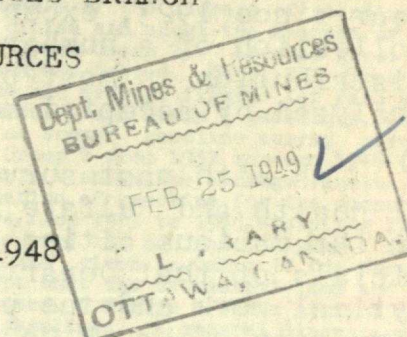


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BUREAU OF MINES
MINES, FORESTS AND SCIENTIFIC SERVICES BRANCH
DEPARTMENT OF MINES AND RESOURCES
OTTAWA, CANADA

GASOLINE SURVEY FOR SUMMER, 1948



by

P. B. Seely and F. E. Goodspeed

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Preface

The quality of the gasoline sold in Canada has been examined by the staff of the Division of Fuels of the Bureau of Mines each year since 1923, except 1940. This was done by arranging for the collection of a number of samples from the principal centres of distribution in most of the provinces, and having them carefully analyzed by accepted methods at the Fuel Research Laboratories.

As with past surveys, inspectors of the Department of National Health and Welfare cooperated in the collection of the samples in the various cities other than Ottawa, and the assistance of officials of that Department is gratefully acknowledged. The analytical work and the preparation of this report were under the supervision of Mr. H.McD. Chantler, and under the general direction of Mr. P.V. Rosewarne. Reports on the results obtained have been prepared and published from time to time and each year an effort made to increase the data and to present it in better form.

The purpose of these surveys of quality was to make available to the government and to others who might desire it, reliable information regarding the characteristics of gasoline actually sold.

In this report, the results of the analyses of sixty-one samples of gasoline, collected in July and August, 1948, are given in detail. The analyses were made according to A.S.T.M. test methods and the characteristics tested include colour, gravity, vapour pressure, volatility, per cent sulphur, corrosion tendency, gum content, amount of tetraethyl lead added, and knock-rating. The changes in average knock-ratings for the consecutive years can easily be followed on the graphs shown in the report.

The average volatility of Group I gasolines is slightly better than that of Group 2 gasolines. The average knock-rating of Group I was found to be 79 octane number, and that of Group 2 to be 75 octane number. In general, the results show that there has been no marked change in quality from the gasoline sold during the summer of 1947.

R.E. Gilmore
Chief, Division of Fuels.

GASOLINE SURVEY FOR SUMMER 1948.

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P.B. Seely and P.E. Goodspeed.

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A study of the gasoline sold in Canada during the summer has been made annually since 1923 at the Fuel Research Laboratories of the Division of Fuels, Bureau of Mines, and from the results obtained reports have been prepared and published up to and including 1947(1). From July 7 to August 7 in 1948, 61 samples of gasoline were obtained from the nine principal distributing cities in eight provinces, namely, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. These samples represent 20 brands of motor fuel sold by 14 wholesale dealers and distributors. This report contains the results of the analyses of these 61 samples of gasoline. The support and generous cooperation of the Food and Drug Laboratories of the Department of National Health and Welfare in the collection of samples are gratefully acknowledged.

The purpose of this survey is not to ascertain whether the samples of motor fuel conform with a specification, Dominion Government(2), Provincial or otherwise. It is intended as a means whereby information regarding the characteristics of gasoline actually being sold will become available. No effort, therefore, has been made to fit the results into predetermined groups; rather, it is desired that the actual analyses would define as clearly as possible the limits of the different groups of gasoline on the market. However, in this survey it was found that the groups determined by the analyses correspond to the grades which are known in the oil trade as "premium" and "regular" gasoline.

Method of Analysis

The characteristics of the gasoline were tested generally according to the latest revision of the methods(3) of testing of the American Society for Testing Materials (A.S.T.M.). The distillation range was determined according to A.S.T.M. method D 86 and was reported on the "per cent evaporated" basis. The "per cent evaporated" at any temperature is the sum of the "per cent recovered" and the distillation loss. The "per cent evaporated" temperatures were obtained from a plotted graph. The knock ratings of the gasoline are expressed in A.S.T.M. motor octane numbers and were determined by the A.S.T.M. method D 357-40. The Reid vapour pressure was determined according to A.S.T.M. method D 323. The sulphur content was determined according to A.S.T.M. method D 90-34T, except that a modified apparatus(4) was used. The gum content was determined by A.S.T.M. method D 381. When the residual material obtained by the above gum test was "oily", the gum content was determined according to the Canadian Government Specifications Board Specification No. 3-GP-0, Method 40-2(5). The difference between the amounts of gum found by these two methods was reported as "oil". The corrosion test was made according to A.S.T.M. method D 130. The specific gravity was determined by means of the hydrometer at room temperature, according to A.S.T.M. method D 287 and the result was calculated to 60°F., according to the National Standard Oil Tables(6). The equivalent gravity in degrees A.P.I. was obtained from the same tables. The apparent colour of the gasoline was observed. The tetraethyl lead content was determined according to A.S.T.M. method D 526 using the volumetric molybdate method.

Results of Laboratory Examination.

The results of the laboratory examination of the gasolines collected are shown by cities in Table I and the samples are divided into two separate groups, viz: Group 1 and Group 2 gasolines. This table gives the A.S.T.M. motor octane number, tetraethyl lead content, distillation characteristics, specific and A.P.I. gravity, Reid vapour pressure, sulphur content, and gum content of all the

samples. Averages for Group 1 and Group 2 gasolines are reported at the foot of each column in the table. Table II is a summary of the average of gasoline survey analyses by cities and shows the average of all samples in Group 1 and Group 2. It also gives the average of all samples tested. Table III gives the minimum, maximum and average figures for each characteristic of Group 1 and Group 2 gasolines. Table IV is a summary of summer gasoline survey results for Group 1 and Group 2 from 1937 through 1948 (except 1940). Table V shows the average results obtained by examination of gasoline for the summers of twenty-five years, from 1923 to 1948, excepting 1940, when a gasoline survey was not made. Figure 1 shows graphically the data given in Table IV for Group 1 gasolines, except that the tetraethyl lead and gum contents are omitted. Figure 2 shows similar data for the Group 2 gasolines. A general discussion of the significance of the laboratory tests, together with the relationship between these tests and the actual operation of the fuel in an engine will be found in the report on Gasoline Surveys for 1930 and 1931(7). Intervening changes in the significance of tests on motor fuels were discussed in the Gasoline Surveys for 1935 and 1936(8). For further information on motor fuels, a report(9) entitled The Significance of Tests of Petroleum Products, prepared by A.S.T.M. Committee D-2 of American Society for Testing Materials; the Coordinating Research Council Handbook(10), and other reports (11) (12) (13) (14) (15) should be consulted.

Knock Ratings

The knock ratings of the samples tested were determined in a Coordinating Fuel Research Engine (16) known more briefly as the "C.F.R. Engine". The A.S.T.M. motor method, D 357-40(3) was used and the results are expressed in A.S.T.M. motor octane numbers. For purposes of brevity, throughout this report A.S.T.M. motor octane number is stated simply as motor octane number or as octane number.

According to the knock rating only, the samples fall into two groups, although there is some overlapping. The range in octane number of each group was as follows:

- Group 1. Gasolines with octane numbers of 78 and above.
- Group 2. Gasolines with octane numbers between 77 and 70.

