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Gasoline Survey for 1933

BY

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GASOLINE SURVEY FOR 1933

The Division of Fuels and Fuel Testing of the Mines Branch has made at the Fuel Research Laboratories a continuous study of the gasoline sold in Canada for the past ten years, and annual reports (1) have been prepared from the results obtained. This report contains the results in detail of the analysis of 117 samples of gasoline collected (2) from wholesalers and distributors in fifteen cities during August 1933. It was found that the average gasoline sold in Canada was of good quality, with a higher volatility than that sold during any previous year, and that the variation in quality was less than in any previous year. The knock rating of the average gasoline sold in 1933 was 65 Octane number and this rating is estimated to be 3 Octane numbers higher than the knock rating of the average gasoline sold in 1932. According to their knock ratings, the samples collected in 1933 may be divided into four grades. These grades would have average Octane numbers of 76, 69, 62, and 51 respectively; 90·6 per cent of the samples had knock ratings over 56 Octane number. The average Reid vapour pressure of the samples was 6·9 pounds per square inch; 92·2 per cent of the 1933 gasoline samples contained not over 10 milligrams of gum per 100 millilitres. All except one of the gasolines gave a negative corrosion test with a copper strip. Since 1927 there has been an increasing tendency to market artificially coloured gasoline.

METHODS OF ANALYSIS USED

The distillation range was determined according to the American Society for Testing Materials method No. D86-30. The specific gravity was obtained by the use of the chainomatic specific gravity balance at room temperature and the result calculated to 60° F. according to the National Standard Petroleum Oil Tables (3) published by the United States Bureau of Standards. The degrees A.P.I. were obtained by converting the specific gravity according to the above oil tables. The knock ratings of the gasoline were expressed in Octane numbers, and were determined in a Series 30 knock-testing engine, manufactured by the Ethyl Gasoline Corporation. The operating conditions (4) were a speed of 900 r.p.m., a jacket temperature of 345° F., and a spark advance 15 degrees below top dead centre. The Reid vapour pressure was determined according to the A.S.T.M. tentative method No. D323-32T. The gum content was determined in all of the samples collected according to the A.S.T.M. proposed (5) method A and also on part of the samples collected according to the A.S.T.M. proposed method B. The corrosion test was made according to the A.S.T.M. method D130-30. The colour was determined according to the A.S.T.M. tentative method D156-23T, except when the samples were artificially coloured, when the apparent colour is reported.

RESULTS OF LABORATORY EXAMINATION

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 (6).

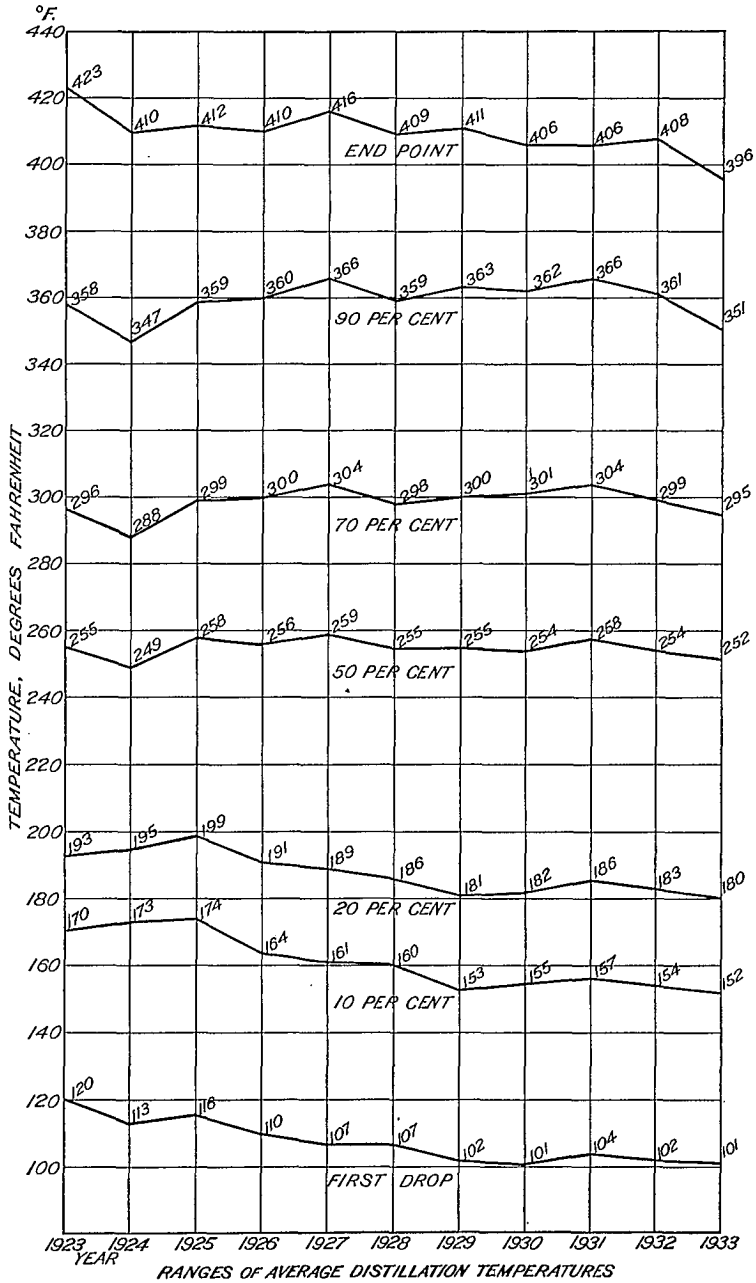
The results of the laboratory examination of the gasoline tested in 1933 are shown by cities in Table I, and the average analyses are summarized in Table II. The average results obtained by examination of samples for the eleven years from 1923 to 1933 are shown in Table III, and Figure I shows graphically the ranges of average distillation temperatures for the same eleven years. In order to determine the variation in quality of the gasoline, the average of the 10 per cent of samples having the highest index numbers and the average of the 10 per cent having the lowest index numbers were calculated for 1933 and the results are shown in Tables IV and V. Table VI shows the difference between the average index numbers of the maximum and minimum 10 per cent of the samples collected in the eleven years, 1923 to 1933. Table VII shows the knock ratings of 61 of the 123 samples of gasoline collected in 1932, as determined by two methods and arranged according to arbitrary grades. Table VIII gives a classification according to knock ratings of the samples collected in 1933 and Table IX shows a classification of the same samples arranged according to average knock ratings in grades. Table X gives a classification of the 1933 samples according to the results of the Reid vapour pressure determination. A classification of the samples collected in 1933 according to their gum content is shown in Table XI; and the gum content, as determined by two methods, of part of the 1933 samples is recorded in Table XII. The percentage of artificially coloured gasoline in the past seven years is shown in Table XIII.

