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DEPARTMENT OF MINES AND RESOURCES
HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

MINES AND GEOLOGY BRANCH
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GASOLINE SURVEYS FOR 1935 AND 1936

BY

P. V. Rosewarne and H. McD. Chantler

Price, 25 cents

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The Division of Fuels of the Bureau of Mines has made, at the Fuel Research Laboratories, a continuous study of the gasoline sold in Canada for the past twelve years, and annual reports have been prepared from the results obtained. During the early part of August in 1935, 179 samples of gasoline were collected, and during the early part of August in 1936, 180 samples were collected from the wholesale dealers and distributors in fifteen cities. This report contains the results in detail of the analyses of these 359 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 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 following points in the distillation range, 10 per cent, 20 per cent, 50 per cent, 70 per cent, 90 per cent, and the end point. The acidity of the gasoline was tested according to Method No. 510-2 of the U.S. Federal Specification Board.[3] 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 Oil Tables.[4] The degrees A. P. I. were obtained by converting the specific gravity according to the above tables. The knock ratings of the gasoline were expressed in octane numbers, and were determined according to A.S.T.M. tentative method D357-36T.[5] The Reid vapour pressure was determined according to the A.S.T.M. tentative method D323-32T. The gum content was made according to A.S.T.M. tentative method D381-34T. The sulphur content was determined according to A.S.T.M. tentative method D90-34T, except that a modified apparatus[6] was used. The corrosion test was made according to A.S.T.M. method D130-30. The colour was determined according to A.S.T.M. tentative method D156-34T, except that the apparent colour is reported when the sample was artificially coloured. The tetraethyl lead content was determined by analysis, according to the method used in the Ethyl Gasoline Corporation Laboratories.

RESULTS OF LABORATORY EXAMINATION

The results of the laboratory examination of the gasoline tested in 1935 are shown by cities in Table I. This table gives data on A.S.T.M. octane number, tetraethyl lead content, distillation characteristics, specific and A.P.I. gravity, Reid vapour pressure, sulphur content, gum content,

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and colour. It shows, also, the price and tax per gallon, the group of each sample, and the average analysis for each city. Table II gives similar analyses for 1936. The average results obtained by examination of samples for the fourteen years 1923 to 1936 are shown in Table III, and Figure 1 shows graphically the ranges of average distillation temperature for the same fourteen years. Figure 2 shows the comparison between the average distillation curves for the year 1931 and 1936. Tables IV and V give the average analyses of the three groups of gasoline sold in Canada in 1935 and 1936. In Table VI the data of the gasoline survey analyses for 1935 are summarized in a statement of the minimum and maximum figure for each characteristic of each of the three groups of gasolines and in a range of figures covering 90 per cent of the samples in each group. A similar summary for the gasoline survey analyses for 1936 is given in Table VII. Table VIII shows the group of 67 brands of gasoline sold by 33 companies in 1935, and Table IX shows the group of 66 brands of gasoline sold by 33 companies in 1936. The octane numbers of 31 of the gasoline samples for 1935, as determined in two different knock-testing engines, are given in Table X. The tetraethyl lead content of gasoline samples in 1935, according to two groups, is shown in Table XI.

CHANGES IN CHARACTERISTICS OF MOTOR FUELS

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 was given in the report on "Gasoline Survey for 1930-31."[7] Since then rapid advance has been made in the design of motors, so that a short discussion of the effect of these changes on the gasoline being sold is in order. Probably the most important change in the design of gasoline engines is that by which the overall efficiency of the engine has been materially increased by raising the compression ratio,[8] or in other words, by compressing the gasoline and air mixture in the combustion chamber to a greater extent before igniting it. This improvement in design was only practicable when motor fuels that burn smoothly under the higher pressures were available for general use. It was followed by other improvements, engines being produced having a high compression ratio but operating satisfactorily on fuels of lower knock rating than formerly thought possible. At the same time gasoline manufacturers were studying fuels more closely, especially with regard to the relation between knock rating and the source of the crude oil from which the gasoline was made, between knock rating and the various fractions that go to make up a satisfactory commercial gasoline, and between knock rating and the products of different methods of production and refining.

One result has been that oil companies now place on the market several grades of gasoline, usually three, differing principally in knock rating, sold at different prices, and generally distinguished from one another by being dyed different colours, and by being given a different trade name. The reason for the three grades appears to have been a reluctance on the part of owners of older automobiles to pay the premium for a higher class fuel, giving very little increased efficiency to their engines not designed for high compression.

These fundamental changes were accompanied by research on the type of engine best suited for testing the fuel and distinguishing between the different grades. A number of engines were proposed but at length an engine designed and sold by the Ethyl Gasoline Corporation, which had taken a very active part in the development and marketing of high anti-knock fuels, was adopted. It was known as Series 30 Ethyl Gasoline Knock-Testing Unit, a later modification being Series 30B. Most of those interested in the problem formed a co-operative fuel research committee which advocated the adoption of a new engine incorporating many improvements. This engine as finally approved is known as the Co-operative Fuel Research Engine, or more briefly, as the "C.F.R." engine. The general approval given the "C.F.R." engine was largely due to the fact that it rated fuels more like the rating that would be given by an automobile engine under actual driving conditions.

Another problem was to select a material as a standard for comparison of the various fuels. This material would be required to have definite characteristics, relatively constant for a considerable period of time, and should be available at a reasonable price. The most suitable material was found to be a mixture of two substances, namely, iso-octane and normal heptane, definite chemical compounds, liquid at ordinary temperatures, miscible with each other in all proportions, and obtainable in a high state of purity, although not very cheaply. The normal heptane causes an ordinary engine of low compression ratio to knock very badly when it is used alone as a fuel, but the iso-octane does not cause knocking unless the compression ratio of the engine is very high. When the two liquids are mixed and used as fuel the point at which knocking occurs upon increasing the compression ratio, is approximately proportional to the relative quantity of iso-octane and normal heptane present in the fuel mixture. In other words, the higher the percentage of iso-octane present the higher the compression ratio of the engine can be raised. The tendency of ordinary gasoline to cause knocking is estimated by comparison with various blends of iso-octane and normal heptane. The higher the octane number the less likely the fuel is to knock. An octane number of 100 is equivalent to the knock rating of pure iso-octane and no normal heptane. Conversely, an octane number of 0 is equivalent to the knock rating of normal heptane with no iso-octane.

SPECIFICATIONS AND REGULATIONS

One consequence of our better knowledge of the behaviour of gasoline in an engine has been the desire to set up minimum standards of quality for gasoline offered for sale to the public. At the present time standards have been set in Canada by the provinces of Nova Scotia, New Brunswick, and Quebec. These standards will undoubtedly need periodic revision in order that the best results may be secured.

The province of Nova Scotia has enacted[9] that only three grades of gasoline may be sold as fuel for internal combustion engines and that of these the two better grades may be sold for use in automobiles. The grades are distinguished principally by the octane number. For grade 1 the octane number shall be not less than 75, for grade 2 not less than 66, and for

grade 3 may be less than 66. Grade 1 and grade 2 have the same distillation range and that of grade 3 is somewhat higher, i.e. grade 3 gasoline is less volatile than grades 1 and 2. Other requirements such as sulphur content, corrosive action, freezing point, vapour pressure, gum, and specific gravity are the same for all three grades. The vapour pressure and distillation range are somewhat modified for gasoline for winter use and the freezing point requirement applies only to winter gasoline.

The regulations[10] for the province of Quebec are not quite so stringent as five grades of gasoline are recognized and no restrictions are imposed regarding the type of engine in which they may be used. Grades 1 and 2 are practically identical with similar grades in Nova Scotia. The Quebec grade 3 has a minimum octane number of 56, and grade 4 has an octane number of less than 56. Distillation range and other requirements are similar to those for grade 3 in Nova Scotia. Grade 5 is gasoline which does not meet the specifications for grades 1, 2, 3, or 4, and yet is capable of generating power.

The regulations[11] for the province of New Brunswick are similar to those for the province of Quebec, except that there is no grade 5.

A specification, which appears to be defined sufficiently clearly to ensure the purchaser's receiving a satisfactory product and yet allow him all reasonable choice, has been adopted by the Canadian Government Purchasing Standards Committee for the supply of motor gasoline to Dominion Government departments. A copy of it is attached as an appendix.

PURPOSE OF THE GASOLINE SURVEY

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 pre-determined grades; the object was for the analyses themselves to indicate fairly definitely the limits of the different groups of gasoline on the market. The limits found do not entirely agree with those set out in the specifications discussed above, but are in reasonable conformity with them.

According to the analyses of the gasoline samples collected in Canada in 1935 and 1936, 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 was 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.

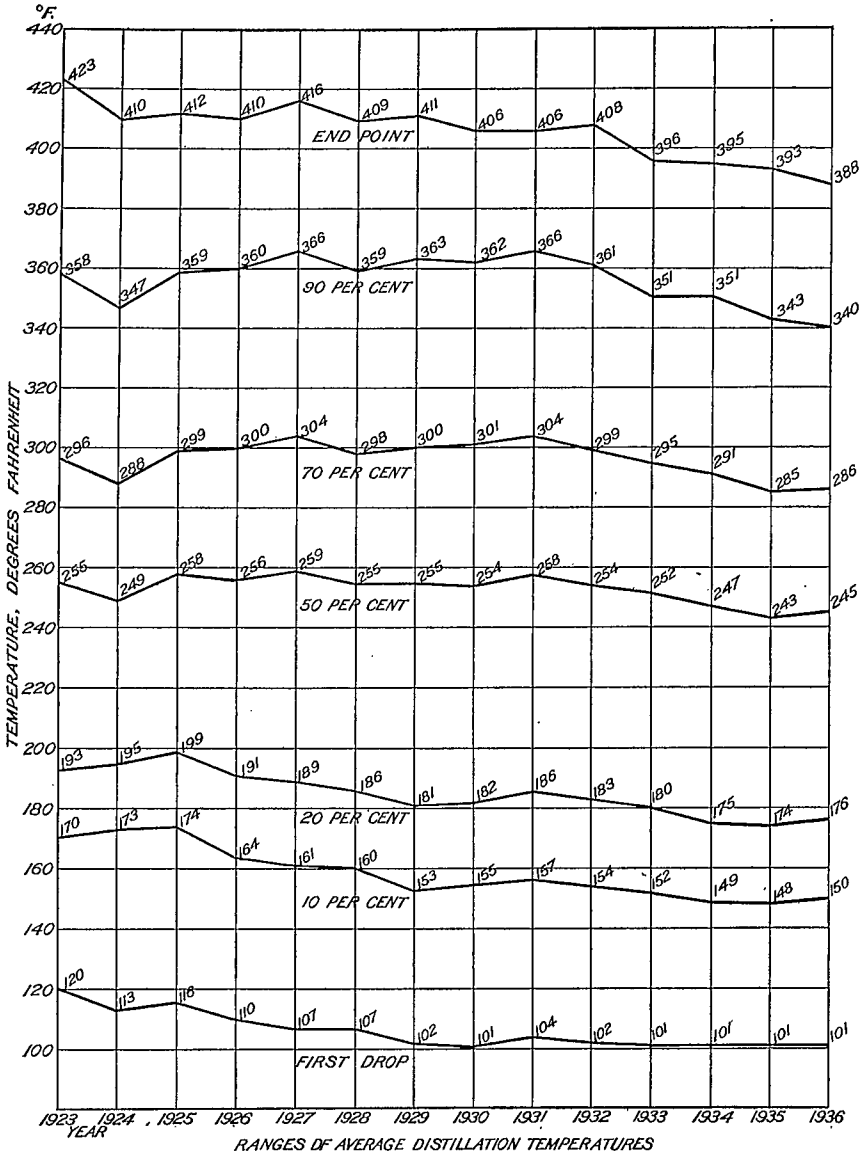
°F.
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
TEMPERATURE, DEGREES FAHRENHEIT
END POINT
423 410 412 410 416 409 411 406 406 408 396 395 393 388
90 PER CENT
358 347 359 360 366 359 363 362 366 361 351 351 343 340
70 PER CENT
296 288 299 300 304 298 300 301 304 299 295 291 285 286
50 PER CENT
255 249 258 256 259 255 255 254 258 254 252 247 243 245
20 PER CENT
193 195 199 191 189 186 181 182 186 183 180 175 174 176
10 PER CENT
170 173 174 164 161 160 153 155 157 154 152 149 148 150
FIRST DROP
120 113 116 110 107 107 102 101 104 102 101 101 101 101
1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936
YEAR
RANGES OF AVERAGE DISTILLATION TEMPERATURES

