2.0				
05-09	2	93	X	-	-	-								
05-09	3	91	X	-	-	-								
05-09	4	92	-	-	-	-	95.0	4L	1,790	1.5				
05-09	5	95	-	-	-	-								
05-09	6	93	-	-	-	-								
05-09	7	91	X	-	-	-								
05-09	8	90	-	-	-	-								
05-09	9	89	X	X	-	-								
05-09	10	95	-	-	-	-	95.0	4L	1,930	0.8				
05-10	1	96	-	-	-	-	96.0	4	1,180	2.0				
05-10	2	94	-	-	-	-								
05-10	3	92	X	X	-	-								
05-10	4	93	X	X	-	-								
05-10	5	94	-	-	-	-	97.0	4	1,200	2.0				
05-10	6	97	-	-	-	-								
05-10	7	95	-	-	-	-								
05-10	8	93	-	-	-	-								
05-10	9	92	X	X	-	-								
05-10	10	93	-	-	-	-								
05-10	11	97	-	-	-	-	97.0	4	1,200	2.0				
05-11	1	88	X	X	-	-	88.0	4	1,500	0.5				
05-11	2	90	X	X	-	-								
05-11	3	89	X	X	-	-								
05-11	4	91	X	X	-	-								
05-11	5	92	-	-	-	-								
05-11	6	92	X	X	-	-								
05-11	7	93	X	-	-	-								
05-11	8	89	X	X	-	-	89.0	3	1,800	0.2				
05-11	9	91	X	X	-	-								
05-11	10	93	-	-	-	-								
05-11	11	92	X	X	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
05-11	12	89	-	-	-	-	89.0	4	1,670	0.2				
06-01	1		-	-	-	-	91.0	3	2,600	1.0	89.0	3	2,400	2.2
06-01	2	91	-	-	-	-								
06-01	3	89	-	-	-	-								
06-01	4	87	-	-	-	-								
06-01	5	85	-	-	-	-								
06-01	6	85	X	-	-	X	89.5	3	2,100	1.0	88.0	3	2,100	3.1
06-01	7	84	X	X	-	X								
06-01	8	85	X	X	-	X								
06-01	9	86	X	X	-	X								
06-01	10	87	-	-	-	-								
06-01	11	87	X	X	-	X								
06-01	12	87	X	X	-	X								
06-01	13	88	-	-	-	-								
06-01	14	88	-	-	-	-								
06-01	15	87	-	-	-	-								
06-01	16	87	-	-	-	-								
06-01	17	85	X	X	-	X								
06-02	1		-	-	-	-	92.0	4	1,800	1.8	91.0	4	2,400	2.9
06-02	2	92	X	-	-	X								
06-02	3	92	-	-	-	-								
06-02	4	90	X	X	-	X								
06-02	5	89	X	X	-	X								
06-02	6	91	-	-	-	-	93.0	4	2,200	1.8	91.0	4	2,200	2.8
06-02	7	91	-	-	-	-								
06-02	8	91	X	X	-	X								
06-02	9	92	-	-	-	-								
06-02	10	92	X	X	-	X								
06-02	11	92	-	-	-	-								
06-02	12	92	X	X	-	X								
06-02	13	93	X	X	-	X								
06-02	14	94	-	-	-	-								
06-03	1		-	-	-	-	90.0	4	3,100	0.4	89.0	4	2,800	1.6
06-03	2	90	-	-	-	-								
06-03	3	90	-	-	-	-								
06-03	4	88	X	X	-	X								
06-03	5	89	X	X	-	X	89.0	4	3,000	0.4	88.0	4	3,400	1.4
06-03	6	90	X	X	-	X								
06-03	7	90	-	-	-	-								
06-03	8	90	X	X	-	X								
06-03	9	91	X	X	-	X								
06-03	10	91	-	-	-	-								
06-03	11	91	X	-	-	X								
06-03	12	92	X	-	-	X								
06-03	13	93	-	-	-	-								
06-03	14	91	-	-	-	-								
06-03	15	91	-	-	-	-								
06-03	16	89	X	X	-	X								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
06-03	17	90	-	-	-	-	90.0	3	2,500	0.4	88.0	4	2,600	1.6
06-03	18	90	X	X	-	X								
06-03	19	92	-	-	-	-								
06-04	1		-	-	-	-	90.0	4	2,600	0.4	89.5	3	2,400	1.4
06-04	2	90	-	-	-	-								
06-04	3	90	-	-	-	-								
06-04	4	88	-	-	X	-								
06-04	5	86	-	-	-	-								
06-04	6	86	-	-	-	-								
06-04	7	84	X	X	X	-								
06-04	8	86	-	-	-	-	91.0	3	2,700	0.4	91.0	3	3,100	2.8
06-04	9	86	-	-	-	-								
06-04	10	86	X	X	-	X								
06-04	11	87	X	X	-	X								
06-04	12	87	-	-	-	-								
06-04	13	88	X	-	-	-								
06-04	14	89	-	-	-	-								
06-04	15	87	-	-	-	-								
06-04	16	85	-	-	-	-								
06-04	17	84	X	-	-	X								
06-04	18	84	X	X	-	X								
06-04	19	86	X	-	-	-								
06-04	20	87	X	X	-	X								
06-05	1		-	-	-	-	89.5	3	3,500	0.4	85.4	4	2,500	2.0
06-05	2	90	-	-	-	-								
06-05	3	88	X	X	-	X								
06-05	4		-	-	-	-	89.0	3	2,900	0.4	88.0	3	2,800	2.5
06-05	5	89	X	X	-	X								
06-05	6	90	X	X	-	X								
06-05	7	90	-	-	-	-								
06-05	8	90	X	X	-	X								
06-05	9	89	X	X	-	X								
06-05	10	91	X	-	-	X								
06-05	11	92	X	X	-	X								
06-05	12	93	-	-	-	-								
06-05	13	93	X	X	-	X								
06-05	14	95	-	-	-	-								
06-06	1		-	-	-	-	93.0	4L	1,675	3.2	92.0	4L	1,500	4.2
06-06	2	93	-	-	-	-								
06-06	3	91	-	-	-	-								
06-06	4	91	-	-	-	-								
06-06	5	89	-	-	-	-								
06-06	6	89	X	-	-	-								
06-06	7	87	X	X	-	X								
06-06	8	87	-	-	-	-								
06-06	9	88	-	-	-	-	93.0	3	2,100	2.6	91.0	4L	1,400	4.0
06-06	11	88	-	-	-	-								
06-07	1		-	-	-	-	91.0	3	2,150	3.0				

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
06-07	2	91	-	-	-	-								
06-07	3	91	-	-	-	-								
06-07	4	89	-	-	-	-								
06-07	5	87	-	-	-	-								
06-07	6	87	-	-	-	-								
06-07	7	85	X	X	-	-								
06-07	8	85	-	-	-	-	88.0	3	2,400	3.0	85.0	3	2,100	4.0
06-07	9	88	-	-	-	-								
06-07	10	85	-	-	-	-								
06-07	11	84	-	-	-	-								
06-07	12	84	-	-	-	-								
06-07	13	84	X	-	-	X								
06-07	14	84	-	-	-	-	88.0	2	2,200	3.0	86.0	3L	1,900	4.0
06-08	1		-	-	-	-	92.0	3L	2,460	2.6				
06-08	2	92	X	X	-	X								
06-08	3	92	X	X	-	X								
06-08	4	93	X	X	-	X								
06-08	5		-	-	-	-	93.0	4L	2,400	2.6	91.0	4L	1,700	4.0
06-08	6	93	X	X	-	X								
06-08	7	94	-	-	-	-								
06-08	8	94	X	X	-	X								
06-08	9	95	-	-	-	-								
06-08	10	95	X	-	-	X								
06-08	11	94	X	X	-	X								
06-08	12	94	X	X	-	X								
06-08	13	96	X	-	-	X								
06-08	14	96	X	X	-	X	93.0	4L	2,150	2.6	93.0	4L	2,200	3.8
06-08	15	98	-	-	-	-								
06-08	16	98	-	-	-	-								
06-09	1	95	-	-	-	-	95.0	2	2,100	2.4	89.0	3	1,800	3.7
06-09	2	95	-	-	-	-								
06-09	3	93	X	X	X	X								
06-09	4	93	-	-	-	-								
06-09	5	91	X	X	X	X								
06-09	6	93	-	-	-	-								
06-09	7	93	X	-	-	X								
06-09	8	93	-	-	-	-								
06-09	9	91	X	X	-	X								
06-09	10	91	X	X	-	X								
06-09	11	92	-	-	-	-								
06-09	12	92	X	X	-	X								
06-09	13	93	-	-	-	-								
06-09	14	93	-	-	-	-								
06-09	15	93	-	-	-	-	96.0	2	2,000	2.4	95.0	4L	1,100	3.0
06-10	1		-	-	-	-	94.0	3	1,700	1.2	94.0	3	1,800	2.2
06-10	2	94	-	-	-	-								
06-10	3	92	-	-	-	-								
06-10	4	89	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
06-10	5	87	-	-	-	-								
06-10	6	87	X	X	-	X								
06-10	7		-	-	-	-	93.0	3	2,200	1.2	93.0	3	2,300	3.0
06-10	8	88	X	X	-	X								
06-10	9	89	-	-	-	-								
06-10	10	89	-	-	-	-								
06-10	11	87	-	-	-	-								
06-10	12	87	-	-	-	-								
06-10	13	85	-	-	-	-								
06-10	14	85	-	-	-	-								
06-10	15	87	-	-	-	-								
06-10	16	85	-	-	-	-								
06-10	17	85	X	X	-	X								
06-10	18	86	-	-	-	-								
06-10	19	86	-	-	-	-								
06-10	20	86	-	-	-	-	95.0	3	1,600	1.2	94.0	3	1,500	2.2
06-11	1		-	-	-	-	89.0	4L	1,500	2.6	89.0	4L	1,400	3.6
06-11	2	89	-	-	-	-								
06-11	3	89	-	-	-	-								
06-11	4	87	-	-	-	-								
06-11	5	85	X	X	-	X								
06-11	6	85	X	X	-	X								
06-11	7	86	-	-	-	-								
06-11	8	86	X	X	-	X								
06-11	9	87	-	-	-	-								
06-11	10	87	-	-	-	-								
06-11	11	86	-	-	-	-								
06-11	12	86	-	-	-	-								
06-11	13	86	X	-	-	-								
06-11	14	86	-	-	-	-								
06-11	15		-	-	-	-	87.0	4L	1,700	2.6	89.0	4L	1,400	3.6
06-11	16	86	X	-	-	-								
06-11	17	86	-	-	-	-								
06-11	18	85	X	X	-	X								
06-11	19	86	-	-	-	-								
06-12	1		-	-	-	-	85.0	3	2,200	0.8	84.0	3	2,000	2.0
06-12	2	88	-	-	-	-								
06-12	3	85	-	-	-	-								
06-12	4	85	-	-	-	-								
06-12	5	83	-	-	-	-								
06-12	6	83	-	-	-	-								
06-12	7	83	X	-	-	-								
06-12	8	84	X	X	-	X								
06-12	9	84	-	-	-	-								
06-12	10	83	X	X	-	X								
06-12	11	83	X	X	-	X								
06-12	12	84	X	X	-	X								
06-12	13	84	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
06-12	14	84	-	-	-	-								
06-12	15	84	-	-	-	-	87.0	3	2,100	0.8	87.0	3	2,100	1.8
07-01	1	85	-	-	-	-	85.0	3	3,700					
07-01	2	84	X	X	-	-								
07-01	3	85	X	X	-	-								
07-01	4	86	X	X	-	-								
07-01	5	87	-	-	-	-								
07-01	6	86	X	-	-	-	86.0	3	3,200					
07-01	7	87	-	-	-	-								
07-02	1	82	-	-	-	-	83.0	3	2,900					
07-02	2	81	-	-	-	-								
07-02	3	80	-	-	-	-								
07-02	4	79	-	-	-	-								
07-02	5	78	-	-	-	-								
07-02	6	77	X	-	-	-								
07-02	7	78	X	-	-	-								
07-02	8	79	-	-	-	-	83.0	3	3,250					
07-03	1	89	-	-	-	-	88.0	4	1,750					
07-03	2	88	X	X	-	-								
07-03	3	89	X	-	-	-								
07-03	4	88	X	-	-	-								
07-03	5	89	-	-	-	-								
07-03	6	90	-	-	-	-								
07-03	7	91	X	-	-	-								
07-03	8	92	-	-	-	-								
07-03	9	91	-	-	-	-	92.0	3	2,100					
07-04	1	92	-	-	-	-	91.0	3	2,700					
07-04	2	91	-	-	-	-								
07-04	3	90	-	-	-	-								
07-04	4	89	-	-	-	-								
07-04	5	88	-	-	-	-								
07-04	6	87	X	X	-	X	92.0	2	2,650					
07-04	7	88	-	-	-	-								
07-05	1	86	-	-	-	-	86.0	3	2,950					
07-05	2	85	X	X	-	-								
07-05	3	86	-	-	-	-								
07-05	4	86	-	-	-	-	86.0	3	2,900					
07-06	1	91	-	-	-	-	91.0	3	2,800					
07-06	2	90	X	X	-	-								
07-06	3	90	X	X	-	-								
07-06	4	91	-	-	-	-	93.0	3	2,600					
07-07	1	91	-	-	-	-	91.0	4	1,900					
07-07	2	90	-	-	-	-								
07-07	3	89	X	X	-	X								
07-07	4	90	X	X	-	X								
07-07	5	90	-	-	-	-	92.0	4	2,300					
07-07	6	91	-	-	-	-								
07-08	1	91	-	-	-	-	91.0	4U	2,450					