VOLATILITY

It is interesting to compare the results obtained with those obtained in previous years. In Table III are given the average of 88 samples collected in Canada, presumably in 1916 and reported (7) by the laboratories of the Department of Inland Revenue; the average results of the following numbers of samples collected (2) in Canada in successive years from 1923 to 1933 inclusive: 48, 59, 73, 76, 83, 77, 84, 124, 134, 123, and 117. When judged by the distillation range, which has been the ordinarily accepted standard, it will be observed that the gasoline sold in Canada in 1933 shows an average of good quality, with a higher volatility than that sold during any previous year. This increase in volatility is due chiefly to the lowering of the average distillation temperatures of the 90 per cent and end points of the distillation range, which is shown graphically in Figure 1.

Table VI shows the difference between the average index numbers of the maximum 10 per cent and minimum 10 per cent of the samples collected in Canada in the eleven years 1923 to 1933. The difference between the two averages has been used previously for the purpose of comparison, as a measure of the variation in quality. It will be observed that the variation in quality during 1933 was less than in any previous year. This decrease in the difference of the average volatility in the higher and lower groups in the past three years indicates a growing tendency towards a more uniform grade of gasoline.

In 1933 the group having the higher volatility has an average volatility greater than the corresponding groups examined in 1931 and 1932. The group having the lower volatility has an average volatility greater



RANGES OF AVERAGE DISTILLATION TEMPERATURES

Figure 1.

than the corresponding groups examined in any previous year. This indicates that there is a tendency to market a more volatile grade of gasoline.

KNOCK RATINGS

In 1932 the knock ratings of the gasoline were determined in a knock testing engine, manufactured by the Ethyl Gasoline Corporation, known as Series 30. The operating conditions were: a speed of 600 r.p.m., a jacket temperature of 212° F., and a spark advance 22 degrees below top dead centre. In 1933, the knock ratings were determined in the same engine, but the operating conditions were changed to a speed of 900 r.p.m., a jacket temperature of 345° F., and a spark advance 15 degrees below top dead centre. This change in operating conditions was made in order to give knock ratings in fair agreement with actual ratings of fuels in automobiles (4). The knock ratings of the gasoline were expressed in Octane numbers. The petroleum industry now generally uses the engine and the method as developed by a Co-operative Fuel Research Committee in the United States (8).

In order to determine the difference in knock ratings due to the change in operating conditions, 61 of the 123 samples collected in 1932 were tested by both of the above methods. The results are shown in Table VII classified according to knock ratings in Octane numbers at 212° F. and 600 r.p.m. and arranged in four grades, as follows:—

Grade I. Gasolines of high knock ratings with Octane numbers of 73 and over.

Grade II. Gasolines of medium knock ratings with Octane numbers between 72 and 65.

Grade III. Gasolines of low knock ratings with Octane numbers between 64 and 57.

Grade IV. Gasolines of very low or poor knock ratings with Octane numbers of 56 and under.

It will be observed that, owing to the change in operating conditions from 212° F. and 600 r.p.m. to 345° F. and 900 r.p.m., the average difference in knock rating is 2 Octane numbers for Grade I, or from 76 Octane number at 212° F. and 600 r.p.m. to 74 Octane number at 345° F. and 900 r.p.m.; 3 Octane numbers for Grade II, or from 68 to 65 Octane number; 4 Octane numbers for Grade III or from 61 to 57; and 5 Octane numbers for Grade IV or from 56 to 51 Octane number. The average difference in knock rating for all the 61 samples tested was 3 Octane numbers or from 67 to 64 Octane number. Therefore, knock ratings determined at 345° F. and 900 r.p.m. are generally lower than the knock ratings determined at 212° F. and 600 r.p.m., and the lower the grade the greater is the difference in knock ratings.

In 1933, the knock ratings of the gasoline were determined only under operating conditions of 345° F. and 900 r.p.m. The results for individual samples are given in Table I, and Table VIII shows that 11·1 per cent of all the samples are in the range 79 to 75 Octane number; 11·1 per cent in the range 74 to 70; 26·5 per cent in the range 69 to 65; 31·6 per cent in the range 64 to 60; 12 per cent in the range 59 to 55; 6 per cent in the range 54 to 50; and 1·7 per cent in the range 49 to 45. The highest knock

rating was 77 Octane number and the lowest was 46 Octane number. The average knock rating of the 117 samples was 65 Octane number at 345° F. and 900 r.p.m., which is equivalent to 68 Octane number at 212° F. and 600 r.p.m. The average knock rating of the gasoline collected in 1932 was 65 Octane number at 212° F. and 600 r.p.m. Therefore, as indicated by these surveys, the knock ratings of the average gasoline sold in Canada in 1933 was estimated to be 3 Octane numbers higher than the knock rating of the average gasoline sold in 1932. This indicates an improvement in the knock rating of the average gasoline being sold in Canada.

As shown in Table IX, 15 samples, or 12·8 per cent, had an Octane number of 73 and over, with an average Octane number of 76; 42 samples, or 35·9 per cent, had Octane numbers ranging between 72 and 65, with an average Octane number of 69; 49 samples, or 41·9 per cent, had Octane numbers ranging between 64 and 57 with an average Octane number of 62; and 11 samples, or 9·4 per cent, were below 57 with an average Octane number of 51. According to knock ratings only, the 1933 samples may be divided into four grades, namely, Grade I with an average Octane number of 76, Grade II with an average of 69, Grade III with an average of 62, and Grade IV with an average Octane number of 51. The average knock rating of all grades sold in 1933 is better than corresponding grades sold in 1932, when compared according to the same test procedure.

Tetra-ethyl lead was blended with the majority of the gasoline samples in Grade I and Grade II in order to increase their knock ratings, and benzol was added to 2 samples for a similar purpose.

VAPOUR PRESSURE

The average Reid vapour pressure of the gasoline samples collected in Canada during 1933 was 6·9 pounds per square inch. This is a decrease of 0·5 pound per square inch in average vapour pressure from that observed for samples collected in 1932, when the average Reid vapour pressure was 7·4 pounds per square inch. A classification of the 1933 samples according to the results of the Reid vapour pressure determination is shown in Table X. This table shows that 20·5 per cent of the samples had Reid vapour pressures of 6 pounds or less per square inch, 66·7 per cent had between 8 and 6·1 pounds per square inch, and 12·8 per cent of the samples had vapour pressures between 10 and 8·1 pounds. The Reid vapour pressure is used to predict the temperatures at which vapour lock will occur. Vapour lock does not occur in all engines under similar conditions with fuels of the same vapour pressure, and on that account, in the writer's opinion, the Reid vapour pressure should not exceed 10 pounds per square inch. It is to be noted that none of the samples of gasoline collected in 1933 had Reid vapour pressures over 10 pounds per square inch.

GUM

The gum content of motor fuels is determined by evaporating a quantity of the gasoline under an air jet. The method used for all the samples collected was A.S.T.M. proposed method A, which determines the gum content in milligrams per 100 millilitres using a glass dish at 212° F. with air jet. The results are indicative of the amount of gum that may

be deposited if the fuel is used immediately. Unfortunately, it was impossible to test the samples for gum as soon as they were received so that the results of the gum content of this survey indicate not only the actual gum in the samples at the time they were collected but also include the gum formed during four months storage. The determinations were made in duplicate and the average reported to the nearest five milligrams. Those samples that averaged less than 2 milligrams of gum were reported as "nil," since that amount is considered to be negligible.