Figure 1

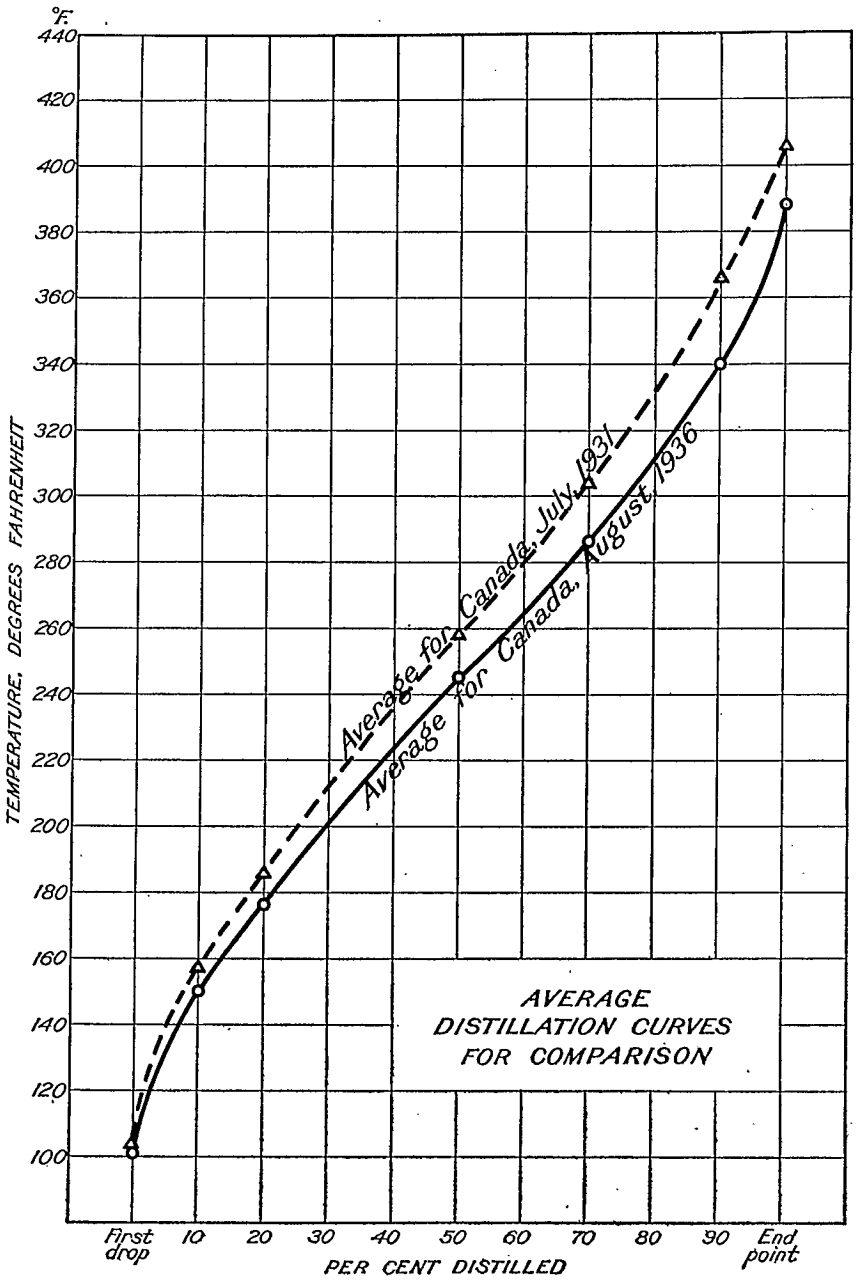
°F.
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
TEMPERATURE, DEGREES FAHRENHEIT
Average for Canada, July, 1931
Average for Canada, August, 1936
AVERAGE
DISTILLATION CURVES
FOR COMPARISON
First drop
10
20
30
40
50
60
70
80
90
End point
PER CENT DISTILLED

Figure 2

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 recently recognized, and because of the publicity given it.

The average volatility of gasoline sold in Canada during the past fourteen years indicates that a motor fuel of higher volatility is now being marketed generally throughout the country. Comparison of the results, as shown graphically in Figure 1, indicates that the average volatility for the year 1935 was higher than that of any previous year since these surveys have been made. The average volatility for the year 1936 was practically the same as that in 1935. Figure 2 shows the comparison between the distillation curves for the years 1931 and 1936, and indicates the marked increase in volatility in the past five years. This definite trend has been accelerated during recent years by progress in the control of the reaction by which petroleum oils are "cracked" or broken up so that the demand for any particular product may be more easily met, and by the realization that the more volatile fractions are important in producing a finished article that has a higher and more consistent knock rating.

Another interesting feature brought out is the very evident trend towards uniformity of the fuels being sold. This continues to be true despite the larger number of brands of gasoline on the market. 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 tendency on the part of the refiners to work towards a uniform volatility particularly for their "Premium" and "Regular" gasolines, but the adoption of the specifications referred to above has undoubtedly given the movement an added impetus.

The gasoline sold in the cities of Regina, Calgary, and Edmonton is more volatile than the gasoline sold in the other cities in Canada. This is undoubtedly due to blending with the natural gasoline being produced at Turner Valley.

KNOCK RATINGS

In 1935, a new knock-testing engine known as the Co-operative Fuel Research Engine, or more briefly as the "C.F.R." engine, was installed in the Fuel Research Laboratories. The knock rating of the samples collected in 1935 and 1936 was determined with this engine according to the A.S.T.M. tentative method D357-36T and the results were expressed in octane numbers.

According to the knock rating only, the 1935 and 1936 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 Table I and the group in which each sample falls is also noted in this table. In 1935, the highest knock rating was 80 octane number and the lowest was 47 octane number. In 1936 the highest knock rating was 81 octane number and the lowest was 46 octane number.

As shown in Table IV, in 1935, the average octane number of the samples in the above three groups was as follows: 76 for Group I, 68 for Group II, and 57 for Group III. In 1936, according to Table V, 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. This indicates an improvement in octane numbers of all three groups of gasoline sold in 1936 as compared to 1935.

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 67 brands of gasoline sold by 33 companies in 1935, and Table IX gives a similar classification by groups of 66 brands of gasoline sold by 33 companies in 1936. An improvement was noted in the knock rating of several of the brands of gasoline sold by oil companies in 1936, when compared with similar brands sold in 1935; several brands which were in Group III in 1935 had changed to Group II in 1936. The samples from the same brand of gasoline were more uniform and also usually maintained a higher octane number.

In 1934, the knock rating of the gasoline was determined in a Series 30B engine at 900 r.p.m. and at 345° F.[12] In 1935, the knock rating of the gasoline was determined in a "C.F.R." engine by the A.S.T.M. method. The knock rating of 31 of the gasoline samples collected in 1935 was determined in both engines by the above-mentioned methods. The results expressed in octane numbers are shown in Table X. The "C.F.R." engine rating differs from the Series 30B rating by 0 to 2 octane numbers for gasolines in Groups I and II, but the ratings differ by 1 to 4 octane numbers for gasolines in Group III. The "C.F.R." engine rating for Group III gasolines is usually higher than the Series 30B rating.

TETRAETHYL LEAD AND BENZOL

Tetraethyl lead was blended with the majority of the gasolines in Group I and Group II, in 1935 and 1936, in order to increase their knock rating. Table XI shows the tetraethyl lead content in Group I and Group II of the gasoline samples collected in 1935, and Table I shows the tetraethyl lead content of the individual samples. In Group I, the maximum tetraethyl lead content was 3·72 cubic centimetres; the minimum was 1·50 cubic centimetres, and the average content was 2·48 cubic centimetres per Imperial gallon. In Group II, the maximum tetraethyl lead content was 1·88 cubic centimetres, the minimum was 0·18 cubic centimetre, and the average content was 0·98 cubic centimetre per Imperial gallon.

Benzol, which is also blended with gasoline in order to increase the knock rating, was added to two samples in Group II in 1935, and in 1936 was added to one sample in Group I and one sample in Group II.

VAPOUR PRESSURE

The Reid vapour pressure test is used as a safeguard to minimize fire hazard in the transportation of gasoline, and also to indicate the temperature at which vapour lock[13] 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 doubtfully regarded.

In 1935, only 2 of the 179 samples collected had a vapour pressure of more than 10 pounds per square inch. Both were obtained from Toronto, one having a vapour pressure of 11·9 pounds and the other having 12 pounds. The lowest vapour pressure, namely 4·7 pounds, was obtained from the sample from Saint John, N.B. The average vapour pressure for all the samples in 1935 was 7·7 pounds per square inch.

In 1936, 4 of the 180 samples collected had a vapour pressure of more than 10 pounds per square inch. One sample from Toronto had a vapour pressure of 10·3 pounds, two from Edmonton had 10·5 and 10·9 pounds respectively, and one from Saint John had a vapour pressure of 11·1 pounds per square inch. The lowest vapour pressure, namely 5·4 pounds, was obtained from a sample from Halifax. The average vapour pressure for all samples collected in 1936 was the same as in 1935, namely 7·7 pounds per square inch.

GUM

The amount of gum in motor fuels is important. Excessive gum causes valves and piston-rings to stick and the engine to operate unsatisfactorily. In exceptional cases carburettor jets and fuel lines may be affected. Unfortunately, the amount of gum usually increases after the fuel has been in storage for some time. The amount of gum which may be formed during storage for a given length of time is of great importance to refiners and wholesale dealers, and tests have been devised that indicate more or less satisfactorily this potential gum-forming tendency of gasoline. The gum shown in this report is the amount in the gasoline when examined.

On the samples of gasoline collected in August 1935, the determinations were made between November 1935 and February 1936, or after storage of, roughly, five months. The amount of gum was determined by evaporating a quantity of gasoline under a jet of warm air. The results were reported to the nearest 5 milligrams. Those samples containing less than 2 milligrams were reported as "nil," that amount being considered negligible. In 1935 an increasing proportion of the samples were found to contain a small amount of lubricating oil to serve as a "top-lubricant" during use of the fuel. When this oil is present it interferes with the determination of gum to such an extent that a different method has to be adopted. In this report samples containing top-lubricant are reported under the column for gum simply as being "oily."

Gum determinations were not made on the samples collected in 1936.

The gum content for each sample collected in 1935 is shown in Table I; 39 of the 179 samples collected in 1935 contained lubricating oil, pre-

sumably added as "top-lubricant." The gum content of 106 samples was less than 2 milligrams per 100 millilitres and has, therefore, been reported as "nil." Only 34 of the samples containing no "top-lubricant" were found to contain an appreciable amount of gum. Of these 34 samples, 22 had 5 milligrams of gum, 9 had 10 milligrams, 2 had 15 milligrams, and only 1 had 30 milligrams.

The limit of tolerance for multi-cylinder engines has been stated[14] to be not over 10 milligrams per 100 millilitres. The above results indicate that only three of the samples tested in 1935 contained sufficient gum to cause unsatisfactory operation in the engine.

SULPHUR

All commercial gasolines contain certain compounds having a small amount of sulphur. Some of these materials are detrimental to the engine and some are not. Those that are injurious combine with copper or brass to form a grey or a black coating, which, if severe, may become a scale that flakes off and clogs the small carburettor jets. After fuel containing sulphur is burned an acid substance is formed that has a tendency to pit and corrode the polished steel and iron surfaces of the engine bearings, especially those not thoroughly lubricated. It has become an accepted practice for the refiner to reduce the sulphur content to less than 0·10 per cent of sulphur. In some cases it may be possible to permit a higher percentage of sulphur without harm but the difficulty lies in being able to determine readily whether the sulphur is present in an injurious form. The above limit has been adopted as safe by a number of representative organizations.

The average sulphur content of the gasoline samples collected in Canada in 1935 was 0·06 per cent. Only 18 samples of the 179 samples tested had a sulphur content exceeding 0·10 per cent. Two of these eighteen samples were from eastern Canada and sixteen were from western Canada; the majority were gasolines in Group III from the cities of Calgary and Edmonton.

