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GASOLINE SURVEYS FOR 1937 AND 1938

BY

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GASOLINE SURVEYS FOR 1937 AND 1938

A study of the gasoline sold in Canada has been made annually for the past sixteen years at the Fuel Research Laboratories of the Division of Fuels, Bureau of Mines, and reports have been prepared from the results obtained. During the early part of August in 1937, 60 samples of gasoline were collected, and during the latter part of July and the early part of August in 1938, 60 samples were collected from the wholesale dealers and distributors in nine cities. This report contains the results in detail of the analyses of these 120 samples of gasoline. The support and co-operation of the Department of Pensions and National Health in collecting the samples is gratefully acknowledged.

METHODS OF ANALYSIS USED

The distillation range was determined according to the American Society for Testing Materials (A.S.T.M.) method D86-35[1]. From the results so obtained, a weighted index number was calculated after the method advocated by Gruse[2], except that the temperatures of the distillation range were expressed in degrees Fahrenheit instead of in degrees Centigrade. By this method, the index number is the sum of the 10 per cent, 20 per cent, 50 per cent, 70 per cent, 90 per cent, and end point of the distillation range. The knock ratings of the gasoline are expressed in octane numbers, and were determined according to A.S.T.M. tentative method D357-37T[1]. The Reid vapour pressure was determined according to the A.S.T.M. tentative method D323-37T[1]. The specific gravity was determined by means of the hydrometer at room temperature, according to A.S.T.M. standard method D287-37[1], and the result calculated to 60°F., according to the National Standard Oil Tables[3]. The degrees A.P.I. were obtained by converting the specific gravity according to the above tables. The apparent colour of the gasoline was observed.

RESULTS OF LABORATORY EXAMINATION

The results of the laboratory examination of the gasoline tested in 1937 are shown by cities in Table I. This table gives the A.S.T.M. octane number, distillation characteristics, specific and A.P.I. gravity, Reid vapour pressure, and colour. It shows, also, the price and tax per gallon and the group of each sample, and the average analysis for each city. Table II gives similar analyses for 1938. The average results obtained by examination of samples for the sixteen years 1923 to 1938 are shown in Table III, and Figure 1 shows graphically the ranges of average distillation temperature for the same sixteen years. Figure 2 shows the comparison between the average distillation curves for the year 1936 and 1938, as the average distillation curve for 1937 was practically the same as for 1938. Tables

IV and V give the average analyses of the three groups of gasoline sold in Canada in 1937 and 1938. In Tables VI and VII summaries of the characteristics of the gasolines collected in 1937 and 1938 are shown. Table VIII shows the group of 28 brands of gasoline sold by 18 companies in 1937 and 1938.

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 the engine will be found in the report on Gasoline Surveys for 1930 and 1931[4]. The recent changes in characteristics of motor fuels were discussed in the Gasoline Surveys for 1935 and 1936[5]. This latter report also contains a brief discussion of the specifications and regulations of the Provinces of Nova Scotia[6], New Brunswick[7], and Quebec[8] and gives the Canadian Government Purchasing Standards Committee—Specification for Gasoline—No. 3-GP-1[9] in detail.

The purpose of this survey was not to ascertain whether any particular sample conformed to a specification, Provincial or otherwise. It is solely a means whereby information regarding the characteristics of gasoline actually being sold would become available. No effort therefore has been made to fit the results into predetermined grades; the object was to allow the actual analyses to define as clearly as possible the limits of the different groups of gasoline on the market.

According to the analyses of the gasoline samples collected in Canada in 1937 and 1938, three recognizable groups of gasoline are being sold. These groups may be defined as:—

Group I. Gasolines with octane numbers of 75 and above.
Group II. Gasolines with octane numbers between 74 and 65.
Group III. Gasolines with octane numbers of 64 and below.

These three groups correspond to the grades which are known in the oil trade as "Premium", "Regular", and "Third Grade" gasoline.

VOLATILITY

From the foregoing it might be inferred that knock rating is the most important characteristic of a motor fuel, but that is not so. The basic and fundamental principles on which a gasoline engine works require a fuel that can be easily vaporized and mixed with the oxygen of the air. Volatility, therefore, is the most important single characteristic of a motor fuel for gasoline engines. The importance of proper volatility has been recognized by manufacturers and refiners so thoroughly that only rarely is trouble experienced from faulty volatility. Knock rating of fuel appears to be of greater importance only because its effect on general operation of the engine has been recognized only comparatively recently, and because of the publicity given to its determination.

Since 1933, a motor fuel of high volatility has been marketed generally throughout the country, as indicated by the average volatility of gasoline sold in Canada during the past sixteen years. Comparison of the results, as given in Table III and as shown graphically in Figure 1, indicates that the average volatility for 1937 was lower than that of the three

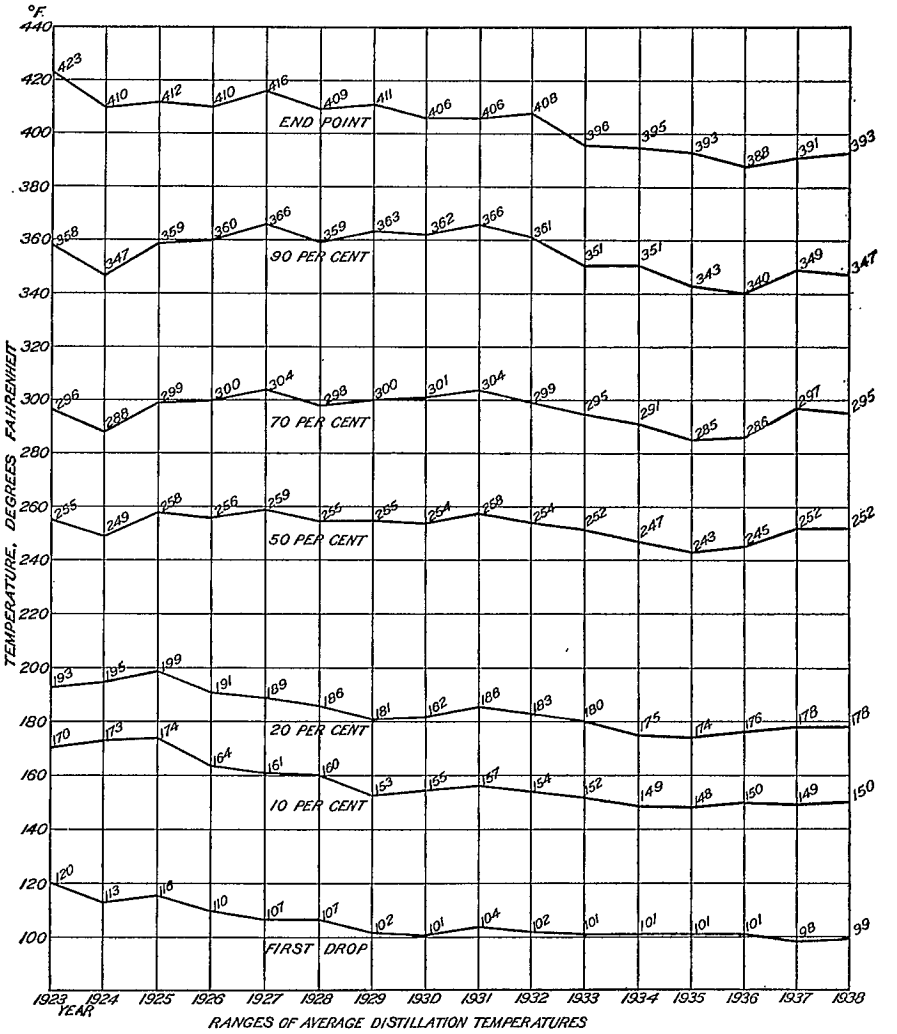
°F.
TEMPERATURE, DEGREES FAHRENHEIT
END POINT
90 PER CENT
70 PER CENT
50 PER CENT
20 PER CENT
10 PER CENT
FIRST DROP
YEAR
RANGES OF AVERAGE DISTILLATION TEMPERATURES