As shown in Table I and Table XI, the gum content as determined by the above method at 212° F., of 86 samples, or 73·5 per cent of the 117 samples was less than 2 milligrams per 100 millilitres and has, therefore, been reported as nil. Only 31 samples, or 26·5 per cent of the total number collected, were found to contain an appreciable amount of gum. Of these, 14 samples, or 11·9 per cent of all samples, had 5 milligrams of gum; 8 samples, or 6·8 per cent, had 10 milligrams; 2 samples had 15 milligrams; 1 sample had 20; 1 sample had 25; 1 sample had 30 milligrams; and 4 samples, or 3·4 per cent of all samples, had residues over 250 milligrams and were reported as "oily" to indicate that the residues had the appearance of lubricating oil and did not dry to a hard varnish-like or gummy coating, as is usually the case. These four samples appeared to contain lubricating oil, presumably added as a "top lubricant" and which could not be separated from the gum by this method.

As two methods had been proposed by the American Society for Testing Materials for the determination of the gum content of gasoline, it was deemed desirable to test also by method B those samples that showed an appreciable quantity of gum by method A. Method A differs from method B only in the temperature at which the evaporation is made, namely 212° F. for method A and 374° F. for method B. It is to be noted that the samples were in storage for a further period of three months, before being tested by method B, and, therefore, the amount of gum, as shown in this report by this method, includes the gum in the samples as received and also the gum formed during seven months storage.

As shown by Table XII, the gum content as determined by method B was generally less than the gum content as determined by method A. In some cases the gum content as determined by method B was more than the gum content by method A, but this may be due to the gum formed during the additional three months storage. In three of the four samples that contained lubricating oil, the determination by method B apparently removed the lubricating oil and left the gum residue only, whereas in the other sample, some of the lubricating oil remained, and this sample obviously requires special treatment.

The limit of tolerance for multi-cylinder engines has been stated (9) to be not over 10 milligrams per 100 millilitres by method A. The above results show that 92·2 per cent of all the samples collected in 1933, had gum contents less than the above limit, namely not over 10 milligrams.

CORROSION

The corrosion test for motor fuels is made by observing the tarnishing or corroding of a strip of polished copper immersed for three hours in a sample of the gasoline heated to 122° F. according to A.S.T.M. method

No. D 130-30. The copper strip should not show more than a "slight discoloration." The test is intended to show the possible corrosive effect of the gasoline on the metal in the fuel and induction systems of internal combustion engines. As shown in Table I, all but one of the 117 samples collected in 1933 gave a negative test for corrosion, which indicates that little fear of corrosion need be felt with these gasolines at atmospheric temperatures.

As the copper-strip corrosion test depends on time and temperature (10) the test was also made at 212° F. for thirty minutes. Under these conditions nine samples, namely laboratory Nos. 12, 15, 19, 29, 35, 40, 50, 96, and 103, gave a positive test for corrosion, although only one of these samples, namely, laboratory No. 103, had given a positive test at 122° F. for 3 hours. As it is stated (11) that the test at 212° F. is too severe for gasoline, these results are not shown in Table I and are only reported here for record and comparison.

COLOUR

Since 1927 there has been an increasing tendency to colour artificially the gasolines being put on the market. According to the samples examined in the annual survey, the percentage of artificially coloured gasoline sold in Canada during the past seven years, as indicated in Table XIII, was as follows: 10 per cent in 1927; 13 per cent in 1928; 18 per cent in 1929; 26 per cent in 1930; 34 per cent in 1931; 52 per cent in 1932; and 66 per cent in 1933.

SUMMARY AND CONCLUSIONS

In August, 1933, 117 samples of gasoline were collected from fifteen different 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 analysis of the samples has shown that the average gasoline sold during 1933 was of good quality. The average gasoline in 1933 was more volatile than the average gasoline sold in any previous year.

The variation in quality of the average gasoline in 1933 was less than in any preceding year. This indicates a growing tendency towards a more uniform grade of gasoline.

In 1932, the knock ratings of the gasoline were determined in a Series 30 engine at 600 r.p.m. and 212° F. In 1933, the knock ratings of the fuel were determined in a Series 30 engine at 900 r.p.m. and 345° F. This change in operating conditions was made to give knock ratings in fair agreement with actual ratings of gasoline in automobiles. When compared on the same basis of test procedure, the knock ratings of the average gasoline sold during 1933 was estimated to be 3 Octane numbers higher than the knock ratings of the average gasoline sold during 1932.

According to knock ratings only, the 1933 gasoline samples may be divided into four grades, namely, Grade I with an average Octane number of 76; Grade II with an average of 69; Grade III with an average of 62; and Grade IV with an average of 51 Octane number. Slightly over 90 per cent of the 1933 samples were in Grades I, II, and III, with knock ratings in excess of 56.

Tetra-ethyl lead was blended with the majority of the 1933 gasoline samples in Grades I and II, and benzol was added to 2 samples in order to increase their knock ratings.

The average Reid vapour pressure of the 1933 gasoline samples was 6·9 pounds per square inch, a decrease of 0·5 pound from the average Reid vapour pressure of the 1932 gasoline samples. All samples collected in 1933 had Reid vapour pressures less than 10 pounds.

Ninety-two per cent of the 1933 gasoline samples contained not more than 10 milligrams of gum per 100 millilitres, which is considered the safe limit of tolerance for gum in gasoline for use in automobiles. Four of the gasoline samples contained lubricating oil, presumably added as a "top lubricant."

All but one of the 1933 gasoline samples gave a negative test for corrosion with a copper strip.

Since 1927 there has been an increasing tendency to market artificially coloured gasolines. Sixty-six per cent of the gasolines collected in 1933 were artificially coloured.

List of References

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8. American Society for Testing Materials Method No. D 357-33T.
9. Proceedings of the American Society for Testing Materials, 1932, vol. 32, pt. 1, p. 409.
10. United States Bureau of Mines Bull. No. 333, p. 54.
11. Proceedings of the American Society for Testing Materials, 1928, vol. 28, pt. 1, p. 516.