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
07-08	2	90	-	-	-	-								
07-08	3	89	X	-	-	-								
07-08	4	90	X	-	-	-	91.0	4U	2,400					
07-08	5	91	-	-	-	-								
07-09	1	90	-	-	-	-	90.0	3	3,000					
07-09	2	89	-	-	-	-								
07-09	3	88	-	-	-	-								
07-09	4	87	-	-	-	-								
07-09	5	86	-	-	-	-								
07-09	6	85	-	-	-	-								
07-09	7	84	X	X	-	-	89.0	4	2,500					
07-09	8	85	-	-	-	-								
07-10	1	90	-	-	-	-	90.0	4	1,700		90.0	4	2,600	
07-10	2	89	-	-	-	-								
07-10	3	88	X	-	-	-								
07-10	4	88	X	-	-	-	95.0	4	2,500					
07-10	5	89	-	-	-	-								
07-11	1	89	-	-	-	-	89.0	3	2,950					
07-11	2	88	-	-	-	-								
07-11	3	87	-	-	-	-								
07-11	4	86	-	-	-	-								
07-11	5	85	-	-	-	-								
07-11	6	84	-	-	-	-								
07-11	7	83	X	X	-	X	88.0	4	2,100					
07-11	8	84	-	-	-	-								
07-12	1	92	-	-	-	-	92.0	4U						
07-12	2	91	-	-	-	-								
07-12	3	90	-	-	-	-								
07-12	4	89	-	-	-	-								
07-12	5	88	-	-	-	-								
07-12	6	87	-	-	-	-								
07-12	7	86	-	X	-	X	93.0	4	1,950					
07-12	8	87	-	-	-	-								
07-13	1	91	-	-	-	-	91.0	4U	1,450					
07-13	2	90	-	-	-	-								
07-13	3	89	-	-	-	-								
07-13	4	88	X	-	-	-								
07-13	5	88	X	X	-	X								
07-13	6	89	X	-	-	-	91.0	4U	2,500					
07-13	7	90	-	-	-	-								
07-14	1	92	X	-	-	-	91.0	3	2,700					
07-14	2	91	X	X	-	-								
07-14	3	90	X	X	-	-								
07-14	4	91	-	-	-	-								
07-14	5	90	X	X	-	-	93.0	2	2,600					
07-14	6	91	-	-	-	-								
07-15	1	88	X	X	-	-	87.0	3	2,100					
07-15	2	89	X	X	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
07-15	3	90	X	-	-	-								
07-15	4	91	X	-	-	-								
07-15	5	92	-	-	-	-								
07-15	6	91	X	-	-	-	86.0	4	2,100					
07-16	1	84	-	-	-	-	84.0	4	2,150	7.0				
07-16	2	82	-	-	-	-								
07-16	3	80	-	-	-	-								
07-16	4	78	-	-	-	-								
07-16	5	77	-	-	-	-								
07-16	6	78	-	-	-	-								
07-17	1	94	X	-	-	-	93.0	3	5,600		93.0	4U	5,500	
07-17	2	93	X	-	-	-								
07-17	3	94	X	-	-	-								
07-17	4	94	X	X	-	-								
07-17	5	94	-	-	-	-								
07-17	6	94	X	-	-	-	93.0	4L	4,900					
07-17	7	95	-	-	-	-								
07-18	1	85	X	X	-	-	85.0	3	2,250					
07-18	2	87	X	X	-	-								
07-18	3	87	-	-	-	-								
07-18	4	86	X	X	-	-								
07-18	5	87	-	-	-	-	85.0	4	2,500					
08-01	1	84	-	-	-	-	86.0	3	2,600	2.0				
08-01	2	82	-	-	-	-								
08-01	3	80	-	-	-	X								
08-01	4	78	X	X	-	X								
08-01	5	79	X	X	-	-	85.0	3	2,550	2.0				
08-01	6	84	X	-	-	-								
08-01	7	82	X	-	-	-								
08-01	8	80	-	-	-	-								
08-01	9	78	-	-	-	-								
08-01	10	76	X	-	-	-	84.0	3	2,700	2.0				
08-01	11	77	-	-	-	-								
08-02	1	93	-	-	-	-	94.0	3	2,900	1.7	94.0	3	2,450	5.5
08-02	2	91	X	-	-	-								
08-02	3	89	X	X	-	-								
08-02	4	90	X	-	-	-					100.0	3	2,400	5.5
08-02	5	92	-	-	-	-								
08-02	6	90	-	-	-	-								
08-02	7	89	-	-	-	-								
08-02	8	88	-	-	-	-								
08-02	9	86	-	-	X	-								
08-02	10	84	X	X	-	-								
08-02	11	86	X	-	-	-								
08-02	12	85	-	-	-	-								
08-02	13	84	-	-	-	-								
08-02	14	83	X	X	-	-	96.0	3	2,850	1.7	99.0	3L	2,000	4.5
08-03	1	93	-	-	-	-	92.0	3	2,450	0.5	90.0	3	1,900	2.0

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
08-03	2	93	-	-	-	-								
08-03	3	91	-	-	-	-								
08-03	4	89	-	-	-	-								
08-03	5	88	X	-	-	-								
08-03	6	87	X	X	-	X								
08-03	7	88	-	-	-	-	92.0	3	3,700	0.7	90.0	3	3,700	2.0
08-03	8	90	-	-	-	-								
08-03	9	88	-	-	-	-								
08-03	10	87	-	-	-	-								
08-03	11	86	X	-	-	-								
08-03	12	86	X	-	-	-								
08-03	13	86	-	-	-	-								
08-03	14	85	-	-	-	-								
08-03	15	85	-	-	-	-								
08-03	16	86	-	-	-	-	92.0	4	2,750	0.6				
08-04	1	85	-	-	-	-	85.0	4	2,200	0.5				
08-04	2	83	-	-	-	-								
08-04	3	81	-	-	-	-								
08-04	4	80	X	X	-	-								
08-04	5	81	X	X	-	-								
08-04	6	82	X	-	-	-								
08-04	7	82	-	-	-	-	84.0	3	2,050	0.5	84.0	4	1,900	
08-04	8	80	X	X	-	-								
08-04	9	81	-	-	-	-	84.0	3	2,100	0.5	84.0	4	1,900	6.0
08-05	1	87	-	-	-	-	87.0	4	1,750	0.7	88.0	4	1,750	3.0
08-05	2	85	-	-	-	-								
08-05	3	83	-	-	-	-								
08-05	4	82	X	X	-	-								
08-05	5	83	-	-	-	-								
08-05	6	82	-	-	-	-								
08-05	7	81	X	X	-	-	88.0	3	2,400	1.0				
08-05	8	84	-	-	-	-								
08-05	9	82	-	-	-	-								
08-05	10	82	-	-	-	-								
08-05	11	80	-	-	-	-								
08-05	12	78	X	X	-	X								
08-05	13	79	-	-	-	-	88.0	3	2,200	1.0				
08-06	1	-	-	-	-	-	87.0	3L	2,000	1.2				
08-06	2	89	-	-	-	-								
08-06	3	87	-	-	-	-								
08-06	4	85	-	-	-	-								
08-06	5	84	-	-	-	-								
08-06	6	83	-	-	-	-								
08-06	7	82	-	-	-	-								
08-06	8	80	-	-	-	-								
08-06	9	78	-	-	-	-								
08-06	10	77	-	-	-	-								
08-06	11	76	-	-	-	-	87.0	3L	2,500	1.2				

