EFFECT OF THE FOURTH MILLILETER ON

GASOLINE TEL CONCENTRATIONS

Introduction

Petroleum refiners currently are licensed to use up to 3.0 millileters of tetraethyllead per gallon in automotive gasolines. Under this condition premium and regular gasolines contain 2.53 and 1.93 ml TEL per gallon, respectively. These are the national average TEL figures estimated for 1958. The "super-premium" gasolines average about 2.85 ml TEL per gallon, but they represent only 2 to 5 per cent of all gasoline sold.

Presented in this report is an estimate of what will happen to average TEL concentrations during the next five years if refiners are licensed to use up to 4 ml TEL per gallon. Five geographical regions, as well as the average United States situation, are treated separately in the analysis.

Summary

Gasoline TEL concentrations have been predicted through 1963 for two conditions - 3.0 ml TEL per gallon maximum and 4.0 ml TEL per gallon maximum. Estimates for the total United States are summarized in the following table:

	Annual Average TEL, ml/gallon					
	58	59	60	61	62	63
Total Gasoline (Pool)						
3.0 max.	2.12	2.35	2.46	2.60	2.74	2.78
4.0 max.	2.21	2.42	2.63	2.80	2.99	3.17

On a total gasoline, or pool basis, some variation in concentration occurs among the five geographical refining regions. However, these inter-regional differences are small.

Introducing the 4th milliliter of TEL will have the following effects on current and five year 'look ahead' TEL levels:

I. Current (1958) --
   1. U.S. total pool gasoline would increase 0.09 ml -- 4% higher than current predictions for 1958.
   2. The regional gasoline pool increases would range between 0.24 ml (10%) for the Western region and 0.03 ml (2%) for the Gulf Coast.

II. Five Year 'Look Ahead' (1963) --
   1. U.S. total pool gasoline would increase 0.39 ml -- 14% higher than that predicted for 1963 under 3 ml TEL restrictions.
   2. The regional gasoline pool increases would range between 0.65 ml (22%) for the Eastern region, and 0.18 ml (5%) for the Gulf Coast.

These conclusions are summarized for the total U.S. gasoline pool and the individual regional pools in Figures 1 and 2, respectively.

"Super-premium" gasolines which constitute 2 to 5% of total gasoline currently average about 2.85 ml TEL per gallon. They will probably be blended to a concentration approaching 4.0 ml TEL per gallon if the fourth milliliter is allowed.