TABLE I

Gasoline Survey Analyses for 1933 by Cities

Sample No.	Distillation Range							Recovery	Residue	Distillation loss	Index No. ° F.	Specific gravity	Degrees A.P.I.	Vapour pressure	Gum, milligrams per 100 millilitres	Corrosion test	Colour, Saybolt	Octane number at 345° F. and 900 r.p.m.
	1st drop ° F.	10% ° F.	20% ° F.	50% ° F.	70% ° F.	90% ° F.	End point ° F.											
HALIFAX, N.S.																		
1	104	155	185	272	313	367	402	97·5	1·3	1·2	1694	0·743	58·9	8·3	25	No	Green	68
2	104	156	186	259	296	347	387	98·0	1·1	0·9	1631	0·740	59·7	6·4	15	No	Red	77
3	104	155	185	260	304	349	389	98·0	1·0	1·0	1642	0·740	59·7	6·3	5	No	+26	59
4	115	164	187	259	306	365	413	98·0	1·2	0·8	1694	0·750	57·2	4·6	5	No	Red	74
5	109	156	180	239	283	340	379	98·0	1·0	1·0	1577	0·746	58·2	6·4	5	No	Blue	68
Average	107	157	185	258	300	354	394	97·9	1·1	1·0	1648	0·744	58·7	6·4	.....	.....	.....	.....
ST. JOHN, N.B.																		
6	110	163	192	261	298	355	400	97·0	1·1	1·9	1669	0·742	59·2	5·3	5	No	+23	60
7	103	148	175	250	292	347	412	97·5	1·6	0·9	1624	0·741	59·5	7·1	300	No	Yellow	61
8	106	146	181	260	298	349	387	97·5	1·1	1·4	1621	0·739	60·0	7·7	Nil	No	Green	68
9	102	154	186	260	302	358	402	97·5	1·2	1·3	1662	0·740	59·7	7·0	Nil	No	+26	59
10	104	151	181	251	296	354	399	97·0	1·2	1·8	1632	0·743	58·9	6·5	Nil	No	Blue	66
Average	105	152	183	256	297	353	400	97·3	1·2	1·5	1641	0·741	59·5	6·7	.....	.....	.....	.....
QUEBEC, QUE.																		
11	102	150	180	257	301	356	399	97·5	1·2	1·3	1643	0·742	59·2	7·3	Nil	No	Green	65
12	104	155	184	260	299	348	397	98·0	1·1	0·9	1643	0·740	59·7	6·4	Nil	No	+21	60
13	104	154	180	244	290	348	407	97·0	1·1	1·9	1623	0·735	61·0	6·7	Nil	No	+30	57
14	100	151	182	258	294	349	387	97·0	1·1	1·9	1621	0·739	60·0	6·6	10	No	Red	76
15	98	150	182	260	296	342	380	97·0	1·2	1·8	1610	0·737	60·5	7·7	10	No	Green	67
6	101	145	166	235	277	334	378	98·0	1·2	0·8	1535	0·735	61·0	7·3	Nil	No	Red	77
Average	102	151	179	252	293	346	391	97·4	1·2	1·4	1612	0·738	60·2	7·0	.....	.....	.....	.....

TABLE I—(Continued)

Gasoline Survey Analyses for 1933 by Cities

Sample No.	Distillation Range							Recovery	Residue	Distillation loss	Index No. °F.	Specific gravity	Degrees A.P.I.	Vapour pressure	Gum, milligrams per 100 millilitres	Corrosion test	Colour, Saybolt	Octane number at 345° F. and 900 r.p.m.
	1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.											
MONTREAL, QUE.																		
17	101	153	186	265	318	380	408	97·0	1·1	1·9	1710	0·743	58·9	6·8	Nil	No	Red	75
18	97	149	178	254	296	349	379	97·0	1·1	1·9	1605	0·736	60·8	7·9	5	No	Green	66
19	102	153	182	260	306	361	422	97·5	1·7	0·8	1684	0·745	58·4	5·5	350	No	Red	76
20	98	149	176	240	279	330	367	97·0	1·1	1·9	1541	0·728	62·9	7·9	10	No	Green	70
21	100	149	176	251	295	354	404	97·0	1·2	1·8	1629	0·740	59·7	6·7	Nil	No	Purple	70
22	102	153	183	261	302	355	402	97·5	1·1	1·4	1656	0·745	58·4	5·8	5	No	+20	63
23	104	158	186	268	307	354	391	98·0	1·2	0·8	1664	0·754	56·2	5·7	Nil	No	Red	75
24	94	143	176	262	309	358	390	97·0	1·2	1·8	1638	0·745	58·4	8·3	Nil	No	Blue	69
25	96	141	168	248	290	345	395	98·0	1·2	0·8	1587	0·738	60·2	7·9	Nil	No	Blue	69
26	99	151	178	255	299	356	407	98·0	1·2	0·8	1646	0·740	59·7	6·9	Nil	No	Green	69
Average	99	150	179	256	300	354	397	97·4	1·2	1·4	1636	0·741	59·5	6·9	.....	.....	.....	.....
OTTAWA, ONT.																		
27	96	141	174	258	302	352	390	97·5	0·9	1·6	1617	0·739	60·0	7·9	Nil	No	+12	62
28	98	148	178	245	285	348	405	97·0	1·2	1·8	1609	0·733	61·5	8·3	Nil	No	+30	57
29	121	167	177	203	240	321	386	98·0	1·0	1·0	1494	0·788	48·1	6·0	5	No	Pink	74
30	102	158	179	232	282	336	397	98·0	1·2	0·8	1584	0·748	57·7	6·6	Nil	No	Green	62
31	100	156	183	248	290	348	397	98·0	1·2	0·8	1622	0·736	60·8	7·3	10	No	+29	57
32	120	178	202	266	314	373	404	98·0	1·2	0·8	1737	0·750	57·2	3·6	5	No	Red	75
33	96	154	185	270	314	372	404	97·0	1·2	1·8	1699	0·742	59·2	7·7	Nil	No	Green	64
34	97	150	180	257	308	372	406	97·0	1·2	1·8	1673	0·737	60·5	7·4	Nil	No	+20	56
35	104	155	184	264	306	359	409	97·5	1·3	1·2	1677	0·744	58·7	6·3	15	No	Red	76
36	100	149	178	258	304	358	404	98·0	1·2	0·8	1651	0·742	59·2	6·4	Nil	No	Green	69
37	101	151	176	248	288	347	407	97·5	1·2	1·3	1617	0·738	60·2	6·9	Nil	No	+27	64
38	94	134	158	222	264	324	383	97·0	1·0	2·0	1485	0·731	62·1	8·4	Nil	No	Green	70
39	101	144	170	242	280	340	394	97·0	1·0	2·0	1570	0·733	61·5	8·6	Nil	No	+26	64
40	105	154	186	264	308	365	430	97·0	1·6	1·4	1707	0·748	57·7	6·1	290	No	Red	76
41	99	148	177	255	299	356	403	97·5	1·2	1·3	1638	0·741	59·5	6·4	Nil	No	Green	69
42	97	143	171	244	286	348	403	97·5	1·2	1·3	1595	0·736	60·8	7·0	Nil	No	+26	65
43	93	144	173	245	288	348	391	97·0	1·0	2·0	1589	0·735	61·0	8·8	Nil	No	+30	61
44	107	165	194	263	305	353	391	98·0	1·1	0·9	1671	0·753	56·4	4·9	10	No	Red	75
45	101	160	190	264	312	369	402	98·0	1·3	0·7	1697	0·743	58·9	6·9	Nil	No	Blue	64
46	97	149	178	252	300	362	398	97·0	1·2	1·8	1639	0·735	61·0	8·9	Nil	No	+29	55
47	97	144	166	236	275	334	378	97·5	1·0	1·5	1533	0·735	61·0	7·1	Nil	No	Red	77
48	96	142	165	237	278	334	382	98·0	1·0	1·0	1538	0·734	61·3	7·3	Nil	No	+30	64
49	92	139	168	248	290	343	392	97·5	1·1	1·4	1580	0·737	60·5	8·2	Nil	No	Blue	69
50	104	156	185	266	309	364	428	97·0	1·6	1·4	1708	0·748	57·7	6·3	350	No	Red	77
51	96	145	172	254	296	352	404	98·0	1·2	0·8	1623	0·738	60·2	7·2	Nil	No	Green	69
52	101	159	184	260	300	356	407	97·5	1·2	1·3	1666	0·742	59·2	6·2	Nil	No	+26	62
Average	101	151	178	250	293	351	400	97·5	1·2	1·3	1623	0·742	59·2	7·0	.....	.....	.....	.....