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
08-06	12	85	-	-	-	-								
08-06	13	83	-	-	-	-								
08-06	14	79	-	-	-	-								
08-06	15	76	-	-	-	-	87.0	3L	2,250	1.2				
08-07	1	92	X	-	-	-	95.0	3	2,400	0.8	93.0	3	2,110	5.0
08-07	2	93	X	-	-	-								
08-07	3	93	-	-	-	X								
08-07	4	91	-	-	-	-								
08-07	5	89	X	X	-	-								
08-07	6	90	X	-	-	-								
08-07	7	89	X	-	-	-	96.0	3	2,100	0.7				
08-07	8	90	X	-	-	-								
08-07	9	90	X	X	-	-	93.0	3	2,300	0.8				
08-08	1	88	X	X	-	-	90.0	3	2,100	0.8	86.0	3	2,150	4.5
08-08	2	90	X	-	-	-								
08-08	3	91	-	-	-	-								
08-08	4	90	-	-	-	-	91.0	3	2,000	0.8	91.0	3	2,000	4.5
08-08	5	92	-	-	-	-								
08-08	6	90	X	-	-	-								
08-08	7	88	X	X	-	X								
08-08	8	89	-	-	-	-	92.0	3	3,100	0.8	92.0	3	3,000	4.5
08-09	1	90	X	X	-	-	100.0	3	2,600	1.7	100.0		2,400	3.5
08-09	2	92	-	-	-	-								
08-09	3	91	X	X	-	-								
08-09	4	92	-	-	-	-								
08-09	5	90	-	-	-	-								
08-09	6	88	X	-	-	-	100.0	3	2,900	1.5	100.0		2,850	3.5
08-09	7	89	-	-	-	-	100.0	3	2,800	1.7				
08-10	1	88	-	-	-	-	90.0	3L	2,000	1.4				
08-10	2	86	X	X	-	-								
08-10	3	87	-	-	-	-	92.0	3L	2,300	1.4				
08-10	4	88	-	-	-	-								
08-10	5	86	-	-	-	-								
08-10	6	84	X	X	-	-								
08-10	7	85	X	-	-	X	89.0	3L	2,200	1.4				
08-11	1	88	-	-	-	-	88.0	3	2,850	1.8				
08-11	2	86	-	-	-	-								
08-11	3	84	-	-	-	-								
08-11	4	82	X	X	X	-								
08-11	5	83	-	-	-	-	87.0	3	2,850	1.8				
08-11	6	86	-	-	-	-								
08-11	7	84	-	-	-	-								
08-11	8	82	-	-	-	-								
08-11	9	80	X	-	-	-								
08-11	10	81	-	-	-	-	90.0	3	2,900	1.8	90.0		1,750	5.0
08-12	1	82	-	-	-	-	84.0	3	2,100	1.2				
08-12	2	80	-	-	-	-								
08-12	3	78	-	-	-	X								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
08-12	4	79	-	-	-	-								
08-12	5	78	-	-	-	-	82.0	3	2,000	1.2				
08-12	6	78	-	-	-	-								
08-12	7	76	-	-	-	-								
08-12	8	76	-	-	-	X								
08-12	9	77	-	-	-	-	82.0	3	2,000	1.2				
08-13	1	90	-	-	-	-	91.0	4	1,500	0.7				
08-13	2	88	X	-	-	-								
08-13	3	89	-	-	-	-	91.0	4	1,900	0.7				
08-13	4	90	-	-	-	-								
08-13	5	88	-	-	-	-								
08-13	6	86	X	X	-	X								
08-13	7	87	X	-	-	-	90.0	4	1,900	0.7				
08-14	1	88	-	-	-	-	89.0	2	3,200	0.7				
08-14	2	86	X	X	-	-								
08-14	3	87	X	X	-	-								
08-14	4	88	-	-	-	-								
08-14	5	87	-	-	-	-	93.0	2	3,100	0.7				
08-14	6	91	-	-	-	-								
08-14	7	89	X	-	-	-								
08-14	8	87	-	-	-	-								
08-14	9	87	X	X	-	-								
08-14	10	88	-	-	-	-	91.0	2	3,300	0.7				
08-15	1	90	X	-	-	-	93.0	4	1,800	0.5				
08-15	2	88	X	X	-	-								
08-15	3	89	X	X	-	-								
08-15	4	90	-	-	-	-	91.0	4	1,900	0.5				
08-15	5	88	-	-	-	-								
08-15	6	89	-	-	-	-	91.0	4	1,900	0.5				
08-16	1	88	-	-	-	-	90.0	3	2,800	2.1	88.0	3	2,550	5.0
08-16	2	86	-	-	-	-								
08-16	3	84	-	-	-	-								
08-16	4	82	-	-	-	-								
08-16	5	80	X	X	-	-	93.0	3	2,900	2.1	91.0	3	2,150	5.0
08-16	6	82	X	X	-	-								
08-16	7	84	X	-	-	-								
08-16	8	86	-	-	-	-								
08-16	9	85	X	X	-	-	95.0	3	2,750	2.1	93.0	3L	2,150	5.0
08-17	1	92	-	-	-	-	94.0	3	2,200	0.7				
08-17	2	92	-	-	-	-								
08-17	3	88	X	X	-	-								
08-17	4	89	X	-	-	-								
08-17	5	87	X	X	-	-	94.0	2	2,400	0.7				
08-17	6	90	X	-	-	-								
08-17	7	92	-	-	-	-								
08-17	8	91	-	-	-	-	96.0	3	2,000	0.7				
08-18	1	94	-	-	-	-	98.0	4L	1,400	3.0	97.0		1,600	8.0
08-18	2	92	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
08-18	3	90	-	-	-	-								
08-18	4	91	-	-	-	-	101.0	2	3,150	0.7	99.0		1,450	8.0
08-18	5	92	X	-	-	-								
08-18	6	94	-	-	-	-								
08-18	7	93	-	-	-	-	115.0	2	2,950	0.7	103.0		1,600	8.0
08-19	1	90	-	-	-	-	93.0	3	1,900	0.9				
08-19	2	88	-	-	-	-								
08-19	3	86	X	X	-	-								
08-19	4	87	X	X	-	X								
08-19	5	88	-	-	-	-	93.0	4	2,200	0.8				
08-19	6	90	-	-	-	-								
08-19	7	90	-	-	-	-								
08-19	8	88	-	-	-	-								
08-19	9	86	-	-	-	X								
08-19	10	87	-	-	-	-	93.0	4	2,100	0.8				
26-01	1	94	-	-	-	-	94.0	3L	1,475	1.2	94.0	3L	1,550	5.0
26-01	2	92	X	X	-	-								
26-01	3	90	X	X	-	-								
26-01	4	91	-	-	-	-								
26-01	5	94	-	-	-	-	94.0	3L	1,500	1.2	94.0	3L	1,600	5.0
26-01	6	92	-	-	-	-								
26-01	7	90	X	X	-	-								
26-01	8	91	X	X	-	-								
26-01	9	91	X	X	-	-								
26-01	10	94	-	-	-	-	94.0	3L	1,550	1.2	94.0	3L	1,650	5.0
26-02	1	90	-	-	-	-	90.0	4L	1,700	1.2	90.0	4L	1,700	4.4
26-02	2	88	X	X	-	X								
26-02	3	89	X	X	-	-								
26-02	4	90	-	-	-	-	90.0	4L	1,700	1.2	90.0	4L	1,700	4.4
26-02	5	88	X	X	-	-								
26-02	6	86	X	X	-	X								
26-02	7	87	-	-	-	X								
26-02	8	88	X	X	-	-								
26-02	9	90	-	-	-	-	90.0	4L	1,700	1.2	90.0	4L	1,725	4.4
26-03	1	90	-	-	-	-	90.0	3	1,350	0.9	90.0	3	1,250	3.0
26-03	2	88	-	-	-	-								
26-03	3	88	-	-	-	-								
26-03	4	86	X	X	-	-								
26-03	5	87	-	-	-	-								
26-03	6	90	-	-	-	-	90.0	3	1,600	0.9	90.0	3	1,400	3.0
26-03	7	88	X	X	-	-								
26-03	8	89	X	X	-	-								
26-03	9	90	-	-	-	-								
26-03	10	89	-	-	-	-	89.0	3	1,450	0.9				
26-04	1	91	-	-	-	-	91.0	4	2,425	0.3	91.0	4	2,200	4.4
26-04	2	89	-	-	-	-								
26-04	3	87	-	-	-	X								
26-04	4	88	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
26-04	5	90	-	-	-	-	90.0	4	2,000	0.3	90.0	4	1,850	4.4
26-04	6	88	-	-	-	-								
26-04	7	86	-	-	-	-								
26-04	8	87	-	-	-	-								
26-04	9	89	-	-	-	-	89.0	4	2,100	0.3	89.0	4	1,950	3.5
26-05	1	93	-	-	-	-	93.0	3U	2,200	1.2				
26-05	2	91	X	-	-	-								
26-05	3	89	-	-	-	X								
26-05	4	90	-	-	-	-								
26-05	5	90	-	-	-	-								
26-05	6	93	-	-	-	-	93.0	3U	2,150	1.2				
26-05	7	91	-	-	-	-								
26-05	8	89	X	X	-	-								
26-05	9	90	-	-	-	-								
26-05	10	93	-	-	-	-	93.0	3U	1,725	1.2				
26-06	1	93	-	-	-	-	93.0	2	2,500	1.2				
26-06	2	91	-	-	-	-								
26-06	3	89	X	-	-	-								
26-06	4	87	X	X	X	-								
26-06	5	88	X	X	-	-								
26-06	6	93	-	-	-	-	93.0	2	3,200	1.2				
26-06	7	91	-	-	-	-								
26-06	8	89	X	X	-	-								
26-06	9	90	X	X	-	-								
26-06	10	93	-	-	-	-	93.0	2	3,300	1.2	93.0	2	3,300	3.5
26-07	1	92	-	-	-	-	92.0	3	4,050	0.6				
26-07	2	90	-	-	-	-								
26-07	3	88	X	X	-	-								
26-07	4	89	X	X	-	-								
26-07	5	90	X	X	-	-								
26-07	6	93	-	-	-	-	93.0	3	3,900	0.6	93.0	3	4,100	1.5
26-07	7	91	-	-	-	-								
26-07	8	89	X	X	-	-								
26-07	9	90	X	X	-	-								
26-07	10	94	-	-	-	-	94.0	3	3,950	0.6	94.0	3	4,050	1.5
26-08	1	92	-	-	-	-	92.0	4L	1,650	1.2				
26-08	2	90	-	-	-	-								
26-08	3	90	-	-	-	-								
26-08	4	88	-	-	-	X								
26-08	5	89	-	-	-	-								
26-08	6	90	-	-	-	-								
26-08	7	95	-	-	-	-	95.0	4L	1,625	1.2	95.0	4L	1,625	3.5
26-08	8	93	-	-	-	-								
26-08	9	91	-	-	-	-								
26-08	10	89	-	-	-	-								
26-08	11	87	-	-	-	-								
26-08	12	85	-	-	-	-								
26-08	13	83	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
26-08	14	84	-	-	-	-								
26-08	15	95	-	-	-	-	95.0	4L	1,675	1.2	95.0	4L	1,600	3.5
26-09	1	82	X	X	-	-	82.0	2	2,350	1.2				
26-09	2	83	X	X	-	-								
26-09	3	84	-	-	-	-								
26-09	4	88	-	-	-	-	88.0	2	2,500	1.2				
26-09	5	86	-	-	-	-								
26-09	6	84	-	-	-	-								
26-09	7	82	-	-	-	-								
26-09	8	80	X	X	-	-								
26-09	9	81	-	-	-	-								
26-09	10	79	X	X	-	X								
26-09	11	84	-	-	-	-								
26-09	12	-	-	-	-	-	84.0	2	2,500	1.2				
26-10	1	84	-	-	-	-	84.0	3U	2,025	0.9				
26-10	2	82	-	-	-	-								
26-10	3	80	-	-	-	X								
26-10	4	81	-	-	-	-								
26-10	5	90	-	-	-	-	90.0	3U	2,300	0.9	90.0	3U	2,150	3.5
26-10	6	88	-	-	-	-								
26-10	7	86	-	-	-	-								
26-10	8	84	-	-	-	-								
26-10	9	82	-	-	-	-								
26-10	10	80	-	-	-	-								
26-10	11	78	X	X	-	-								
26-10	12	79	-	-	-	-								
26-10	13	80	-	-	-	-								
26-10	14	89	-	-	-	-	89.0	3U	2,475	0.9	89.0	3U	2,250	3.5
26-11	1	90	-	-	-	-	90.0	4	1,750	0.6	90.0	4	1,750	4.7
26-11	2	88	X	X	-	X								
26-11	3	86	X	X	-	-								
26-11	4	87	-	-	-	-								
26-11	5	90	-	-	-	-	90.0	4	1,750	0.6				
26-11	6	88	-	-	-	-								
26-11	7	86	-	-	-	-								
26-11	8	86	-	-	-	-								
26-11	9	84	-	-	-	-								
26-11	10	82	-	-	-	-								
26-11	11	80	-	-	-	-								
26-11	12	78	X	X	-	-								
26-11	13	79	-	-	-	-								
26-11	14	93	-	-	-	-	93.0	4	2,250	0.6				
26-12	1	91	-	-	-	-	91.0	4	1,700	0.3	92.0	3	3,825	1.2
26-12	2	89	-	-	-	-								
26-12	3	87	X	X	-	-								
26-12	4	88	-	-	-	-								
26-12	5	92	-	-	-	-	92.0	4	1,975		92.0	4	2,050	1.2
26-12	6	90	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
26-12	7	88	-	-	-	-								
26-12	8	86	X	X	-	-								
26-12	9	87	-	-	-	-								
26-12	10	91	-	-	-	-	91.0	4	2,075	0.3	91.0	4	2,200	1.2
26-13	1	91	-	-	-	-	91.0	4	2,350	0.3				
26-13	2	89	-	-	-	-								
26-13	3	87	X	X	-	-								
26-13	4	88	X	X	-	-								
26-13	5	92	-	-	-	-	92.0	4	2,300	0.3	92.0	4	2,375	7.4
26-13	6	90	-	-	-	-								
26-13	7	88	-	-	-	-								
26-13	8	86	X	X	-	-								
26-13	9	87	-	-	-	-								
26-13	10	91	-	-	-	-	91.0	4	2,300	0.3	91.0	4	2,500	1.8
26-14	1	83	-	-	-	-	83.0	3L	2,100	1.2	83.0	3L	2,000	4.4
26-14	2	81	-	-	-	-								
26-14	3	79	-	-	-	-								
26-14	4	77	-	-	-	X								
26-14	5	76	X	X	-	-								
26-14	6	89	-	-	-	-	89.0	3L	2,000	1.2				
26-14	7	87	-	-	-	-								
26-14	8	85	-	-	-	-								
26-14	9	83	-	-	-	-								
26-14	10	81	X	X	-	-								
26-14	11	89	-	-	-	-	89.0	3L	2,225	1.2	89.0	3L	2,350	4.4
26-15	1	86	-	-	-	-	86.0	3U	2,150	1.2	86.0	3U	2,150	9.4
26-15	2	84	-	-	-	-								
26-15	3	82	-	-	-	-								
26-15	4	80	-	-	-	-								
26-15	5	81	-	-	-	-								
26-15	6	91	-	-	-	-	91.0	3U	2,400	1.2	91.0	3U	2,250	2.1
26-15	7	89	-	-	-	-								
26-15	8	87	-	-	-	-								
26-15	9	85	-	-	-	-								
26-15	10	83	-	-	-	-								
26-15	11	81	-	-	-	-								
26-15	12	79	-	-	-	-								
26-15	13	77	-	-	-	-								
26-15	14	76	-	-	-	-								
26-15	15	93	-	-	-	-	93.0	3U	2,550	1.2	93.0	3U	2,300	2.1
28-01	1	89	-	-	-	-	89.0	3U	2,100	0.7	88.0	3L	1,200	5.0
28-01	2	87	-	-	-	-								
28-01	3	85	X	-	-	-								
28-01	4	86	X	-	-	-								
28-01	5	87	-	-	-	-								
28-01	6	1A	-	-	-	-								
28-01	7	1A	-	-	-	-								
28-01	8	1A	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
28-01	9	87	-	-	-	-	89.0	3U	2,200	0.7	89.0	3U	2,400	2.5
28-02	1	92	-	-	-	-	92.0	4	1,500	0.2	91.0	3	1,800	1.2
28-02	2	90	-	-	-	-								
28-02	3	89	X	-	-	-								
28-02	4	88	-	-	-	-								
28-02	5	86	X	X	-	-								
28-02	6	87	-	-	-	-								
28-02	7	92	-	-	-	-	92.0	4	1,400	0.5	91.0	4	1,400	1.2
28-02	8	90	-	-	-	-								
28-02	9	88	-	-	-	-								
28-02	10	87	-	-	-	-								
28-02	11	85	-	-	-	-								
28-02	12	83	X	X	-	-								
28-02	13	84	X	-	-	-								
28-02	14	85	X	-	-	-								
28-02	15	86	X	-	-	-								
28-02	16	87	-	-	-	-								
28-03	1	90	-	-	-	-	90.0	3U	2,900	0.5	87.0	2	2,500	1.5
28-03	2	98	X	-	-	-								
28-03	3	89	X	-	-	-								
28-03	4	90	X	-	-	-								
28-03	5	91	-	-	-	-								
28-03	6	91	-	-	-	-	91.0	3U	2,900	0.5	89.0	3U	2,800	1.5
28-03	7	90	X	X	-	-								
28-04	1	91	-	-	-	-	91.0	4	2,200	0.2	91.0	4	1,800	2.0
28-04	2	89	-	-	-	-								
28-04	3	89	-	-	-	-								
28-04	4	1A	-	-	-	-								
28-04	5	87	-	-	-	-								
28-04	6	85	-	-	-	-								
28-04	7	83	-	-	-	-								
28-04	8	81	-	-	-	-								
28-04	9	80	-	-	-	-								
28-04	10	1A	-	-	-	-	88.0	4	2,100	0.2	89.0	3	1,600	2.5
28-05	1	87	-	-	-	-	87.0	2	2,700	0.5	86.0	3U	2,000	2.5
28-05	2	85	-	-	-	-								
28-05	3	83	-	-	-	-								
28-05	4	83	-	-	-	-								
28-05	5	81	-	-	-	-								
28-05	6	80	-	-	-	-	87.0	2	2,700	0.2	86.0	2	2,000	1.2
28-05	7	1A	-	-	-	-								
28-05	8	1A	-	-	-	-								
28-05	9	1A	-	-	-	-								
28-05	10	80	-	-	-	-								
28-05	11	1A	-	-	-	-								
28-06	1	93	-	-	-	-	93.0	4	1,450	0.2	93.0	3	4,300	2.0
28-06	2	91	X	-	-	-								
28-06	3	92	X	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
28-06	4	93	X	-	-	-								
28-06	5	94	X	-	-	-								
28-06	6	95	-	-	-	-	93.0	3	4,300	0.2	93.0	4	1,300	1.2
28-06	7	94	-	-	-	-								
28-06	8	93	X	-	-	-								
28-06	9	1A	X	-	-	-								
28-06	10	1A	X	-	-	-								
28-07	1	87	-	-	-	-	87.0	3	2,300	0.2	92.0	4	3,700	1.5
28-07	2	85	-	-	X	X								
28-07	3	1A	-	-	-	-								
28-07	4	83	-	-	-	-								
28-07	5	81	X	-	-	-								
28-07	6	82	X	X	-	-								
28-07	7	83	-	-	-	-								
28-07	8	87	X	-	-	-	87.0	3	1,700	0.2	86.0	3	1,800	1.2
28-07	9	88	-	-	-	-								
28-07	10	87	-	-	-	-								
28-07	11	86	X	-	-	X								
28-07	12	88	-	-	-	X								
28-08	1	91	-	-	-	-	91.0	3L	2,200	1.0	89.0	3U	2,300	2.5
28-08	2	89	-	-	-	-								
28-08	3	87	-	-	-	-								
28-08	4	85	-	-	-	-								
28-08	5	83	-	-	-	-								
28-08	6	81	X	X	-	-								
28-08	7	82	X	-	-	-								
28-08	8	91	-	-	-	-	91.0	3L	2,400	1.0	89.0	3L	2,500	2.0
28-08	9	83	-	-	-	-								
28-08	10	82	X	-	-	-								
28-08	11	1A	-	-	-	-								
28-09	1	90	-	-	-	-	90.0	3	1,700	0.7	89.0	4	1,800	1.5
28-09	2	88	-	-	-	-								
28-09	3	86	X	-	-	-								
28-09	4	87	-	-	-	-								
28-09	5	1A	-	-	-	-								
28-09	6	86	X	-	-	-								
28-09	7	87	X	X	-	-								
28-09	8	88	-	-	-	-								
28-09	9	1A	-	-	-	-								
28-09	10	88	X	-	-	-	90.0	4	1,700	0.7	90.0	4	1,700	5.0
28-09	11	89	X	X	-	-								
28-09	12	90	-	-	-	-								
28-10	1	90	-	-	-	-	90.0	3U	2,200	1.2	85.0	3U	2,100	1.2
28-10	2	88	X	-	-	-								
28-10	3	89	-	-	-	-								
28-10	4	1A	X	X	-	-								
28-10	5	89	X	-	-	-								
28-10	6	90	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
28-10	7	89	X	-	-	-	91.0	3U	2,500	1.2	91.0	3U	2,500	2.2
28-10	8	90	X	-	-	-								
28-10	9	91	X	-	-	-								
28-10	10	92	-	-	-	-								
28-10	11	1A	-	-	-	-								
28-11	1	92	-	-	-	-	92.0	3	1,100	0.2	91.0	4	1,100	1.2
28-11	2	90	-	-	-	-								
28-11	3	88	-	-	-	-								
28-11	4	86	-	-	-	-								
28-11	5	85	X	X	-	-								
28-11	6	86	X	-	-	-								
28-11	7	87	-	-	-	-								
28-11	8	88	X	-	-	-	92.0	4	1,300	0.7	91.0	4	1,300	1.8
28-11	9	86	X	X	-	-								
28-11	10	87	X	-	-	-								
28-11	11	88	X	-	-	-								
28-11	12	89	-	-	-	-								
28-11	13	1A	-	-	-	-								
28-12	1	90	-	-	-	-	90.0	3	2,500	0.7				
28-12	2	88	X	X	-	-								
28-12	3	89	-	X	-	X								
28-12	4	89	X	-	-	-								
28-12	5	90	X	-	-	-								
28-12	6	92	X	-	-	-	92.0	3	2,600	0.5	89.0	3	2,500	1.5
28-12	7	93	-	-	-	-								
28-12	8	92	X	-	-	-								
28-12	9	1A	-	-	-	-								
28-12	10	1A	X	-	-	X								
28-13	1	83	-	-	-	-	83.0	4	1,300	0.5	83.0	4	1,300	1.5
28-13	2	1A	-	-	-	-								
28-13	3	81	X	-	-	-								
28-13	4	82	X	-	-	-								
28-13	5	1A	-	-	-	-								
28-13	6	81	X	-	-	-								
28-13	7	82	-	-	-	-								
28-13	8	1A	-	-	-	-								
28-13	9	6A	-	-	-	-								
28-13	10	6A	-	-	-	-								
28-13	11	6A	-	-	-	-								
28-14	1	87	-	-	-	-	87.0	2U	1,600	0.5	83.0	3U	2,000	1.5
28-14	2	85	X	X	-	X								
28-14	3	86	-	-	-	-								
28-14	4	86	X	X	-	-								
28-14	5	87	X	-	-	-								
28-14	6	88	-	-	-	-								
28-14	7	87	-	-	-	-								
28-14	8	1A	-	-	-	-	85.0	2	1,800	0.5	82.0	2	1,600	2.0
28-14	9	1A	-	-	-	-								