Figure 1.

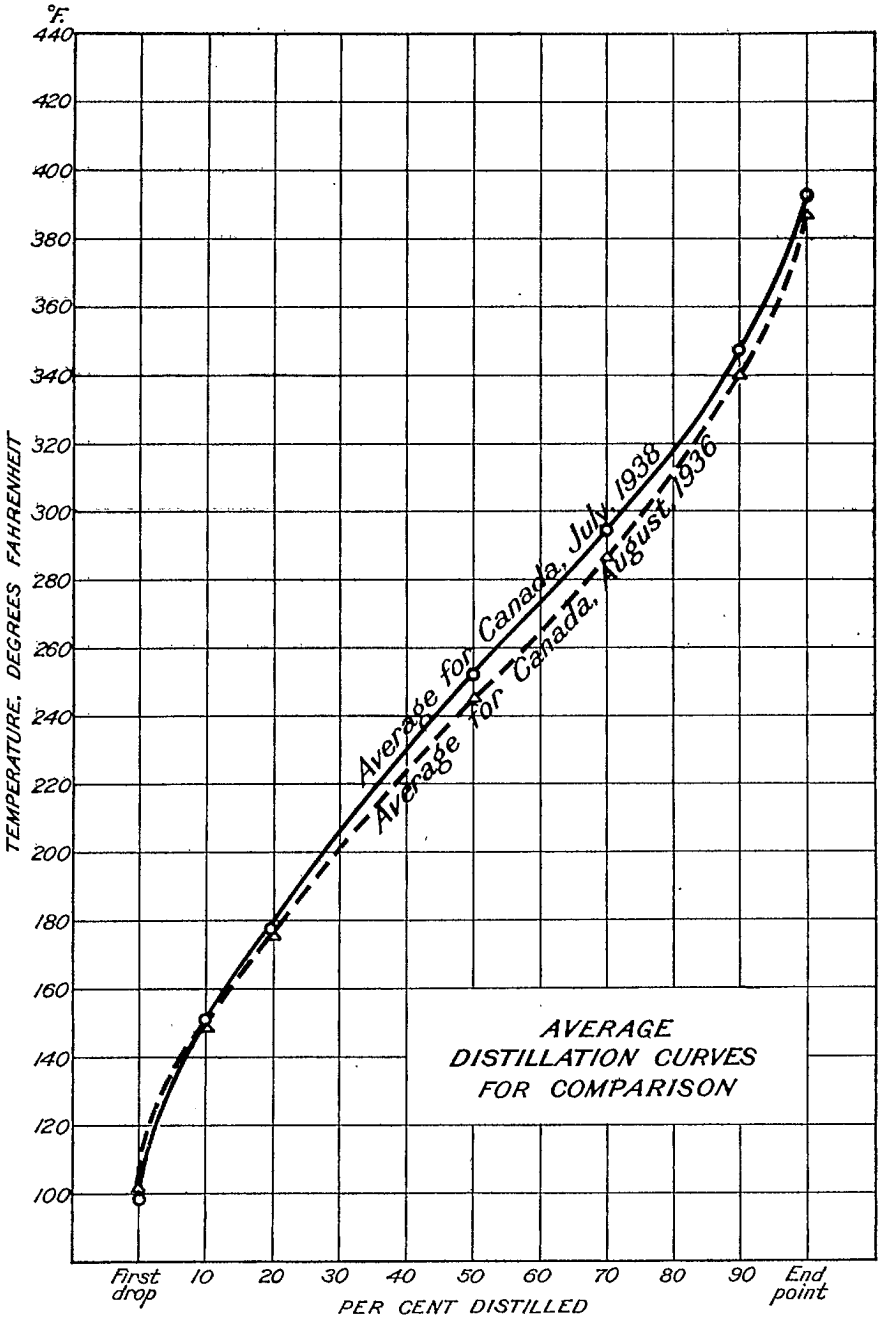
°F.
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
TEMPERATURE, DEGREES FAHRENHEIT
Average for Canada, July, 1938
Average for Canada, August, 1936
AVERAGE
DISTILLATION CURVES
FOR COMPARISON
First drop
10
20
30
40
50
60
70
80
90
End point
PER CENT DISTILLED

Figure 2.

previous years. The average volatility for the year 1938 was practically the same as that in 1937. The decrease in volatility in 1937 and 1938 as compared to 1936 was due principally to approximately 8°F. rise in the average distillation temperature of the 50, 70, and 90 per cent points in the distillation range, as shown graphically in Figure 2. However, it should be noted that there was approximately a 2°F. drop in the average distillation temperature of the first drop and 10 per cent points in the distillation range. As this lower portion of the distillation range was more volatile in 1937 and 1938 than in 1936, it indicates the trend for easier starting motor fuels.

The trend towards uniformity of the fuels being sold was even more pronounced in 1937 and 1938 than in 1936. The variation in volatility in 1937 was less than in any previous year and the variation in 1938 was less than in 1937. Study of the tables at the end of this report will show, with few exceptions, that there is not a great deal of difference in the volatility of Group I and Group II and that the greatest variation in volatility occurs in Group III gasoline. This trend has been observed for some time past and indicates a definite tendency on the part of the refiners to work towards a uniform volatility for their "Premium" and "Regular" gasolines.