CORROSION

The corrosion test for motor fuels is made by immersing a strip of polished copper for three hours in a sample of the gasoline heated to 122° F., according to A.S.T.M. method D130-30, and observing the tarnishing or corrosion that takes place. The copper strip should not show more than a "slight discoloration." The test[15] is intended to show the possible corrosive effect of the gasoline on the metal in the fuel and induction systems of internal combustion engines. The corrosion test was made only on the samples collected in 1935. All but 2 of the 179 samples gave a negative test for corrosion, showing little need for fear of corrosion with these gasolines at atmospheric temperatures. The two samples which gave a positive corrosion test in 1935 were sample No. 147 from Calgary and sample No. 157 from Edmonton.

In 1935, the acidity of the gasoline was also tested according to the U.S. Bureau of Mines method 510·2. This test involves extracting the distillation residue with water and testing the extract for acidity with an

indicator. All gasoline samples collected in 1935 gave a negative test for acidity, showing that they had been properly treated at the refinery to remove free acid, such as sulphuric acid, before being delivered to the consumer.

GRAVITY

The specific gravity and gravity in degrees A.P.I. for each sample collected in 1935 and 1936 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, and it is only of value when used in conjunction with the distillation 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. As indicated by the results of these surveys, the specific gravity of the gasoline sold in summer usually varies from 0·720 to 0·755 with a corresponding variation in degrees A.P.I. from about 65 to 56. Turner Valley naphtha gasoline sold in Alberta in 1936 had a specific gravity of about 0·695, or an A.P.I. gravity of about 72. When motor fuels contain an appreciable amount of benzol, the specific gravity is usually higher. The four samples that contained benzol in 1935 and 1936 had a specific gravity varying from 0·761 to 0·788 with corresponding variation in degrees A.P.I. from about 54 to 48.

COLOUR

Gasoline is a clear, water-white liquid when freshly distilled. In 1935 the Saybolt colour number was determined for all samples not artificially coloured. The higher the Saybolt number, the lighter, or "whiter" is the colour of the gasoline. It will be noted that the 1935 samples had colour numbers from +12 to +30 Saybolt; but it is difficult to draw any clear-cut distinctions between motor fuels on the basis of colour. In 1936, for samples that were not artificially coloured, the colour was simply reported as "white."

Many gasolines on the market have small quantities of various dyes 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. Since 1927, there has been an increasing tendency to dye the motor fuels being put on the market. The apparent colour of the samples containing dye is reported in Tables I and II. As shown in Table IV, of the samples collected in 1935, 100 per cent of the Group I gasolines, 74 per cent of the Group II, and only 16 per cent of the Group III gasolines were artificially coloured. As shown in Table V, of the samples collected in 1936, 100 per cent of the Group I gasolines, 81 per cent of the Group II, and only 7 per cent of the Group III gasolines were artificially coloured. The oil companies and distributors are therefore colouring their motor fuels in order to distinguish different brands or grades; the general tendency is to dye only Group I and Group II gasolines, and to leave colourless or "white" the Group III gasolines, which are usually termed "Third Grade."

PRICE

In 1935, the samples were collected from July 30 to August 7, except in Ottawa, when the samples were taken from July 16 to 18. In 1936, the samples were collected from August 6 to 18. The retail price and the Provincial tax at the time each sample was taken are shown in Table I for 1935 and in Table II for 1936. Generally speaking, in Canada in 1935 and 1936, the retail price of the "Premium" or Group I gasoline was two cents higher than the retail price of the "Regular" or Group II gasoline, 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 1935 and 1936 in several cities, Group II and Group III gasolines sold at the same price. As shown in Table I, in Canada in August, 1935, the highest retail price excluding tax was 28·2 cents in Edmonton, and the lowest retail price was 11 cents in Montreal. As shown in Table II, in Canada in August, 1936, the highest retail price excluding tax was 30 cents in Edmonton, and the lowest retail price was 12 cents in Montreal, but at that time a price war was stated to affect the price in Montreal. The Provincial tax in 1935 and 1936 varied from 6 to 8 cents per gallon, depending on the province in which the gasoline was purchased.

SUMMARY AND CONCLUSIONS

The gasoline surveys for 1935 and 1936 comprised the collection and analyses of 359 samples. The samples for each survey were collected in August, 179 coming from fifteen cities in 1935 and 180 from the same cities in 1936. 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 67 different brands of motor fuels in 1935 and 66 brands in 1936.

The analyses of the samples has shown that the average gasoline during 1935 and 1936 was of good quality. The average gasoline in 1935 was more volatile than the average gasoline sold in any previous year. The volatility of the average gasoline in 1936 was practically the same as in 1935.

Three groups of gasoline are being sold in Canada, according to the analysis of the 1935 and 1936 gasoline samples. These groups differ principally in knock rating, as the average volatility of all groups is practically the same. They are usually known as "Premium" or Group I, "Regular" or Group II, and "Third Grade" or Group III. In 1935, the average knock rating of Group I gasoline was 76 octane number, of Group II was 68 octane number, and of Group III gasoline was 57 octane number. The average octane number of corresponding groups of gasoline in 1936 was 77 for Group I, 69 for Group II, and 60 for Group III. This indicates an improvement in the average knock ratings of the three groups of gasoline sold in Canada. Tables are included which show the group of 67 different brands of gasoline in 1935 and 66 brands in 1936.

Tetraethyl lead was blended with the majority of the gasolines in Group I and Group II in 1935 and 1936, and benzol was added to two samples in 1935 and two samples in 1936, in order to increase their knock

ratings. In 1935, the average tetraethyl lead content for Group I gasoline was 2·5 c.c. per Imperial gallon and for Group II was 1 c.c. per Imperial gallon.

The gasoline samples collected in 1935 and 1936 had the same average Reid vapour pressure, namely 7·7 pounds per square inch. All but two of the samples collected in 1935 and four of those collected in 1936 had Reid vapour pressures less than 10 pounds.

Only three of the samples collected in 1935 contained more than 10 milligrams of gum per 100 millilitres, which is considered the usual limit of tolerance for gum in gasoline for use in automobiles. Thirty-nine of these samples contained lubricating oil, presumably added as "top-lubricant."

The average sulphur content of the gasoline samples collected in 1935 was 0·06 per cent. This amount is considerably less than the amount usually accepted as the limit for good gasoline, viz. 0·10 per cent. Only 18 of the 179 samples collected in 1935 exceeded the above limit and of these the majority were from the cities of Calgary and Edmonton.

All but two of the samples collected in 1935 gave a negative test for corrosion with a copper strip and all the samples gave a negative test for acidity.

As indicated by these surveys the specific gravity of gasoline usually varies in summer from about 0·720 to 0·755 with a corresponding variation in degrees A.P.I. from about 65 to 56.

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 during the first two weeks in August, is shown for each sample of gasoline. In 1935, the highest retail price shown was 28·2 cents per Imperial gallon and the lowest retail price shown was 11 cents per Imperial gallon; and in 1936 the highest shown was 30 cents and the lowest shown was 12 cents. The Provincial tax varies from 6 to 8 cents per gallon depending on the province in which the gasoline is sold.

Summaries of the data of the characteristics of the gasoline collected in 1935 and 1936 are included.

The Specification for Gasoline of the Canadian Government Purchasing Standards Committee is attached as an Appendix.

REFERENCES

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TABLE I

Gasoline Survey Analyses for 1935 by Cities

Sample No. (1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milligrams per 100 millilitres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.										
HALIFAX, N.S.																						
1	24	8	I	76	1·70	100	148	176	239	275	339	407	97·0	1·6	1·4	1584	0·733	61·5	7·6	0·02	Oily	Red
2	22	8	II	68	0·41	104	150	177	246	289	351	404	97·0	1·4	1·6	1617	0·738	60·2	7·0	0·07	Oily	Green
3	22	8	II	65	.....	102	150	171	221	254	322	380	98·0	1·1	0·9	1498	0·728	62·9	7·3	0·04	Nil	+25
4	24	8	I	75	1·51	106	153	178	238	273	335	402	97·0	1·6	1·4	1579	0·733	61·5	7·2	0·02	Oily	Red
5	22	8	II	68	0·41	104	153	180	252	294	350	401	97·0	1·5	1·5	1630	0·740	59·7	7·4	0·06	Oily	Green
6	22	8	III	52	0·60	98	154	182	254	298	355	416	97·5	1·4	1·1	1659	0·742	59·2	7·1	0·07	Oily	Purple
7	22	8	II	65	.....	104	145	172	242	288	350	392	98·0	1·0	1·0	1589	0·734	61·3	7·3	0·05	10	White
8	22	8	II	70	1·04	96	144	172	244	290	350	388	96·5	1·0	2·5	1588	0·730	62·3	9·6	0·04	Nil	Blue
9	22	8	II	66	.....	102	142	167	245	289	348	400	97·5	0·9	1·6	1591	0·735	61·0	7·7	0·07	5	+17
10	22	8	II	69	.....	108	146	171	246	293	355	390	98·0	0·8	1·2	1601	0·743	58·9	7·4	0·13	10	Blue
Average.	.....	.....	.....	.....	.....	102	148	175	243	284	346	398	97·4	1·2	1·4	1594	0·736	60·8	7·6	0·06	.....	.....
SAINT JOHN, N.B.																						
11	22	8	II	68	0·77	96	140	172	248	294	351	377	97·0	0·8	2·2	1582	0·734	61·3	8·9	0·02	Nil	Green
12	22	8	III	57	.....	120	176	200	263	302	351	402	98·0	1·0	1·0	1694	0·748	57·7	4·7	0·05	5	+16
13	22	8	III	61	.....	110	162	198	268	304	351	402	98·0	1·0	1·0	1685	0·744	58·7	6·4	0·02	Nil	+26
14	22	8	II	69	0·46	107	151	180	252	293	352	409	97·5	1·2	1·3	1637	0·738	60·2	7·4	0·06	Oily	Green
15	22	8	III	61	.....	106	158	194	270	302	352	400	97·0	1·2	1·8	1676	0·744	58·7	7·0	0·02	Nil	+29
16	24	8	I	75	1·67	107	154	181	250	289	344	407	97·0	1·6	1·4	1625	0·738	60·2	7·1	0·02	Oily	Red
17	22	8	III	59	0·51	104	151	176	244	292	356	400	97·0	1·1	1·9	1619	0·740	59·7	6·9	0·05	Oily	Purple
18	22	8	III	61	.....	105	164	194	262	302	352	401	98·0	1·1	0·9	1675	0·746	58·2	5·3	0·03	Nil	+26
19	24	8	I	75	1·69	106	154	182	251	284	342	404	98·0	1·6	0·4	1617	0·738	60·2	6·8	0·02	Oily	Red
20	22	8	II	68	0·70	108	154	180	249	292	347	396	98·0	1·0	1·0	1618	0·741	59·5	6·2	0·08	10	Blue
Average.	.....	.....	.....	.....	.....	107	156	186	256	295	350	400	97·5	1·2	1·3	1643	0·741	59·5	6·7	0·04	.....	.....