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WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
28-14	10	1A	-	-	-	-								
28-15	1	89	X	-	-	-	89.0	4U	2,000	1.5	88.0	4U	2,000	2.5
28-15	2	87	X	-	-	-								
28-15	3	1A	X	-	-	-								
28-15	4	88	X	-	-	-								
28-15	5	89	X	-	-	-								
28-15	6	90	X	-	-	-								
28-15	7	91	-	-	-	-								
28-15	8	1A	-	-	-	-								
28-15	9	89	-	-	-	-								
28-15	10	88	X	-	-	-								
28-15	11	1A	-	-	-	-	88.0	4U	1,800	1.5	87.0	4U	1,700	2.5
28-16	1	88	-	X	X	-	88.0	3L	2,000	0.5	86.0	3L	2,000	1.5
28-16	2	90	-	-	-	-								
28-16	3	88	-	-	-	-								
28-16	4	86	X	-	-	-								
28-16	5	84	-	-	-	-								
28-16	6	82	X	-	-	-								
28-16	7	82	-	-	-	-								
28-16	8	80	X	X	-	-								
28-16	9	81	X	-	-	-								
28-16	10	82	X	-	-	-								
28-16	11	83	X	-	-	-								
28-16	12	84	X	-	-	-								
28-16	13	85	X	-	-	-								
28-16	14	86	X	-	-	-								
28-16	15	86	-	-	-	-								
28-16	16	89	-	-	-	-	89.0	2	1,500	0.7	84.0	2	2,200	1.5
28-16	17	1A	-	-	-	-								
28-17	1	92	-	-	-	-	91.0	2	2,600	0.8	92.0	3L	2,200	6.0
28-17	2	92	-	-	-	-								
28-17	3	90	-	-	-	-								
28-17	4	88	-	-	-	-								
28-17	5	86	-	-	-	-								
28-17	6	83	X	-	-	-								
28-17	7	6A	X	-	-	-								
28-17	8	88	X	-	-	-								
28-17	9	89	-	-	-	-								
28-17	10	90	-	-	-	-	91.0	2	2,400	0.5	93.0	3L	1,600	
28-18	1	95	-	-	-	-	95.0	3	1,200	4.0	94.0	3		
28-18	2	93	-	-	-	-								
28-18	3	91	-	-	-	-								
28-18	4	91	-	-	-	-								
28-18	5	89	-	-	-	-								
28-18	6	87	X	X	-	-								
28-18	7	88	X	X	-	X								
28-18	8	89	X	-	-	-								
28-18	9	90	X	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
28-18	10	91	X	-	-	-								
28-18	11	6A	-	-	-	-	92.0	3	1,200	3.5	92.0	3	1,100	4.5
28-19	1	91	-	-	-	-	91.0	2	1,550	0.5	86.0	3U	2,400	2.0
28-19	2	89	-	-	-	-								
28-19	3	86	-	-	-	-								
28-19	4	84	-	-	-	-								
28-19	5	82	X	X	-	-								
28-19	6	6A	-	-	-	-								
28-19	7	80	-	-	-	-								
28-19	8	1A	-	-	-	-								
28-19	9	1A	-	-	-	-	89.0	2	2,600	0.5	84.0	3U	2,600	2.0
28-19	10	1A	-	-	-	-								
28-20	1	1A	-	-	-	-	90.0	3	2,100	1.0	89.0	3	2,000	2.0
28-20	2	1A	-	-	-	-								
28-20	3	87	-	-	-	-								
28-20	4	85	X	-	-	-								
28-20	5	86	X	X	-	-								
28-20	6	87	-	-	-	-								
28-20	7	87	-	-	-	-								
28-20	8	1A	-	-	-	-	90.0	2	2,100	0.5	89.0	3	2,000	1.8
28-20	9	1A	-	-	-	-								
28-20	10	86	X	-	-	-								
29-01	1	91	-	-	-	-	91.5	5	3,000	0.1	91.0	5	1,700	1.0
29-01	2	89	-	-	-	-								
29-01	3	87	-	-	-	-								
29-01	4	85	-	-	-	-								
29-01	5	85	-	-	-	-								
29-01	6	83	X	X	-	X								
29-01	7	84	-	-	-	-	90.5	5	3,300	0.1	90.0	5	1,800	1.0
29-01	8	90	-	-	-	-								
29-01	9	86	-	-	-	-								
29-01	10	86	-	-	-	-								
29-01	11	84	X	X	-	X								
29-01	12	85	X	X	-	-								
29-01	13	85	X	X	-	-								
29-01	14	85	-	-	-	-								
29-01	15	86	-	-	-	-								
29-01	16	86	-	-	-	-								
29-01	17	86	-	-	-	-	91.0	4	3,000	0.1	91.0	5	2,800	1.0
29-02	1	87	-	-	-	-	87.0	4L	2,300	1.0	82.5	3U	2,700	2.0
29-02	2	87	-	-	-	-								
29-02	3	85	-	-	-	X								
29-02	4	83	-	-	-	-								
29-02	5	83	-	-	-	-								
29-02	6	81	-	-	-	-								
29-02	7	81	X	-	-	-								
29-02	8	79	X	X	-	X								
29-02	9	80	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
29-02	10	80	-	-	-	-								
29-02	11	82	-	-	-	-	87.0	4L	2,300	1.0	83.0	3U	2,700	2.5
29-02	12	87	-	-	-	-								
29-02	13	82	-	-	-	-								
29-02	14	80	-	-	-	X								
29-02	15	78	X	X	-	-								
29-02	16	79	X	X	-	-								
29-02	17	80	-	-	-	-	89.0	3U	2,600	1.0	86.5	3U	2,700	2.0
29-03	1	92	-	-	-	-	92.0	4	2,000	1.0	92.0	4	2,000	2.0
29-03	2	92	-	-	-	-								
29-03	3	90	-	-	-	-								
29-03	4	88	-	-	-	-								
29-03	5	86	X	X	-	-								
29-03	6	86	-	-	-	-								
29-03	7	84	-	-	-	-								
29-03	8	82	X	X	-	-								
29-03	9	83	X	X	-	-	91.0	4	1,400	1.0	91.0	4	1,500	2.0
29-03	10	91	-	-	-	-								
29-03	11	91	-	-	-	-								
29-03	12	86	X	X	-	-								
29-03	13	87	-	-	-	-								
29-03	14	87	-	-	-	-								
29-03	15	87	-	-	-	-								
29-03	16	87	-	-	-	-								
29-03	17	87	-	-	-	-	92.5	4	2,000	1.0	92.0	4	2,000	2.0
29-04	1	91	-	-	-	-	91.0	3L	2,500	1.5	90.0	3L	2,200	3.5
29-04	2	91	-	-	-	-								
29-04	3	89	X	X	-	-								
29-04	4	90	-	-	-	-								
29-04	5	90	-	-	-	-	92.0	2U	2,400	1.2	91.0	3L	2,400	3.5
29-04	6	92	-	-	-	-								
29-04	7	92	-	-	-	-								
29-04	8	92	-	-	-	-								
29-04	9	90	-	-	-	-								
29-04	10	88	-	-	-	-								
29-04	11	86	-	-	-	-								
29-04	12	86	-	-	-	-								
29-04	13	84	-	-	-	-								
29-04	14	82	-	-	-	-								
29-04	15	80	-	-	-	-								
29-04	16	78	-	-	-	-								
29-04	17	78	-	-	-	-								
29-04	19	76	-	-	-	-	90.0	3U	2,700	1.6	88.0	3L	2,500	5.0
29-05	1	92	-	-	-	-	91.5	4L	1,200	1.3	89.0	4L	1,200	2.5
29-05	2	92	-	-	-	-								
29-05	3	90	-	-	-	-								
29-05	4	88	-	-	-	-								
29-05	5	86	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
29-05	6	86	-	-	-	-								
29-05	7	84	-	-	-	-								
29-05	8	84	-	-	-	-								
29-05	9	82	X	X	-	X								
29-05	10	83	-	-	-	-								
29-05	11	83	X	X	-	X								
29-05	12	91	-	-	-	-	93.0	3U	2,700	1.0	89.0	4L	1,100	2.5
29-05	13	93	-	-	-	-								
29-05	14	85	-	-	-	-								
29-05	15	83	-	-	-	-								
29-05	16	81	-	-	-	-								
29-05	17	79	X	X	-	-								
29-05	18	80	-	-	-	-								
29-05	19	80	-	-	-	-	92.5	4L	1,300	1.5	89.5	4L	1,300	2.5
29-06	1	88	-	-	-	-	87.5	2U	2,400	1.0	85.0	3U	2,700	2.0
29-06	2	86	-	-	-	-								
29-06	3	84	-	-	-	-								
29-06	4	82	-	-	-	-								
29-06	5	82	-	-	-	-								
29-06	6	80	-	-	-	-								
29-06	7	78	-	-	-	-								
29-06	8	76	-	-	-	-	87.5	3U	2,200	1.0	85.5	3U	2,700	2.5
29-06	9	87	-	-	-	-								
29-06	10	87	-	-	-	-								
29-06	11	87	-	-	-	-								
29-06	12	87	-	-	-	-								
29-06	13	76	-	-	-	-								
29-06	14	76	-	-	-	-								
29-06	16	76	-	-	-	-	92.0	3U	2,500	1.0	88.0	3U	2,500	2.0
29-07	1	96	-	-	-	-	95.0	2	1,400	0.5	95.0	5	1,600	1.5
29-07	2	94	X	X	-	-								
29-07	3	95	X	-	-	-	95.0	5	1,500	0.5	94.5	4	2,200	1.5
29-07	4	95	-	-	-	-								
29-07	12	97	-	-	-	-								
29-07	13	95	-	-	-	-								
29-07	14	93	X	X	-	-								
29-07	15	94	X	-	-	-	95.0	5	1,500	0.5	94.0	4	2,800	1.5
29-07	16	94	-	-	-	-								
29-07	17	94	-	-	-	-								
29-07	18	94	-	-	-	-								
29-08	1	96	-	-	-	-	96.0	4	3,400	0.5	96.0	4	3,200	1.5
29-08	2	94	-	-	-	-								
29-08	3	92	X	-	-	-								
29-08	4	93	X	-	-	-								
29-08	5	93	X	-	-	-								
29-08	6	90	X	X	-	-								
29-08	7	91	X	X	-	X	96.0	4	3,200	0.5	95.5	4	3,200	1.5
29-08	8	96	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
29-08	9	93	-	-	-	-								
29-08	10	93	-	-	-	-								
29-08	11	91	X	X	-	-								
29-08	12	92	X	X	-	-								
29-08	13	93	-	-	-	-								
29-08	14	93	-	-	-	-								
29-08	15	93	-	-	-	-								
29-08	16	93	-	-	-	-	96.0	4	2,400	0.5	95.0	3	2,000	1.5
29-09	1	92	-	-	-	-	92.0	3U	2,300	0.8	91.0	3U	2,300	2.0
29-09	2	90	-	-	-	-								
29-09	3	88	-	-	-	-								
29-09	4	86	-	-	-	-								
29-09	5	86	-	-	-	-								
29-09	6	84	-	-	-	-								
29-09	7	82	-	-	-	-								
29-09	8	80	-	-	-	-								
29-09	9	78	-	-	-	-								
29-09	10	78	-	-	-	-								
29-09	11	76	-	-	-	-	92.0	3L	1,600	0.8	91.0	3U	2,100	2.5
29-09	12	92	-	-	-	-								
29-09	13	76	X	X	-	-								
29-09	14	76	-	-	-	-								
29-09	15	76	-	-	-	-								
29-09	16	76	-	-	-	-	93.0	3U	2,100	0.6	93.0	3U	2,200	2.5
29-10	1	102	-	-	-	-	102.0	3L	2,000	1.4	102.0	3U	2,500	3.5
29-10	2	100	-	-	-	-								
29-10	3	98	-	-	-	-								
29-10	4	96	-	-	-	-								
29-10	5	96	-	-	-	-								
29-10	6	94	-	-	-	-								
29-10	7	92	-	-	-	-								
29-10	8	92	-	-	-	-								
29-10	9	90	-	-	-	-								
29-10	10	90	-	-	-	-								
29-10	11	90	-	-	-	-								
29-10	12	88	-	-	-	-								
29-10	13	86	-	-	-	-								
29-10	14	84	-	-	-	-								
29-10	15	82	-	-	-	-								
29-10	16	80	X	X	-	-								
29-10	17	81	X	-	-	-								
29-10	18	83	-	-	-	-	98.0	3U	2,500	1.0	98.0	3U	2,400	3.5
29-10	19	98	-	-	-	-								
29-10	20	84	-	-	-	-								
29-10	21	82	-	-	-	-								
29-10	22	80	-	-	-	-								
29-10	23	78	X	-	-	-								
29-10	24	76	X	X	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
29-10	25	77	X	-	-	-								
29-10	26	77	X	-	-	-								
29-10	27	79	-	-	-	-	96.0	3U	2,300	1.0	96.0	3U	2,500	3.5
29-11	1	92	-	-	-	-	92.5	4L	1,700	1.6	90.0	3U	2,000	4.0
29-11	2	90	-	-	-	-								
29-11	3	88	-	-	-	-								
29-11	4	86	X	X	-	X								
29-11	5	87	-	-	-	X								
29-11	6	87	-	-	-	-	92.5	2U	4,000	0.6	92.5	3U	2,400	5.0
29-11	7	92	-	-	-	-								
29-11	8	92	-	-	-	-								
29-11	9	86	-	-	-	-								
29-11	10	84	-	-	-	-								
29-11	12	80	-	-	-	-								
29-11	13	78	X	X	-	-								
29-11	14	79	-	-	-	-	92.5	2U	2,600	0.8	92.0	3L	2,000	5.0
29-12	1	93	-	-	-	-	93.0	2U	2,500	0.6	90.0	4L	1,800	2.0
29-12	2	91	-	-	-	-								
29-12	3	89	-	-	-	-								
29-12	4	87	-	-	-	-								
29-12	6	85	-	-	-	-								
29-12	7	83	X	X	-	-								
29-12	8	84	-	-	-	-								
29-12	9	88	-	-	-	-	94.0	2U	2,900	0.6	91.0	4L	2,000	2.0
29-12	10	94	-	-	-	-								
29-12	11	87	-	-	-	-								
29-12	12	85	X	X	-	-								
29-12	13	86	-	-	-	-								
29-12	14	86	-	-	-	-								
29-12	15	86	-	-	-	-								
29-12	16	86	-	-	-	-	96.5	2U	3,000	0.6	96.0	3U	2,100	2.0
40-01	1	TF	-	-	-	-	85.0	3	2,350		85.0	3	2,100	2.0
40-01	2	85	-	-	-	-								
40-01	3	83	-	-	-	-								
40-01	4	81	-	-	-	-								
40-01	5	79	-	-	-	X								
40-01	6	79	-	-	-	-								
40-01	7	79	-	-	-	-								
40-01	8	77	-	-	-	X								
40-01	9	78	-	-	-	-								
40-01	10	79	-	-	-	-								
40-01	11	TF	-	-	-	-								
40-01	12	TF	-	-	-	-								
40-01	13	TF	-	-	-	-								
40-01	14	78	-	-	-	-								
40-01	15	75	-	-	-	-								
40-01	16	76	-	-	-	-	85.0	3			84.0	3		2.0
40-02	1	TF	-	-	-	-					82.0	3		3.0