TORONTO, ONT.

53	95	140	168	239	281	338	376	97·5	1·0	1·5	1542	0·729	62·6	8·5	Nil	No	Green	67
54	100	151	175	244	280	329	368	97·0	1·1	1·9	1547	0·725	63·8	8·0	Nil	No	Green	69
55	104	153	178	236	281	332	367	98·0	1·1	0·9	1547	0·750	57·2	6·5	10	No	+18	62
56	98	149	175	244	280	331	367	97·0	1·1	1·9	1546	0·726	63·4	8·0	10	No	Green	69
57	93	144	176	254	292	336	369	98·0	1·0	1·0	1571	0·734	61·3	7·3	Nil	No	+19	60
58	106	159	186	270	311	364	402	98·0	1·2	0·8	1692	0·753	56·4	5·8	Nil	No	Blue	68
59	100	138	162	233	278	342	383	97·0	1·0	2·0	1536	0·729	62·6	8·4	Nil	No	+30	64
60	98	143	169	247	292	346	397	97·0	1·2	1·8	1594	0·737	60·5	8·2	Nil	No	Blue	68
61	98	153	177	243	279	327	366	97·5	1·2	1·3	1545	0·728	62·9	6·9	Nil	No	Green	69
62	98	155	186	258	293	335	370	98·0	1·2	0·8	1597	0·735	61·0	7·1	5	No	+21	59
Average	99	149	175	247	287	338	376	97·5	1·1	1·4	1572	0·735	61·0	7·5	.....	.....	.....	.....

HAMILTON, ONT.

63	100	154	187	266	312	368	403	97·5	1·3	1·2	1690	0·744	58·7	7·0	Nil	No	Green	62
64	98	148	178	246	290	348	380	97·0	1·0	2·0	1590	0·732	61·8	9·3	Nil	No	+30	58
65	98	149	177	245	283	322	373	97·5	1·1	1·4	1549	0·729	62·6	7·7	Nil	No	Green	67
66	96	151	182	258	293	340	370	97·0	1·1	1·9	1594	0·736	60·8	7·8	Nil	No	+26	60
67	104	156	184	270	306	368	405	97·0	1·2	1·8	1689	0·755	55·9	6·6	5	No	Red	76
68	98	149	180	252	298	349	380	97·0	1·1	1·9	1608	0·738	60·2	9·4	Nil	No	Blue	64
69	96	143	165	236	279	339	379	97·5	1·0	1·5	1541	0·735	61·0	6·7	Nil	No	+30	64
70	100	145	169	239	286	355	405	97·5	1·2	1·3	1599	0·731	62·1	7·3	Nil	No	+30	57
71	97	149	177	244	284	332	368	98·0	0·8	1·2	1554	0·731	62·1	7·1	Nil	No	Green	68
72	96	157	187	258	293	338	373	97·0	1·0	2·0	1606	0·736	60·8	7·1	Nil	No	+26	59
Average	98	150	179	251	292	346	384	97·3	1·1	1·6	1602	0·737	60·5	7·6	.....	.....	.....	.....

LONDON, ONT.

73	100	157	189	272	321	379	406	98·0	1·2	0·8	1724	0·744	58·7	7·1	Nil	No	Green	63
74	94	148	178	251	290	340	382	98·0	1·0	1·0	1589	0·735	61·0	7·1	Nil	No	+27	58
75	96	146	176	254	290	338	380	97·0	1·0	2·0	1584	0·738	60·2	7·7	Nil	No	+22	57
76	99	153	179	243	278	327	378	97·0	1·2	1·8	1558	0·729	62·6	7·1	30	No	Green	68
77	103	153	181	261	310	361	401	98·0	1·2	0·8	1667	0·750	57·2	5·8	5	No	Blue	68
78	94	134	158	228	276	344	387	97·0	1·2	1·8	1527	0·727	63·1	8·7	Nil	No	+27	62
79	98	150	178	240	278	324	366	98·0	1·1	0·9	1536	0·728	62·9	7·5	Nil	No	Green	68
80	100	154	181	242	276	326	367	97·0	1·1	1·9	1546	0·728	62·9	7·5	Nil	No	Violet	69
Average	98	149	178	249	290	342	383	97·5	1·1	1·4	1591	0·735	61·0	7·3	.....	.....	.....	.....

FORT WILLIAM, ONT.

81	98	151	186	270	320	380	408	97·0	1·2	1·8	1715	0·744	58·7	8·4	Nil	No	Green	64
82	103	156	184	243	279	328	372	97·5	1·0	1·5	1562	0·729	62·6	6·6	Nil	No	+28	52
83	96	143	173	245	285	336	383	98·0	1·0	1·0	1565	0·728	62·9	7·8	5	No	Green	62
84	102	157	187	267	309	365	405	97·5	1·1	1·4	1690	0·745	58·4	6·5	Nil	No	Blue	64
85	110	166	194	273	322	375	409	98·0	1·2	0·8	1739	0·749	57·4	5·9	5	No	Green	64
Average	102	154	185	260	303	357	395	97·6	1·1	1·3	1654	0·739	60·0	7·0	.....	.....	.....	.....

TABLE I—(Concluded)