Generally speaking, the major oil companies now sell only two brands of gasoline at their service stations. The knock ratings of individual samples are given in Table I and the group in which each sample falls is shown. Of the 61 samples of gasoline collected, 25 samples were Group 1 gasoline and 36 samples were Group 2 gasoline.

Maximum and Minimum Knock Ratings

The maximum and minimum knock ratings of the samples tested are shown in Table III. The range in knock rating of the Group 1 gasolines was from a high of 82.0 to a low of 75.7 octane numbers. The corresponding range of Group 1 gasolines in 1947 was from 82.2 to 76.0 octane numbers, and in 1946 was from 81 to 75 octane numbers. For the Group 2 gasoline samples the range in knock rating was from a high of 77.8 to a low of 72.4 octane numbers in 1948. The corresponding range of Group 2 gasolines in 1947 was from 77.3 to 72.4 octane numbers, and in 1946 was from 76 to 70 octane numbers.

Change in Knock Rating

The average knock rating of the gasoline sold in Canada in eleven summers, 1937 through 1948, ex-

excepting 1940, are shown in Table IV and graphically in Figure 1 for Group 1 gasoline and in Figure 2 for Group 2 gasoline. These results indicate that by the summer of 1941, the average knock rating of Group 1 gasoline had risen to 79.0 octane number and for Group 2 gasoline it had risen to 73.6 octane number. For the years 1942 to 1945 wartime restrictions (17) applied in Canada. Therefore by the summer of 1945, the average knock rating of Group 1 motor fuel had fallen to 73.5 octane number and of Group 2 motor fuel had fallen to 68.5 octane number. After the wartime restrictions were lifted in August 1945, the average knock rating of the gasolines rose in 1946 to 77.8 for Group 1 and to 73.6 octane number for Group 2. This rise in the average knock rating of the gasolines continued in 1947, with Group 1 gasoline reaching a high of 79.2 octane number and Group 2 a high of 75.0 octane number. The average knock ratings for the gasoline tested in the summer of 1948 were 79.0 for Group 1 and 75.0 octane number for Group 2. This indicates that there was practically no change in the average knock rating of either Group 1 or Group 2 gasolines from the summer of 1947 to the summer of 1948.

The difference between the average knock rating of Group 1 and Group 2 motor fuels was 7.1 octane numbers in summer 1939, 5.4 in summer 1941 and 4.2 in both the summers of 1946 and 1947 and 4.0 octane numbers in summer 1948.

The average knock ratings of Group 1 and Group 2 motor fuels sold in the provinces of Manitoba, Saskatchewan and Alberta were about 2 octane numbers lower than for similar grades of motor fuels sold in the other provinces in the past summer.

Tetraethyl Lead Content

Tetraethyl lead is used to improve the knock rating of gasolines. The tetraethyl lead content of the individual samples and the average tetraethyl lead content of Group 1 and of Group 2 samples from each city are given in Table I and also, in Table II. As shown in Table III, the maximum tetraethyl lead content of Group 1 gasoline was 3.94 millilitres and the minimum was 1.11 millilitres per Imperial gallon. For Group 2, the maximum tetraethyl lead content was 3.02 millilitres and the minimum was 0.71 millilitres per Imperial gallon. The average tetraethyl lead content of Group 1 motor fuels was 2.80 millilitres as compared with 2.61 millilitres in summer 1947 and 2.45 millilitres per Imperial gallon in summer of 1946. In summer of 1948, the average tetraethyl lead content of Group 2 motor fuel was 1.71 millilitres as compared with 1.42 millilitres in summer 1947 and 1.40 millilitres per Imperial gallon in summer of 1946. The proportion of tetraethyl lead used in motor fuel was slightly greater in 1948 than it was in 1947.

Volatility

The volatility of the gasoline is indicated by the distillation range temperatures which are given in Tables I to V and are shown graphically in Figures 1 and 2. The distillation temperatures are reported on the "per cent evaporated" basis, as was done in the Gasoline Survey reports between 1939 and 1947, rather than on the "per cent recovered" basis, as in Gasoline Survey reports previous to 1939. It is now accepted practice in the petroleum industry to report the distillation range of motor fuels on the "per cent evaporated" basis because these temperatures indicate more correctly the actual volatility of motor fuel as it occurs in engine operation.

The average volatility of the motor fuels was practically the same in the two summers of 1947 and 1948. In 1948, Group 1 gasolines had a higher average volatility than Group 2 gasolines, as shown in

Table III. The 10, 20, 30, 50 and 70 per cent evaporated points in the distillation range of Group 1 gasolines was approximately 4°F. lower than the same points in the distillation range of Group 2 gasolines. Since 1946, the Group 1 motor fuels have been more volatile than the Group 2 motor fuels.

Vapour Pressure

The Reid vapour pressure for each of the samples tested is shown in Table I. The average Reid vapour pressure of all the gasolines tested in 1948 was 8.7 pounds per square inch. In 1947, it was 8.6 pounds and in 1946, it was 8.4 pounds. The highest Reid vapour pressure in 1948, was 11.1 pounds and the lowest was 5.1 pounds. Seven samples or 11 per cent of the samples tested had a Reid vapour pressure over 10 pounds. Six of these high vapour pressure gasolines were from the cities of Montreal and Ottawa. The average Reid vapour pressure of the Group 1 motor fuels was 8.9 pounds and for Group 2 motor fuels was 8.6 pounds. Before the war, in the summers 1937 to 1939, there was a definite trend toward higher Reid vapour pressures for the gasolines being sold. Since the war this trend toward higher vapour pressures for motor fuels is apparent again.

Sulphur

The sulphur content for each of the samples tested is shown in Table I. The average sulphur content of all of the gasolines was 0.07 per cent by weight. In the three previous summers of 1945, 1946 and 1947, the average sulphur content for the motor fuels was also 0.07 per cent. The sulphur content varied from a high of 0.15 per cent to a low of 0.01 per cent in 1948. Twelve samples, or 20 per cent of the 61 samples tested, had a sulphur content exceeding 0.10 per cent. The average sulphur content of Group 1 was 0.08 per cent and of Group 2 motor fuels was 0.06 per cent. The motor fuels sold in the Maritime Provinces of Nova Scotia and New Brunswick had a higher average sulphur content than the motor fuels sold in the other provinces of Canada.

Gum

The existent gum in the samples of gasoline was determined by the air-jet evaporation method, A.S.T.M. D 381-46(3). With this method the gum is deposited as a hard, varnish-like, or as a tacky residue. If the gasoline contains nonvolatile lubricating or solvent oil, the gum is deposited as an oily residue, because it is gum plus oil. In all cases where the gum was "oily", the gum was determined again according to the method prescribed in the Canadian Government Specifications Board Specification No. 3-GP-0 method 40-2(5) entitled, "Existent gum in presence of top cylinder lubricant". By this method the oil is extracted from the gum with A.S.T.M. precipitation naphtha(3), and the oil-free residue is reported as gum. The difference between the amount of gum determined by A.S.T.M. method D 381-46 and the amount of gum determined by method 40-2 of Specification No. 3-GP-0 is reported as oil. Therefore, in this report when the gum content is stated, it refers only to "oil-free" gum. Oil, if present, is shown in brackets in Table I. For example, "Gum 4(16)" means that the gasoline contains 4 milligrams of gum plus 16 milligrams of oil per 100 millilitres of gasoline.