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WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
40-02	2	82	-	-	-	-								
40-02	3	80	-	-	-	-								
40-02	4	79	-	-	-	X								
40-02	5	TF	-	-	-	-								
40-02	6	TF	-	-	-	-								
40-02	7	79	-	-	-	-								
40-02	8		-	-	-	-								
40-02	9	77	-	-	-	-								
40-02	10	75	-	-	-	-								
40-02	11	82	-	-	-	-								
40-02	12	78	-	-	-	-								
40-02	13	75	-	-	-	X								
40-02	14	82	-	-	-	-								
40-02	15	75	-	-	-	-								
40-02	16	76	-	-	-	X	83.0	3	2,200		82.0	3	2,200	2.0
40-03	1	TF	-	-	-	-	87.0	3	3,700					
40-03	2	87	-	-	-	-								
40-03	3	85	-	-	-	-								
40-03	4	83	-	-	-	-								
40-03	5	81	-	-	-	-								
40-03	6	79	-	-	-	-								
40-03	7	77	X	X	-	X	82.0	2	2,200					
40-03	8	79	-	-	-	-								
40-03	9	77	-	-	-	-								
40-03	10	75	X	-	-	-								
40-03	11	77	-	-	-	-								
40-03	12	Ag	-	-	-	-	83.0	2	2,350					
40-04	1	TF	-	-	-	-	89.0	4U	1,800	2.0	87.0	4U	1,600	3.0
40-04	2	88	-	-	-	-								
40-04	3	86	X	X	-	-								
40-04	4	87	X	X	-	-	92.0	4L	1,600		91.5	4L	1,600	4.0
40-04	5	88	X	X	-	-								
40-04	6	90	-	-	-	-								
40-04	7	88	X	X	-	-								
40-04	8	89	X	X	-	-								
40-04	9	90	X	X	-	X								
40-04	10	89	X	X	-	-								
40-04	11	90	-	-	-	-								
40-04	12	Ag	-	-	-	-	92.0	4U	1,800	2.0	91.0	4L	1,800	3.0
40-05	1		-	-	-	-								
40-05	2		-	-	-	-	96.0	3U			95.0	3U		7.0
40-05	3	95	-	-	-	-								
40-05	4	93	X	-	-	-								
40-05	5	91	-	-	-	-								
40-05	6		-	-	-	-	94.0	3U			94.0	3U		7.0
40-05	7	89	-	-	-	-								
40-05	8	87	-	-	-	-								
40-05	9	85	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
40-05	10	83	X	-	-	-								
40-05	11	81	X	-	-	-								
40-05	12		-	-	-	-								
40-05	13		-	-	-	-								
40-05	14	82	X	X	-	-								
40-05	15	83	X	X	-	-								
40-05	16	84	X	X	-	-								
40-05	17		-	-	-	-								
40-05	18	86	X	X	-	-								
40-05	19	88	-	-	-	-								
40-05	20	86	X	X	-	-								
40-05	21	87	X	X	-	-								
40-05	22	88	X	X	-	-								
40-05	23	89	X	-	-	-								
40-05	24		-	-	-	-	93.0	3L			93.0	3L		3.0
40-06	1	88	-	-	-	-	88.0	2	2,400		85.0	4U	2,000	5.0
40-06	2	86	-	-	-	-								
40-06	3	84	-	-	-	-								
40-06	4	82	-	-	-	-								
40-06	5	80	-	-	-	-								
40-06	6	78	-	-	-	-								
40-06	7	75	X	X	-	-								
40-06	8	77	X	-	-	-								
40-06	9	79	-	-	-	-								
40-06	10	77	-	-	-	-								
40-06	11		-	-	-	-	87.0	2			86.0	3		2.0
40-07	1	TF	-	-	-	-	88.0	4L	1,900	1.0	86.0	4L	1,900	2.5
40-07	2	88	-	-	-	X								
40-07	3	86	-	-	-	-								
40-07	4	84	-	-	-	-								
40-07	5	82	-	-	-	-								
40-07	6	TF	-	-	-	-								
40-07	7	82	X	-	-	-								
40-07	8	83	X	-	-	-								
40-07	9	84	X	-	-	-								
40-07	10	85	-	-	-	-								
40-07	11	84	X	-	-	-								
40-07	12	83	-	-	-	-	88.0	2	2,400		85.0	4U	2,000	5.0
40-08	1	TF	-	-	-	-	90.0	4	2,300		88.0	4	2,000	
40-08	2	88	-	-	-	-								
40-08	3	88	-	-	-	-								
40-08	4	84	-	-	-	-								
40-08	5	82	-	-	-	-								
40-08	6	80	-	-	-	-								
40-08	7	78	X	-	-	-								
40-08	8	75	X	X	-	-								
40-08	9	77	X	-	-	-								
40-08	10	76	X	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
40-08	11	75	X	-	-	-								
40-08	12	Ag	-	-	-	-	89.0	2	2,100		87.0	4	2,300	2.5
40-09	1	TF	-	-	-	-	94.0	4	2,000		93.0	4	2,000	2.0
40-09	2	93	-	-	-	-								
40-09	3		-	-	-	-								
40-09	4	91	X	-	-	-								
40-09	5	89	X	-	-	-								
40-09	6	87	X	-	-	-								
40-09	7	85	X	X	-	-								
40-09	8	87	X	X	-	-								
40-09	9	89	X	-	-	-								
40-09	10	88	X	-	-	-								
40-09	11	87	X	-	-	-								
40-09	12	Ag	X	-	-	-	93.0	4	2,000		92.0	4	1,800	2.0
40-10	1	TF	-	-	-	-	88.5	2	2,000		88.5	2	2,300	8.0
40-10	2	89	-	-	-	-								
40-10	3	87	X	X	-	-								
40-10	4	88	X	-	-	-								
40-10	5	89	X	-	-	-								
40-10	6	90	X	-	-	-	88.5	2	1,750		88.5	2	2,200	5.0
40-10	7	88	-	-	-	-								
40-10	8	86	-	-	-	-								
40-10	9	84	X	X	-	-								
40-10	10	86	-	-	-	-								
40-10	11	85	-	-	-	-								
40-10	12	Ag	-	-	-	-	87.5	2	2,500		87.0	2	2,500	5.0
40-11	1	TF	-	-	-	-	94.0	2	2,250	-9.0	94.0	3	3,000	-8.0
40-11	2	94	-	-	-	-								
40-11	3	92	X	-	-	-								
40-11	4	90	X	-	-	-								
40-11	5	91	X	-	-	-								
40-11	6	TF	-	-	-	-								
40-11	7	TF	X	-	-	-	94.0	2	2,700	-9.0	94.0	3	2,600	-8.0
40-11	8	91	X	X	-	-								
40-11	9	92	X	X	-	-								
40-11	10	93	X	-	-	-								
40-11	11	94	X	-	-	-								
40-11	12	95	-	-	-	-								
40-11	13	TF	-	-	-	-								
40-11	14	94	X	-	-	-								
40-11	15	94	X	-	-	-								
40-11	16	92	X	X	-	-								
40-11	17	95	X	-	-	-								
40-11	18	96	X	-	-	-	97.0	4	2,000	-8.0	96.0	3	2,300	-6.0
40-12	1	TF	-	-	-	-	88.0	3U	2,700		87.0	3L	1,800	4.5
40-12	2	88	X	-	-	-								
40-12	3	86	X	X	-	-								
40-12	4	84	X	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
40-12	5	87	X	-	-	-								
40-12	6	88	X	-	-	-	88.0	2U	2,600		88.0	2U	2,700	1.5
40-12	7	88	-	-	-	-								
40-12	8	86	-	-	-	-								
40-12	9	84	X	-	-	-								
40-12	10	85	X	-	-	-								
40-12	11	86	X	-	-	-								
40-12	12	88	X	-	-	-								
40-12	13	88	X	-	-	-								
40-12	14	86	X	-	-	-								
40-12	15	84	X	-	-	-								
40-12	16	82	X	-	-	-								
40-12	17	83	X	-	-	-	86.0	2U	3,000		86.0	2U	2,000	2.0
41-01	1	91	-	-	-	-	94.0		2,600	1.0				
41-01	2	91	-	-	-	-								
41-01	3	91	-	-	-	-								
41-01	4	89	-	-	-	-								
41-01	5	89	-	X	-	X								
41-01	6	91	-	-	-	-								
41-01	7	90	X	X	-	X	94.0		2,500	1.0				
41-01	8	92	-	-	-	-								
41-01	9	92	-	-	-	-								
41-01	10	90	X	X	-	-								
41-01	11	91	-	-	-	-								
41-02	1	94	-	-	-	-	95.0		2,100	21.0				
41-02	2	92	-	-	-	-								
41-02	3	90	-	-	-	-								
41-02	4	88	-	-	-	-								
41-02	5	86	-	-	-	-								
41-02	6	84	X	X	-	-	95.0		2,100	1.2				
41-02	7	85	X	-	-	-								
41-02	8	86	-	-	-	-								
41-02	9	85	X	-	-	-								
41-03	1	90	-	-	-	-								
41-03	2	88	X	-	-	X								
41-03	3	88	-	-	-	-								
41-03	4	86	-	-	-	X								
41-03	5	90	-	-	-	-								
41-03	6	90	-	-	-	-								
41-03	7	88	-	-	-	-								
41-03	8	88	-	-	-	-								
41-03	9	86	-	-	-	-								
41-03	10	84	X	X	-	X	87.0	4	2,250	0.8				
41-03	11	90	-	-	-	-								
41-03	12	88	-	-	-	-								
41-03	13	86	X	X	-	X								
41-03	14	84	X	-	-	X	87.0	4	2,250	0.8				
41-03	15	88	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
41-04	1	92	-	-	-	-	97.0		1,900	1.8				
41-04	2	90	-	-	-	-								
41-04	3	88	X	X	-	-								
41-04	4	94	-	-	-	-	97.0		1,900	1.8				
41-04	5	92	-	-	-	-								
41-04	6	90	-	-	-	-								
41-04	7	88	X	X	-	-								
41-04	8	88	-	-	-	-								
41-04	9	88	X	X	-	-								
41-04	10	90	-	-	-	-								
41-05	1	87	-	-	-	-	89.0		2,250	1.0				
41-05	2	85	X	X	-	-								
41-05	3	84	X	-	-	-								
41-05	4	84	-	-	-	-								
41-05	5	84	X	-	-	-								
41-05	6	89	-	-	-	-	89.0		2,250	1.2				
41-05	7	87	-	-	-	-								
41-05	8	85	-	-	-	-								
41-05	9	84	X	X	-	-								
41-05	10	89	-	-	-	-								
41-05	11	87	-	-	-	-								
41-06	1	92	X	-	-	-								
41-06	2	98	-	-	-	-	98.0	4	2,100	1.0				
41-06	3	96	-	-	-	-								
41-06	4	94	-	-	-	-								
41-06	5	92	-	-	-	-								
41-06	6	90	X	X	-	-								
41-06	7	94	-	-	-	-	98.0	4	2,100	0.8				
41-06	8	92	-	-	-	-								
41-06	9	90	X	X	-	-								
41-06	10	91	-	-	-	-								
41-07	1	86	-	-	-	-	88.0	3	2,200	0.8				
41-07	2	84	X	X	X	-								
41-07	3	84	X	X	X	-	88.0	3	2,200	0.8				
41-07	4	90	-	-	-	-								
41-07	5	88	-	-	-	-								
41-07	6	86	-	-	-	-								
41-07	7	84	X	X	-	-								
41-07	8	86	X	X	-	-								
41-07	9	83	X	X	X	-	88.0	3	2,150	0.8				
41-07	10	88	-	-	-	-								
41-07	11	86	-	-	-	-								
41-08	1	92	-	-	-	-								
41-08	2	90	-	-	-	-	102.0		2,100	1.1				
41-08	3	95	-	-	-	-								
41-08	4	93	-	-	-	-								
41-08	5	91	-	-	-	-								
41-08	6	89	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
41-08	7	88	-	-	-	-	101.0		2,100	1.1				
41-09	1	98	-	-	-	-	100.0	3	2,250	1.0	10.0			
41-09	2	96	-	-	-	-								
41-09	3	94	-	-	-	-								
41-09	4	92	-	X	-	X								
41-09	5	98	-	-	-	-								
41-09	6	90	X	X	-	X	100.0	3	2,250	1.1				
41-09	7	100	-	-	-	-								
41-09	8	98	-	-	-	-								
41-09	9	96	-	-	-	-								
41-09	10	94	-	-	-	-								
41-09	11	92	-	-	-	-								
41-09	12	90	X	-	-	-								
41-09	13	91	-	-	-	-								
41-10	1	91	-	-	-	-	91.0		2,100	2.4				
41-10	2	91	-	-	-	-								
41-10	3	89	-	-	-	-								
41-10	4	87	-	-	-	-								
41-10	5	85	-	-	-	-								
41-10	6	83	-	-	-	-								
41-10	7	81	-	-	-	-								
41-10	8	82	X	X	-	-								
41-10	9	86	-	-	-	-	92.0		2,100	2.5				
41-10	10	86	-	-	-	-								
41-10	11	84	-	-	-	-								
41-10	12	82	X	X	-	-								
41-10	13	83	-	-	-	-								
41-11	1	91	-	-	-	-	94.0		2,100	1.0				
41-11	2	90	-	-	-	-								
41-11	3	89	X	X	-	X								
41-11	4	92	-	-	-	X	94.0		2,100	1.0				
41-11	5	92	-	-	-	-								
41-11	6	90	-	-	-	-								
41-11	7	88	-	-	-	-								
41-11	8	88	-	-	-	-								
41-11	9	86	X	X	-	-								
41-11	10	86	X	X	-	-								
41-12	1	92	-	-	-	-								
41-12	2	92	-	-	-	-								
41-12	3	90	-	-	-	-								
41-12	4	90	X	X	-	X								
41-12	5	98	-	-	-	-								
41-12	6	96	-	-	-	-								
41-12	7	94	-	-	-	-	96.0	3L	3,100	1.8				
41-12	8	92	-	-	-	-								
41-12	9	92	X	X	-	-	96.0	3L						
41-12	10	96	-	-	-	-								
41-12	11	94	-	-	-	X								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
41-12	12	96	-	-	-	-								
41-12	13	92	X	-	-	-								
41-12	14	93	-	-	-	-								
41-13	1	94	-	-	-	-								
41-13	2	92	-	-	-	X								
41-13	3	90	-	-	-	-	102.0		2,100	1.2				
41-13	4	88	-	-	-	-								
41-13	5	88	X	-	-	-								
41-13	6	88	X	X	-	X	102.0		2,100	1.0				
41-13	7	100	-	-	-	-								
41-13	8	100	-	-	-	-								
41-13	9	96	-	-	-	-								
41-13	10	94	-	-	-	-								
41-13	11	92	-	-	-	-								
41-13	12	90	-	X	-	X								
41-14	1	94	-	-	-	-								
41-14	2	94	-	-	-	-								
41-14	3	92	-	-	-	-	97.0		2,200	1.1				
41-14	4	90	-	-	-	-								
41-14	5	98	X	X	-	-								
41-14	6	86	-	-	-	-								
41-14	7	86	X	X	-	-	97.0		2,200	1.1				
41-14	8	89	-	-	-	-								
41-14	9	88	X	X	-	-								
41-14	10	89	-	-	-	-								
41-15	1	88	X	-	-	-								
41-15	2	94	-	-	-	-	94.0		2,200	1.0				
41-15	3	92	-	-	-	-								
41-15	4	90	-	-	-	-								
41-15	5	88	X	X	-	-								
41-15	6	86	X	-	-	-								
41-15	7	94	-	-	-	-								
41-15	8	92	-	-	-	-								
41-15	9	90	X	-	-	-	94.0		2,100	0.8				
41-15	10	91	-	-	-	-								
41-15	11	91	-	-	-	-								
41-15	12	90	X	X	-	-								
41-15	13	92	-	-	-	-								
41-16	1	90	-	-	-	-								
41-16	2	90	-	-	-	-								
41-16	3	90	-	-	-	-	87.0		2,600	1.2				
41-16	4	88	-	-	-	-								
41-16	5	86	-	-	-	-								
41-16	6	84	X	X	-	-	87.0		2,600	1.1				
41-16	7	90	-	-	-	-								
41-16	8	88	-	-	-	-								
41-16	9	88	-	-	-	-								
41-16	10	84	X	X	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
41-16	11	84	-	-	-	-								
41-17	1	92	-	-	-	-	91.5		2,200	1.0				
41-17	2	92	-	-	-	-								
41-17	3	90	-	-	-	-								
41-17	4	88	-	-	-	-								