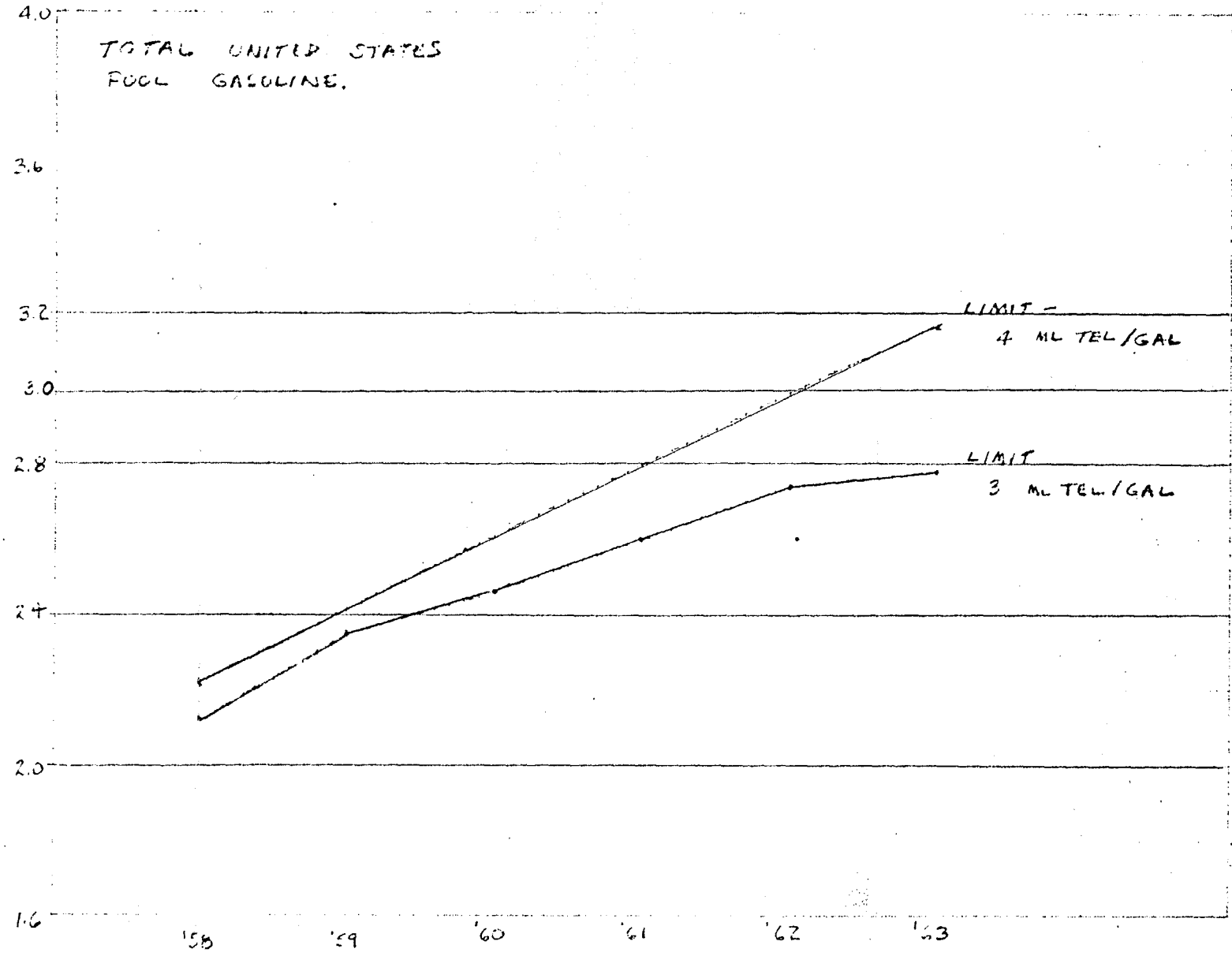

TOTAL UNITED STATES
POOL GASOLINE.
4.0
3.6
3.2
3.0
2.8
2.4
2.0
1.6
TEL - ML/GAL
LIMIT -
4 ML TEL/GAL
LIMIT
3 ML TEL/GAL
'58
'59
'60
'61
'62
'63