The gum content for each of the samples examined is shown in Table I. The average gum content of the samples was 4 milligrams per 100 millilitres. This average does not include the abnormally high gum contents of three samples which contained 73, 49 and 47 milligrams. In the four summers of 1944 to 1947 the average gum content for the motor fuels was also 4 milligrams. It is now generally accepted (2) that not over 7 milligrams of gum should be present in

100 millilitres of motor fuel. Eleven samples, or 18 per cent of the samples tested, had a gum content exceeding 7 milligrams. Seven of these samples were Group 1 motor fuels. The average gum content for Group 1 gasolines was 5 milligrams and for Group 2 was 4 milligrams per 100 millilitres.

In 1948, as in 1947, several of the oil companies added "solvent oil" to their motor fuels as a top-cylinder lubricant. The gum residue of these samples was therefore "oily". Twenty-one samples, or 34 per cent of the motor fuels tested in 1948, contained oil. The average gum content of the above samples was 3 milligrams per 100 millilitres and the average oil content of these samples was 22 milligrams. The highest oil content was 105 milligrams and the lowest was 4 milligrams per 100 millilitres of gasoline.

Gravity

The specific gravity at 60°F., and the equivalent gravity in degrees A.P.I. at 60°F. for each sample tested, are shown in Table I. The average specific gravity of all the gasolines collected was 0.736 or 60.8 degrees A.P.I. This is equivalent to a weight of 7.36 pounds per Imperial gallon. As indicated in Table III, the overall variation in specific gravity of the gasolines was from 0.723 to 0.750, or from 64.2 to 57.2 degrees A.P.I. This is equivalent to a variation in weight of from 7.23 pounds to 7.50 pounds per Imperial gallon from summer motor fuel. The average specific gravity of Group 1 motor fuels was 0.737 or 60.5 degrees A.P.I. and for Group 2 motor fuels was 0.735 or 61.0 degrees A.P.I.

Colour

The apparent colour of the gasoline was observed in all samples but has not been reported in any of the tables. All of the samples of motor fuel in Group 1 and Group 2 were artificially coloured in 1948. Twenty-three of the 25 samples of Group 1 motor fuel were dyed red and the other two samples were dyed blue. The majority of the Group 2 motor fuels were coloured yellow or orange.

Corrosion

The corrosion test for motor fuels is made by immersing a strip of polished copper for three hours in a sample of gasoline heated to 122°F. according to A.S.T.M. method D 130-30(3). The tarnish, or corrosion that takes place is then observed and recorded. The copper strip should not show more than "extremely slight discolouration". The corrosion test was made on all the samples collected, but was not reported in any of the tables. None of the 61 samples gave a positive test for corrosion according to the above procedure.

Summary and Conclusions

This gasoline survey comprises the analyses of 61 samples of motor fuel collected for the Fuel Research Laboratories during the period from July 7th to August 7th in 1948 from nine cities in Canada. These samples represent 20 brands of motor fuel sold by 14 wholesalers and distributors. As the above samples were collected from eight provinces, namely, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia, they may be accepted as representative of the motor fuels sold in Canada during the summer of 1948. For convenience and easy reference, summaries of the data obtained are tabulated and a comparison of gasoline characteristics is shown graphically.

Only Group 1 and Group 2 gasolines were tested. Samples of Group 3 gasolines were not collected. Since the war, it has become general practice not to

sell Group 3 gasolines, except by special order, at the service stations of the major oil companies in Canada. Group 1 is usually known as premium, Group 2 as regular and Group 3 as third grade. These three groups differ principally in knock rating.

The average knock rating of Group 1 gasolines collected was 79.0 A.S.T.M. motor octane number, while in 1947 it was 79.2. The average knock rating of Group 2 gasolines in 1948 was 75.0 A.S.T.M. motor octane number, which is the same as it was in summer 1947. Thus, there was practically no change in the average knock rating of either Group 1 or Group 2 motor fuels during the summers of 1947 and 1948.

The difference between the average knock rating of Group 1 and Group 2 motor fuels in Canada in the three summers of 1946, 1947 and 1948, has remained constant at about 4 octane numbers. In the summer of 1948, the knock rating of Group 1 and Group 2 motor fuels sold in the Prairie Provinces was about 2 octane numbers lower than for similar grades of motor fuels sold in the other provinces.

The average tetraethyl lead content of the gasolines tested was 2.80 millilitres per Imperial gallon for Group 1 motor fuels and 1.71 millilitres per Imperial gallon for Group 2 motor fuels.

The average volatility of these motor fuels sold in Canada was practically the same as the average volatility of motor fuels in the summer of 1947. Group 1 gasolines had a higher average volatility than Group 2 gasolines.

The average Reid vapour pressure of the motor fuels tested was 8.7 pounds as compared with 8.6 pounds in summer 1947. Seven samples had a Reid vapour pressure over 10 pounds. The average Reid vapour pressure of the Group 1 motor fuels was 8.9 pounds and of the Group 2 motor fuels was 8.6 pounds.

The average sulphur content of the gasolines in Canada was 0.07 per cent by weight in summer 1948 and was also 0.07 per cent in the previous three summers of 1945, 1946 and 1947. The highest sulphur content was 0.15 per cent in summer 1948. The average sulphur content of the Group 1 motor fuels was 0.08 per cent and of Group 2 was 0.06 per cent. The motor fuels sold in the Eastern Maritime Provinces had a higher average sulphur content than the motor fuels in the other provinces of Canada.

The average gum content of all the gasolines was 4 milligrams per 100 millilitres of motor fuel; but this average does not include three samples with abnormally high gum content of 73, 49 and 47 milligrams. The average gum content for Group 1 gasolines was 5 milligrams, and for Group 2 gasolines was 4 milligrams. Eleven samples exceeded the usually accepted limit of 7 milligrams of gum per 100 millilitres.

Twenty-one samples, or 34 per cent of the motor fuels, contained oil. These samples gave a gum residue which was "oily". The average gum content of these samples was 3 milligrams and the average oil content was 22 milligrams per 100 millilitres of motor fuel.

The average specific gravity of the gasolines was 0.736 or 60.8 degrees A.P.I. All of the Group 1 and Group 2 motor fuels were artificially coloured. Twenty-three of the 25 samples of Group 1 motor fuels were dyed red and the other two samples were dyed blue. The majority of the Group 2 motor fuels were dyed yellow or orange.

None of the motor fuels tested in summer 1948 gave a positive test for corrosion with the copper strip.

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TABLE I
GASOLINE SURVEY ANALYSES BY CITIES FOR SUMMER 1948.