TABLE I—Continued

Gasoline Survey Analyses for 1935 by Cities—Continued

Sample No. 1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range							Recov-ery %	Resi-due %	Dis-tilla-tion loss %	Index No. °F.	Specific gravity	De-grees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milli-grams per 100 milli-litres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.										
QUEBEC, QUE.																						
21	24	6	I	75	2·47	94	137	168	242	290	348	384	97·0	1·1	1·9	1569	0·736	60·8	8·7	0·06	Nil	Red
22	22	6	II	70	0·78	96	141	169	244	293	352	394	96·5	1·2	2·3	1593	0·736	60·8	8·7	0·07	5	Green
23	22	6	II	65	.....	98	139	162	244	292	351	398	97·0	1·0	2·0	1586	0·735	61·0	8·1	0·06	5	+26
24	24	6	I	76	1·63	97	151	179	248	285	340	407	97·0	1·7	1·3	1610	0·737	60·5	7·5	0·03	Oily	Red
25	22	6	II	68	0·51	98	150	180	254	296	355	411	97·5	1·5	1·0	1646	0·742	59·2	6·8	0·04	Oily	Green
26	22	6	III	60	.....	98	144	175	249	292	348	398	97·0	1·0	2·0	1606	0·740	59·7	7·4	0·07	10	Green
27	21	6	II	70	0·79	97	140	166	244	290	349	394	97·0	0·9	2·1	1583	0·737	60·5	8·4	0·07	Nil	Blue
28	21	6	II	65	.....	95	134	159	242	288	352	399	96·5	0·8	2·7	1574	0·733	61·5	8·7	0·09	Nil	+16
29	22	6	II	66	.....	96	137	161	225	267	328	378	97·0	0·9	2·1	1496	0·730	62·3	7·8	0·05	Nil	+20
Average.	.....	.....	.....	.....	.....	97	141	169	244	288	347	396	97·0	1·1	1·9	1585	0·736	60·8	8·0	0·06	.....	.....
MONTREAL, QUE.																						
30	19	6	I	76	2·49	96	152	177	246	294	357	391	97·0	1·0	2·0	1617	0·736	60·8	8·7	0·03	Nil	Red
31	17	6	II	66	0·83	97	145	175	248	298	359	394	97·0	1·0	2·0	1619	0·736	60·8	8·7	0·01	Nil	Green
32	11	6	III	62	.....	98	145	174	254	299	353	388	97·0	0·9	2·1	1613	0·739	60·0	8·4	0·04	Nil	+23
33	17	6	II	69	0·18	103	154	176	230	280	344	408	97·5	1·5	1·0	1592	0·761	54·4	6·9	0·07	Oily	Purple
34	17	6	II	66	.....	96	144	176	253	295	342	388	97·0	1·0	2·0	1598	0·739	60·0	7·7	0·06	Nil	+24
35	19	6	I	74	1·70	102	157	189	256	296	351	421	97·0	1·8	1·2	1670	0·745	58·4	6·3	0·04	Oily	Red
36	17	6	II	69	0·63	100	152	184	257	299	352	414	97·0	1·4	1·6	1658	0·742	59·2	7·4	0·04	Oily	Green
37	17	6	II	65	.....	98	156	182	258	297	346	388	97·0	1·0	2·0	1627	0·742	59·2	7·7	0·07	Nil	+16
38	11	6	II	65	.....	96	148	178	254	294	343	388	97·5	1·0	1·5	1605	0·739	60·0	7·6	0·06	Nil	+12
39	17	6	II	69	1·79	105	159	185	260	307	359	402	97·5	1·2	1·3	1672	0·743	58·9	6·4	0·05	Oily	Blue
40	12½	6	III	60	.....	102	157	182	247	284	335	378	97·5	0·8	1·7	1583	0·736	60·8	7·4	0·05	5	Red
41	17	6	II	67	.....	96	146	176	252	292	342	389	97·5	1·2	1·3	1597	0·743	58·9	7·4	0·11	5	Blue
42	17	6	II	69	0·61	100	162	191	262	302	356	418	97·0	1·4	1·6	1691	0·749	57·4	6·4	0·04	Oily	Green
43	17	6	II	66	.....	101	149	180	256	297	345	388	97·0	1·0	2·0	1615	0·741	59·5	6·8	0·07	Nil	+12
Average.	.....	.....	.....	.....	.....	99	152	180	252	295	349	397	97·2	1·1	1·7	1625	0·742	59·2	7·4	0·05	.....	.....

TABLE I—Continued

Gasoline Survey Analyses for 1935 by Cities—Continued

Sample No. (1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milligrams per 100 millilitres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.										
OTTAWA, ONT.																						
44	19	6	II	66	0·58	102	145	180	256	298	360	410	96·5	1·4	2·1	1649	0·741	59·5	8·5	0·05	Oily	Gold
45	17	6	III	60	.....	102	157	190	264	303	358	406	97·0	1·0	2·0	1678	0·743	58·9	6·9	0·01	Nil	+30
46	21	6	II	72	.....	118	164	179	210	260	337	393	98·0	0·9	1·1	1543	0·788	48·1	5·8	0·10	5	Pink
47	19	6	II	65	.....	103	152	184	260	300	353	403	97·5	1·1	1·4	1652	0·745	58·4	7·1	0·04	Nil	Green
48	19	6	III	59	.....	102	157	192	263	303	359	405	97·0	1·0	2·0	1679	0·743	58·9	6·9	0·02	Nil	Blue
49	21	6	I	76	2·35	101	151	180	248	293	348	378	97·0	1·0	2·0	1598	0·734	61·3	8·1	0·01	Nil	Red
50	19	6	II	68	0·63	100	146	172	249	294	354	382	97·5	1·0	1·5	1597	0·736	60·8	8·7	0·02	Nil	Green
51	19	6	III	59	.....	97	145	174	246	294	351	383	97·0	1·0	2·0	1593	0·733	61·5	9·1	0·01	Nil	+27
52	19	6	II	64	.....	107	154	180	252	296	350	383	98·0	1·0	1·0	1615	0·741	59·5	7·5	0·02	Nil	+24
53	21	6	I	74	1·64	105	157	188	256	295	350	413	97·5	1·8	0·7	1659	0·742	59·2	7·1	0·03	Oily	Red
54	19	6	II	71	0·62	96	147	178	254	294	354	408	97·0	1·4	1·6	1635	0·740	59·7	8·1	0·04	Oily	Green
55	19	6	II	65	.....	103	147	171	250	293	348	383	98·0	0·8	1·2	1592	0·740	59·7	8·2	0·05	Nil	White
56	16	6	III	59	.....	101	146	177	242	287	349	390	97·5	1·0	1·5	1591	0·735	61·0	8·2	0·02	Nil	+24
57	21	6	I	74	2·36	100	145	175	244	287	348	391	98·0	1·0	1·0	1590	0·735	61·0	8·4	0·02	Nil	Red
58	19	6	II	68	1·58	104	159	188	259	301	354	392	98·0	1·0	1·0	1653	0·738	60·2	7·3	0·04	Nil	Green
59	19	6	III	60	.....	100	150	182	260	302	357	401	97·0	1·2	1·8	1652	0·739	60·0	7·8	0·02	Nil	+27
60	21	6	I	75	1·83	106	158	186	258	296	353	419	97·0	1·8	1·2	1670	0·743	58·9	7·3	0·04	Oily	Red
61	19	6	II	70	0·53	102	148	178	258	298	356	407	97·0	1·4	1·6	1645	0·742	59·2	7·9	0·02	Oily	Green
62	19	6	III	59	.....	107	156	192	264	300	356	404	98·0	1·2	0·8	1672	0·743	58·9	6·7	0·03	Nil	+30
63	16	6	III	59	.....	96	145	172	244	286	348	391	97·0	1·0	2·0	1586	0·733	61·5	8·7	0·03	Nil	+27
64	21	6	I	75	2·42	104	152	179	245	289	346	388	97·0	1·1	1·9	1599	0·734	61·3	8·1	0·01	Nil	Red
65	19	6	II	69	0·63	100	146	174	249	295	354	383	97·0	1·0	2·0	1601	0·736	60·8	8·7	0·02	Nil	Blue
66	19	6	III	59	.....	99	148	178	249	296	354	384	97·0	1·0	2·0	1609	0·734	61·3	8·8	0·01	Nil	+30
67	21	6	I	76	1·93	100	143	169	238	283	343	400	97·5	1·0	1·5	1576	0·738	60·2	7·9	0·03	Nil	Red
68	19	6	II	66	.....	98	136	160	229	274	334	383	97·5	1·0	1·5	1516	0·731	62·1	8·0	0·04	Nil	+27
69	19	6	II	65	.....	100	146	176	253	292	341	382	97·0	1·2	1·8	1590	0·741	59·5	7·3	0·09	15	Blue
70	21	6	I	75	1·85	107	162	190	255	295	353	417	97·0	1·8	1·2	1672	0·746	58·2	6·5	0·03	Oily	Red
71	19	6	II	69	0·80	104	156	190	262	303	357	416	97·0	1·6	1·4	1684	0·748	57·7	6·6	0·02	Oily	Green
72	19	6	III	61	.....	104	159	191	266	299	350	394	97·0	1·0	2·0	1659	0·744	58·7	6·9	0·01	5	+24
73	19	6	II	65	.....	104	158	188	259	297	347	394	98·0	1·1	0·9	1643	0·745	58·4	7·0	0·07	Nil	+25
Average.	.....	.....	.....	.....	.....	102	151	180	251	294	351	396	97·3	1·2	1·5	1623	0·741	59·5	7·7	0·03	.....	.....

TABLE I—Continued

Gasoline Survey Analyses for 1935 by Cities—Continued

Sample No. (1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milligrams per 100 millilitres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.										
TORONTO, ONT.																						
74	17½	6	III	59	.....	97	150	177	242	283	336	371	97·0	1·0	2·0	1559	0·731	62·1	8·6	0·01	Nil	+30
75	19	6	II	67	0·45	98	140	170	244	290	341	374	97·5	1·0	1·5	1559	0·733	61·5	8·1	0·04	Nil	Green
76	21	6	I	75	2·55	98	154	177	233	284	347	388	97·0	0·9	2·1	1583	0·730	62·3	7·8	0·03	Nil	Red
77	19	6	II	67	1·35	102	146	170	244	294	355	394	98·0	0·9	1·1	1603	0·730	62·3	7·0	0·04	Nil	Green
78	17½	6	III	59	.....	97	142	164	230	276	343	388	98·0	1·0	1·0	1543	0·726	63·4	7·7	0·03	Nil	+28
79	16½	6	III	62	.....	87	111	122	172	234	362	430	96·5	1·5	2·0	1431	0·722	64·5	12·0	0·08	Nil	Blue
80	14½	6	III	53	.....	85	111	126	191	257	361	448	96·5	1·4	2·1	1494	0·706	68·9	11·9	0·08	Nil	+29
81	21	6	I	74	2·64	100	150	176	248	289	344	401	97·0	1·5	1·5	1608	0·736	60·8	7·1	0·04	Oily	Red
82	19	6	II	69	1·37	96	151	179	244	286	334	384	97·5	1·4	1·1	1578	0·733	61·5	7·6	0·05	Oily	Green
83	17½	6	III	56	.....	100	159	186	252	284	333	371	97·5	0·9	1·6	1585	0·735	61·0	7·0	0·07	Nil	White
84	19	6	II	69	1·37	95	131	150	224	283	355	397	97·5	1·2	1·3	1540	0·719	65·3	8·8	0·04	Nil	Blue
85	17½	6	III	55	.....	95	132	152	226	290	365	401	97·5	1·0	1·5	1566	0·717	65·9	8·6	0·04	Nil	+20
86	19	6	II	67	.....	94	135	157	224	267	323	382	97·5	1·0	1·5	1488	0·729	62·6	8·8	0·04	Nil	+27
87	19	6	III	63	.....	102	144	172	254	293	343	387	97·5	1·0	1·5	1593	0·740	59·7	8·2	0·10	30	Blue
Average.	.....	.....	.....	.....	.....	96	140	163	230	279	346	394	97·3	1·1	1·6	1552	0·728	62·9	8·5	0·05	.....	.....
HAMILTON, ONT.																						
88	19	6	II	65	.....	100	153	178	254	291	336	377	97·5	1·0	1·5	1589	0·739	60·0	7·7	0·10	5	Green
89	16½	6	III	58	.....	104	154	178	247	282	326	372	98·0	1·1	0·9	1559	0·733	61·5	7·0	0·09	Nil	White
90	21	6	I	76	3·15	98	155	179	243	285	342	387	98·0	1·1	0·9	1591	0·737	60·5	8·0	0·04	Nil	Red
91	19	6	II	66	0·81	98	150	176	249	293	347	377	97·0	1·0	2·0	1592	0·737	60·5	8·3	0·03	Nil	Green
92	17½	6	III	58	.....	98	149	177	243	283	336	376	98·0	1·1	0·9	1564	0·732	61·8	8·1	0·03	Nil	White
93	17	6	III	55	.....	104	155	180	248	284	329	370	98·0	1·1	0·9	1566	0·732	61·8	7·0	0·07	10	+21
94	19	6	II	69	1·67	101	159	189	249	288	333	386	97·5	1·3	1·2	1604	0·735	61·0	7·5	0·07	Oily	Green
95	17½	6	III	55	.....	100	155	183	247	284	330	369	98·0	0·8	1·2	1568	0·731	62·1	7·3	0·06	Nil	White
96	21	6	I	76	3·15	102	148	172	237	286	347	389	97·5	1·0	1·5	1579	0·732	61·8	7·9	0·03	Nil	Red
97	19	6	II	68	0·75	96	148	174	248	288	343	373	97·5	1·1	1·4	1574	0·735	61·0	8·9	0·03	Nil	Blue
98	17½	6	III	58	.....	96	153	177	242	284	342	383	98·0	0·6	1·4	1581	0·732	61·8	8·6	0·01	Nil	+30
99	19	6	II	67	.....	103	133	156	222	268	328	382	98·0	1·0	1·0	1489	0·728	62·9	8·5	0·03	Nil	+29
Average.	.....	.....	.....	.....	.....	100	151	177	244	285	336	378	97·8	1·0	1·2	1571	0·734	61·3	7·9	0·05	.....	.....