KNOCK RATINGS

The knock rating of the samples collected in 1937 and 1938 was determined in a Co-operative Fuel Research engine, which is known more briefly as the "C.F.R." engine, according to the A.S.T.M. tentative method D357-37T[1], and the results are expressed in octane numbers.

According to the knock ratings only, the 1937 and 1938 samples may be divided into three groups as follows:—

Group I. Gasolines of high knock rating with octane numbers of 75 and above.

Group II. Gasolines of medium knock rating with octane numbers between 74 and 65.

Group III. Gasolines of low knock rating with octane numbers of 64 and below.

The knock rating expressed in octane numbers for the individual samples is given in Tables I and II and the group in which each sample falls is also noted in these tables. In 1937, the highest knock rating was 81 octane number and the lowest was 55 octane number. In 1938 the highest knock rating was 81 octane number and the lowest was 58 octane number.

As shown in Tables IV and V the average octane number of the samples in the above three groups, in 1937 and 1938, was 78 for Group I, 70 for Group II, and 60 for Group III. In 1936 the average octane number of the samples in the same three groups was 77 for Group I, 69 for Group II, and 60 for Group III, and in 1935, 76 for Group I, 68 for Group II, and 57 for Group III. This indicates a steady improvement in octane numbers of the Group I and Group II gasolines sold from 1935 to 1938.

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The octane numbers of the samples of each brand were averaged and this average determined the group of that brand. Table VIII shows the classification by groups of 28 brands of gasoline sold by 18 companies in 1937 and 1938. This is a combined table representing 25 brands sold by 17 companies in 1937 and 24 brands sold by 15 companies in 1938. It should be noted that no brand changed its group from 1937 to 1938. It will be observed from Table VIII that four brands of gasoline, which are usually in Group III, are in Group II in the Provinces of Nova Scotia, New Brunswick, and Quebec in order to comply with the Provincial regulations. Generally speaking, the samples from the same brand of gasoline maintained a higher octane number in the year 1937 than in 1936 and this improvement was continued by several brands in 1938.

VAPOUR PRESSURE

The Reid vapour pressure test is used to indicate the temperature at which vapour lock[10] may occur when the gasoline is used as fuel for an automobile engine. Vapour lock does not occur in all engines under similar conditions with fuels of the same vapour pressure and therefore no hard and fast limit can be set beyond which trouble would always be experienced. Any sample, however, having a vapour pressure over 10 pounds per square inch should be regarded doubtfully.

In 1937 none of the 60 samples collected had a vapour pressure of more than 10 pounds per square inch. The highest vapour pressure, namely 9·9 pounds, was obtained from a sample from Toronto. The lowest vapour pressure, namely 6·0 pounds, was obtained from a sample from Montreal. The variation in vapour pressure of only 3·9 pounds from the highest to the lowest was considerably smaller than the variation in 1936. The average vapour pressure for all the samples in 1937 was 8·0 pounds per square inch, which is higher than the average vapour pressure of 7·7 pounds in 1936.

In 1938, only one of the 60 samples collected had a vapour pressure of more than 10 pounds per square inch. A sample from Toronto had the highest vapour pressure, namely 10·4 pounds, and the lowest vapour pressure, namely 5·2 pounds, was obtained from a sample also from Toronto. The variation in vapour pressure of 5·2 pounds from the highest to the lowest in 1938 was higher than in 1937 but not so high a variation as in 1936. The average vapour pressure for all the samples in 1938 was 8·2 pounds per square inch. The above indicates a tendency towards higher vapour pressures, and generally speaking, more uniform vapour pressures for the gasolines being sold.

GRAVITY

The specific gravity and gravity in degrees A.P.I. for each sample collected in 1937 and 1938 are shown in Tables I and II. Gravity has been used in the petroleum industry for many years as an easy and convenient method of refinery control, but should not be used as an indicator of quality[11], and it is only of value when used in conjunction with the dis-

tillation range to indicate the probable source of the fuel or the treatment it has received. It is reported here for comparison with the gravity obtained in previous surveys and for the information it may give. In 1937 the specific gravity of the gasoline varied from 0·691 to 0·750 with a corresponding variation in degrees A.P.I. from 73·3 to 57·2. In 1938 the specific gravity of the gasoline varied from 0·722 to 0·759 with a corresponding variation in degrees A.P.I. from 64·5 to 54·9. The average specific gravity for all the samples collected in 1937 was 0·739 or 60 degrees A.P.I. and in 1938 was 0·740 or 59·7 degrees A.P.I. This is equivalent to a weight of about 7·4 pounds per Imperial gallon.

COLOUR

Gasoline is a clear, water-white liquid when freshly distilled. The colour of gasolines that were not artificially coloured is simply reported as "white". Many gasolines on the market have small quantities of dye of distinctive colour dissolved in them, in order to make them more attractive, to distinguish readily between different brands or groups, or to indicate the presence of tetraethyl lead so that the gasoline shall be used only as motor fuel. The apparent colour of the samples containing dye and of the colourless or "white" samples is reported in Tables I and II. It should be emphasized that it is difficult to draw any clear-cut distinctions between motor fuels on the basis of colour and it is reported here only for the information it may give. As shown in Table IV, of the samples collected in 1937, 100 per cent of the Group I gasolines, 92 per cent of the Group II, and none of the Group III gasolines were artificially coloured. As shown in Table V, of the samples collected in 1938, 100 per cent of the Group I, 90 per cent of the Group II, and none of the Group III gasolines were artificially coloured. The general tendency of the oil refiners and distributors would, therefore, appear to be toward colouring Group I and Group II gasolines, and not colouring, or leaving "white", the Group III gasolines, which are usually termed "Third Grade".

PRICE

In 1937 the samples were collected from August 2 to August 6, except in Winnipeg, when the samples were taken on August 13. In 1938 the samples were collected from July 22 to July 29, except in Winnipeg and Vancouver when the samples were taken on August 10. The retail price and the Provincial tax at the time each sample was taken are shown in Table I for 1937 and in Table II for 1938. Generally speaking, throughout Canada the retail price of the "Premium" or Group I gasoline was two cents per Imperial gallon higher than the retail price of the "Regular" or Group II gasoline, during 1937 and 1938, and the retail price of the "Third Grade" or Group III gasoline was one to two cents lower than the retail price of the "Regular" gasoline, although in 1937 and 1938 in several cities Group II and Group III gasolines sold at the same price. As shown in Table I, in August, 1937, the highest retail price excluding tax was 28·5 cents per Imperial gallon in Regina for a Group I gasoline

and the lowest retail price was 14·8 cents in Toronto for a Group III gasoline. As shown in Table II, in 1938 at about the same time of the year, the highest retail price excluding tax was 26 cents per Imperial gallon in Winnipeg for a Group I gasoline, and the lowest retail price was 16 cents in Toronto for a Group III gasoline. The Provincial tax in 1937 varied from 6 to 8 cents per Imperial gallon and in 1938 from 6 to 10 cents, depending on the province in which the gasoline was purchased.