41-17	5	86	X	X	-	-								
41-17	6	92	-	-	-	-								
41-17	7	92	-	-	-	-								
41-17	8	90	-	-	-	-								
41-17	9	88	X	X	-	-								
41-17	10	89	-	-	-	-	92.0		2,100	1.0				
41-17	11	70	-	-	-	-								
41-18	1	92	-	-	-	-								
41-18	2	90	X	-	-	-								
41-18	3	91	-	-	-	-								
41-18	4	91	X	-	-	-	96.0		2,200	1.0				
41-18	5	91	X	X	-	-								
41-18	6	90	X	-	-	-								
41-18	7	96	-	-	-	-								
41-18	8	94	-	-	-	-								
41-18	9	92	X	X	-	-	96.0		2,200	1.0				
41-18	10	93	-	-	-	-								
41-19	1	90	-	-	-	-	90.0	4	1,900	0.8				
41-19	2	90	-	-	-	-								
41-19	3	88	-	-	-	-								
41-19	4	86	-	-	-	-								
41-19	5	82	-	-	-	-	90.0	4	1,800	0.8				
41-19	6	86	-	-	-	-								
41-19	7	84	-	-	-	-								
41-19	8	82	X	X	-	-								
41-19	9	80	X	X	-	-								
41-19	10	83	-	-	-	-								
41-20	1	94	-	-	-	-								
41-20	2	94	-	-	-	-								
41-20	3	92	-	-	-	-	96.0	4	2,100	1.0				
41-20	4	90	X	X	-	X								
41-20	5	96	-	-	-	-								
41-20	6	94	-	-	-	-								
41-20	7	92	-	-	-	-								
41-20	8	90	X	X	-	-	96.0	4	2,100	1.0				
41-20	9	91	-	-	-	-								
41-20	10	91	-	-	-	-								
41-20	11	90	X	X	-	-								
41-20	12	92	-	-	-	-								
41-20	13	91	-	-	-	-								
46-01	1	84	-	-	-	-	84.0	3U	1,850	1.0				
46-01	2	82	-	-	-	-								
46-01	3	80	-	-	-	X								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
46-01	4	78	X	X	-	-								
46-01	5	79	-	-	-	-								
46-01	6	84	-	-	-	-								
46-01	7	82	-	-	-	X								
46-01	8	80	-	-	-	X								
46-01	9	78	X	X	-	-								
46-01	10	79	-	-	-	-								
46-03	1	87	-	-	-	-					87.0	3L	1,900	2.0
46-03	2	85	X	X	-	-								
46-03	3	86	-	-	-	-								
46-03	4	87	-	-	-	-								
46-03	5	85	X	X	-	-								
46-03	6	86	-	-	-	-								
46-05	1	93	-	-	-	-					93.0	4	2,000	1.0
46-05	2	91	X	-	-	X								
46-05	3	92	-	-	-	-								
46-05	4	93	-	-	-	-								
46-05	5	91	X	-	-	X								
46-05	6	92	-	-	-	-								
46-06	1	90	-	-	-	-					90.0	4	1,625	2.0
46-06	2	88	-	-	-	-								
46-06	3	86	X	-	-	X								
46-06	4	84	X	X	-	X								
46-06	5	85	-	-	-	-								
46-06	6	90	-	-	-	-								
46-06	7	88	X	-	-	X								
46-06	8	86	X	-	-	X								
46-06	9	84	X	X	-	X								
46-06	10	85	-	-	-	-								
46-07	1	91	-	-	-	-					91.0	2	2,900	1.0
46-07	2	89	X	-	-	-								
46-07	3	87	X	X	-	X								
46-07	4	88	-	-	-	-								
46-07	5	91	-	-	-	-								
46-07	6	89	-	-	-	-								
46-07	7	87	X	X	-	X								
46-07	8	88	-	-	-	-								
46-08	1	87	X	X	-	-					87.0	4	1,575	
46-08	2	88	X	X	-	-								
46-08	3	89	-	-	-	-								
46-08	4	87	X	-	-	-								
46-08	5	85	X	X	-	X								
46-08	6	86	-	-	-	-								
46-09	1	88	-	-	-	-					88.0	4L		2.0
46-09	2	86	X	X	-	X								
46-09	3	87	-	-	-	X								
46-09	4	88	-	-	-	-								
46-09	5	86	X	X	-	X								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
46-09	6	87	-	-	-	X								
46-10	1	85	-	-	-	-					85.0	2	2,750	1.0
46-10	2	83	X	-	-	-								
46-10	3	81	X	-	-	X								
46-10	4	79	X	X	-	X								
46-10	5	80	-	-	-	-								
46-10	6	85	-	-	-	-								
46-10	7	83	-	-	-	-								
46-10	8	81	X	X	-	X								
46-10	9	82	-	-	-	-								
46-11	1	84	X	X	-	X					84.0	3U	2,450	1.5
46-11	2	85	X	X	-	X								
46-11	3	86	X	X	-	-								
46-11	4	87	-	-	-	-								
46-11	5	84	X	X	-	X								
46-11	6	85	X	X	-	-								
46-11	7	86	X	X	-	-								
46-11	8	87	-	-	-	-								
47-01	1	99	-	-	-	-	99.0	2U	2,600		10.0			
47-01	2	97	-	-	-	-								
47-01	3	97	-	-	-	-								
47-01	4	97	-	-	-	-								
47-01	5	95	-	-	-	-								
47-01	6	95	-	-	-	-								
47-01	7	93	-	-	-	-								
47-01	8	93	-	-	-	-								
47-01	9	91	-	-	-	-								
47-01	10	87	-	-	-	-								
47-01	11	83	X	X	-	-								
47-01	12	85	-	-	-	-								
47-01	13	84	X	X	-	-								
47-01	14	85	X	X	-	-	93.0	2U	2,200		10.0			
47-01	15	86	-	-	-	-								
47-01	16	86	-	-	-	-								
47-01	17	86	-	-	-	-	95.0	2U	2,200		10.0			
47-02	1		-	-	-	-	95.0	4	900	0.2	93.0	4	1,500	1.2
47-02	2	95	-	-	-	-								
47-02	3	93	-	-	-	-								
47-02	4	89	X	-	-	-								
47-02	5	86	X	-	-	-								
47-02	6	87	-	-	-	-	96.0	4	900	0.2	93.0	4	1,300	1.2
47-02	7	85	-	-	-	-								
47-02	8	85	-	-	-	-								
47-02	9	84	X	X	-	-								
47-02	10	85	-	-	-	-								
47-02	11	85	X	-	-	-								
47-02	12	85	-	-	-	-	96.0	4	900	0.2	94.0	4	1,100	1.2
47-02	13	SS	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
47-02	14	SS	-	-	-	-								
47-03	1		-	-	-	-	89.5	4	3,500	7.0	87.0	4	2,500	5.0
47-03	2	89	-	-	-	-								
47-03	3	87	-	-	-	-								
47-03	4	85	-	-	-	-								
47-03	5	83	-	-	-	-								
47-03	6	81	-	-	-	-								
47-03	7	77	-	-	-	-								
47-03	8	76	-	-	-	-								
47-03	9	76	-	-	-	-	85.0	4	3,500	7.0	83.0	4	2,500	5.0
47-03	10	85	-	-	-	-								
47-03	11	80	-	-	-	-								
47-03	12	76	-	-	-	-								
47-03	13	76	-	-	-	-	89.0	4	2,500	7.0	87.0	4	2,500	5.0
47-04	1	103	-	-	-	-	103.0	4L	2,000	1.0	103.0	4L	2,000	2.0
47-04	2	101	-	-	-	-								
47-04	3	99	-	-	-	-								
47-04	4	97	-	-	-	-								
47-04	5	95	-	-	-	-								
47-04	6	91	-	-	-	-								
47-04	7	87	-	-	-	-								
47-04	8	83	-	-	-	-								
47-04	9	84	-	-	-	-								
47-04	10	83	-	-	-	-								
47-04	11	81	X	X	-	-								
47-04	12	82	-	-	-	-	97.0	4L	2,000	1.0	97.0	4L	2,000	2.0
47-04	13	83	-	-	-	-								
47-04	14	80	-	-	-	-								
47-04	15	76	-	-	-	-								
47-04	16	76	X	X	-	-	97.0	4L	2,000	1.0	97.0	4L	2,000	2.0
47-04	17	78	-	-	-	-								
47-04	18	77	-	-	-	-								
47-04	19	SS	-	-	-	-								
47-04	20	SS	-	-	-	-	100.0	4L	1,800	1.0	100.0	4L	1,800	2.0
47-05	1	94	-	-	-	-	94.5	2U	4,500	0.6	93.0	4L	2,000	3.0
47-05	2	90	-	-	-	-								
47-05	3	86	-	-	-	-								
47-05	4	85	X	X	-	-								
47-05	5	86	X	X	-	-								
47-05	6	87	-	-	-	-								
47-05	7	87	-	-	-	-								
47-05	8	SS	-	-	-	-								
47-05	9	SS	-	-	-	-								
47-05	10	87	-	-	-	-	94.0	2U	4,500	0.6	93.0	4L	2,000	3.0
47-05	11	86	X	X	-	-								
47-05	12		-	-	-	-	94.0	2U	4,500	0.6	93.0	4L	2,000	3.0
47-06	1	94	-	-	-	-	94.0	3U	3,200	0.5	92.0	4L	3,000	1.5
47-06	2	92	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
47-06	3	90	-	-	-	-								
47-06	4	91	-	-	-	-								
47-06	5	90	-	-	-	-								
47-06	6	88	-	-	-	-								
47-06	7	86	-	-	-	-								
47-06	8	84	-	-	-	-	89.0	3U	3,250		88.0	4L	3,000	1.5
47-06	9	85	-	-	-	-								
47-06	10	SS	-	-	-	-								
47-06	11	82	-	-	-	-								
47-06	12	80	-	-	-	-								
47-06	13	78	X	X	-	-	90.0	3U	3,250	0.5	90.0	4L	3,000	1.5
47-06	14	82	-	-	-	-								
47-06	15	81	-	-	-	-								
47-06	16	80	-	-	-	-								
47-06	17	79	-	-	-	-								
47-06	18	78	X	X	-	-								
47-07	1	95	-	-	-	-	95.0	2	4,000	0.5	98.0	3	1,750	12.5
47-07	2	91	-	-	-	-								
47-07	3	88	X	X	-	-								
47-07	4	90	-	-	-	-								
47-07	5	89	-	-	-	-								
47-07	6	88	-	-	-	-								
47-07	7	87	-	-	-	-								
47-07	8	86	-	-	-	-								
47-07	9	85	X	X	-	-								
47-07	10	86	-	-	-	-								
47-07	11	SS	-	-	-	-	94.0	2	4,000	0.5	98.0	3	1,750	12.5
47-07	12	90	-	-	-	-								
47-07	13	88	-	-	-	-								
47-07	14	86	X	X	-	-								
47-07	15	87	X	X	-	-								
47-07	16	89	-	-	-	-	94.0	2	4,750	0.5	99.0	3	2,000	12.5
47-07	17	88	-	-	-	-								
47-07	18	SS	-	-	-	-								
47-08	1	90	-	-	-	-	90.0	3L	2,750	1.8	89.0	3L	2,500	3.0
47-08	2	88	-	-	-	-								
47-08	3	82	X	X	-	-								
47-08	4	85	-	-	-	-								
47-08	5	84	-	-	-	-								
47-08	6	83	-	-	-	-								
47-08	7	82	X	X	-	-								
47-08	8	SS	-	-	-	-								
47-08	9	SS	-	-	-	-								
47-08	10	84	-	-	-	-	89.0	3L	2,750	1.8	89.0	3L	2,000	3.0
47-08	11	82	X	X	-	-								
47-08	12	82	X	X	-	-								
47-08	13	83	X	X	-	-	91.0	3L	2,750	1.8	91.0	3L	2,000	3.0
47-08	14	84	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
47-08	15	SS	-	-	-	-								
47-09	1		-	-	-	-	94.0	4	2,000	0.5	97.0	3U	2,150	3.0
47-09	2	97	X	-	-	-								
47-09	3	97	-	-	-	-								
47-09	4	98	-	-	-	-								
47-09	5	97	-	-	-	-								
47-09	6	96	X	X	-	-								
47-09	7	98	-	-	-	-								
47-09	8	97	-	-	-	-								
47-09	9	SS	-	-	-	-								
47-09	10	SS	-	-	-	-								
47-09	11	SS	-	-	-	-	95.0	4L	2,000	0.5	97.0	3U	2,150	3.0
47-09	12	98	-	-	-	-								
47-09	13	96	-	-	-	-								
47-09	14	95	-	-	-	-								
47-09	15	94	-	-	-	X								
47-09	16	93	-	-	-	-								
47-09	17	92	-	-	-	X								
47-09	18	91	X	X	-	-								
47-09	19	91	X	X	-	-	94.0	4L	2,000	0.5	96.0	3U	2,000	3.0
47-10	1	95	-	-	-	-	95.0	3L	2,000	0.8	10.0			
47-10	2	91	-	-	-	-								
47-10	3	89	-	-	-	-								
47-10	4	87	X	X	-	-								
47-10	5	88	-	-	-	-								
47-10	6	87	X	X	-	-								
47-10	7	SS	-	-	-	-								
47-10	8	SS	-	-	-	-								
47-10	9	SS	-	-	-	-								
47-10	10	SS	-	-	-	-								
47-10	11	88	-	-	-	-	95.0	3L	2,000	0.8	10.0			
47-10	12	87	X	X	-	-								
47-10	13	88	X	X	-	-	95.0	3L	2,000	0.8	10.0			
47-10	14	89	-	-	-	-								
47-10	15	SS	-	-	-	-								
47-11	1	93	-	-	-	-	93.0	3	2,800	4.5	93.0	3	2,800	
47-11	2	90	-	-	-	-								
47-11	3	86	X	X	-	-								
47-11	4	88	X	-	-	-								
47-11	5	92	-	-	-	-	92.0	3	3,000	4.5	92.0	3	2,800	
47-11	6	90	-	-	-	-								
47-11	7	89	-	-	-	-								
47-11	8	88	-	-	-	-								
47-11	9	87	X	X	-	-								
47-11	10	SS	-	-	-	-								
47-11	11	SS	-	-	-	-	92.0	3	2,800	4.5	92.0	3	2,650	
47-12	1	94	-	-	-	-	91.0	4	1,750	0.2	94.0	4	1,750	1.2
47-12	2	91	X	X	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
47-12	3	92	X	X	-	-								
47-12	4	93	-	-	-	-								
47-12	5	SS	-	-	-	-								
47-12	6	SS	-	-	-	-								
47-12	7	SS	-	-	-	-								
47-12	8	94	-	-	-	-	91.0	4	1,650	0.2	94.0	4	1,650	1.2
47-12	9	93	-	-	-	-								
47-12	10	92	-	-	-	-								
47-12	11	92	-	-	-	-								
47-12	12	91	X	X	-	-								
47-12	13	SS	-	-	-	-								
47-12	14	SS	-	-	-	-								
47-12	15	SS	-	-	-	-								
47-12	16	SS	-	-	-	-								
47-12	17	SS	-	-	-	-	92.0	4	1,850	0.2	95.0	4	1,750	1.2
47-13	1	90	-	-	-	-	89.0	3U	2,600	C.6	89.0	3L	2,500	2.2
47-13	2	87	-	-	-	-								
47-13	3	85	-	-	-	-								
47-13	4	82	X	X	-	-								
47-13	5	85	-	-	-	-	89.0	3U	2,600	0.6	89.0	3L	2,500	2.2
47-13	6	84	-	-	-	-								
47-13	7	83	X	X	-	-	88.0	3U	2,600	0.6	88.0	3L	2,600	2.2
47-13	8	87	-	-	-	-								
47-14	1	89	-	-	-	-	89.0	4L	1,750	0.7	88.5	4L	1,650	2.5
47-14	2	87	X	X	-	-								
47-14	3	88	-	-	-	-								
47-14	4	87	-	-	-	-								
47-14	5	89	-	-	-	-	89.0	4L	1,750	0.7	89.0	4L	1,600	2.5
47-14	6	87	X	X	-	-								
47-14	7	88	-	-	-	-								
47-14	8	87	-	-	-	-	90.0	4L	1,750	0.7	90.0	4L	1,620	2.5
47-14	9	87	-	-	-	-								
47-14	10	87	-	-	-	-								
47-15	1	92	-	-	-	-	92.0	2U	5,000	0.8	10.0			
47-15	2	90	-	-	-	-								
47-15	3	88	-	-	-	-								
47-15	4	86	-	-	-	-								
47-15	5	84	X	X	-	-	91.0	2U	4,500	0.8	87.0	4L	2,650	1.5
47-15	6	85	X	X	-	-								
47-15	7	88	-	-	-	-								
47-15	8	86	X	X	-	-								
47-15	9	87	X	X	-	-	91.0	2U	4,500	0.8	88.0	4L	2,650	1.5
47-16	1	103	-	-	-	-	103.0	4	1,700	1.0	103.0	4	1,500	5.0
47-16	2	98	-	-	-	-								
47-16	3	96	-	-	-	-								
47-16	4	95	-	-	-	-								
47-16	5	94	-	-	-	-								
47-16	6	92	X	X	-	-	94.0	4	1,500	1.0	94.0	4	1,500	5.0