FIGURE 1

PLOT BY _____ DATE _____

WITNESSED BY _____ DATE _____

ETHYL CORPORATION RESEARCH LABORATORIES AT _____

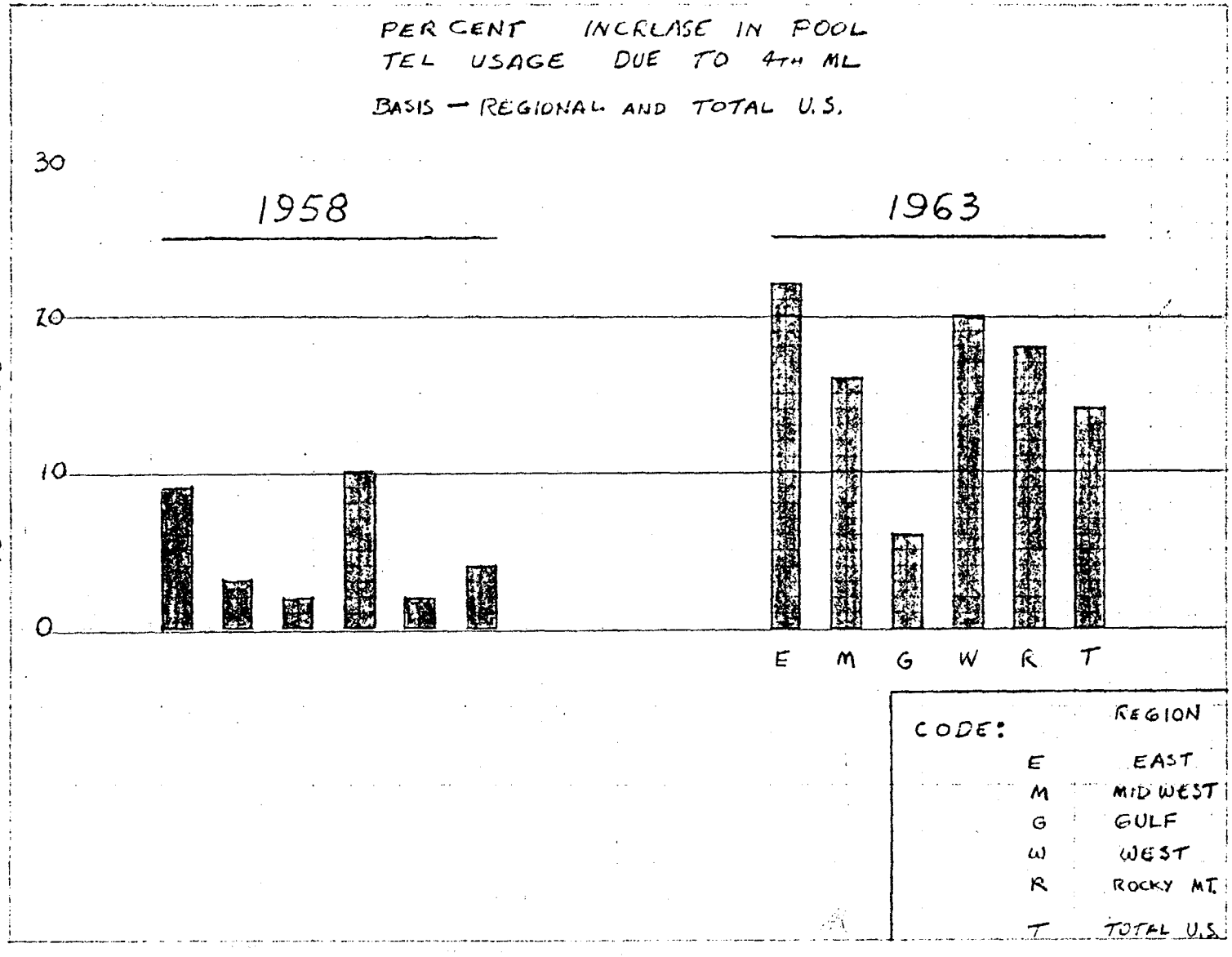


FIGURE 2.

Discussion - Basis

The documentation of the approach employed in this evaluation can be logically divided into three distinct steps:

1. Per Cent of Gasoline at Maximum TEL -- By our definition, that percentage of gasoline that has greater than 2.5 ml TEL per gallon constitutes maximum TEL. The average TEL content of this gasoline would be between 2.7 to 2.8 ml TEL per gallon. Figure 3 depicts this relationship and is based on Gasoline Testing Laboratory data.

   We have assumed that if the 4th milliliter were available to the industry, it would be employed only by that segment that is currently at the maximum TEL limit.

2. Gasoline Pool Octane Improvement Processing Costs -- Shown in Figure 4 are the estimated pool processing costs on a regional basis for 1958 and for 1963. A straight interpolation between these points gives the values for intermediate years. Basically, these costs were derived from computing octane improvement costs for catalytic reforming heavy thermal naphtha (1958 costs) and isomerization (1963 costs) for each of the regions. These processes were chosen because they can be considered almost independent of regional crude and hydrocarbon effects. They depend almost exclusively upon relative refinery costs (steam and fuel) and product costs (gasoline and butane). The 1958 octane improvement costs considered variable operating costs only (excludes labor, depreciation, labor burden and maintenance). For 1963 the octane improvement costs were on a total operating cost basis. Both the 1958 and 1963 costs were on a 0 % investment return basis.

3. Gasoline Pool Octane Improvement Costs For TEL Increase From 3 to 4 ml per gallon -- Shown in Table 4 are the regional mean TEL costs for octane improvement between 3 and 4 ml TEL per gallon. These are given for both premium and regular gasolines. They are based upon 1957 Refinery Fall Survey Data. Distribution curves of TEL costs versus per cent of regional gasoline were plotted for both premium and regular gasolines. A regional sample of 10 refineries was employed for each distribution curve. For the sake of brevity these distribution curves have not been included in this memorandum.