SUMMARY AND CONCLUSIONS

The gasoline surveys for 1937 and 1938 comprised the collection and analyses of 120 samples; 60 samples were collected in August 1937 from nine cities and 60 samples were collected during the latter part of July and the early part of August 1938 from the same nine cities. As these cities are widely separated and are distribution centres throughout the country, the samples taken may be accepted as representative of the gasoline sold in Canada at that time. The samples consisted of 25 different brands of motor fuel in 1937 and 24 brands in 1938.

The analyses of the samples have shown that the average gasoline during 1937 and 1938 was of good quality. The average gasoline in 1937 was less volatile than the average gasoline sold in the three previous years. The volatility of the average gasoline in 1938 was practically the same as in 1937.

The variation in volatility in 1937 was less than in any previous year and the variation in 1938 was less than in 1937. There is a definite trend towards uniformity for the Group I and Group II gasolines.

Three groups of gasoline are being sold in Canada, according to the analyses of the 1937 and 1938 gasoline samples. These groups differ principally in knock rating. They are usually known as "Premium" or Group I, "Regular" or Group II, and "Third Grade" or Group III. In 1937 and in 1938, the average knock rating of Group I gasoline was 78 octane number, of Group II was 70 octane number, and of Group III gasoline was 60 octane number. From 1935 to 1938 there was a steady improvement of the average knock ratings of the gasolines in Group I and Group II. A table is included which shows the group of 28 different brands of gasoline in 1937 and 1938.

The average Reid vapour pressure of the gasoline samples collected in 1937 was 8·0 pounds per square inch and for those collected in 1938 was 8·2 pounds. All of the samples collected in 1937 and all but two of the samples collected in 1938 had Reid vapour pressures less than 10 pounds.

The specific gravity of the samples collected in 1937 varied from 0·691 to 0·750 with a corresponding variation in degrees A.P.I. from 73·3 to 57·2. In 1938, the specific gravity of the samples collected varied from 0·722 to 0·759 or from 64·5 to 54·9 degrees A.P.I.

According to the colour of gasoline samples, the general tendency is to colour artificially only Group I and Group II gasolines and to leave colourless or "white" Group III or "Third Grade" gasoline.

The retail price and tax at the time the samples were collected—usually the first two weeks in August in 1937 and the last two weeks in

July 1938—is shown for each sample of gasoline. In 1937 the highest retail price shown was 28·5 cents per Imperial gallon and the lowest retail price shown was 14·8 cents per Imperial gallon; in 1938 the highest shown was 26 cents and the lowest shown was 16 cents. The Provincial tax varied in 1937 from 6 to 8 cents per Imperial gallon and in 1938 from 6 to 10 cents, depending on the province in which the gasoline was sold.

Summaries of the data of the characteristics of the gasoline collected in 1937 and 1938 are included.

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TABLE I

Gasoline Survey Analyses for 1937 by Cities

Sample No. (1937)	Price, cents per gallon		Group	A.S.T.M. Octane No.	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Colour
	Gasoline	Tax			1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.								
HALIFAX, N.S.																			
1	20	8	II	73	97	156	187	258	298	349	394	97·0	1·3	1·7	1642	0·744	58·7	8·5	Green
2	20	8	II	71	100	157	190	261	299	350	390	97·0	1·2	1·8	1647	0·744	58·7	8·7	Purple
3	22	8	I	79	95	162	189	249	290	342	385	97·0	1·0	2·0	1617	0·743	58·9	7·7	Red
4	20	8	II	74	93	152	192	268	310	358	393	96·0	1·0	3·0	1673	0·748	57·7	8·7	Blue
5	20	8	II	72	99	144	172	248	292	342	380	96·5	1·0	2·5	1578	0·740	59·7	8·2	Blue
Average....	.....	.....	.....	.....	97	154	186	257	298	348	388	96·7	1·1	2·2	1631	0·744	58·7	8·4	.....
SAINT JOHN, N.B.																			
6	22	8	I	77	96	148	175	249	300	360	389	97·0	1·1	1·9	1621	0·736	60·8	8·8	Red
7	20	8	II	67	92	154	188	269	309	356	395	96·5	1·0	2·5	1671	0·747	57·9	9·2	White
8	20	8	II	72	100	158	190	262	301	351	390	96·0	1·1	2·9	1652	0·745	58·4	8·1	Purple
9	20	8	II	73	100	155	183	254	292	345	389	97·0	1·0	2·0	1618	0·740	59·7	7·8	Blue
10	20	8	II	72	103	144	169	245	288	338	381	97·0	1·0	2·0	1565	0·740	59·7	8·4	Blue
Average....	.....	.....	.....	.....	98	152	181	256	298	350	388	96·7	1·0	2·3	1625	0·742	59·2	8·5	.....
MONTREAL, QUE.																			
11	18½	6	I	77	100	153	182	256	307	366	397	96·5	1·1	2·4	1661	0·739	60·0	9·0	Red
12	17	6	II	70	100	150	179	250	302	365	392	96·0	1·0	3·0	1638	0·737	60·5	8·2	Green
13	17	6	II	65	94	152	181	264	311	363	398	96·5	1·0	2·5	1669	0·741	59·5	8·7	Green
14	20	6	I	79	106	158	186	265	308	354	396	96·5	1·3	2·2	1667	0·748	57·7	7·0	Red
15	17½	6	II	70	99	150	180	255	305	363	396	96·0	1·0	3·0	1649	0·736	60·8	9·2	Green
16	17½	6	II	66	104	157	182	254	294	340	383	98·0	1·0	1·0	1610	0·743	58·9	6·0	White
17	17½	6	II	70	100	152	180	255	300	348	387	98·0	1·0	1·0	1622	0·746	58·2	7·0	Blue
18	17½	6	II	72	98	152	182	263	304	351	394	97·0	1·0	2·0	1646	0·745	58·4	7·6	Green
Average....	.....	.....	.....	.....	100	153	181	258	304	356	393	96·8	1·1	2·1	1645	0·742	59·2	7·8	.....

OTTAWA, ONT.