Sample No.	Group	A.S.T.M. Motor Octane No.	Tetra-ethyl Lead 1/	DISTILLATION RANGE, °F.											End Pt.	Residue %	Loss %	GRAVITY		Reid V.P. lb.	Sulphur %	Gum2/
				I. B. P.	Per Cent Evaporated								Spec-ific	Deg. A.P.I.								
					5	10	20	30	50	70	90	95										
HALIFAX, N.S.																						
1	I	77.2	3.26	109	131	146	175	200	243	288	350	381	405	1.8	1.2	0.744	58.7	8.4	0.14	73 1/2		
2	I	77.5	1.83	95	112	132	164	191	241	288	352	381	416	1.4	2.1	0.741	59.5	10.2	0.15	10(10)		
Average		77.4	2.55	102	121	139	169	195	242	288	351	381	410	1.6	1.6	0.742	59.2	9.3	0.15	10		
3	II	74.4	2.28	96	118	137	170	202	258	306	361	381	424	1.2	1.8	0.744	58.7	8.5	0.14	11		
4	II	74.3	0.71	100	118	134	163	192	247	294	352	378	410	1.2	1.8	0.741	59.5	8.8	0.11	24		
5	II	74.8	1.17	101	124	140	166	190	239	290	346	367	394	1.5	1.5	0.737	60.5	8.4	0.06	1(4)		
Average		74.5	1.39	99	120	137	166	195	248	297	353	375	409	1.3	1.7	0.741	59.5	8.6	0.10	12		
SAINT JOHN, N.B.																						
6	I	77.5	2.91	112	140	159	183	206	251	289	350	376	416	1.2	1.8	0.750	57.2	5.1	0.12	49 3/4		
7	I	79.2	3.59	99	118	134	162	194	244	290	348	377	409	1.3	1.7	0.736	60.8	9.1	0.09	2		
Average		78.4	3.25	105	129	146	172	200	247	289	349	376	412	1.3	1.7	0.743	58.9	7.1	0.11	2		
8	II	77.8	2.03	110	142	159	184	204	234	265	318	356	404	1.1	0.9	0.737	60.5	7.5	0.01	1		
9	II	73.7	1.00	100	123	139	163	189	239	288	344	367	402	1.4	1.6	0.736	60.8	7.5	0.06	4(16)		
10	II	74.8	1.66	110	132	145	170	197	245	291	345	367	394	1.4	0.6	0.735	61.0	7.5	0.05	7		
Average		75.4	1.56	107	132	148	172	197	239	281	336	363	400	1.3	1.0	0.736	60.8	7.5	0.04	4		
MONTREAL, QUE.																						
11	I	80.2	1.54	105	122	137	161	188	236	288	347	376	399	1.3	2.2	0.740	59.7	8.6	0.02	1		
12	I	79.6	3.72	102	121	137	166	192	236	273	331	360	399	1.5	2.0	0.730	62.3	9.6	0.10	1(12)		
13	I	80.2	3.67	104	127	143	168	190	232	272	334	364	395	1.5	2.0	0.738	60.2	11.1	0.08	2		
Average		80.0	2.98	104	123	139	165	190	235	278	337	367	398	1.4	2.1	0.736	60.8	9.8	0.07	1		
14	II	75.4	2.05	104	120	137	167	194	241	282	330	356	380	1.3	3.2	0.734	61.3	10.1	0.06	2		
15	II	74.8	2.00	100	116	134	161	190	236	276	338	372	398	1.6	2.9	0.729	62.6	9.6	0.06	1(35)		
16	II	76.2	2.05	104	118	134	164	193	244	286	348	373	403	1.2	2.8	0.745	58.4	9.0	0.12	1		
17	II	76.7	2.36	92	110	129	162	195	241	278	328	357	379	1.1	2.9	0.732	61.8	11.1	0.04	6		
18	II	75.5	2.32	102	124	138	167	194	237	278	333	368	408	1.6	1.4	0.731	62.1	9.4	0.07	1(28)		
Average		75.7	2.16	100	118	134	164	193	240	280	335	365	394	1.4	2.6	0.734	61.3	9.8	0.07	2		
OTTAWA, ONT.																						
19	I	79.2	3.47	96	114	128	157	186	232	272	326	352	386	1.3	2.2	0.733	61.5	9.7	0.07	7		
20	I	79.4	3.57	104	124	140	168	195	241	278	328	353	395	1.6	1.4	0.735	61.0	9.2	0.11	6(60)		
21	I	80.2	3.38	99	112	128	155	184	231	275	329	354	398	1.6	2.4	0.730	62.3	10.6	0.12	6		
22	I	79.6	3.80	102	130	146	172	193	232	266	320	356	393	1.4	1.4	0.739	60.0	7.7	0.13	26		
23	I	79.0	3.10	94	108	124	144	165	209	256	319	352	394	1.2	2.8	0.723	64.2	10.3	0.09	11(105)		
24	I	80.0	1.23	104	116	136	166	190	232	272	349	382	420	1.2	2.3	0.742	59.2	8.8	0.01	2		
25	I	80.2	3.47	94	110	125	152	181	229	270	325	354	403	1.4	3.6	0.728	62.9	10.7	0.11	7(24)		
Average		79.7	3.15	99	116	132	159	185	229	270	328	358	398	1.4	2.3	0.733	61.5	9.6	0.09	9		
26	II	74.8	1.57	103	116	130	161	189	234	274	328	352	394	1.3	2.7	0.733	61.5	9.3	0.04	6		
27	II	75.0	1.59	106	122	137	162	186	229	265	316	336	382	1.6	2.4	0.728	62.9	9.7	0.05	47 1/2		
28	II	75.5	1.76	97	124	141	167	190	232	267	312	340	376	1.6	1.8	0.730	62.3	9.1	0.04	4		
29	II	75.0	1.14	104	126	143	168	192	233	271	322	352	396	1.2	2.3	0.738	60.2	8.7	0.12	3		
30	II	76.6	2.65	108	129	148	179	209	252	287	334	355	386	1.2	1.8	0.740	59.7	8.5	0.10	4		
31	II	76.7	1.77	102	120	137	164	188	230	264	312	340	388	1.2	2.3	0.728	62.9	9.6	0.03	4		
Average		75.6	1.75	103	123	139	167	192	235	271	321	346	387	1.4	2.2	0.733	61.5	9.1	0.06	4		

1/ Millilitres per Imperial gallon.

2/ Milligrams per 100 millilitres. The number of milligrams of oil, if present, is shown in brackets.

3/ Not included in average.

TABLE I (Continued)
GASOLINE SURVEY ANALYSES BY CITIES FOR SUMMER 1948.