Discussion - Description

For a given region the pool processing costs were allocated to costs for premium and regular gasoline. Employing the corresponding regional distribution curve for 3 to 4 ml TEL (average cost), it was determined what per cent of refiners would

employ the 4th ml over processing based upon relative economics only. With the value and that corresponding to the per cent of gasoline at maximum TEL the amount of the 4th ml that is economically attractive was determined for each regional premium and regular gasoline. These values were combined in the ratio of premium to regular sales for a given region to give the regional pool value. The regional pool values were combined in proportion to regional refinery production to give the corresponding total U.S. values.

The regional and total U.S. premium, regular and pool TEL levels based on limits of 3 and 4 ml are shown in Tables 1, 2, and 3. These include values for 1958 and 1963. The effect of the 4th ml as a per cent over currently projected TEL levels for both 1958 and 1963 is also given. These values, except for correction of a 'typo' (Western Region Pool), and the figures for the Rocky Mountain region (excluded in teletype) are as given in our teletype of June 18 to Mr. Turner and Dr. Kirby.

As mentioned, our 4th milliliter analysis is based on TEL response data obtained on Fall 1957 refinery samples by regions. Yet, we have attempted to adjust base TEL levels (by regions) to the U.S. pool concentrations now anticipated for average 1958. This leads to some questions about some of the regional effects we are indicating, particularly the Gulf Coast. However, in the time available we cannot take a more rigorous approach to the analysis by regions.

TABLE 1

PREMIUM ONLY - 1958

INCREASE IN USE OF TEL WITH 4TH ML

	TEL Concentration Present Estimate	Delta ml For 4th ml	% Increase Due to 4th ml
East	2.61	.55	21
Midwest	2.65	.15	6
Gulf Coast	2.38	.08	3
West Coast	2.66	.47	18
Rocky Mt.	2.20	.10	5
All U.S.	2.53	.23	9.1

PREMIUM ONLY - 1963

	TEL Concentration Present Estimate For 1963	Delta ml For 4th ml	% Increase Over Present Estimate For 1963 Due to 4th ml
East	2.90	.92	32
Midwest	2.90	.92	32
Gulf Coast	2.90	.34	12
West Coast	2.90	.92	32
Rocky Mt.	2.90	.92	32
All U.S.	2.90	.70	24

TABLE 2

REGULAR ONLY - 1958

INCREASE IN USE OF TEL WITH 4TH ML

	TEL Concentration Present Estimate	Delta ml For 4th ml	% Increase Due to 4th ml
East	2.12	.05	2.4
Midwest	1.92	.04	2.1
Gulf Coast	1.84	.01	0.5
West Coast	1.84	.01	0.5
Rocky Mt.	1.74	.02	1.1
All U.S.	1.93	.03	1.6

REGULAR ONLY - 1963

	TEL Concentration Present Estimate For 1963	Delta ml For 4th ml	% Increase Over Present Estimate For 1963 Due to 4th ml
East	2.90	.53	18
Midwest	2.81	.28	10
Gulf Coast	2.63	.11	4
West Coast	2.63	.21	8
Rocky Mt.	2.50	.29	12
All U.S.	2.72	.24	9

TABLE 3

POOL - 1958

INCREASE IN USE OF TEL WITH 4TH ML

	TEL Concentration Present Estimate	Delta ml For 4th ml	% Increase Due to 4th ml
East	2.26	.21	9
Midwest	2.13	.07	3
Gulf Coast	2.01	.03	2
West Coast	2.25	.24	10
Rocky Mt.	1.88	.04	2
All U.S.	2.12	.09	4

POOL - 1963

	TEL Concentration Present Estimate For 1963	Delta ml For 4th ml	% Increase Over Present Estimate For 1963 Due to 4th ml
East	2.90	.65	22
Midwest	2.83	.46	16
Gulf Coast	2.72	.18	6
West Coast	2.77	.56	20
Rocky Mt.	2.62	.48	18
All U.S.	2.78	.39	14