19	21½	6	I	77	94	147	176	252	303	362	392	97·0	1·0	2·0	1632	0·737	60·5	9·1	Red
20	19½	6	II	70	92	142	170	249	298	360	391	97 0	1·2	1·8	1610	0·735	61·0	9·5	Green
21	19½	6	III	64	92	148	180	263	311	363	400	97·5	1·0	1·5	1665	0·742	59·2	8·3	White
22	19½	6	II	70	97	148	171	253	300	349	384	97·0	1·4	1·6	1605	0·739	60·0	8·5	Green
23	19½	6	II	69	92	146	177	253	305	362	394	97·0	0·8	2·2	1637	0·736	60·8	8·7	Bronze
24	21½	6	I	77	94	147	176	248	295	352	394	97·0	1·2	1·8	1612	0·741	59·5	8·7	Red
25	19½	6	II	69	102	158	191	274	318	358	399	97·0	1·2	1·8	1698	0·747	57·9	7·0	Green
26	19½	6	II	67	103	154	185	267	310	354	388	97·0	0·8	2·2	1658	0·746	58·2	6·8	White
27	21½	6	I	77	96	153	182	252	299	356	397	96·5	1·0	2·5	1639	0·743	58·9	7·8	Red
28	19½	6	II	71	98	145	174	248	294	354	391	97·0	0·8	2·2	1606	0·741	59·5	8·0	Gold
29	19½	6	II	70	105	150	178	255	298	347	385	97·5	1·2	1·3	1613	0·746	58·2	8·1	Blue
30	19½	6	II	71	99	151	184	266	307	352	398	97·0	1·2	1·8	1658	0·745	58·4	7·3	Green
Average....	.....	.....	.....	.....	97	149	178	257	303	356	393	97·0	1·1	1·9	1636	0·742	59·2	8·2	.....

TORONTO, ONT.

31	18½	6	II	70	92	148	182	262	309	358	388	97·0	0·8	2·2	1647	0·736	60·8	9·3	Green
32	18½	6	II	71	94	144	172	242	286	342	380	97·0	1·1	1·9	1566	0·741	59·5	9·0	Green
33	17	6	III	59	98	150	178	245	289	346	380	97·0	1·1	1·9	1588	0·730	62·3	9·1	White
34	17⅝	6	III	60	104	154	183	247	286	332	367	97·0	0·9	2·1	1569	0·732	61·8	7·1	White
35	14⅜	6	III	55	94	139	166	239	279	322	359	96·5	0·6	2·9	1504	0·714	66·7	9·3	White
36	21	6	I	77	96	148	178	252	300	356	397	96·5	1·1	2·4	1631	0·737	60·5	9·9	Red
37	20½	6	I	76	96	143	172	250	299	357	394	97·0	1·0	2·0	1615	0·741	59·5	8·5	Red
38	18½	6	II	70	97	144	174	252	298	344	384	98·0	1·2	0·8	1596	0·744	58·7	8·1	Blue
Average....	.....	.....	.....	.....	96	146	176	249	293	345	381	97·0	1·0	2·0	1590	0·734	61·3	8·8	.....

WINNIPEG, MAN.

39	25	7	II	69	96	144	174	258	303	348	380	97·5	1·0	1·5	1607	0·736	60·8	8·2	Green
40	26	7	I	76	98	143	174	256	300	344	386	97·0	1·1	1·9	1603	0·735	61·0	8·5	Red
41	24	7	II	68	102	157	188	254	294	340	391	97·0	1·0	2·0	1624	0·737	60·5	7·4	Green
42	24	7	II	69	98	162	188	244	288	332	364	97·5	1·0	1·5	1578	0·736	60·8	6·7	Blue
43	24⅞	7	II	68	100	156	183	252	294	340	388	97·0	1·1	1·9	1613	0·735	61·0	7·4	Green
44	19	7	III	64	98	133	156	239	295	352	403	97·0	1·2	1·8	1578	0·732	61·8	9·3	White
Average....	.....	.....	.....	.....	99	149	177	251	296	343	385	97·1	1·1	1·8	1601	0·735	61·0	7·9	.....

TABLE I—Concluded

Gasoline Survey Analyses for 1937 by Cities—Concluded

Sample No. (1937)	Price, cents per gallon: Gasoline	Price, cents per gallon: Tax	Group	A.S.T.M. Octane No.	Distillation Range: 1st drop °F.	Distillation Range: 10% F.	Distillation Range: 20% F.	Distillation Range: 50% °F.	Distillation Range: 70% °F.	Distillation Range: 90% °F.	Distillation Range: End point °F.	Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Colour
REGINA, SASK.																			
45	28½	7	I	77	99	141	169	254	301	348	377	97·0	0·9	2·1	1590	0·737	60·5	8·6	Red
46	26½	7	II	70	102	145	173	257	302	349	378	97·0	1·1	1·9	1604	0·736	60·8	8·2	Green
47	26½	7	II	69	102	152	180	256	299	346	390	97·5	0·9	1·6	1623	0·736	60·8	7·8	Green
48	24	7	III	60	96	150	180	263	310	362	404	96·5	1·1	2·4	1669	0·737	60·5	8·5	White
49	26½	7	II	71	96	147	179	262	308	356	385	97·0	1·0	2·0	1637	0·743	58·9	7·3	Orange
Average....	.....	.....	.....	.....	99	147	176	259	304	352	387	97·0	1·0	2·0	1625	0·738	60·2	8·1	.....
CALGARY, ALTA.																			
50	26	7	I	76	104	146	166	230	270	322	379	98·0	1·0	1·0	1513	0·729	62·6	7·3	Red
51	18	7	III	60	103	125	131	156	191	275	393	98·0	1·2	0·8	1271	0·691	73·3	8·1	White
52	24	7	II	71	103	146	168	236	280	334	391	98·0	1·1	0·9	1555	0·729	62·6	7·5	Green
53	24	7	II	70	97	146	176	263	310	359	397	97·5	1·1	1·4	1651	0·744	58·7	6·6	Orange
54	24	7	II	66	93	137	167	256	302	358	396	97·5	1·0	1·5	1616	0·741	59·5	8·4	Orange
Average....	.....	.....	.....	.....	100	140	162	228	270	330	391	97 8	1·1	1·1	1521	0·727	63·1	7·6	.....
VANCOUVER, B.C.																			
55	22	7	I	81	103	154	182	248	286	339	396	97·0	1·2	1·8	1605	0·744	58·7	7·0	Red
56	20	7	II	72	102	153	185	258	298	352	412	97·0	1·2	1·8	1658	0·747	57·9	6·8	Green
57	20	7	II	72	97	147	180	268	323	378	410	97·5	1·0	1·5	1706	0·750	57·2	6·7	Gold
58	20	7	II	71	90	133	159	242	292	358	405	98·0	0·8	1·2	1589	0·743	58·9	8·1	Orange
59	22	7	I	81	104	157	186	248	286	338	405	97·5	1·0	1·5	1620	0·745	58·4	6·7	Red
60	20	7	II	72	101	158	189	258	296	350	414	97·5	1·0	1·5	1665	0·748	57·7	6·6	Orange
Average....	.....	.....	.....	.....	100	150	180	254	297	353	407	97·4	1·0	1·6	1641	0·746	58·2	7·0	.....