Sam- ple No.	Group	A.S.T.M. Motor Octane No.	Tetra- ethyl Lead 1/	DISTILLATION RANGE, °F.										End Pt.	Res- idue %	Loss %	GRAVITY		Reid V.P. lb.	Sul- phur %	Gum 2/
				I. B. P.	Per Cent Evaporated								Spec- ific				Deg. A.P.I.				
					5	10	20	30	50	70	90	95									
TORONTO, ONT.																					
32	I	77.2	1.89	100	117	132	159	185	232	280	348	371	396	1.2	2.8	0.740	59.7	9.4	0.07	11	
33	I	79.7	3.93	109	131	145	169	190	230	271	327	354	389	1.4	1.6	0.733	61.5	8.0	0.04	2	
34	I	80.8	1.11	102	120	136	164	188	230	272	348	382	418	1.3	2.7	0.741	59.5	8.8	0.02	1	
Average		79.2	2.31	104	123	138	164	188	231	274	341	369	401	1.3	2.4	0.738	60.2	8.7	0.04	5	
35	II	75.5	1.65	100	127	141	165	187	232	278	341	364	386	1.0	0.5	0.732	61.8	7.6	0.02	3	
36	II	74.5	1.01	103	120	136	163	193	246	278	313	330	382	1.3	2.7	0.734	61.3	9.4	0.07	2	
37	II	74.8	0.96	100	119	137	164	189	231	276	340	368	402	1.4	2.1	0.737	60.5	8.8	0.04	1(7)	
38	II	74.7	1.22	101	126	141	169	192	232	272	328	354	388	1.2	1.8	0.733	61.5	8.3	0.05	1	
39	II	76.0	2.52	100	114	141	178	208	252	288	334	353	381	1.0	2.0	0.742	59.2	7.9	0.07	8	
Average		75.1	1.47	101	121	139	168	194	239	278	331	354	388	1.2	1.8	0.736	60.8	8.4	0.05	3	
WINNIPEG, MAN.																					
40	I	78.2	2.67	100	121	136	167	196	244	288	344	368	395	1.0	2.0	0.741	59.5	9.1	0.06	4	
41	I	76.3	1.86	106	126	140	164	189	232	278	340	368	398	1.6	1.4	0.740	59.7	8.5	0.06	6(25)	
Average		77.3	2.27	103	123	138	165	192	238	283	342	368	396	1.3	1.7	0.740	59.7	8.8	0.06	5	
42	II	74.9	1.32	100	120	134	164	187	233	272	329	352	380	1.0	3.0	0.732	61.8	10.0	0.04	1	
43	II	74.2	1.18	98	118	136	163	185	231	274	338	364	400	1.2	1.8	0.734	61.3	8.7	0.04	1(29)	
44	II	74.2	1.24	109	130	145	168	191	228	269	326	352	391	1.4	1.6	0.732	61.8	7.6	0.05	2(17)	
45	II	73.4	2.36	108	129	146	172	194	239	284	336	359	384	1.2	1.3	0.727	63.1	7.8	0.05	5	
Average		74.2	1.53	104	124	140	167	189	233	275	332	357	389	1.2	1.9	0.731	62.1	8.5	0.05	2	
REGINA, SASK.																					
46	I	76.8	2.97	100	114	137	178	210	259	300	344	372	394	1.3	2.2	0.741	59.5	8.5	0.08	1	
47	I	75.7	1.88	100	118	136	164	190	242	285	339	367	408	1.2	1.3	0.733	61.5	9.0	0.06	2(6)	
Average		76.3	2.43	100	116	136	171	200	250	292	341	369	401	1.2	1.8	0.737	60.5	8.7	0.07	2	
48	II	73.4	1.61	106	120	134	164	193	244	284	341	370	402	1.5	2.5	0.733	61.5	8.9	0.06	2(5)	
49	II	74.5	1.24	104	123	140	165	188	226	266	324	351	385	1.2	1.8	0.732	61.8	7.2	0.06	3	
50	II	73.6	1.45	106	122	137	166	194	242	285	338	363	406	1.2	2.3	0.732	61.8	9.0	0.04	3(25)	
Average		73.8	1.43	105	122	137	165	192	237	278	334	361	398	1.3	2.2	0.732	61.8	8.4	0.05	3	
EDMONTON, ALTA.																					
51	I	77.4	3.94	106	135	152	176	199	244	289	352	376	406	1.2	0.8	0.739	60.0	6.9	0.06	13	
52	I	80.8	2.62	105	125	140	160	178	213	245	306	336	393	1.3	2.2	0.734	61.3	7.5	0.07	1(11)	
Average		79.1	3.28	105	130	146	168	188	228	267	329	356	399	1.2	1.5	0.736	60.8	7.2	0.07	7	
53	II	72.4	1.96	112	134	152	177	201	245	289	348	367	398	1.2	1.8	0.737	60.5	5.9	0.04	1(12)	
54	II	72.7	1.99	110	130	145	173	203	244	291	351	373	400	1.2	1.6	0.740	59.7	5.9	0.05	5	
55	II	74.6	1.20	102	120	135	160	187	236	280	336	356	381	1.2	1.8	0.733	61.5	8.8	0.01	2(7)	
Average		73.2	1.72	108	128	144	170	197	242	287	345	365	393	1.2	1.7	0.737	60.5	6.9	0.03	3	
VANCOUVER, B.C.																					
56	I	81.1	2.65	102	122	136	159	179	216	250	312	348	398	1.4	2.6	0.733	61.5	8.3	0.08	1(13)	
57	I	82.0	1.87	106	120	133	155	176	223	265	326	356	386	1.3	1.2	0.735	61.0	8.4	0.03	2	
Average		81.6	2.26	104	121	134	157	177	219	257	319	352	392	1.3	1.9	0.734	61.3	8.3	0.06	2	
58	II	76.3	2.12	105	128	148	178	209	246	279	326	351	384	1.3	2.2	0.741	59.5	8.4	0.10	4	
59	II	77.1	1.92	103	123	139	165	190	232	268	323	354	390	1.4	1.6	0.733	61.5	9.4	0.08	1(13)	
60	II	76.3	1.65	101	124	142	172	200	248	290	358	384	401	1.2	1.8	0.744	58.7	7.7	0.11	2	
61	II	76.5	3.02	102	131	150	182	207	245	284	327	349	384	1.2	1.8	0.742	59.2	8.5	0.08	1	
Average		76.6	2.18	103	126	145	174	201	243	280	333	359	390	1.3	1.8	0.740	59.7	8.5	0.09	2	

1/ Millilitres per Imperial gallon.

2/ Milligrams per 100 millilitres. The number of milligrams of oil, if present, is shown in brackets.

TABLE II

AVERAGE OF GASOLINE SURVEY ANALYSES BY CITIES FOR SUMMER 1948.

CITY	No. of Samples	Group	A.S.T.M. Motor Octane No.	Tetra- ethyl Lead*	DISTILLATION RANGE, °F.							End Pt.	Res- idue %	Loss %	Gravity at 60°F.		Reid V.P. lb.	Sul- phur %	Gum**				
					I. B. P.	Per Cent Evaporated					10				20	50				70	90	Spec- ific	Deg. A.P.I.
Halifax, N.S....	2	I	77.4	2.55	102	139	169	242	288	351	410	1.6	1.6	0.742	59.2	9.3	0.15	10					
Saint John, N.B.	2	I	78.4	3.25	105	146	172	247	289	349	412	1.3	1.7	0.743	58.9	7.1	0.11	2					
Montreal, Que...	3	I	80.0	2.98	104	139	165	235	278	337	398	1.4	2.1	0.736	60.8	9.8	0.07	1					
Ottawa, Ont.....	7	I	79.7	3.15	99	132	159	229	270	328	398	1.4	2.3	0.733	61.5	9.6	0.09	9					
Toronto, Ont.....	3	I	79.2	2.31	104	138	164	231	274	341	401	1.3	2.4	0.738	60.2	8.7	0.04	5					
Winnipeg, Man...	2	I	77.3	2.27	103	138	165	238	283	342	396	1.3	1.7	0.740	59.7	8.8	0.06	5					
Regina, Sask....	2	I	76.3	2.43	100	136	171	250	292	341	401	1.2	1.8	0.737	60.5	8.7	0.07	2					
Edmonton, Alta..	2	I	79.1	3.28	105	146	168	228	267	329	399	1.2	1.5	0.736	60.8	7.2	0.07	7					
Vancouver, B.C..	2	I	81.6	2.26	104	134	157	219	257	319	392	1.3	1.9	0.734	61.3	8.3	0.06	2					
(7) Average Group I (25)			79.0	2.80	102	138	164	234	276	336	400	1.4	2.0	0.737	60.5	8.9	0.08	5					
Halifax, N.S....	3	II	74.5	1.39	99	137	166	248	297	353	409	1.3	1.7	0.741	59.5	8.6	0.10	12					
Saint John, N.B.	3	II	75.4	1.56	107	148	172	239	281	336	400	1.3	1.0	0.736	60.8	7.5	0.04	4					
Montreal, Que...	5	II	75.7	2.16	100	134	164	240	280	335	394	1.4	2.6	0.734	61.3	9.8	0.07	2					
Ottawa, Ont.....	6	II	75.6	1.75	103	139	167	235	271	321	387	1.4	2.2	0.733	61.5	9.1	0.06	4					
Toronto, Ont.....	5	II	75.1	1.47	101	139	168	239	278	331	388	1.2	1.8	0.736	60.8	8.4	0.05	3					
Winnipeg, Man...	4	II	74.2	1.53	104	140	167	233	275	332	389	1.2	1.9	0.731	62.1	8.5	0.05	2					
Regina, Sask....	3	II	73.8	1.43	105	137	165	237	278	334	398	1.3	2.2	0.732	61.8	8.4	0.05	3					
Edmonton, Alta..	3	II	73.2	1.72	108	144	170	242	287	345	393	1.2	1.7	0.737	60.5	6.9	0.03	3					
Vancouver, B.C..	4	II	76.6	2.18	103	145	174	243	280	333	390	1.3	1.8	0.740	59.7	8.5	0.09	2					
Average Group II (36)			75.0	1.71	103	140	168	239	280	334	393	1.3	2.0	0.735	61.0	8.6	0.06	4					
(29) (17) Average of all Samples.....	(61)	I&II	-	-	103	139	166	237	278	335	396	1.3	2.0	0.736	60.8	8.7	0.07	4					