Gasoline Survey Analyses for 1933 by Cities

Sample No.	Distillation Range							Recovery	Residue	Distillation loss	Index No. °F.	Specific gravity	Degrees A.P.I.	Vapour pressure	Gum, milligrams per 100 millilitres	Corrosion test	Colour, Saybolt	Octane number at 345° F. and 900 r.p.m.
	1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.											
WINNIPEG, MAN.																		
86	102	157	188	268	320	377	408	98·0	1·1	0·9	1718	0·746	58·2	6·8	10	No	Green	64
87	102	155	182	249	287	337	383	97·0	1·2	1·8	1593	0·731	62·1	6·7	Nil	No	Green	64
88	99	149	178	241	280	332	376	98·0	1·0	1·0	1556	0·728	62·9	6·9	Nil	No	Green	64
89	104	158	184	249	291	347	401	98·0	1·2	0·8	1630	0·737	60·5	6·2	Nil	No	+20	54
90	106	158	184	245	287	344	403	98·0	1·1	0·9	1621	0·732	61·8	6·7	Nil	No	+30	50
91	105	162	182	234	271	329	385	98·0	1·1	0·9	1563	0·729	62·6	5·6	20	No	Red	71
Average	103	157	183	248	289	344	392	97·8	1·1	1·1	1613	0·734	61·3	6·5	.....	.....	.....	.....
REGINA, SASK.																		
92	104	155	181	242	280	332	388	98·0	1·0	1·0	1578	0·730	62·3	5·7	Nil	No	Green	64
93	113	167	189	250	286	337	386	98·0	1·0	1·0	1615	0·731	62·1	5·7	Nil	No	+29	51
94	110	166	190	260	309	390	462	97·0	1·3	1·7	1777	0·745	58·4	4·6	Nil	No	Green	46
95	99	156	180	243	281	332	385	97·0	1·2	1·8	1577	0·728	62·9	6·2	Nil	No	Green	64
96	104	156	180	257	305	364	404	98·0	1·2	0·8	1666	0·746	58·2	5·3	Nil	No	Yellow	64
Average	106	160	184	250	292	351	405	97·6	1·1	1·3	1642	0·736	60·8	5·5	.....	.....	.....	.....
CALGARY, ALTA.																		
97	104	156	170	208	240	304	376	98·0	1·1	0·9	1454	0·722	64·5	5·5	Nil	No	+30	57
98	104	150	172	239	282	348	406	97·5	1·2	1·3	1597	0·730	62·3	6·5	5	No	Green	64
99	104	152	175	240	284	351	409	97·0	1·2	1·8	1611	0·730	62·3	6·8	Nil	No	Green	64
100	107	155	179	244	289	363	428	97·5	1·3	1·2	1658	0·734	61·3	6·0	Nil	No	+23	51
101	102	149	174	241	284	350	410	97·5	1·2	1·3	1608	0·731	62·1	6·5	Nil	No	Green	63
Average	104	152	174	234	276	343	406	97·5	1·2	1·3	1585	0·729	62·6	6·3	.....	.....	.....	.....

EDMONTON, ALTA.

102	108	159	186	255	304	384	446	97·5	1·2	1·3	1734	0·739	60·0	6·0	Nil	No	+27	49
103	109	155	180	248	306	365	407	98·0	1·3	0·7	1661	0·749	57·4	6·0	Nil	Yes	Red	68
104	109	158	179	238	278	344	413	98·0	1·2	0·8	1610	0·732	61·8	5·9	Nil	No	+23	51
105	106	156	180	244	292	373	439	97·5	1·5	1·0	1684	0·734	61·3	5·8	Nil	No	+26	50
106	106	152	176	241	288	353	416	98·0	1·2	0·8	1626	0·731	62·1	6·4	Nil	No	Green	64
Average	108	156	180	245	294	364	424	97·8	1·3	0·9	1663	0·737	60·5	6·0	.....	.....	.....	.....

VANCOUVER, B.C.

107	98	156	186	263	303	358	396	97·5	1·0	1·5	1662	0·751	56·9	7·4	Nil	No	+20	69
108	100	153	193	280	323	381	414	97·0	1·3	1·7	1744	0·754	56·2	6·6	Nil	No	Violet	63
109	98	152	187	276	320	383	417	97·0	1·2	1·8	1735	0·752	56·7	7·4	Nil	No	Green	70
110	100	153	188	277	322	381	415	97·5	1·2	1·3	1736	0·753	56·4	7·0	Nil	No	Green	70
111	103	167	191	245	290	358	401	98·0	1·1	0·9	1652	0·743	58·9	5·0	Nil	No	Yellow	70
112	102	152	188	278	323	382	419	98·0	1·1	0·9	1742	0·754	56·2	6·3	Nil	No	Red	69
Average	100	155	189	270	314	374	410	97·5	1·2	1·3	1712	0·751	56·9	6·6	.....	.....	.....	.....

VICTORIA, B.C.

113	98	149	184	272	320	379	418	98·0	1·2	0·8	1722	0·753	56·4	7·0	Nil	No	Green	70
114	102	154	192	274	324	383	414	97·0	1·3	1·7	1741	0·753	56·4	6·7	Nil	No	Green	70
115	108	152	178	255	296	352	395	97·0	1·2	1·8	1628	0·744	58·7	6·5	Nil	No	+26	69
116	102	166	191	246	291	362	400	97·0	1·1	1·9	1656	0·744	58·7	5·2	Nil	No	Yellow	70
117	99	148	183	274	320	382	415	97·0	1·2	1·8	1722	0·751	56·9	7·0	Nil	No	Red	70
Average	102	154	186	264	310	372	408	97·2	1·2	1·6	1694	0·749	57·4	6·5	.....	.....	.....	.....

TABLE II

Average of Gasoline Survey Analyses for Cities for 1933

City	Distillation Range							Recovery	Residue	Distillation loss	Index No. ° F.	Specific gravity	Degrees A.P.I.	Vapour pressure	Octane number at 345° F. and 900 r.p.m.
	1st drop ° F.	10% ° F.	20% ° F.	50% ° F.	70% ° F.	90% ° F.	End point ° F.								
Halifax, N.S.	107	157	185	258	300	354	394	97·9	1·1	1·0	1648	0·744	58·7	6·4	.....
Saint John, N.B.	105	152	183	256	297	353	400	97·3	1·2	1·5	1641	0·741	59·5	6·7	.....
Quebec, Que.	102	151	179	252	293	346	391	97·4	1·2	1·4	1612	0·738	60·2	7·0	.....
Montreal, Que.	99	150	179	256	300	354	397	97·4	1·2	1·4	1636	0·741	59·5	6·9	.....
Ottawa, Ont.	101	151	178	250	293	351	400	97·5	1·2	1·3	1623	0·742	59·2	7·0	.....
Toronto, Ont.	99	149	175	247	287	338	376	97·5	1·1	1·4	1572	0·735	61·0	7·5	.....
Hamilton, Ont.	98	150	179	251	292	346	384	97·3	1·1	1·6	1602	0·737	60·5	7·6	.....
London, Ont.	98	149	178	249	290	342	383	97·5	1·1	1·4	1591	0·735	61·0	7·3	.....
Fort William, Ont.	102	154	185	260	303	357	395	97·6	1·1	1·3	1654	0·739	60·0	7·0	.....
Winnipeg, Man.	103	157	183	248	289	344	392	97·8	1·1	1·1	1613	0·734	61·3	6·5	.....
Regina, Sask.	106	160	184	250	292	351	405	97·6	1·1	1·3	1642	0·736	60·8	5·5	.....
Calgary, Alta.	104	152	174	234	276	343	406	97·5	1·2	1·3	1585	0·729	62·6	6·3	.....
Edmonton, Alta.	108	156	180	245	294	364	424	97·8	1·3	0·9	1663	0·737	60·5	6·0	.....
Vancouver, B.C.	100	155	189	270	314	374	410	97·5	1·2	1·3	1712	0·751	56·9	6·6	.....
Victoria, B.C.	102	154	186	264	310	372	408	97·2	1·2	1·6	1694	0·749	57·4	6·5	.....
Average (117 samples)*	101	152	180	252	295	351	396	97·5	1·2	1·3	1626	0·739	60·0	6·9	65

*This is the average value for all the samples tested.