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel RON	Customer Observations				Max-Thr. Requirement				Part-Thr. Requirement			
			Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
47-16	7	93	-	-	-	-								
47-16	8	91	-	-	-	-								
47-16	9	89	X	-	-	-								
47-16	10	90	X	X	-	-	94.0	4	1,500	1.0	94.0	4	1,500	5.0
47-16	11	92	-	-	-	-								
47-17	1	93	-	-	-	-	93.0	2U	4,500	0.8	92.0	4L	2,100	1.8
47-17	2	91	-	-	-	-	93.0	2U	4,500	0.8	92.0	4L	2,100	1.8
47-17	3	96	-	-	-	-								
47-17	4	97	-	-	-	-								
47-17	5	94	-	-	-	X								
47-17	6	89	X	X	-	X								
47-17	7	92	-	-	-	-								
47-17	8	91	-	-	-	-								
47-17	9	90	-	-	-	-								
47-17	10	88	X	X	-	X	93.0	2U	4,500	0.8	92.0	4L	2,100	1.8
47-17	11	91	-	-	-	-								
47-17	12	90	-	-	-	-								
47-17	13	89	-	-	-	-								
47-18	1	94	-	-	-	-	93.0	4	2,900	0.5	92.0	4	1,100	10.0
47-18	2	92	-	-	-	-								
47-18	3	91	-	-	-	-								
47-18	4	90	-	-	-	-								
47-18	5	89	-	-	-	-								
47-18	6	87	-	-	-	-								
47-18	7	86	X	X	-	-								
47-18	8	92	-	-	-	-	93.0	4	2,800	0.5	92.0	4	11	10.0
47-18	9	91	-	-	-	-								
47-18	10	89	-	-	-	-								
47-18	11	88	-	-	-	-								
47-18	12	86	X	X	-	-	93.0	4	2,750	0.5	92.0	4	1,100	10.0
47-19	1	94	-	-	-	-	91.0	4	2,500	0.5	94.0	4	3,000	4.0
47-19	2	92	-	-	-	-								
47-19	3	91	-	-	-	-								
47-19	4	90	-	-	-	-								
47-19	5	89	-	-	-	-								
47-19	6	87	-	-	-	-								
47-19	7	86	-	-	-	-								
47-19	8	85	X	-	-	-								
47-19	9	87	-	-	-	-								
47-19	10	87	-	-	-	-								
47-19	11	92	-	-	-	-	91.0	4	2,500	0.5	94.0	4	3,000	4.0
47-19	12	89	-	-	-	-								
47-19	13	86	X	-	-	-								
47-19	14	85	-	-	-	-								
47-19	15	84	-	-	-	-								
47-19	16	83	X	X	-	X								
47-19	17	87	-	-	-	-								
47-19	18	87	-	-	-	-								