TABLE I—Continued

Gasoline Survey Analyses for 1935 by Cities—Continued

Sample No. (1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range							Recov-ery %	Resi-due %	Dis-tilla-tion loss %	Index No. °F.	Specific gravity	De-grees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milli-grams per 100 milli-litres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.										
LONDON, ONT.																						
100	22½	6	I	77	3·01	100	152	179	240	285	344	380	98·0	1·0	1·0	1580	0·736	60·8	7·1	0·02	Nil	Red
101	20½	6	II	68	1·54	104	148	179	254	303	353	385	98·0	1·0	1·0	1622	0·735	61·0	7·9	0·05	Nil	Green
102	20½	6	III	58	.....	99	149	178	248	292	350	384	98·0	1·0	1·0	1601	0·734	61·3	7·3	0·02	Nil	+22
103	20½	6	III	49	.....	105	155	182	249	289	348	404	97·5	1·1	1·4	1627	0·731	62·1	6·8	0·03	10	+22
104	20½	6	II	67	1·31	100	138	161	240	294	358	395	97·0	1·1	1·9	1586	0·727	63·1	7·5	0·04	5	Green
105	20½	6	III	52	.....	101	146	171	243	284	343	388	98·0	1·0	1·0	1575	0·730	62·3	7·3	0·04	10	+21
106	20½	6	II	66	.....	98	138	162	228	272	334	382	97·5	1·1	1·4	1516	0·731	62·1	8·0	0·03	5	+21
107	22½	6	I	75	3·38	98	144	168	237	274	324	378	97·0	1·5	1·5	1525	0·724	63·9	8·4	0·04	Oily	Red
108	20½	6	II	68	1·69	103	158	188	253	290	338	385	97·0	1·5	1·5	1612	0·734	61·3	7·2	0·07	Oily	Green
109	20½	6	III	50	.....	106	155	182	244	282	331	373	98·5	0·8	0·7	1567	0·732	61·8	6·7	0·06	15	+23
Average						101	148	175	244	287	342	385	97·7	1·1	1·2	1581	0·731	62·1	7·4	0·04		
FORT WILLIAM, ONT.																						
110	.....	.....	II	68	0·70	100	150	176	245	292	351	385	97·0	1·0	2·0	1599	0·734	61·3	9·1	0·04	Nil	Green
111	.....	.....	III	58	.....	94	146	176	245	293	350	382	97·0	0·9	2·1	1592	0·733	61·5	9·7	0·02	Nil	+30
112	25·7	6	I	75	3·15	97	149	173	240	278	327	383	97·0	1·6	1·4	1550	0·728	62·9	8·1	0·04	Oily	Red
113	23·7	6	II	68	1·35	94	140	172	246	284	335	381	97·0	1·4	1·6	1558	0·730	62·3	8·8	0·06	Oily	Green
114	25·7	6	I	76	3·22	93	137	165	233	271	322	375	96·5	1·6	1·9	1503	0·721	64·8	9·6	0·04	Oily	Red
115	23·7	6	II	69	1·21	95	143	170	247	286	334	380	97·0	1·6	1·4	1560	0·728	62·9	9·7	0·05	Oily	Green
116	23·7	6	II	69	1·84	104	163	189	261	304	354	391	98·0	1·2	0·8	1662	0·742	59·2	7·0	0·04	Nil	Blue
117	22	6	III	59	.....	100	149	177	244	288	348	391	98·0	1·0	1·0	1597	0·732	61·8	8·4	0·01	Nil	+30
118	23·7	6	II	68	0·70	94	145	173	247	293	346	382	97·5	0·8	1·7	1586	0·735	61·0	8·7	0·04	Nil	Green
119	21·7	6	III	58	.....	100	150	178	246	292	350	385	97·0	1·0	2·0	1601	0·735	61·0	8·3	0·03	Nil	+30
Average						97	147	175	245	288	342	384	97·2	1·2	1·6	1581	0·732	61·8	8·7	0·04		
WINNIPEG, MAN.																						
120	24·7	7	II	68	0·75	97	148	176	248	295	350	381	97·0	1·0	2·0	1598	0·736	60·8	8·5	0·03	Nil	Green
121	22·7	7	III	59	.....	96	146	172	243	290	346	382	98·0	0·9	1·1	1579	0·734	61·3	8·5	0·02	Nil	+30
122	26·7	7	I	75	2·97	94	140	167	234	272	322	378	97·0	1·5	1·5	1513	0·724	63·9	9·0	0·04	Oily	Red
123	24·7	7	II	68	1·27	104	148	176	247	286	335	388	98·0	1·4	0·6	1580	0·732	61·8	7·5	0·07	Oily	Green
124	22·7	7	III	58	.....	96	152	180	245	285	330	374	98·0	1·0	1·0	1566	0·731	62·1	7·2	0·07	Nil	White
125	26·7	7	I	75	3·30	96	145	170	236	274	320	376	97·5	1·7	0·8	1521	0·725	63·7	8·5	0·04	Oily	Red
126	24·7	7	II	69	1·57	99	153	183	256	302	354	394	97·5	1·2	1·3	1642	0·739	60·0	7·3	0·04	Nil	Blue
127	22·7	7	III	58	.....	101	156	178	243	288	344	390	98·0	1·0	1·0	1599	0·733	61·5	7·8	0·04	Nil	+25
128	24·7	7	III	63	.....	94	138	162	239	289	346	399	98·5	1·1	0·4	1573	0·735	61·0	7·9	0·02	Nil	Green
129	22·7	7	II	65	.....	98	140	165	238	286	348	405	97·0	1·1	1·9	1582	0·735	61·0	7·7	0·01	Nil	White
Average						97	146	173	243	287	339	387	97·6	1·2	1·2	1575	0·732	61·8	8·0	0·04		

TABLE I—Continued

Gasoline Survey Analyses for 1935 by Cities—Continued

Sample No. (1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range							Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milligrams per 100 millilitres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.										
REGINA, SASK.																						
130	28	7	I	74	3·44	99	141	167	232	268	310	344	97·0	0·9	2·1	1462	0·724	63·9	8·3	0·09	5	Red
131	23	7	III	57	.....	96	150	174	242	278	316	351	97·5	0·9	1·6	1511	0·725	63·7	8·0	0·04	Nil	+25
132	28	7	I	75	3·40	95	138	165	230	266	309	342	97·0	1·0	2·0	1450	0·720	65·0	9·5	0·08	5	Red
133	26	7	II	69	1·88	102	146	166	226	264	311	362	98·0	1·1	0·9	1475	0·719	65·3	7·7	0·04	5	Green
134	23	7	III	58	.....	104	151	177	244	296	373	423	97·0	1·0	2·0	1664	0·735	61·0	7·5	0·02	Nil	+24
135	26	7	II	70	1·83	103	143	163	223	262	312	360	97·5	1·1	1·4	1463	0·719	65·3	8·0	0·06	Nil	Green
136	23	7	III	56	.....	98	153	176	236	271	322	370	97·5	0·9	1·6	1528	0·726	63·4	6·4	0·04	Nil	+23
137	26	7	II	70	1·82	102	150	169	227	261	301	342	98·0	1·0	1·0	1450	0·720	65·0	7·5	0·04	Nil	Blue
138	23	7	III	57	.....	95	138	160	224	263	304	349	97·0	0·7	2·3	1438	0·718	65·6	8·9	0·04	Nil	+30
139	26	7	II	70	0·87	100	153	181	263	309	359	397	97·5	1·0	1·5	1662	0·746	58·2	7·2	0·10	Nil	Golden
Average.	.....	.....	.....	.....	.....	99	146	170	235	274	321	364	97·4	1·0	1·6	1510	0·725	63·7	7·9	0·06	.....	.....
CALGARY, ALTA.																						
140	25½	7	III	55	.....	110	159	176	220	252	307	387	98·0	1·0	1·0	1501	0·728	62·9	5·8	0·05	5	+26
141	19	7	III	47	.....	112	165	184	236	278	351	429	98·0	1·3	0·7	1643	0·738	60·2	5·3	0·13	Nil	Green
142	27½	7	I	76	3·63	93	140	168	249	295	349	388	97·0	1·0	2·0	1589	0·738	60·2	8·5	0·11	5	Red
143	18	7	III	52	.....	108	133	142	184	273	470	539	98·0	1·5	0·5	1741	0·726	63·4	6·8	0·24	Nil	+19
144	19	7	III	58	.....	116	141	146	173	205	276	390	97·5	1·1	1·4	1331	0·703	69·8	6·6	0·14	Nil	+26
145	27½	7	I	75	3·72	110	145	160	210	245	284	336	97·0	1·4	1·6	1380	0·714	66·7	7·5	0·10	Oily	Red
146	25½	7	II	67	1·83	100	141	160	221	262	314	372	97·0	1·0	2·0	1470	0·718	65·6	7·6	0·10	Nil	Green
147	22½	7	III	51	.....	105	147	166	217	258	337	422	97·5	1·3	1·2	1547	0·721	64·8	7·4	0·13	Nil	+27
148	25½	7	II	65	1·55	107	142	156	210	254	312	376	97·5	1·1	1·4	1450	0·715	66·4	7·0	0·11	Nil	Green
149	25½	7	II	69	0·86	108	160	187	266	308	359	399	98·0	1·0	1·0	1679	0·747	57·9	6·4	0·11	Nil	Golden
Average.	.....	.....	.....	.....	.....	107	147	164	219	263	336	404	97·5	1·2	1·3	1533	0·725	63·7	6·9	0·12	.....	.....
EDMONTON, ALTA.																						
150	22	7	III	53	.....	107	157	174	226	264	326	407	98·0	1·2	0·8	1554	0·729	62·6	6·1	0·12	10	+19
151	19	7	III	62	.....	99	124	132	161	190	244	331	97·0	1·1	1·9	1182	0·689	73·9	9·1	0·12	Nil	+28
152	23	7	III	56	.....	115	171	191	256	304	368	419	98·0	1·1	0·9	1709	0·742	59·2	6·9	0·02	Nil	+27
153	21	7	III	58	.....	100	136	160	238	295	365	425	97·0	1·2	1·8	1619	0·732	61·8	8·1	0·06	Nil	+30
154	27	7	I	75	3·58	106	145	160	210	244	286	338	97·0	1·3	1·7	1383	0·714	66·7	7·4	0·09	Oily	Red