TABLE II

Gasoline Survey Analyses for 1938 by Cities

Sample No. (1938)	Price, cents per gallon: Gasoline	Price, cents per gallon: Tax	Group	A.S.T.M. Octane No.	Distillation Range: 1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.	Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Colour
HALIFAX, N.S.																			
1	18½	10	II	70	106	153	182	253	294	350	405	98·0	1·1	0·9	1637	0·742	59·2	8·0	Green
2	20½	10	I	77	104	158	183	251	288	342	402	97·5	1·0	1·5	1624	0·741	59·5	7·1	Red
3	18½	10	II	69	104	158	188	256	294	343	407	97·5	1·1	1·4	1646	0·741	59·5	6·6	Purple
4	18½	10	II	71	101	151	177	248	296	349	394	97·0	1·0	2·0	1615	0·739	60·0	9·3	Blue
5	18½	10	II	70	99	149	177	248	295	350	394	97·0	1·0	2·0	1613	0·740	59·7	9·2	Yellow
Average....	.....	.....	.....	.....	103	154	182	251	293	347	400	97·4	1·0	1·6	1627	0·741	59·5	8·0	.....
SAINT JOHN, N.B.																			
6	18½	10	II	69	101	152	180	251	296	351	398	97·0	1·1	1·9	1628	0·743	58·9	7·6	Green
7	18½	10	II	68	103	152	178	251	287	338	379	97·5	1·0	1·5	1585	0·741	59·5	7·8	Green
8	18½	10	II	70	101	158	188	256	290	342	397	97·0	1·2	1·8	1631	0·742	59·2	7·5	Green
9	20	10	I	77	98	157	178	248	295	352	397	97 0	1·0	2·0	1627	0·740	59·7	8·8	Red
10	18½	10	II	68	107	160	189	261	304	352	394	98·0	0·9	1·1	1660	0·753	56·4	6·7	Orange
Average....	.....	.....	.....	.....	102	156	183	253	294	347	393	97·3	1·0	1·7	1626	0·744	58·7	7·7	
MONTREAL, QUE.																			
11	19	6	I	77	100	144	171	247	285	330	371	97·0	0·9	2·1	1548	0·732	61·8	9·1	Red
12	17	6	II	72	97	136	164	252	289	326	366	97·5	0·8	1·7	1533	0·733	61·5	8·6	Green
13	17	6	II	65	97	137	160	245	294	348	394	97·0	0·8	2·2	1578	0·729	62·6	9·5	White
14	19	6	I	78	100	151	180	259	300	346	400	98·0	0·9	1·1	1636	0·743	58·9	8·0	Red
15	17½	6	II	72	100	153	182	260	301	350	401	97·0	1·0	2·0	1647	0·744	58·7	8·3	Green
16	17½	6	II	66	102	157	193	274	312	355	394	98·0	0·8	1·2	1685	0·749	57·4	7·5	White
17	17½	6	II	69	98	143	173	255	304	359	395	97·5	1·0	1·5	1629	0·751	56·9	8·3	Blue
18	17½	6	II	71	96	150	183	265	304	351	409	97·0	1·0	2·0	1662	0·745	58·4	8·5	Green
Average....	.....	.....	.....	.....	99	146	176	257	299	346	391	97·4	0·9	1·7	1615	0·741	59·5	8·5	.....

TABLE II—Concluded

Gasoline Survey Analyses for 1938 by Cities—Concluded

Sample No. (1938)	Price, cents per gallon		Group	A.S.T.M. Octane No.	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Colour
	Gasoline	Tax			1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.								
OTTAWA, ONT.																			
19	21½	6	I	78	98	147	175	251	290	337	378	97·5	0·8	1·7	1578	0·735	61·0	9·1	Red
20	19½	6	II	73	100	159	190	261	301	353	401	97·0	1·0	2·0	1665	0·744	58·7	7·8	Green
21	19½	6	II	71	98	145	174	250	294	338	379	98·0	0·8	1·2	1580	0·735	61·0	7·6	Bronze
22	21½	6	I	79	100	153	182	258	298	347	403	98·0	0·9	1·1	1641	0·744	58·7	6·6	Red
23	19½	6	II	74	106	164	193	263	302	348	399	98·0	1·0	1·0	1669	0·749	57·4	7·2	Green
24	19½	6	II	68	97	154	191	268	306	353	390	97·5	0·8	1·7	1662	0·743	58·9	8·0	White
25	21½	6	I	77	102	156	182	248	290	343	388	98·0	1·0	1·0	1607	0·742	59·2	7·6	Red
26	19½	6	II	72	98	144	171	250	293	338	378	97·5	0·8	1·7	1574	0·734	61·3	9·1	Blue
27	19½	6	II	66	91	127	148	228	281	334	380	97·5	0·8	1·7	1498	0·722	64·5	10·0	White
28	19½	6	II	71	98	147	178	257	305	366	402	97·0	1·1	1·9	1655	0·746	58·2	8·1	Gold
29	19½	6	II	69	95	140	170	260	306	356	394	96·5	1·0	2·5	1626	0·744	58·7	9·6	Blue
30	19½	6	II	72	98	151	183	265	305	352	404	97·0	1·0	2·0	1660	0·745	58·4	7·1	Green
Average					98	149	178	255	298	347	391	97·5	0·9	1·6	1618	0·740	59·7	8·2	
TORONTO, ONT.																			
31	18½	6	II	72	97	148	175	243	286	343	380	97·0	0·9	2·1	1575	0·731	62·1	10·4	Green
32	16	6	III	62	98	150	176	238	277	340	383	97·0	1·0	2·0	1564	0·731	62·1	9·4	White
33	20½	6	I	76	96	148	176	248	294	347	392	97·5	0·9	1·6	1605	0·740	59·7	8·6	Red
34	18½	6	II	72	100	150	180	252	296	348	391	98·0	1·0	1·0	1617	0·736	60·8	9·4	Blue
35	18½	6	III	62	92	138	164	241	288	346	388	97·0	0·8	2·2	1565	0·728	62·9	9·9	White
36	20½	6	I	76	95	142	172	250	298	357	398	97·5	0·8	1·7	1617	0·743	58·9	9·0	Red
37	18½	6	II	71	97	146	174	253	302	363	401	97·0	0·9	2·1	1639	0·744	58·7	9·3	Gold
38	18½	6	II	67	102	166	194	271	312	354	392	98·0	0·9	1·1	1589	0·759	54·9	5·2	Blue
Average					97	149	176	249	294	350	391	97·4	0·9	1·7	1609	0·739	60·0	8·9	

WINNIPEG, MAN.