*Millilitres per Imperial gallon. **Milligrams per 100 millilitres.

TABLE III

SUMMARY OF DATA OF GASOLINE SURVEY ANALYSES FOR CANADA FOR SUMMER 1948.

Test	GROUP I			GROUP II		
	(Octane No. 78 and above)			(Octane No. 77 to 70)		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Specific Gravity at 60°F.....	0.723	0.737	0.750	0.727	0.735	0.745
Gravity, degrees A.P.I.....	57.2	60.5	64.2	58.4	61.0	63.1
Reid vapour pressure, lb.....	5.1	8.9	11.1	5.9	8.6	11.1
Sulphur, per cent by wt.....	0.01	0.08	0.15	0.01	0.06	0.14
Gum, milligrams per 100 millilitres	1	51/	26	1	41/	24
Tetraethyl lead, millilitres per Imperial gallon.....	1.11	2.80	3.94	0.71	1.71	3.02
A.S.T.M. Motor Octane number.....	75.7	79.0	82.0	72.4	75.0	77.8
Distillation range,						
Initial boiling point, °F.....	94	102	112	92	103	112
5% evaporated, °F.....	108	121	140	110	123	142
10% evaporated, °F.....	124	138	159	129	140	159
20% evaporated, °F.....	144	164	183	160	168	184
30% evaporated, °F.....	165	189	210	185	194	209
50% evaporated, °F.....	209	234	259	226	239	258
70% evaporated, °F.....	245	276	300	264	280	306
90% evaporated, °F.....	306	336	352	312	334	361
95% evaporated, °F.....	336	365	382	330	359	384
End Point, °F.....	386	400	420	376	393	424
Residue, per cent by vol.....	1.0	1.4	1.8	1.0	1.3	1.6
Distillation loss, per cent by volume.....	0.8	2.0	3.6	0.5	2.0	3.2
Number of samples	---	25	---	---	36	---

1/Not included in average are three samples with gum content of 73, 49 and 47 milligrams.

TABLE IV

SUMMARY OF DATA OF GASOLINE SURVEY ANALYSES BY GROUPS FOR CANADA FOR SUMMERS, 1937 THROUGH 1948. (EXCEPT 1940)

Year	Group	No. of Samples	A.S.T.M. Motor Octane No.	Tetra- ethyl Lead 1/	DISTILLATION RANGE, °F.										End Pt.	Res- idue %	Loss %	GRAVITY		Reid V.P. lb.	Su- phur
					I. B. P.	Per Cent Evaporated					Specific ific	At 60°F.									
						10	20	50	70	90		Deg. A.P.I.									
937	I (Octane No. 75 & above)	14	77.6	-	99	144	173	246	291	344	392	1.1	1.9	0.740	59.7	8.2	-	-			
938	I (Octane No. 75 & above)	14	77.8	-	100	145	174	246	287	337	391	0.9	1.5	0.739	60.0	8.2	-	-			
939	I (Octane No. 75 & above)	13	77.4	-	100	142	175	248	291	342	394	1.0	2.0	0.741	59.5	8.3	-	-			
940	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
941	I (Octane No. 77 & above)	23	79.0	-	101	143	170	239	281	337	391	0.9	1.8	0.743	58.9	8.1	0.0	0.0			
942	I (Octane No. 78 to 75)	32	76.9	-	97	135	163	237	281	341	394	1.0	2.0	0.736	60.8	9.0	0.0	0.0			
943	I (Octane No. 78 to 75)	32	75.7	-	100	140	170	246	287	339	391	1.0	1.7	0.741	59.5	8.1	0.0	0.0			
944	I (Octane No. 76 to 74)	45	74.8	-	100	143	177	255	298	352	403	1.2	1.8	0.745	58.4	8.0	0.0	0.0			
945	I (Octane No. 74 to 73)	64	73.5	-	103	145	176	247	289	343	399	1.2	1.7	0.741	59.5	7.9	0.0	0.0			
946	I (Octane No. 77 & above)	17	77.8	2.45	98	134	162	236	279	335	396	1.3	1.9	0.737	60.5	8.8	0.0	0.0			
947	I (Octane No. 78 & above)	24	79.2	2.61	100	136	162	234	277	334	394	1.2	1.9	0.734	61.3	8.7	0.0	0.0			
948	I (Octane No. 78 & above)	25	79.0	2.80	102	138	164	234	276	336	400	1.4	2.0	0.737	60.5	8.9	0.0	0.0			
937	II (Octane No. 74 to 65)	39	70.1	-	98	145	175	251	296	345	391	1.0	1.9	0.741	59.5	7.9	-	-			
938	II (Octane No. 74 to 65)	41	70.2	-	100	145	175	251	295	344	395	1.0	1.6	0.741	59.5	8.2	-	-			
939	II (Octane No. 74 to 65)	43	70.3	-	99	141	173	249	292	344	392	0.9	2.1	0.739	60.0	8.4	-	-			
940	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
941	II (Octane No. 76 to 70)	53	73.6	-	100	141	173	244	288	341	395	1.0	1.9	0.741	59.5	8.4	0.0	0.0			
942	II (Octane No. 70 to 65)	9	67.1	-	98	129	155	220	263	317	377	0.9	2.4	0.721	64.8	10.1	0.0	0.0			
943	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
944	II (Octane No. 70 to 66)	16	68.6	-	101	146	181	258	296	345	397	1.2	1.6	0.738	60.2	7.4	0.0	0.0			
945	II (Octane No. 70 to 66)	21	68.5	-	103	145	177	251	290	343	405	1.4	1.7	0.739	60.0	7.9	0.0	0.0			
946	II (Octane No. 76 to 70)	41	73.6	1.40	99	137	166	239	283	339	394	1.2	1.8	0.738	60.2	8.2	0.0	0.0			
947	II (Octane No. 77 to 70)	37	75.0	1.42	102	139	166	239	283	339	396	1.1	1.8	0.737	60.5	8.5	0.0	0.0			
948	II (Octane No. 77 to 70)	36	75.0	1.71	103	140	168	239	280	334	393	1.3	2.0	0.735	61.0	8.6	0.0	0.0			

/ Millilitres per Imperial gallon. 2/ Milligrams per 100 millilitres.

TABLE V

AVERAGE OF GASOLINE SURVEY ANALYSES FOR CANADA FOR SUMMERS, 1923 THROUGH 1948.