TABLE I—Concluded

Gasoline Survey Analyses for 1935 by Cities—Concluded

Sample No. (1935)	Price, cents per gallon		Group	A.S.-T.M. octane No.	Tetra-ethyl lead per Imp. gal., cubic centi-metres	Distillation Range						Recovery %	Residue %	Distillation loss %	Index No. °F.	Specific gravity	Degrees A.P.I.	Reid vapour pressure, lb.	Sulphur %	Gum, milligrams per 100 millilitres	Colour, Saybolt
	Gasoline	Tax				1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.									
EDMONTON, ALTA.—*Concluded*																					
155	19	7	III	62	.....	102	125	133	159	187	238	314	97·0	1·2	1·8	1156	0·687	74·5	9·4	0·11	Nil	+30
156	25	7	III	51	.....	107	146	166	215	258	342	427	97·5	1·3	1·2	1554	0·722	64·5	7·5	0·12	5	+25
157	23	7	III	52	.....	100	135	151	204	257	409	511	97·5	1·5	1·0	1667	0·721	64·8	9·2	0·19	5	White
158	25·2	7	II	66	1·73	102	141	157	220	263	321	398	98·0	1·0	1·0	1500	0·718	65·6	7·6	0·10	Nil	Green
159	28·2	7	II	68	.....	100	142	169	248	288	346	395	98·0	0·8	1·2	1588	0·742	59·2	8·5	0·05	5	Orange
Average	.....	.....	.....	.....	.....	104	142	159	214	255	325	396	97·5	1·2	1·3	1491	0·720	65·0	8·0	0·10	.....	.....
VANCOUVER, B.C.																					
160	23	7	II	65	.....	104	154	183	261	305	362	406	97·0	1·0	2·0	1671	0·750	57·2	7·1	0·05	Nil	+26
161	23	7	II	72	0·50	100	142	172	256	296	349	395	97·0	1·0	2·0	1610	0·744	58·7	8·1	0·05	Nil	Blue
162	25	7	I	76	1·60	99	149	177	250	288	344	415	98·0	1·4	0·6	1623	0·747	57·9	7·3	0·05	Oily	Red
163	23	7	II	69	0·47	97	148	178	256	293	345	397	98·0	1·1	0·9	1617	0·747	57·9	7·4	0·05	Nil	Green
164	23	7	II	70	1·23	100	156	184	266	316	380	413	98·0	1·0	1·0	1715	0·750	57·2	7·5	0·03	Nil	Yellow
165	25	7	I	80	1·92	105	150	171	232	268	317	386	98·0	1·2	0·8	1524	0·742	59·2	6·5	0·04	5	Red
166	23	7	II	68	.....	101	147	172	244	284	345	405	98·0	1·2	0·8	1597	0·743	58·9	7·0	0·16	5	+26
167	23	7	II	68	0·36	102	151	176	251	296	365	420	97·0	1·2	1·8	1659	0·744	58·7	7·2	0·23	Nil	Golden
168	25	7	I	77	1·50	98	142	171	251	290	344	414	97·0	1·6	1·4	1612	0·745	58·4	7·8	0·06	Oily	Red
169	23	7	II	70	0·42	99	150	179	255	293	343	390	97·0	0·9	2·1	1610	0·745	58·4	7·7	0·07	5	Orange.
Average	.....	.....	.....	.....	.....	100	149	176	252	293	350	404	97·5	1·2	1·3	1624	0·746	58·2	7·4	0·08	.....	.....
VICTORIA, B.C.																					
170	22	7	I	79	2·88	103	150	177	243	280	337	388	97·5	1·0	1·5	1575	0·743	58·9	7·4	0·07	Nil	Red
171	20	7	II	69	0·75	105	155	182	251	286	340	393	98·0	1·0	1·0	1607	0·744	58·7	7·3	0·10	Nil	Golden
172	24	7	II	71	0·47	102	150	178	253	292	340	391	98·0	1·0	1·0	1604	0·746	58·2	7·3	0·05	Nil	Blue
173	23	7	II	70	0·45	99	149	179	254	291	344	392	98·0	1·2	0·8	1609	0·747	57·9	6·8	0·06	Nil	Green
174	23	7	II	65	.....	103	150	184	261	304	357	403	97·5	1·0	1·5	1659	0·750	57·2	7·2	0·07	Nil	+26
175	24	7	II	68	.....	104	153	176	241	282	344	404	97·0	1·2	1·8	1600	0·743	58·9	6·7	0·15	Nil	+26
176	24	7	I	75	2·23	102	152	185	258	311	377	412	98·0	1·0	1·0	1695	0·750	57·2	7·5	0·03	Nil	Red
177	24	7	II	72	1·41	102	154	180	264	317	380	414	97·0	1·2	1·8	1709	0·748	57·7	8·2	0·03	Nil	Yellow
178	26	7	I	77	1·52	102	144	171	249	292	345	412	97·0	1·4	1·6	1613	0·742	59·2	8·3	0·06	10	Red
179	24	7	II	70	0·42	102	148	180	255	294	341	390	97·5	1·0	1·5	1608	0·746	58·2	7·5	0·06	Nil	Orange
Average	.....	.....	.....	.....	.....	102	150	179	253	295	351	400	97·5	1·1	1·4	1628	0·746	58·2	7·4	0·07	.....	.....

TABLE II

Gasoline Survey Analyses for 1936 by Cities

Sample No. (1936)	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	21	8	II	70	100	149	170	244	293	346	398	97·5	1·1	1·4	1600	0·734	61·3	8·6	Green
2	21	8	II	67	96	142	162	234	278	338	387	97·5	1·1	1·4	1541	0·730	62·3	8·4	White
3	23	8	I	78	104	163	187	242	279	338	400	98·0	1·2	0·8	1609	0·739	60·0	6·1	Red
4	21	8	II	71	100	157	186	265	300	350	391	98·0	1·1	0·9	1649	0·745	58·4	6·7	Green
5	21	8	II	70	102	162	196	262	297	343	403	98·0	1·3	0·7	1663	0·745	58·4	6·5	Purple
6	21	8	II	68	99	156	183	258	292	342	385	97·0	1·0	2·0	1616	0·742	59·2	7·2	White
7	23	8	I	78	98	161	187	241	273	327	388	98·0	1·2	0·8	1577	0·736	60·8	6·4	Red
8	21	8	II	70	95	138	164	244	290	346	393	98·0	1·2	0·8	1575	0·734	61·3	8·6	Blue
9	21	8	II	67	95	137	158	231	275	334	383	97·0	1·0	2·0	1518	0·729	62·6	8·7	White
10	21	8	II	70	106	157	182	250	286	334	376	98·0	1·1	0·9	1585	0·745	58·4	5·4	Blue
Average					100	152	178	247	286	340	390	97·7	1·1	1·2	1593	0·738	60·2	7·3	
SAINT JOHN, N.B.																			
11	21	8	II	71	96	144	174	248	295	348	378	97·0	1·0	2·0	1587	0·736	60·8	8·7	Green
12	21	8	II	65	90	127	154	243	296	350	379	97·0	1·0	2·0	1549	0·728	62·9	11·1	White
13	21	8	II	65	96	139	165	235	276	333	385	98·0	1·2	0·8	1533	0·732	61·8	8·8	White
14	23	8	I	78	104	160	184	243	276	332	393	97·5	1·1	1·4	1588	0·735	61·0	6·4	Red
15	21	8	II	69	107	155	186	266	301	347	402	98·0	1·4	0·6	1657	0·744	58·7	7·2	Green
16	21	8	III	64	104	156	182	254	287	339	394	98·0	1·1	0·9	1612	0·737	60·5	6·5	White
17	23	8	I	77	100	155	183	252	288	338	398	98·0	1·2	0·8	1614	0·739	60·0	6·5	Red
18	21	8	II	70	98	146	169	247	290	350	396	97·0	1·1	1·9	1598	0·734	61·3	8·3	Blue
19	21	8	II	67	97	138	162	234	275	330	384	98·0	1·2	0·8	1523	0·732	61·8	8·0	Green
20	21	8	II	70	99	141	169	242	278	328	372	98·0	1·1	0·9	1530	0·735	61·0	7·5	Blue
Average					99	146	173	246	286	340	388	97·7	1·1	1·2	1579	0·735	61·0	7·9	
QUEBEC, QUE.																			
21	21	6	I	77	100	149	180	253	296	356	398	98·0	1·0	1·0	1632	0·742	59·2	7·6	Red
22	19	6	II	71	98	149	178	249	290	346	392	98·0	1·0	1·0	1604	0·735	61·0	8·0	Green
23	19	6	II	65	98	143	167	234	275	328	380	98·0	1·1	0·9	1527	0·732	61·8	7·6	Green
24	21	6	I	77	98	152	180	254	299	355	396	97·0	1·2	1·8	1636	0·743	58·9	7·8	Red
25	19	6	II	65	96	142	168	236	276	330	382	98·0	1·2	0·8	1534	0·731	62·1	7·8	Green
26	20	6	II	70	100	153	184	259	296	346	400	97·5	1·4	1·1	1638	0·742	59·2	6·1	Green
27	20	6	II	67	107	150	178	249	287	341	386	98·0	1·0	1·0	1591	0·740	59·7	6·9	White
28	21	6	I	76	100	155	181	255	299	354	397	98·0	1·0	1·0	1641	0·742	59·2	7·3	Red
29	19	6	II	71	102	151	184	254	298	352	394	97·0	1·1	1·9	1633	0·738	60·2	7·9	Blue
30	19	6	II	66	100	147	174	243	284	340	388	98·0	1·0	1·0	1576	0·737	60·5	7·6	White
Average					100	149	177	249	290	345	391	97·7	1·1	1·2	1601	0·738	60·2	7·5	

TABLE II—Continued

Gasoline Survey Analyses for 1936 by Cities—Continued

Sample No. (1936)	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.								
MONTREAL, QUE.																			
31	18	6	I	78	100	150	178	247	291	348	378	97·0	1·1	1·9	1592	0·733	61·5	9·4	Red
32	16	6	II	70	98	149	178	246	290	346	377	98·0	1·0	1·0	1586	0·735	61·0	8·2	Green
33	16	6	II	66	94	143	176	256	300	352	382	97·0	1·0	2·0	1609	0·738	60·2	9·3	White
34	16	6	II	70	100	154	187	263	301	351	412	97·5	1·5	1·0	1668	0·743	58·9	7·4	Purple
35	16	6	II	67	103	150	180	255	295	344	385	98·0	0·9	1·1	1609	0·740	59·7	7·2	White
36	18	6	I	79	103	153	184	260	298	349	402	98·0	1·0	1·0	1646	0·741	59·5	7·1	Red
37	16	6	II	70	99	152	186	261	298	347	409	98·0	1·2	0·8	1653	0·742	59·2	7·3	Green
38	16	6	II	67	106	156	186	259	295	342	384	98·0	1·0	1·0	1622	0·743	58·9	6·5	White
39	16	6	II	71	106	150	177	253	298	356	396	98·0	1·0	1·0	1630	0·737	60·5	8·2	Blue
40	12	6	III	62	98	140	168	244	292	356	398	97·0	1·0	2·0	1598	0·730	62·3	9·8	White
41	15	6	II	70	102	149	178	252	287	336	376	98·0	1·0	1·0	1578	0·740	59·7	7·4	Blue
42	18	6	I	79	104	150	182	256	295	348	405	98·0	1·2	0·8	1636	0·741	59·5	7·0	Red
43	16	6	II	71	100	150	180	267	302	356	414	97·5	1·4	1·1	1672	0·740	59·7	8·2	Green
44	16	6	II	67	100	148	174	256	296	343	382	98·0	1·0	1·0	1599	0·737	60·5	7·3	White
Average					101	150	180	255	295	348	393	97·7	1·1	1·2	1621	0·739	60·0	7·9	
OTTAWA, ONT.																			
45	17½	6	II	70	101	150	186	260	299	354	408	97·0	1·1	1·9	1657	0·742	59·2	7·4	Gold
46	16½	6	III	63	102	148	180	264	302	353	408	98·0	1·0	1·0	1655	0·739	60·0	7·4	White
47	20½	6	I	76	117	161	174	202	250	336	378	98·0	1·0	1·0	1501	0·787	48·3	6·2	Pink
48	19½	6	I	79	104	159	186	258	295	350	414	98·0	1·3	0·7	1662	0·742	59·2	6·8	Red
49	17½	6	II	70	102	157	189	261	300	351	410	97·0	1·2	1·8	1668	0·743	58·9	7·2	Green
50	17½	6	III	64	104	156	188	266	301	349	398	97·5	1·1	1·4	1658	0·743	58·9	6·9	White
51	19½	6	I	76	99	148	174	246	289	348	379	98·0	0·7	1·3	1584	0·733	61·5	8·2	Red
52	17½	6	II	69	98	150	176	250	292	346	376	97·0	1·0	2·0	1590	0·735	61·0	8·8	Green
53	17½	6	III	64	99	146	177	254	296	346	380	97·0	1·0	2·0	1599	0·737	60·5	8·4	White
54	19½	6	I	77	92	143	171	246	292	348	379	98·0	0·9	1·1	1579	0·733	61·5	8·7	Red
55	17½	6	II	71	96	148	182	257	296	349	403	98·0	1·2	0·8	1635	0·741	59·5	7·2	Green
56	17½	6	II	65	100	153	182	261	301	351	395	98·0	1·1	0·9	1643	0·741	59·5	7·6	White
57	17½	6	III	60	104	152	180	246	292	347	386	98·0	0·8	1 2	1603	0·735	61·0	7·9	White
58	19½	6	I	76	104	151	178	244	289	348	393	98·0	1·0	1·0	1603	0·736	60·8	6·7	Red
59	17½	6	II	70	100	149	176	248	291	346	379	98·0	1·0	1·0	1589	0·733	61·5	9·0	Green
60	17½	6	III	63	98	140	168	242	292	348	395	98·0	1·0	1·0	1585	0·734	61·3	7·9	White
61	19½	6	I	79	104	153	186	262	303	358	408	97·0	1·4	1·6	1670	0·741	59·5	7·2	Red
62	17½	6	II	70	104	157	186	260	297	350	408	97·0	1·0	2·0	1658	0·743	58·9	7·2	Green
63	17½	6	III	63	104	154	188	268	302	351	400	97·0	1·0	2·0	1663	0·741	59·5	7·0	White
64	15	6	II	69	100	154	171	248	294	351	394	98·0	0·9	1·1	1612	0·739	60·0	9·0	White
65	19½	6	I	77	100	153	182	259	304	361	400	97·5	1·1	1·4	1659	0·744	58·7	7·3	Red
66	17½	6	II	69	98	148	178	249	294	346	376	97·5	1·0	1·5	1591	0·735	61·0	8·2	Blue