TABLE 4

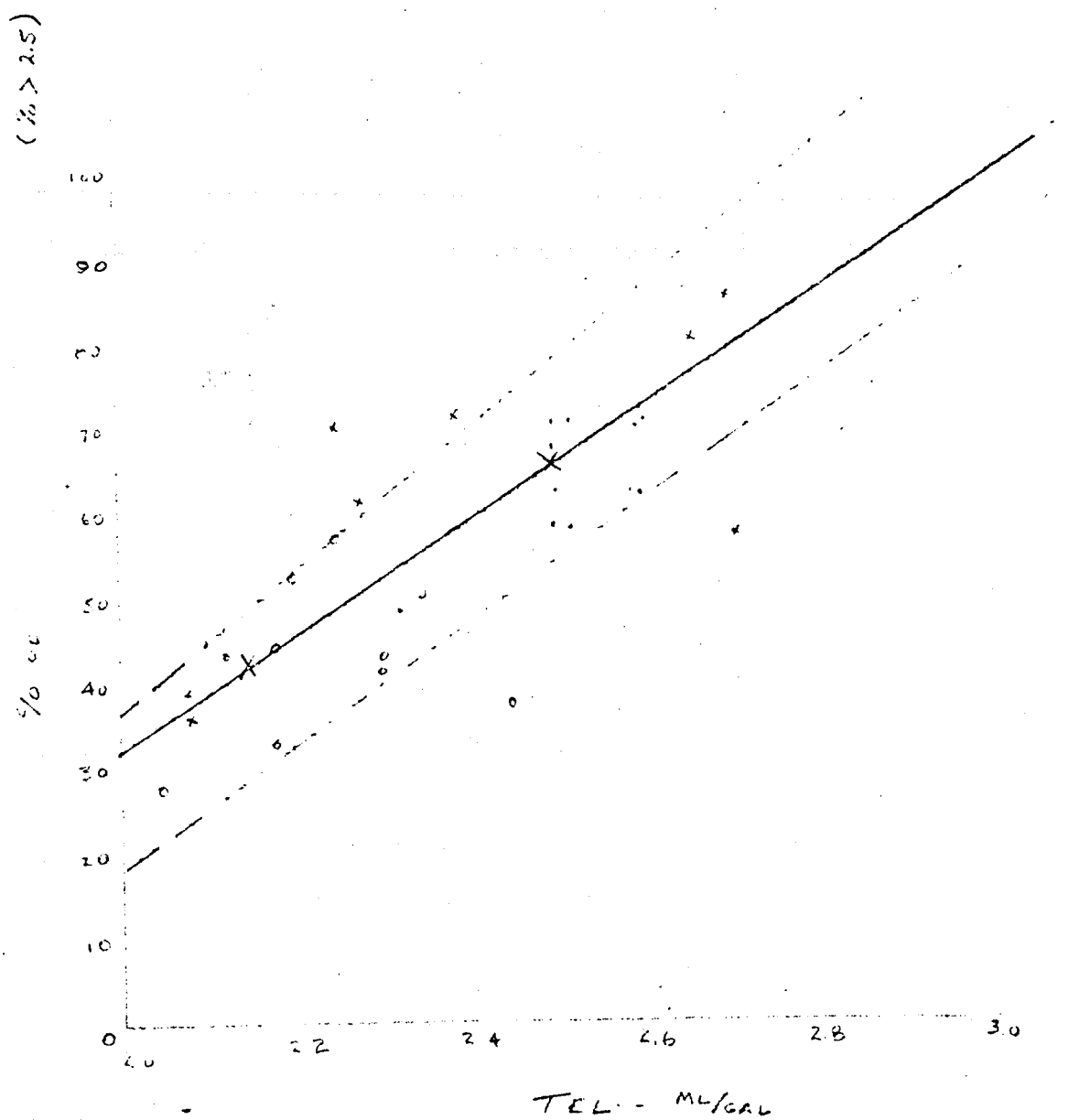
AVERAGE COST DATA - 3.0 to 4.0 ml TEL/Gallon