39	24	7	II	68	98	147	174	249	294	344	382	97·0	0·9	2·1	1590	0·734	61·3	8·8	Green
40	24	7	II	69	100	155	185	251	292	339	393	97·0	1·0	2·0	1615	0·737	60·5	7·4	Green
41	20	7	III	58	104	157	184	248	284	331	371	98·0	0·8	1·2	1575	0·735	61·0	6·6	White
42	24	7	II	71	104	156	183	251	293	345	389	97·5	0·9	1·6	1617	0·741	59·5	7·4	Blue
43	26	7	I	77	98	150	176	243	282	336	386	96·5	1·0	2·5	1573	0·728	62·9	8·8	Red
44	24	7	II	69	103	155	183	250	296	344	386	97·0	1·0	2·0	1614	0·736	60·8	8·1	Green
Average....	.....	.....	.....	.....	101	153	181	249	290	340	384	97·2	0·9	1·9	1597	0·735	61·0	7·9	.....

REGINA, SASK.

45	25½	7	I	77	102	149	175	254	298	348	386	98·0	0·8	1·2	1610	0·740	59·7	8·4	Red
46	23	7	II	70	99	148	176	253	297	348	386	98·0	0·8	1·2	1608	0·737	60·5	8·7	Green
47	23	7	II	71	99	159	185	262	304	355	400	97·5	1·2	1·3	1665	0·742	59·2	8·4	Green
48	20½	7	III	58	99	159	189	255	295	345	385	98·0	0·8	1·2	1628	0·741	59·5	8·5	White
49	23	7	II	70	98	149	178	263	309	357	397	98·0	0·8	1·2	1653	0·743	58·9	8·1	Orange
Average....	.....	.....	.....	.....	99	153	181	257	301	350	391	97·9	0·9	1·2	1633	0·741	59·5	8·4	.....

CALGARY, ALTA.

50	22½	7	I	78	98	147	166	216	247	299	369	98·0	0·8	1·2	1444	0·727	63·1	8·0	Red
51	20	7	II	71	103	149	174	252	299	355	406	98·0	1·2	0·8	1635	0·737	60·5	7·7	Green
52	20	7	II	71	100	145	170	242	288	351	410	97·5	1·1	1·4	1606	0·733	61·5	8·6	Green
53	17½	7	III	59	98	135	156	226	274	339	408	98·0	0·8	1·2	1538	0·725	63·7	9·5	White
54	20	7	II	71	100	153	184	264	308	356	395	98·0	0·8	1·2	1660	0·743	58·9	8·0	
Average....	.....	.....	.....	.....	100	146	170	240	283	340	398	97·9	0·9	1·2	1577	0·733	61·5	8·4	.....

VANCOUVER, B.C.

55	22	7	I	81	100	152	184	261	297	344	401	98·0	1·1	0·9	1639	0·747	57·9	8·3	Red
56	20	7	II	72	100	158	188	254	290	344	402	97·5	1·2	1·3	1636	0·747	57·9	7·5	Green
57	20	7	II	72	94	142	171	252	303	369	405	97·5	0·6	1·9	1642	0·741	59·5	9·0	Gold
58	20	7	II	72	93	134	161	247	297	357	398	98·0	0·8	1·2	1594	0·744	58·7	9·5	Orange
59	22	7	I	81	102	152	185	256	294	344	402	97·5	0·8	1·7	1633	0·747	57·9	7·4	Red
60	20	7	II	72	100	153	185	253	299	352	408	98·0	0·9	1·1	1655	0·749	57·4	6·3	Orange
Average....	.....	.....	.....	.....	98	148	179	255	296	352	403	97·8	0·9	1·3	1633	0·746	58·2	8·0	.....

TABLE III

Average of Gasoline Survey Analyses in Canada from 1923 to 1938

Year	Distillation Range							Recovery %	Residue and distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Sulphur %	Reid vapour pressure, lb.
	1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.							
1923.....	120	170	193	255	296	358	423	97·1	2·9	1695	0·737	60·5	.....	.....
1924.....	113	173	195	249	288	347	410	97·4	2·6	1662	0·736	60·8	.....	.....
1925.....	116	174	199	258	299	359	412	97·0	3·0	1701	0·739	60·0	.....	.....
1926.....	110	164	191	256	300	360	410	97·4	2·6	1681	0·739	60·0	.....	.....
1927.....	107	161	189	259	304	366	416	97·0	3·0	1693	0·741	59·5	.....	.....
1928.....	107	160	186	255	298	359	409	97·3	2·7	1667	0·737	60·5	.....	.....
1929.....	102	153	181	255	300	363	411	97·0	3·0	1663	0·736	60·8	.....	.....
1930.....	101	155	182	254	301	362	406	97·2	2·8	1660	0·741	59·5	0·07	.....
1931.....	104	157	186	258	304	366	406	96·9	3·1	1677	0·741	59·5	0·05	.....
1932.....	102	154	183	254	299	361	408	97·9	2·1	1659	0·742	59·2	.....	7·4
1933.....	101	152	180	252	295	351	396	97·5	2·5	1626	0·739	60·0	.....	6·9
1934.....	101	149	175	247	291	351	395	97·5	2·5	1608	0·738	60·2	.....	7·5
1935.....	101	148	174	243	285	343	393	97·4	2·6	1586	0·735	61·0	0·06	7·7
1936.....	101	150	176	245	286	340	388	97·6	2·4	1585	0·736	60·8	.....	7·7
1937.....	98	149	178	252	297	349	391	97·1	2·9	1616	0·739	60·0	.....	8·0
1938.....	99	150	178	252	295	347	393	97·5	2·5	1615	0·740	59·7	.....	8·2

TABLE IV

Average Analyses of the Three Groups of Gasoline Sold in Canada in 1937

Group	Number of samples	A.S.T.M. octane No.	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Artificially coloured, per cent of samples
			1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.								
I	14	78	99	150	178	250	296	350	392	97·0	1·1	1·9	1616	0·740	59·7	8·2	100
II	39	70	98	150	180	256	300	351	391	97·1	1·0	1·9	1628	0·741	59·5	7·9	92
III	7	60	98	143	168	236	280	336	386	97·1	1·0	1·9	1549	0·725	63·7	8·5	0
Average for all samples	60	.....	98	149	178	252	297	349	391	97·1	1·0	1·9	1616	0·739	60·0	8·0	.....