TABLE II—Continued

Gasoline Survey Analyses for 1936 by Cities—Continued

Sample No. (1936)	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.—*Concluded*														
67	17½	6	III	64	108	152	180	252	297	348	383	98·0	1·0	1·0	1612	0·738	60·2	8·5	White
68	19½	6	I	75	102	144	170	244	288	347	394	98·0	1·0	1·0	1587	0·738	60·2	7·2	Red
69	17½	6	II	69	98	145	167	237	279	336	387	98·0	1·0	1·0	1551	0·735	61·0	8·2	Gold
70	17½	6	II	71	101	151	178	251	288	334	377	98·0	1·0	1·0	1579	0·739	60·0	7·2	Blue
71	19½	6	I	79	98	151	180	260	300	351	410	98·0	1·2	0·8	1652	0·740	59·7	7·4	Red
72	17½	6	II	71	100	152	186	265	303	355	415	98·0	1·2	0·8	1676	0·744	58·7	7·3	Green
73	17½	6	II	67	100	153	182	258	295	342	385	98·0	0·9	1·1	1615	0·741	59·5	6·7	White
74	17½	6	III	64	100	156	187	278	314	358	396	98·0	0·8	1·2	1689	0·747	57·9	6·7	White
Average					101	151	180	253	294	349	394	97·7	1·0	1·3	1621	0·741	59·5	7·6	
					TORONTO, ONT.														
75	14½	6	III	59	98	150	176	244	287	346	392	97·0	1·2	1·8	1595	0·731	62·1	9·5	White
76	17½	6	II	69	100	150	180	247	286	332	385	98·0	1·0	1·0	1580	0·731	62·1	7·2	Green
77	17½	6	II	69	107	158	180	258	303	364	441	98·0	1·2	0·8	1704	0·739	60·0	7·2	Green
78	17½	6	II	69	100	146	177	247	285	333	386	97·0	1·0	2·0	1574	0·730	62·3	7·9	Green
79	16	6	III	60	104	154	184	248	284	332	370	98·0	0·8	1·2	1572	0·741	59·5	7·9	White
80	15½	6	II	67	95	129	150	197	244	325	369	98·0	1·0	1·0	1414	0·742	59·2	10·3	Blue
81	17½	6	II	69	105	155	181	250	289	336	382	97·0	1·2	1·8	1593	0·733	61·5	7·7	Green
82	17½	6	III	59	103	161	186	249	284	332	369	98·0	0·9	1·1	1581	0·734	61·3	6·3	White
83	15	6	II	70	100	146	176	256	301	356	394	97·0	1·1	1·9	1629	0·735	61·0	7·4	Blue
84	14½	6	III	61	96	140	169	247	295	357	395	97·0	1·0	2·0	1603	0·733	61·5	9·1	White
85	17½	6	II	70	101	153	180	256	300	357	394	97·0	1·0	2·0	1640	0·735	61·0	7·6	Blue
86	17½	6	II	69	98	146	170	234	278	337	382	97·5	1·0	1·5	1547	0·734	61·3	8·0	Gold
87	17½	6	II	71	101	151	182	249	287	335	377	98·0	0·8	1·2	1581	0·740	59·7	7·3	Blue
88	17½	6	II	69	96	147	179	245	284	333	380	97·0	1·0	2·0	1568	0·731	62·1	8·1	Green
Average					100	149	176	245	286	341	387	97·5	1·0	1·5	1584	0·735	61·0	8·0	
					HAMILTON, ONT.														
89	17½	6	II	70	100	157	184	249	287	336	370	97·0	0·9	2·1	1583	0·734	61·3	7·7	Green
90	16	6	III	58	101	150	177	244	282	342	386	97·5	0·8	1·7	1581	0·735	61·0	7·3	White
91	16	6	III	59	98	157	182	243	281	326	368	98·0	0·7	1·3	1557	0·731	62·1	8·1	White
92	19½	6	I	75	95	147	173	241	280	330	378	97·5	1·1	1·4	1549	0·730	62·3	8·3	Red
93	17½	6	II	68	101	161	188	249	285	330	380	98·0	1·2	0·8	1593	0·736	60·8	6·9	Green
94	16½	6	III	58	97	156	182	245	282	331	369	98·0	0·8	1·2	1565	0·731	62·1	7·4	White
95	17	6	III	64	100	156	185	255	292	340	383	98·0	1·0	1·0	1611	0·742	59·2	6·6	Red
96	15	6	III	58	100	152	183	248	285	330	368	98·0	0·8	1·2	1566	0·732	61·8	7·3	White
97	19½	6	I	75	107	150	175	240	285	347	390	98·0	0·8	1·2	1587	0·741	59·5	7·1	Red
98	17½	6	II	69	100	142	165	234	275	335	381	97·0	0·9	2·1	1532	0·734	61·3	8·4	Gold
99	17	6	II	69	114	161	173	198	236	318	363	98·0	0·7	1·3	1449	0·777	50·6	6·7	Green
100	15	6	III	58	103	160	186	254	297	352	391	97·0	0·9	2·1	1640	0·736	60·8	7·2	White
Average					101	154	179	242	281	335	377	97·7	0·9	1·4	1568	0·738	60·2	7·4	

TABLE II—Continued

Gasoline Survey Analyses for 1936 by Cities—Continued

Sample No. (1936)	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.								
LONDON, ONT.																			
101	21	6	I	76	105	158	181	238	276	336	380	97·5	0·8	1·7	1569	0·733	61·5	7·6	Red
102	19	6	II	70	97	156	190	261	305	352	374	97·0	0·9	2·1	1638	0·734	61·3	8·9	Green
103	19	6	II	68	100	151	180	248	286	334	384	97·0	1·1	1·9	1583	0·733	61·5	8·0	Green
104	19	6	II	69	102	161	192	262	305	352	376	97·0	0·8	2·2	1648	0·736	60·8	8·0	Blue
105	21	6	I	75	100	146	167	230	270	331	386	98·0	0·8	1·2	1530	0·736	60·8	7·2	Red
106	19	6	II	69	99	145	168	231	277	334	383	97·0	1·0	2·0	1538	0·733	61·5	8·5	Golden
107	19	6	II	70	99	149	175	252	289	336	378	98·0	1·1	0·9	1579	0·739	60·0	7·4	Blue
108	21	6	I	76	96	144	173	245	286	338	384	96·0	1·2	2·8	1570	0·729	62·6	8·6	Red
109	19	6	II	70	102	151	180	248	286	334	378	97·0	1·2	1·8	1577	0·732	61·8	7·8	Green
110	19	6	III	57	103	158	186	246	284	330	366	98·0	1·0	1·0	1570	0·735	61·0	6·8	White
Average					100	152	179	246	286	338	379	97·2	1·0	1·8	1580	0·734	61·3	7·9	
FORT WILLIAM, ONT.																			
111	26·2	6	I	78	93	140	170	243	284	336	382	96·5	1·1	2·4	1555	0·729	62·6	9·5	Red
112	24·2	6	II	68	100	149	175	248	290	347	377	97·0	0·9	2·1	1586	0·736	60·8	8·1	Green
113	24·2	6	III	63	98	144	171	247	291	346	380	97·5	0·9	1·6	1579	0·736	60·8	7·2	White
114	26·2	6	I	77	96	147	175	245	285	337	386	97·0	1·3	1·7	1575	0·731	62·1	7·9	Red
115	24·2	6	II	68	98	156	185	247	289	335	381	97·0	1·4	1·6	1593	0·737	60·5	7·4	Green
116	24·2	6	III	59	100	152	180	247	290	350	386	97·5	0·9	1·6	1605	0·735	61·0	7·7	White
117	24·2	6	II	68	97	152	182	249	286	336	383	97·0	1·2	1·8	1588	0·734	61·3	8·0	Green
118	24·2	6	III	60	92	141	170	240	280	330	364	97·5	0·8	1·7	1525	0·727	63·1	9·5	White
119	24·2	6	II	69	108	159	185	247	284	334	368	97·5	0·9	1·6	1577	0·735	61·0	6·8	Blue
120	24·2	6	III	59	103	156	181	245	283	334	374	98·0	1·2	0·8	1573	0·733	61·5	7·6	White
Average					99	150	177	246	286	339	378	97·2	1·1	1·7	1576	0·733	61·5	8·0	
WINNIPEG, MAN.																			
121	26	7	I	76	95	137	164	228	260	298	334	97·5	0·8	1·7	1421	0·716	66·1	9·1	Red
122	24	7	II	69	102	156	180	248	293	346	380	98·0	0·9	1·1	1603	0·736	60·8	8·2	Green
123	22	7	III	64	102	150	177	257	299	351	386	98·0	1·1	0·9	1620	0·739	60·0	8·8	White
124	26	7	I	75	104	157	184	247	285	331	384	98·0	1·3	0·7	1588	0·735	61·0	7·5	Red
125	24	7	II	67	100	149	172	247	287	335	386	98·0	1·2	0·8	1576	0·730	62·3	8·7	Green
126	22	7	III	59	105	157	185	250	286	334	372	97·5	0·7	1·8	1584	0·731	62·1	6·8	White
127	24	7	II	69	103	154	184	250	287	336	374	98·0	1·0	1·0	1585	0·734	61·3	7·5	Blue
128	22	7	III	59	104	157	186	248	286	338	379	98·0	1·0	1·0	1594	0·734	61·3	7·3	White
129	24	7	II	66	101	151	182	250	290	338	387	97·0	1·2	1·8	1598	0·735	61·0	7·3	Green
130	22	7	III	61	101	149	172	246	290	346	392	98·0	0·9	1·1	1595	0·734	61·3	7·7	White
Average					102	152	179	247	286	335	377	97·8	1·0	1·2	1576	0·732	61·8	7·9	