TABLE III

Annual Averages of Gasoline Survey Analyses for Canada

Year	Distillation Range							Recovery	Residue and distillation loss	Index No. ° F.	Specific gravity	Degrees A.P.I.	Sulphur	Vapour pressure	Octane No. at	
	1st drop ° F.	10% ° F.	20% ° F.	50% ° F.	70% ° F.	90% ° F.	End point ° F.								212° F. and 600 r.p.m.	345° F. and 900 r.p.m.
1916	125	170	192	237	270	330	380	.....	.....	1579	0·732	61·8	.....	.....	.....	.....
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	65	.....
1933	101	152	180	252	295	351	396	97·5	2·5	1626	0·739	60·0	.....	6·9	68*	65

*Estimated.

TABLE IV

Ten per cent of Samples Having Maximum Index Numbers* in 1933

Sample No.	Index No. ° F.	Distillation Range							Recovery %	Residue %	Distillation loss %	Vapour pressure
		1st drop ° F.	10% ° F.	20% ° F.	50% ° F.	70% ° F.	90% ° F.	End point ° F.				
94	1777	110	166	190	260	309	390	462	97·0	1·3	1·7	4·6
108	1744	100	153	193	280	323	381	414	97·0	1·3	1·7	6·6
112	1742	102	152	188	278	323	382	419	98·0	1·1	0·9	6·3
114	1741	102	154	192	274	324	383	414	97·0	1·3	1·7	6·7
85	1739	110	166	194	273	322	375	409	98·0	1·2	0·8	5·9
32	1737	120	178	202	266	314	373	404	98·0	1·2	0·8	3·6
110	1736	100	153	188	277	322	381	415	97·5	1·2	1·3	7·0
109	1735	98	152	187	276	320	383	417	97·0	1·2	1·8	7·4
102	1734	108	159	186	255	304	384	446	97·5	1·2	1·3	6·0
73	1724	100	157	189	272	321	379	406	98·0	1·2	0·8	7·1
113	1722	98	149	184	272	320	379	418	98·0	1·2	0·8	7·0
117	1722	99	148	183	274	320	382	415	97·0	1·2	1·8	7·0
Average	1738	104	157	190	271	319	381	420	97·5	1·2	1·3	6·3

TABLE V

Ten per cent of Samples Having Minimum Index Numbers* in 1933

Sample No.	Index No. ° F.	Distillation Range							Recovery %	Residue %	Distillation loss %	Vapour pressure
		1st drop ° F.	10% ° F.	20% ° F.	50% ° F.	70% ° F.	90% ° F.	End point ° F.				
97	1454	104	156	170	208	240	304	376	98·0	1·1	0·9	5·5
38	1485	94	134	158	222	264	324	383	97·0	1·0	2·0	8·4
29	1494	121	167	177	203	240	321	386	98·0	1·0	1·0	6·0
78	1527	94	134	158	228	276	344	387	97·0	1·2	1·8	8·7
47	1533	97	144	166	236	275	334	378	97·5	1·0	1·5	7·1
16	1535	101	145	166	235	277	334	378	98·0	1·2	0·8	7·3
79	1536	98	150	178	240	278	324	366	98·0	1·1	0·9	7·5
59	1536	100	138	162	233	278	342	383	97·0	1·0	2·0	8·4
48	1538	96	142	165	237	278	334	382	98·0	1·0	1·0	7·3
20	1541	98	149	176	240	279	330	367	97·0	1·1	1·9	7·9
69	1541	96	143	165	236	279	339	379	97·5	1·0	1·5	6·7
53	1542	95	140	168	239	281	338	376	97·5	1·0	1·5	8·5
Average	1522	99	145	167	230	270	331	379	97·5	1·1	1·4	7·4

TABLE VI

Difference Between Maximum and Minimum Index Numbers*

Year	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Maximum, 10%.....	1791	1806	1821	1815	1823	1791	1773	1787	1774	1760	1738
Minimum, 10%.....	1500	1428	1497	1524	1518	1488	1503	1471	1547	1531	1522
Difference.....	291	378	324	291	305	303	270	316	227	229	216

*The index number is the sum of the following points in the distillation range, 10%, 20%, 50%, 70%, 90%, and the end point.

TABLE VII

Knock Ratings of Gasoline Samples* in 1932 Determined by Two Methods and Arranged According to Arbitrary Grades

Grade	Sample No. 1932	Octane number Series 30 Engine		Difference in Octane number due to change in method of testing
		212° F. and 600 r.p.m.	345° F. and 900 r.p.m.	
I. Octane number (at 212° F. and 600 r.p.m.) 73 and above.	17	77	74	3
	24	77	75	2
	29	77	75	2
	53	77	75	2
	14	76	74	2
	19	76	74	2
	37	76	76	0
	32	75	75	0
	116	75	75	0
	3	74	72	2
	6	74	72	2
	47	74	72	2
	41	73	71	2
Average for Grade I (13 samples).....	.....	76	74	2
II. Octane number (at 212° F. and 600 r.p.m.) 72 to 65.	84	72	70	2
	35	71	66	5
	25	70	67	3
	54	70	68	2
	66	69	66	3
	4	69	66	3
	9	69	67	2
	38	69	66	3
	62	68	64	4
	42	68	65	3
	2	68	65	3
	68	68	65	3
	15	68	66	2
	23	68	64	4
	63	68	65	3
	34	68	66	2
	60	68	63	5
	16	67	63	4
	30	67	64	3
	51	67	61	6
	5	66	62	4
	11	66	62	4
	18	66	62	4
	48	66	64	2
	46	65	61	4
	58	65	61	4
Average for Grade II (26 samples).....	.....	68	65	3

TABLE VII—(Concluded)

Knock Ratings of Gasoline Samples* in 1932 Determined by Two Methods and Arranged According to Arbitrary Grades

Grade	Sample No. 1932	Octane number Series 30 Engine		Difference in Octane number due to change in method of testing
		212° F. and 600 r.p.m.	345° F. and 900 r.p.m.	
III. Octane number (at 212° F. and 600 r.p.m.) 64 to 57.	1	64	61	3
	36	64	61	3
	40	64	61	3
	45	64	60	4
	7	63	59	4
	26	63	60	3
	55	63	60	3
	33	62	58	4
	70	61	56	5
	49	61	57	4
	21	61	58	3
	27	61	56	5
	28	61	57	4
	39	61	58	3
	13	60	56	4
	50	60	56	4
	52	60	56	4
	88	60	55	5
	31	59	55	4
	44	59	56	3
	43	58	54	4
Average for Grade III (21 samples).....	.....	61	57	4
IV. Octane number (at 212° F. and 600 r.p.m.) 56 and below.	99	56	51	5
Average for Grade IV (1 sample).....	.....	56	51	5
Average for all (61) samples.....	.....	67	64	3

*Only 61 of the 123 samples were tested by both methods.