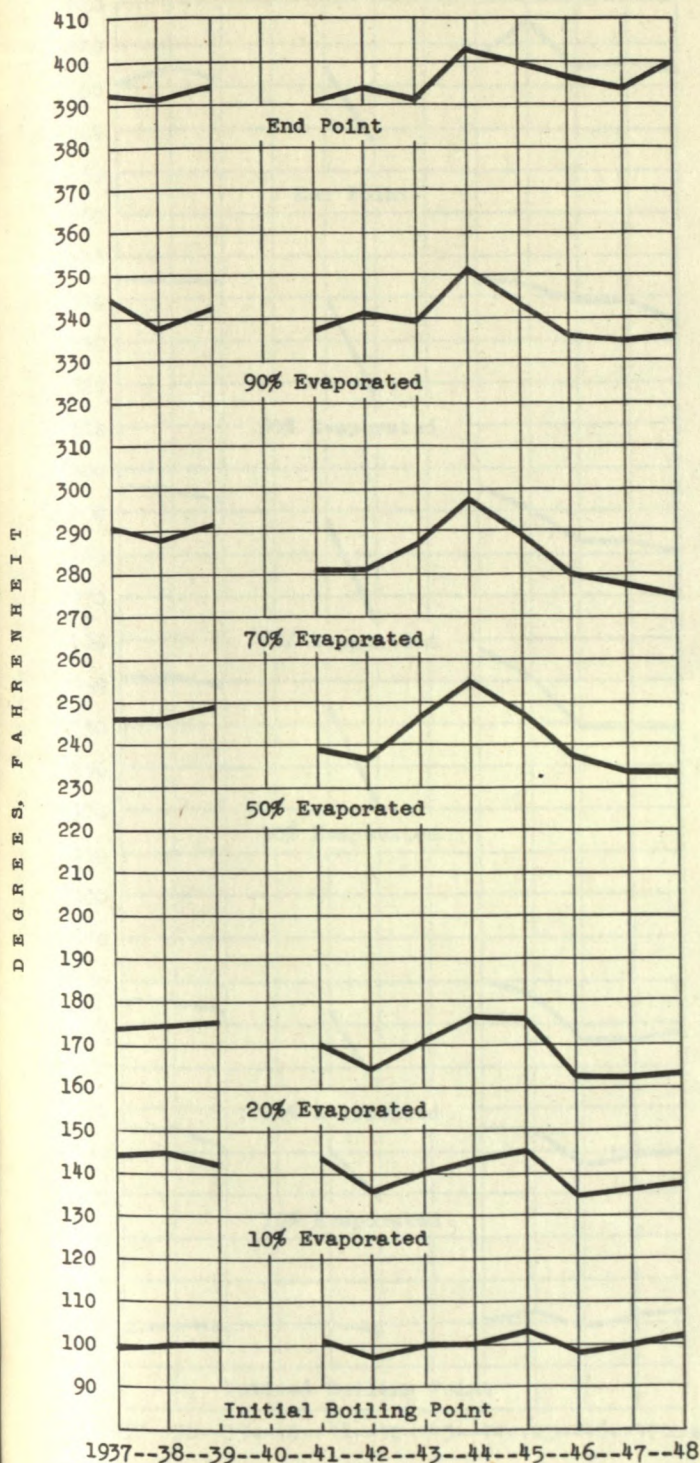
Year	DISTILLATION RANGE, °F.						End Pt.	Res- idue %	Loss %	GRAVITY		Reid V. P. lb.	Sul- phur %
	I. B. P.	Per Cent Evaporated								At 60°F. Spec- ific	Deg. A. P. I.		
		10	20	50	70	90							
1923	120	163	189	251	294	351	423	1.1*	1.8	0.737	60.5	-	-
1924	113	169	192	246	285	341	410	1.1*	1.5	0.736	60.8	-	-
1925	116	168	195	254	295	352	412	1.1*	1.9	0.739	60.0	-	-
1926	110	158	187	253	296	354	410	1.1*	1.5	0.739	60.0	-	-
1927	107	156	184	255	299	359	416	1.1*	1.9	0.741	59.5	-	-
1928	107	155	182	251	294	353	409	1.1*	1.6	0.737	60.5	-	-
1929	102	147	176	250	296	355	411	1.1*	1.9	0.736	60.8	-	-
1930	101	149	178	250	297	356	406	1.1	1.7	0.741	59.5	-	0.07
1931	104	151	181	254	299	359	406	1.3	1.8	0.741	59.5	-	0.05
1932	102	151	181	251	297	357	408	1.2	0.9	0.742	59.2	7.4	-
1933	101	147	176	249	292	345	396	1.2	1.3	0.739	60.0	6.9	-
1934	101	144	172	244	287	346	395	1.2	1.3	0.738	60.2	7.5	-
1935	101	143	171	240	281	337	393	1.1	1.5	0.735	61.0	7.7	0.06
1936	101	145	173	242	283	335	388	1.0	1.4	0.736	60.8	7.7	-
1937	98	143	173	248	293	343	391	1.0	1.9	0.739	60.0	8.0	-
1938	99	145	174	248	291	342	393	0.9	1.6	0.740	59.7	8.2	-
1939	99	142	173	249	292	343	393	0.9	2.1	0.740	59.7	8.3	-
1940	No survey												
1941	101	143	172	243	285	338	392	0.9	1.9	0.741	59.5	8.2	0.06
1942	97	135	161	234	277	333	390	1.0	2.0	0.733	61.5	9.2	0.05
1943	100	140	170	246	287	339	391	1.0	1.7	0.741	59.5	8.1	0.08
1944	100	142	177	257	298	352	401	1.2	1.7	0.743	58.9	7.9	0.06
1945	103	144	175	247	289	345	401	1.2	1.7	0.740	59.7	7.9	0.07
1946	99	137	166	238	282	338	394	1.2	1.8	0.737	60.5	8.4	0.07
1947	101	138	165	237	280	337	395	1.1	1.9	0.736	60.8	8.6	0.07
1948	103	139	166	237	278	335	396	1.3	2.0	0.736	60.8	8.7	0.07

*Estimated.