TABLE V

Average Analyses of the Three Groups of Gasoline Sold in Canada in 1938

Group	Number of samples	A.S.T.M. octane No.	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I	Reid vapour pressure, lb.	Artificially coloured, per cent of samples
			1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.								
I	14	78	100	150	178	249	290	341	391	97·6	0·9	1·5	1599	0·739	60·0	8·2	100
II	41	70	100	150	179	255	298	349	395	97·4	1·0	1·6	1626	0·741	59·5	8·2	90
III	5	60	98	148	174	242	283	340	387	97·6	0·8	1·6	1574	0·732	61·8	8·8	0
Average for all samples	60	.....	99	150	178	252	295	347	393	97·5	0·9	1·6	1615	0·740	59·7	8·2	.....

TABLE VI

Summary of Data of Gasoline Survey Analyses for Canada for 1937

Test	Group I			Group II			Group III		
	Minimum	Range of 90%	Maximum	Minimum	Range of 90%	Maximum	Minimum	Range of 90%	Maximum
Specific gravity	0·729	0·735–0·745	0·748	0·729	0·735–0·748	0·750	0·691	.....	0·742
Degrees A.P.I.	62·6	61·0–58·4	57·7	62·6	61·0–57·7	57·2	73·3	.....	59·2
Reid vapour pressure, lb	6·7	7·0–9·1	9·9	6·0	6·6–9·2	9·5	7·1	.....	9·3
A.S.T.M. Octane No.	76	76–81	81	65	66–73	74	55	.....	64
Distillation range—									
First drop, °F	94	94–104	106	90	92–103	105	92	.....	104
10 per cent, °F	141	143–158	162	133	142–158	162	125	.....	154
20 per cent, °F	166	169–186	189	159	168–190	192	131	.....	183
50 per cent, °F	230	248–256	265	236	242–268	274	156	.....	263
70 per cent, °F	270	286–307	308	280	288–311	323	191	.....	311
90 per cent, °F	322	338–362	366	332	338–363	378	275	.....	363
End point, °F	377	379–397	405	364	380–410	414	359	.....	404
Recovery, per cent	96·5	96·5–97·5	98·0	96·0	96·0–98·0	98·0	96·5	.....	98·0
Residue, per cent	0·9	1·0–1·2	1·3	0·8	0·8–1·2	1·4	0·6	.....	1·2
Distillation loss, per cent	1·0	1·5–2·4	2·5	0·8	1·0–3·0	3·0	0·8	.....	2·9
Index No., °F	1513	1590–1661	1667	1555	1566–1673	1706	1271	.....	1669
Number of samples	.....	14	.....	.....	39	.....	.....	7	.....

TABLE VII

Summary of Data of Gasoline Survey Analyses for Canada for 1938

Test	Group I			Group II			Group III		
	Minimum	Range of 90%	Maximum	Minimum	Range of 90%	Maximum	Minimum	Range of 90%	Maximum
Specific gravity	0·727	0·728–0·747	0·747	0·722	0·731–0·751	0·759	0·725	.....	0·741
Degrees A.P.I.	63·1	62·9–57·9	57·9	64·5	62·1–56·9	54·9	63·7	.....	59·5
Reid vapour pressure, lb.	6·6	7·1–9·1	9·1	5·2	6·6–9·6	10·4	6·6	.....	9·9
A.S.T.M. Octane No.	76	76–81	81	65	66–72	74	58	.....	62
Distillation range—									
First drop, °F.	95	96–102	104	91	94–106	107	92	.....	104
10 per cent, °F.	142	144–157	158	127	136–160	166	135	.....	159
20 per cent, °F.	166	171–184	185	148	161–193	194	156	.....	189
50 per cent, °F.	216	243–259	261	228	243–268	274	226	.....	255
70 per cent, °F.	247	282–298	300	281	287–309	312	274	.....	295
90 per cent, °F.	299	330–352	357	326	338–363	369	331	.....	346
End point, °F.	369	371–402	403	366	379–408	410	371	.....	408
Recovery, per cent.	96·5	97·0–98·0	98·0	96·5	97·0–98·0	98·0	97·0	.....	98·0
Residue, per cent.	0·8	0·8–1·0	1·1	0·6	0·8–1·2	1·2	0·8	.....	1·0
Distillation loss, per cent.	0·9	1·0–2·1	2·5	0·8	1·0–2·1	2·5	1·2	.....	2·2
Index No., °F.	1444	1548–1639	1641	1498	1574–1669	1689	1538	.....	1628
Number of samples	.....	14	.....	.....	41	.....	.....	5	.....

TABLE VIII

Groups** of 28 Brands of Gasoline Sold by 18 Companies in 1937 and 1938

Group I	Group II	Group III	Company or Distributor and Head Office Address (or city from which samples originated)
Peerless Ethyl	Nevr-Nox	*British Motor	British American Oil Co., Ltd., Toronto.
	White Rose No Knock	*White Rose (1937)	Canadian Oil Co., Ltd., Toronto.
	Koolmotor		Cities Service Oil Co., Ltd., Toronto.
		Montana (1937)	Economy Oils, Ltd., (Calgary).
Esso (Imperial Ethyl)	Three Star	*Premier	Imperial Oil, Ltd., Toronto.
	Primrose		Irving Oil Co., Ltd., Saint John.
		Joy (1937)	Joy Oil Co., Ltd., (Toronto).
Cyclo Ethyl	Marathon Blue	*Frontenac (1938)	McColl-Frontenac Oil Co., Ltd., Montreal.
North Star Ethyl (1938)	North Star Green		North Star Oil, Ltd., Winnipeg.
	Fire Chief (1938)		Provincial Oils, Ltd., Saint John.
		Radio (1937)	Radio Oil Refineries, Ltd., (Winnipeg).
Shell Ethyl	Golden Shell		Shell Oil Co. of Canada, Ltd., Toronto.
	Super-Shell		Shell Oil Co. of B.C. Ltd., Vancouver.
	Standard Unsurpassed		Standard Oil Co. of B.C., Ltd., Vancouver.
	Blue Sunoco		Sun Oil Co., Ltd., Toronto.
	Wonder		Supertest Petroleum Corp., Ltd., London.
	Fire Chief		Texas Co. of Canada, Ltd., Calgary.
Union Ethyl	Union "76"		Union Oil Co. of Canada, Ltd., Vancouver.
Average Octane No.....78	Average Octane No.....70	Average Octane No.....60	(The averages were the same in 1937 and 1938)

NOTE:—(1937) or (1938) after a brand indicates that samples were tested *only* in that year.

* In Nova Scotia, New Brunswick, and Quebec, these brands of gasoline are in Group II.

** The group is determined from the average based on tests of a total of 120 samples collected in Canada in August 1937 and in July 1938. The volatility of the individual samples in the three groups, with a few notable exceptions as shown in Tables I and II, does not vary greatly and, therefore the gasolines in each group will be found satisfactory for use in gasoline engines if the compression ratio of the engine in which it is used is not too high. High-compression engines will require either Group II or Group I gasolines. Low-compression engines can use Group III gasolines.