TABLE VIII

Classification of Samples According to Knock Ratings in 1933

City	Octane numbers (Series 30 Engine at 345° F. and 900 r.p.m.)							Total number of samples
	79 to 75	74 to 70	69 to 65	64 to 60	59 to 55	54 to 50	49 to 45	
Halifax	1	1	2	.....	1	.....	.....	5
Saint John	.....	.....	2	2	1	.....	.....	5
Quebec	2	.....	2	1	1	.....	.....	6
Montreal	3	2	4	1	.....	.....	.....	10
Ottawa	6	2	5	9	4	.....	.....	26
Toronto	.....	.....	6	3	1	.....	.....	10
Hamilton	1	.....	2	4	3	.....	.....	10
London	.....	.....	4	2	2	.....	.....	8
Fort William	.....	.....	.....	4	.....	1	.....	5
Winnipeg	.....	1	.....	3	.....	2	.....	6
Regina	.....	.....	.....	3	.....	1	1	5
Calgary	.....	.....	.....	3	1	1	.....	5
Edmonton	.....	.....	1	1	.....	2	1	5
Vancouver	.....	3	2	1	.....	.....	.....	6
Victoria	.....	4	1	.....	.....	.....	.....	5
Total number of samples	13	13	31	37	14	7	2	117
Per cent of total	11·1	11·1	26·5	31·6	12·0	6·0	1·7	100

Knock rating (Octane No.), average for all samples 65
Knock rating (Octane No.), highest sample 77
Knock rating (Octane No.), lowest sample 46

TABLE IX

Classification of the 1933 Samples According to Four Arbitrary Octane Number Grades

City	Grade I, 73 and above Octane No. (at 345° F. and 900 r.p.m.)		Grade II, 72 to 65 Octane No. (at 345° F. and 900 r.p.m.)		Grade III, 64 to 57 Octane No. (at 345° F. and 900 r.p.m.)		Grade IV, 56 and below Octane No. (at 345° F. and 900 r.p.m.)		Total number of samples
	Number of samples	Average Octane number	Number of samples	Average Octane number	Number of samples	Average Octane number	Number of samples	Average Octane number	
Halifax	2	76	2	68	1	59	.....	.....	5
Saint John	.....	.....	2	67	3	60	.....	.....	5
Quebec	2	77	2	66	2	59	.....	.....	6
Montreal	3	75	6	69	1	63	.....	.....	10
Ottawa	7	76	6	69	11	62	2	56	26
Toronto	.....	.....	6	68	4	61	.....	.....	10
Hamilton	1	76	2	68	7	61	.....	.....	10
London	.....	.....	4	68	4	60	.....	.....	8
Fort William	.....	.....	.....	.....	4	64	1	52	5
Winnipeg	.....	.....	1	71	3	64	2	52	6
Regina	.....	.....	.....	.....	3	64	2	49	5
Calgary	.....	.....	.....	.....	4	62	1	51	5
Edmonton	.....	.....	1	68	1	64	3	50	5
Vancouver	.....	.....	5	70	1	63	.....	.....	6
Victoria	.....	.....	5	70	.....	.....	.....	.....	5
Number of samples in grade	15	.....	42	.....	49	.....	11	.....	117
Per cent of total samples	12·8	.....	35·9	.....	41·9	.....	9·4	.....	100
Average Octane No. for grades	.....	76	.....	69	.....	62	.....	51	.....

TABLE X

Classification of Samples According to Results of Reid Vapour Pressure Determination in 1933

City	Reid vapour pressure, pounds per square inch							Total
	10·0 to 9·1	9·0 to 8·1	8·0 to 7·1	7·0 to 6·1	6·0 to 5·1	5·0 to 4·1	4·0 to 3·1	
Halifax	.....	1	.....	3	.....	1	.....	5
Saint John	.....	.....	2	2	1	.....	.....	5
Quebec	.....	.....	3	3	.....	.....	.....	6
Montreal	.....	1	3	3	3	.....	.....	10
Ottawa	.....	6	7	10	1	1	1	26
Toronto	.....	3	4	2	1	.....	.....	10
Hamilton	2	.....	5	3	.....	.....	.....	10
London	.....	1	6	.....	1	.....	.....	8
Fort William	.....	1	1	2	1	.....	.....	5
Winnipeg	.....	.....	.....	5	1	.....	.....	6
Regina	.....	.....	.....	1	3	1	.....	5
Calgary	.....	.....	.....	3	2	.....	.....	5
Edmonton	.....	.....	.....	1	4	.....	.....	5
Vancouver	.....	.....	2	3	.....	1	.....	6
Victoria	.....	.....	.....	4	1	.....	.....	5
Total	2	13	33	45	19	4	1	117
Per cent of total	1·7	11·1	28·2	38·5	16·2	3·4	0·9	100

Reid vapour pressure, average for all samples ..... 6·9
Reid vapour pressure, highest sample ..... 9·4
Reid vapour pressure, lowest sample ..... 3·6

TABLE XI

Classification of Samples According to Gum Content in 1933

City	Gum content in milligrams per 100 millilitres by method A. (glass dish with air jet at 212° F.)								Total
	Over 250 (oily)	30	25	20	15	10	5	Nil	
Halifax	.....	.....	1	.....	1	.....	3	.....	5
Saint John	1	.....	.....	.....	.....	.....	1	3	5
Quebec	.....	.....	.....	.....	.....	2	.....	4	6
Montreal	1	.....	.....	.....	.....	1	2	6	10
Ottawa	2	.....	.....	.....	1	2	2	19	26
Toronto	.....	.....	.....	.....	.....	2	1	7	10
Hamilton	.....	.....	.....	.....	.....	.....	1	9	10
London	.....	1	.....	.....	.....	.....	1	6	8
Fort William	.....	.....	.....	.....	.....	.....	2	3	5
Winnipeg	.....	.....	.....	1	.....	1	.....	4	6
Regina	.....	.....	.....	.....	.....	.....	.....	5	5
Calgary	.....	.....	.....	.....	.....	.....	1	4	5
Edmonton	.....	.....	.....	.....	.....	.....	.....	5	5
Vancouver	.....	.....	.....	.....	.....	.....	.....	6	6
Victoria	.....	.....	.....	.....	.....	.....	.....	5	5
Total	4	1	1	1	2	8	14	86	117
Per cent of total	3·4	0·9	0·9	0·9	1·7	6·8	11·9	73·5	100

TABLE XII

Gum Content of Gasoline Samples* in 1933 Determined by Two Methods

Sample No.	Gum content in milligrams per 100 millilitres	
	By method A (212° F.)	By method B (374° F.)
5	5	Nil
22	5	Nil
32	5	Nil
62	5	Nil
67	5	Nil
77	5	Nil
3	5	5
6	5	5
18	5	5
29	5	5
83	5	5
98	5	5
4	5	10
85	5	10
20	10	Nil
15	10	5
31	10	5
44	10	5
14	10	10
55	10	10
56	10	10
86	10	10
35	15	5
2	15	10
91	20	15
1	25	5
76	30	5
40	290 (oily)	15
7	300 (oily)	115 (oily)
19	350 (oily)	15
50	350 (oily)	15

*Only those samples that showed an appreciable quantity of gum by method A were tested by method B.

TABLE XIII

Percentage of Artificially Coloured Gasolines in Different Years

Year	Artificially coloured gasolines %
1927	10
1928	13
1929	18
1930	26
1931	34
1932	52
1933	66