YEAR-SUMMER

1937--38--39--40--41--42--43--44--45--46--47--48

DISTILLATION RANGE



GROUP I GASOLINE

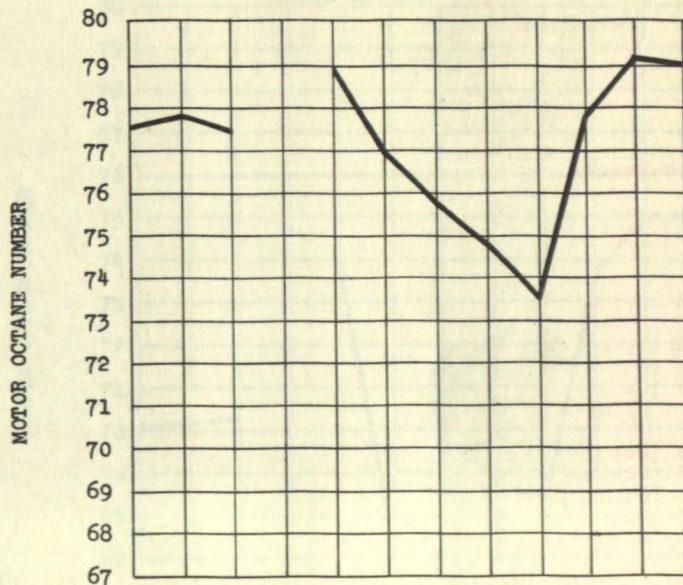
FIGURE I - COMPARISON OF GASOLINE CHARACTERISTICS FROM SUMMER

SURVEYS OF 1937 THROUGH 1948

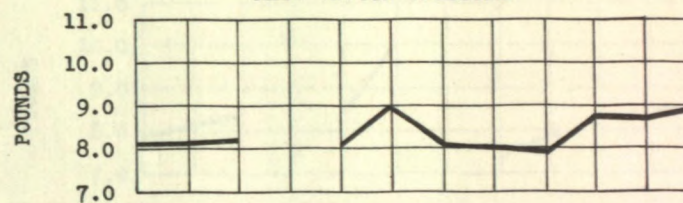
YEAR-SUMMER

1937--38--39--40--41--42--43--44--45--46--47--48

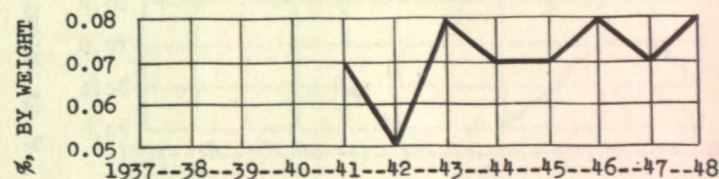
KNOCK RATING



REID VAPOUR PRESSURE



SULPHUR CONTENT

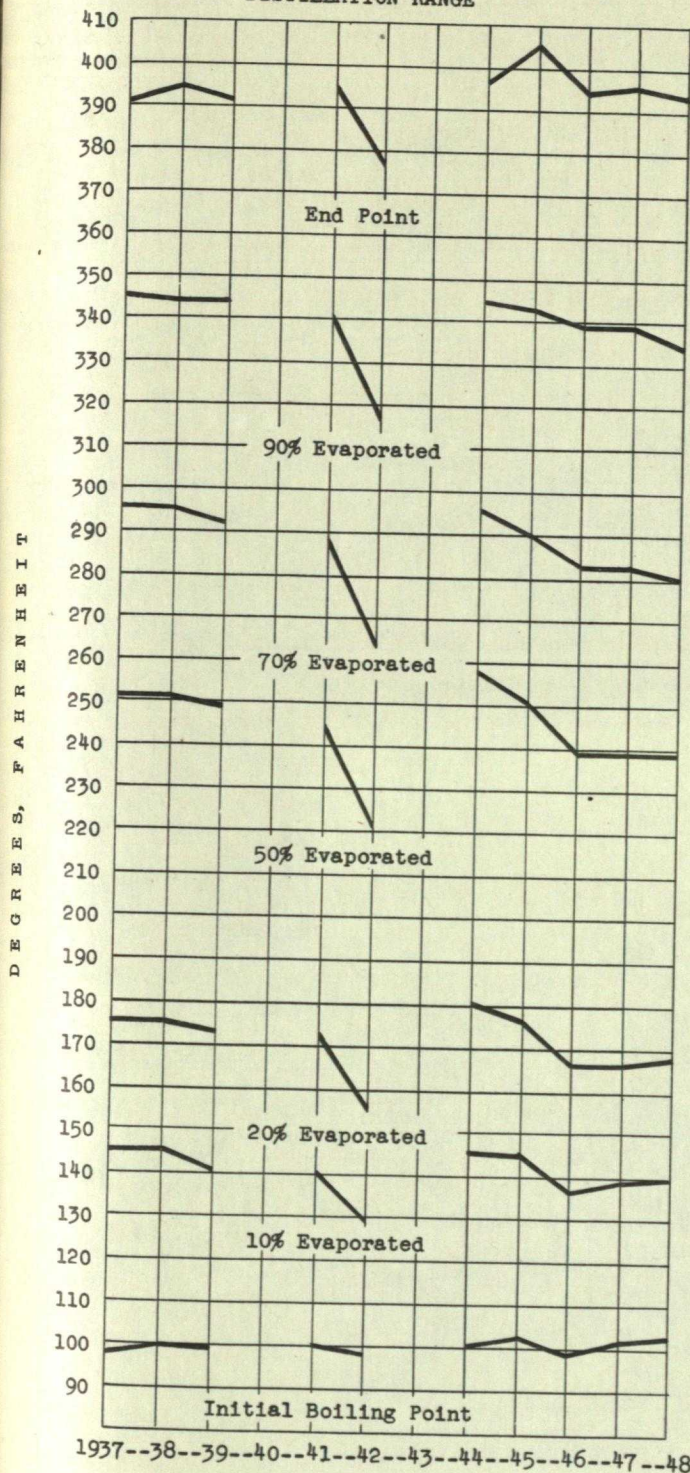


NOTE: No Survey was made in 1940 for Group I.

YEAR-SUMMER

1937--38--39--40--41--42--43--44--45--46--47--48

DISTILLATION RANGE



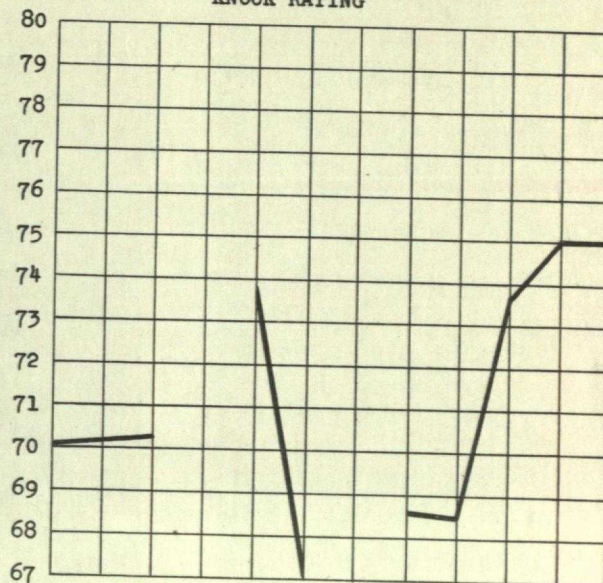
GROUP II GASOLINE

FIGURE II - COMPARISON OF GASOLINE CHARACTERISTICS FROM SUMMER SURVEYS OF 1937 THROUGH 1948

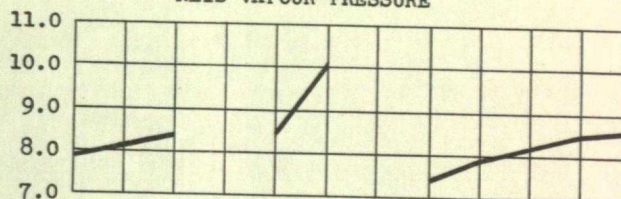
YEAR-SUMMER

1937--38--39--40--41--42--43--44--45--46--47--48

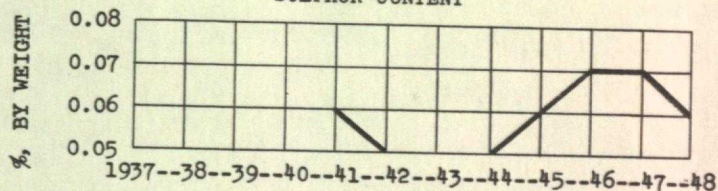
KNOCK RATING



REID VAPOUR PRESSURE



SULPHUR CONTENT



NOTE: No Survey was made in 1940 and 1943 for Group II.