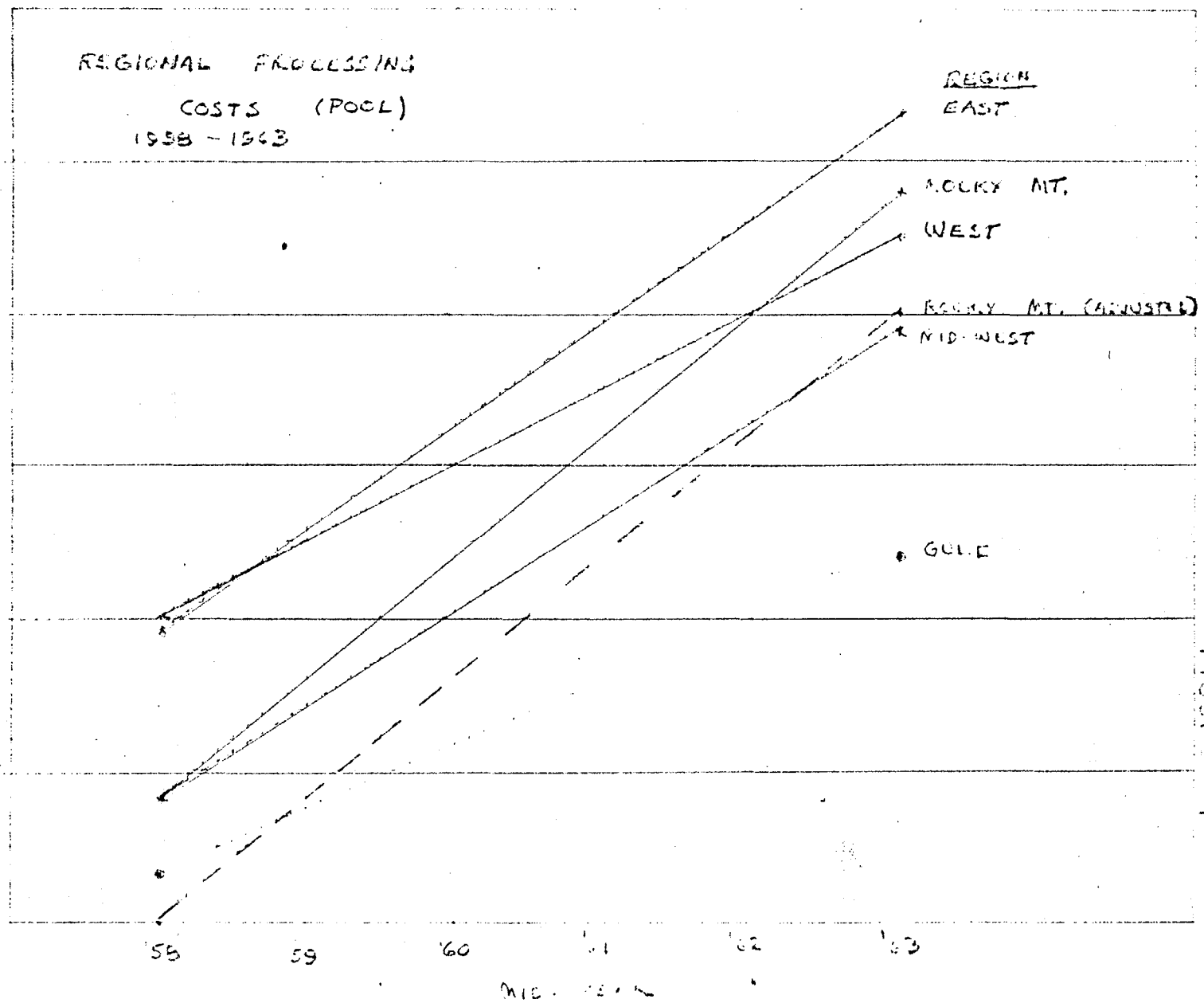
FALL SURVEY DATA - 1957

Region	Premium	Regular
East	12.5	8.3
Midwest	12.7	8.0
Gulf Coast	14.0	7.6
West Coast	12.0	6.3
Rocky Mt.	13.6	6.7
Total U.S.	13.0	7.6

FIGURE 3.

% GASOLINE GREATER THAN
2.5 ML/GAL TEL
VS.
AVERAGE TEL




REGIONAL PROCESSING
COSTS (POOL)
1958 - 1963
REGION
EAST
ROCKY MT.
WEST
ROCKY MT. (ADJUSTED)
MID-WEST
GULF
11
10
9
8
7
6
55
59
60
63