1990 CRC CUSTOMER VERSUS RATER OCTANE NUMBER REQUIREMENT PROGRAM

WEEKLY CUSTOMER/RATER OBSERVATIONS

Obs. No.	Week	Fuel Customer Observations					Max-Thr. Requirement				Part-Thr. Requirement			
		RON	Knk	Obj	Run	Acc	RON	Gear	RPM	Vac	RON	Gear	RPM	Vac
47-19	19	87	-	-	-	-	91.0	4	2,250	0.5	94.0	4	3,000	4.0
47-20	1	97	-	-	-	-	96.5	3U	4,250	0.8	93.5	4L	2,250	2.0
47-20	2	96	-	-	-	-								
47-20	3	95	-	-	-	-								
47-20	4	94	X	-	-	-								
47-20	5	93	-	-	-	-								
47-20	6	92	-	-	-	-								
47-20	7	90	X	X	-	-								
47-20	8	91	X	X	-	-								
47-20	9	92	-	-	-	-								
47-20	10	92	-	-	-	-	97.0	3U	4,000	0.8	94.0	4L	2,250	2.0
47-20	11	95	-	-	-	-								
47-20	12	95	-	-	-	-								
47-20	13	91	-	-	-	-								
47-20	14	90	X	X	-	-	95.0	3U	4,250	0.8	93.0	4L	2,250	2.0

APPENDIX G

DISTRIBUTIONS OF OCTANE NUMBER REQUIREMENTS

TABLE G-1

DISTRIBUTION OF RATER OCTANE NUMBER REQUIREMENT
Phase I

<u>% SATISFACTION</u>	<u>(R+M) / 2</u>	<u>RON</u>	<u>MON</u>
10.0	82.8	86.1	79.4
20.0	84.2	87.8	80.6
30.0	85.3	89.1	81.3
40.0	86.1	90.2	81.9
50.0	87.0	91.3	82.7
60.0	87.9	92.3	83.5
70.0	88.6	93.2	84.1
80.0	89.7	94.4	84.9
90.0	91.4	96.4	86.4
95.0	92.7	97.9	87.5
96.0	93.5	98.7	88.2
97.0	94.5	99.9	89.1
98.0	95.1	100.6	89.6
99.0	95.8	101.4	90.3

95% CONFIDENCE LIMITS

± 50.0	± 0.5	± 0.6	± 0.4
± 90.0	± 0.7	± 0.8	± 0.6

TABLE G-2

DISTRIBUTION OF CUSTOMER OBJECTION OCTANE NUMBER REQUIREMENT
Phase I

<u>% SATISFACTION</u>	<u>(R+M) / 2</u>	<u>RON</u>	<u>MON</u>
20.0	78.9	81.5	76.3
30.0	81.0	83.9	78.1
40.0	82.4	85.6	79.2
50.0	83.2	86.6	79.8
60.0	84.0	87.5	80.4
70.0	84.7	88.4	80.9
80.0	85.8	89.8	81.7
90.0	87.3	91.7	82.9
95.0	88.3	92.8	83.8
96.0	88.5	93.1	84.0
97.0	88.9	93.5	84.3
98.0	89.3	94.0	84.6
99.0	90.4	95.3	85.6

95% CONFIDENCE LIMITS

± 50.0	± 0.5	± 0.7	± 0.4
± 90.0	± 0.7	± 0.9	± 0.5

TABLE G-3

DISTRIBUTION OF CUSTOMER PERCEPTION OCTANE NUMBER REQUIREMENT
Phase I

<u>% SATISFACTION</u>	<u>(R+M) / 2</u>	<u>RON</u>	<u>MON</u>
10.0	75.3	77.3	73.2
20.0	79.7	82.4	77.0
30.0	81.8	84.9	78.7
40.0	82.9	86.2	79.6
50.0	83.9	87.4	80.3
60.0	84.8	88.5	81.0
70.0	85.6	89.6	81.6
80.0	86.8	91.1	82.4
90.0	88.1	92.6	83.6
95.0	89.0	93.6	84.3
96.0	89.2	93.9	84.5
97.0	89.5	94.2	84.8
98.0	89.9	94.7	85.1
99.0	91.0	95.9	86.0

95% CONFIDENCE LIMITS

± 50.0	± 0.5	± 0.7	± 0.4
± 90.0	± 0.7	± 0.9	± 0.6

TABLE G-4

DISTRIBUTION OF (RATER - CUSTOMER OBJECTION) OCTANE NUMBER REQUIREMENT
Phase I

<u>Percent Cum. Frequency</u>	<u>Delta (R+M) / 2</u>	<u>Delta RON</u>	<u>Delta MON</u>
10.0	0.5	0.4	0.4
20.0	1.6	1.9	1.3
30.0	2.5	3.0	2.0
40.0	3.3	4.0	2.5
50.0	4.1	5.0	3.3
60.0	4.9	5.8	3.8
70.0	5.7	6.7	4.5
80.0	7.2	8.5	6.0
90.0	9.5	11.3	7.9
95.0	11.0	12.9	9.2
96.0	11.3	13.4	9.5
97.0	12.1	14.1	10.2
98.0	13.5	16.1	10.9
99.0	14.9	17.5	12.3

95% CONFIDENCE LIMITS

± 50.0	± 0.7	± 0.8	± 0.5
± 90.0	± 0.9	± 1.0	± 0.7

TABLE G-5

DISTRIBUTION OF (RATER - CUSTOMER PERCEPTION) OCTANE NUMBER REQUIREMENT
Phase I

Percent Cum. Frequency	Delta (R+M) / 2	Delta RON	Delta MON
10.0	-0.8	-0.7	-0.6
20.0	0.8	0.9	0.6
30.0	1.7	2.0	1.3
40.0	2.4	2.8	1.8
50.0	3.1	3.7	2.4
60.0	4.0	4.7	3.1
70.0	4.9	5.9	3.9
80.0	6.8	7.9	5.4
90.0	8.4	10.0	6.8
95.0	10.2	12.0	8.3
96.0	10.7	12.3	8.7
97.0	10.9	12.8	9.1
98.0	12.5	15.2	10.3
99.0	14.4	16.9	11.8

95% CONFIDENCE LIMITS

± 50.0	± 0.7	± 0.8	± 0.6
± 90.0	± 0.9	± 1.1	± 0.7

TABLE G-6

DISTRIBUTION OF RATER OCTANE NUMBER REQUIREMENT
Phase II

<u>% SATISFACTION</u>	<u>(R+M) / 2</u>	<u>RON</u>	<u>MON</u>
10.0	83.4	86.8	80.0
20.0	84.9	88.6	81.0
30.0	85.7	89.7	81.7
40.0	86.5	90.7	82.2
50.0	87.4	91.8	83.0
60.0	88.2	92.7	83.7
70.0	89.0	93.7	84.4
80.0	90.1	94.9	85.2
90.0	91.4	96.4	86.4
95.0	92.7	97.9	87.5
96.0	93.3	98.6	88.1
97.0	94.0	99.3	88.6
98.0	94.6	100.0	89.1
99.0	96.0	101.5	90.3

95% CONFIDENCE LIMITS

± 50.0	± 0.6	± 0.6	± 0.5
± 90.0	± 0.8	± 0.9	± 0.6

TABLE G-7

DISTRIBUTION OF CUSTOMER OBJECTION OCTANE NUMBER REQUIREMENT
Phase II

<u>% SATISFACTION</u>	<u>(R+M) / 2</u>	<u>RON</u>	<u>MON</u>
20.0	76.6	78.9	74.4
30.0	80.4	83.2	77.6
40.0	81.8	84.9	78.7
50.0	82.7	86.0	79.4
60.0	83.6	87.0	80.1
70.0	84.8	88.4	81.0
80.0	85.8	89.8	81.7
90.0	86.8	91.2	82.5
95.0	87.8	92.2	83.4
96.0	88.0	92.5	83.5
97.0	88.2	92.8	83.7
98.0	88.9	93.6	84.3
99.0	90.8	95.8	86.0

95% CONFIDENCE LIMITS

± 50.0	± 0.7	± 0.8	± 0.5
± 90.0	± 0.9	± 1.1	± 0.7

TABLE G-8

DISTRIBUTION OF CUSTOMER PERCEPTION OCTANE NUMBER REQUIREMENT
Phase II

<u>% SATISFACTION</u>	<u>(R+M) / 2</u>	<u>RON</u>	<u>MON</u>
10.0	74.8	76.9	72.8
20.0	78.5	81.0	76.0
30.0	81.5	84.6	78.5
40.0	82.5	85.7	79.2
50.0	83.3	86.7	79.9
60.0	84.2	87.7	80.5
70.0	85.3	89.1	81.4
80.0	86.1	90.3	82.0
90.0	87.3	91.6	82.9
95.0	88.2	92.7	83.7
96.0	88.4	93.0	83.9
97.0	88.9	93.6	84.3
98.0	89.8	94.6	85.0

95% CONFIDENCE LIMITS

± 50.0	± 0.6	± 0.7	± 0.4
± 90.0	± 0.8	± 1.0	± 0.6

TABLE G-9

DISTRIBUTION OF (RATER - CUSTOMER OBJECTION) OCTANE NUMBER REQUIREMENT
Phase II

Percent Cum. Frequency	Delta (R+M) / 2	Delta RON	Delta MON
10.0	1.6	1.5	1.2
20.0	2.6	3.0	2.1
30.0	3.3	3.9	2.5
40.0	3.7	4.5	2.9
50.0	4.3	5.2	3.5
60.0...	5.5	6.7	4.5
70.0	7.3	8.6	5.8
80.0	8.8	10.4	7.3
90.0	11.5	13.7	9.6
95.0	13.4	15.8	11.0
96.0	14.3	16.7	11.9
97.0	15.2	17.8	12.8
98.0	16.8	19.7	13.8
99.0	17.8	20.9	14.6

95% CONFIDENCE LIMITS

± 50.0	±1.1	±1.2	±0.8
± 90.0	±1.5	±1.6	±1.1

TABLE G-10

DISTRIBUTION OF (RATER - CUSTOMER PERCEPTION) OCTANE NUMBER REQUIREMENT
Phase II

<u>Percent Cum. Frequency</u>	<u>Delta (R+M)/2</u>	<u>Delta RON</u>	<u>Delta MON</u>
10.0	0.4	0.4	0.3
20.0	1.6	1.8	1.3
30.0	2.5	2.9	1.9
40.0	3.2	3.8	2.5
50.0	3.5	4.5	2.9
60.0	4.6	5.6	3.7
70.0	6.6	7.8	5.2
80.0	8.2	9.7	6.5
90.0	10.6	12.5	9.0
95.0	12.8	15.2	10.7
96.0	13.6	16.0	11.1
97.0	14.8	17.2	12.3
98.0	15.3	18.0	12.6
99.0	17.1	20.3	14.2

95% CONFIDENCE LIMITS

± 50.0	± 1.0	± 1.1	± 0.8
± 90.0	± 1.3	± 1.5	± 1.0