TABLE II—Continued

Gasoline Survey Analyses for 1936 by Cities—Continued

Sample No. (1936)	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.								
REGINA, SASK.																			
131	27½	7	I	75	97	142	168	228	261	294	337	98·0	0·8	1·2	1430	0·719	65·3	8·4	Red
132	25½	7	II	68	99	148	178	256	296	341	374	98·0	1·0	1·0	1593	0·736	60·8	7·7	Green
133	23	7	III	51	112	171	192	246	290	358	410	98·0	1·0	1·0	1667	0·732	61·8	5·6	White
134	27½	7	I	75	108	154	171	222	256	298	343	98·0	1·0	1·0	1444	0·722	64·5	6·1	Red
135	22½	7	III	60	102	154	178	239	276	321	362	98·0	0·5	1·5	1530	0·727	63·1	7·3	White
136	25½	7	II	69	108	156	182	240	272	309	345	97·5	1·4	1·1	1504	0·726	63·4	7·1	Blue
137	22½	7	III	59	104	156	181	240	274	320	360	97·5	0·8	1·7	1531	0·730	62·3	7·0	White
138	25½	7	II	70	101	153	179	238	271	312	376	98·0	1·1	0·9	1529	0·727	63·1	8·2	Green
139	22½	7	III	55	108	158	181	238	282	356	426	97·0	1·2	1·8	1641	0·728	62·9	6·3	White
140	25½	7	II	71	108	164	190	268	309	358	393	97·0	1·0	2·0	1682	0·748	57·7	6·5	Orange
Average					105	155	180	241	279	327	373	97·7	1·0	1·3	1555	0·730	62·3	7·0	
CALGARY, ALTA.																			
141	27	7	I	75	99	141	170	250	296	352	386	98·0	0·9	1·1	1595	0·738	60·2	8·0	Red
142	25	7	II	69	98	146	174	256	300	349	385	98·0	1·0	1·0	1610	0·739	60·0	7·5	Green
143	25	7	II	70	107	147	167	243	294	351	413	98·0	1·0	1·0	1615	0·729	62·6	6·6	Green
144	18	7	III	46	106	157	180	250	296	354	416	98·0	1·2	0·8	1653	0·730	62·3	6·3	White
145	19½	7	III	59	104	134	144	182	223	301	386	97·0	1·0	2·0	1370	0·705	69·2	7·7	White
146	27	7	I	76	110	156	174	220	252	294	354	97·0	1·1	1·9	1450	0·722	64·5	6·8	Red
147	25	7	II	70	107	146	167	240	294	350	410	98·5	0·9	0·6	1607	0·731	62·1	6·5	Green
148	19½	7	III	63	102	124	132	166	209	295	381	97·5	1·0	1·5	1307	0·694	72·4	8·9	White
149	25	7	II	70	108	163	194	267	308	359	394	97·0	0·9	2·1	1685	0·748	57·7	6·3	Orange
150	19½	7	III	62	103	128	135	169	208	276	374	97·5	1·0	1·5	1290	0·697	71·5	8·6	White
Average					104	144	164	224	268	328	390	97·6	1·0	1·4	1518	0·723	64·2	7·3	
EDMONTON, ALTA.																			
151	30	7	I	76	98	143	172	256	301	353	384	97·0	1·0	2·0	1609	0·740	59·7	7·9	Red
152	22·2	7	III	56	97	139	158	233	282	348	405	98·0	1·1	0·9	1565	0·726	63·4	8·1	White
153	28	7	III	58	105	143	154	198	236	310	380	97·0	0·9	2·1	1421	0·712	67·2	7·0	Blue
154	25·5	7	III	62	98	118	124	151	190	286	438	97·5	1·2	1·3	1307	0·689	73·9	10·5	Green
155	22·2	7	II	65	98	115	120	142	171	235	376	98·0	1·0	1·0	1159	0·681	76·3	10·9	White
156	27·7	7	II	70	108	156	170	244	297	350	408	98·0	1·4	0·6	1625	0·731	62·1	6·6	Green
157	22·2	7	III	63	101	126	133	165	203	276	379	98·0	1·0	1·0	1282	0·694	72·4	9·3	White
158	28	7	II	70	107	150	178	257	303	356	394	98·0	0·8	1·2	1638	0·743	58·9	7·2	Orange
159	22·2	7	III	63	102	125	132	166	207	284	368	97·0	0·9	2·1	1282	0·695	72·1	9·0	White
160	28	7	II	67	97	141	170	245	284	343	396	98·0	1·0	1·0	1579	0·739	60·0	8·5	Orange
Average					101	136	151	206	247	314	393	97·7	1·0	1·3	1447	0·715	66·4	8·5	

TABLE II—Concluded

Gasoline Survey Analyses for 1936 by Cities—Concluded

Sample No. (1936)	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.								
VANCOUVER, B.C.																			
161	21	7	II	66	108	158	193	261	300	353	398	97·0	0·9	2·1	1663	0·749	57·4	6·8	White
162	21	7	II	69	103	154	186	260	296	349	414	98·0	1·2	0·8	1569	0·748	57·7	6·7	White
163	18	7	II	65	107	174	205	278	322	379	410	98·0	0·9	1·1	1768	0·762	54·2	6·8	Orange
164	21	7	II	69	100	158	191	275	326	384	416	98·0	1·0	1·0	1750	0·757	55·4	6·7	Yellow
165	23	7	I	81	98	150	175	238	269	314	366	98·0	1·2	0·8	1512	0·741	59·5	8·5	Red
166	21	7	II	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Orange
167	21	7	II	71	106	141	169	244	288	344	388	97·5	1·0	1·5	1574	0·742	59·2	9·0	Orange
168	21	7	II	69	102	156	185	255	294	349	398	98·0	1·0	1·0	1637	0·747	57·9	7·4	Orange
169	23	7	I	78	106	165	195	261	301	357	426	97·5	1·2	1·3	1705	0·752	56·7	6·5	Red
170	21	7	II	70	101	153	185	260	297	356	408	97·0	1·2	1·8	1659	0·746	58·2	7·0	Orange
Average.....	.....	.....	.....	.....	103	157	187	259	299	354	403	97·7	1·1	1·2	1659	0·749	57·4	7·3	.....
VICTORIA, B.C.																			
171	22	7	II	69	97	143	168	249	292	365	425	97·0	1·1	1·9	1642	0·740	59·7	8·3	Blue
172	22	7	II	70	109	162	194	260	298	354	408	98·0	1·2	0·8	1676	0·752	56·7	7·1	Green
173	22	7	II	71	99	140	166	249	295	350	390	98·0	0·9	1·1	1590	0·747	57·9	7·9	White
174	22	7	II	69	103	160	190	270	322	384	412	97·5	1·0	1·5	1738	0·753	56·4	7·8	Yellow
175	22	7	I	81	102	149	170	235	268	310	363	98·0	0·9	1·1	1495	0·740	59·7	7·7	Red
176	22	7	II	71	101	146	168	250	295	355	394	98·0	0·9	1·1	1608	0·747	57·9	8·0	White
177	22	7	II	71	98	141	167	244	290	348	390	97·5	0·8	1·7	1580	0·744	58·7	8·2	Orange
178	24	7	I	78	102	157	179	247	290	342	390	98·0	0·9	1·1	1605	0·745	58·4	7·0	Red
179	22	7	II	70	106	162	189	254	294	350	397	98·0	1·2	0·8	1646	0·748	57·7	7·2	Orange
180	22	7	II	70	102	150	184	257	291	348	408	97·0	1·3	1·7	1638	0·746	58·2	7·3	Orange
Average.....	.....	.....	.....	.....	102	151	177	251	294	351	398	97·7	1·0	1·3	1622	0·746	58·2	7·7	.....

TABLE III

Average of Gasoline Survey Analyses in Canada from 1923 to 1936

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

TABLE IV

Average Analyses of the Three Groups of Gasoline Sold in Canada in 1935

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.	Sulphur %	Artificially coloured, per cent of samples
			1st drop °F.	10% °F.	20% °F.	50% °F.	70% °F.	90% °F.	End point °F.									
I	36	76	101	148	175	242	283	337	390	97·3	1·3	1·4	1575	0·734	61·3	7·8	0·04	100
II	86	68	101	148	175	246	290	345	392	97·4	1·1	1·5	1596	0·738	60·2	7·7	0·06	74
III	57	57	101	149	173	237	280	343	396	97·5	1·1	1·4	1578	0·731	62·1	7·7	0·06	16
Average for all samples	179	.....	101	148	174	243	285	343	393	97·4	1·1	1·5	1586	0·735	61·0	7·7	0·06	.....

TABLE V

Average Analyses of the Three Groups of Gasoline Sold in Canada in 1936

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	37	77	101	151	177	244	284	338	386	97·7	1·0	1·3	1580	0·737	60·5	7·5	100
II	101	69	101	150	178	249	290	343	390	97·6	1·1	1·3	1600	0·738	60·2	7·7	81
III	42	60	102	149	172	236	276	334	386	97·6	1·0	1·4	1553	0·728	62·9	7·7	7
Average for all samples	180	.....	101	150	176	245	286	340	388	97·6	1·0	1·4	1585	0·736	60·8	7·7	.....

TABLE VI

Summary of Data of Gasoline Survey Analyses for Canada for 1935

Test	Group I			Group II			Group III		
	Min.	Range of 90%	Max.	Min.	Range of 90%	Max.	Min.	Range of 90%	Max.
Specific gravity	0·714	0·720–0·746	0·750	0·715	0·719–0·750	0·788	0·703	0·718–0·744	0·748
Degrees A.P.I.	66·7	65·0–58·2	57·2	66·4	65·3–57·2	48·1	69·8	65·6–58·7	57·7
Sulphur, per cent	0·01	0·02–0·09	0·11	0·01	0·02–0·11	0·23	0·01	0·01–0·13	0·24
Reid vapour pressure, lb	6·3	6·5– 8·7	9·6	5·8	6·4– 8·9	9·7	4·7	5·8– 9·4	12·0
Corrosion, copper-strip test	Neg.			Neg.			Neg. except two samples pos.		
A.S.T.M. octane number	74	74– 77	80	64	65– 71	72	47	51– 62	63
Distillation range—									
First drop, °F	93	94–107	110	94	95–107	118	85	94–112	120
10 per cent, °F	137	138–157	162	131	136–159	164	111	125–164	176
20 per cent, °F	160	165–188	190	150	160–188	190	122	133–194	200
50 per cent, °F	210	230–256	258	210	222–262	266	159	173–264	270
70 per cent, °F	244	266–296	311	254	262–304	317	187	234–303	304
90 per cent, °F	284	309–353	377	301	314–360	380	238	304–368	470
End point, °F	336	342–417	421	342	373–413	420	314	351–429	539
Recovery, per cent	96·5	97·0–98·0	98·0	96·5	97·0–98·0	98·0	96·5	97·0–98·0	98·5
Residue, per cent	0·9	1·0– 1·8	1·8	0·8	0·8– 1·5	1·6	0·6	0·8– 1·4	1·5
Distillation loss, per cent	0·4	0·8– 2·0	2·1	0·6	0·9– 2·1	2·7	0·4	0·7– 2·1	2·3
Index No., °F	1380	1450–1670	1695	1450	1475–1679	1715	1156	1431–1685	1741
Number of samples		36			86			57	

TABLE VII

Summary of Data of Gasoline Survey Analyses for Canada for 1936

Test	Group I			Group II			Group III		
	Min.	Range of 90%	Max.	Min.	Range of 90%	Max.	Min.	Range of 90%	Max.
Specific gravity	0·716	0·722–0·745	0·787	0·726	0·730–0·749	0·777	0·689	0·694–0·742	0·747
Degrees A.P.I.	66·1	64·5–58·4	48·3	63·4	62·3–57·4	50·6	73·9	72·4–59·2	57·9
Reid vapour pressure, lb.	6·1	6·2– 9·1	9·5	5·4	6·5– 9·0	11·1	5·6	6·3– 9·5	10·5
A.S.T.M. octane No.	75	75–79	81	65	65–71	71	46	55–64	64
Distillation range—									
First drop, °F.	92	95–108	117	90	96–108	114	92	97–108	112
10 per cent, °F.	137	142–161	165	115	138–162	174	118	125–160	171
20 per cent, °F.	164	168–187	195	120	162–192	205	124	132–187	188
50 per cent, °F.	202	222–260	262	142	234–267	278	151	166–266	278
70 per cent, °F.	250	256–301	304	171	275–305	326	190	207–302	314
90 per cnet, °F.	294	298–357	361	235	328–359	384	276	284–357	358
End point, °F.	334	343–410	426	345	372–414	441	360	364–416	438
Recovery, per cent.	96·0	97·0–98·0	98·0	97·0	97·0–98·0	98·5	97·0	97·0–98·0	98·0
Residue, per cent.	0·7	0·8– 1·3	1·4	0·7	0·9– 1·4	1·5	0·5	0·7– 1·2	1·2
Distillation loss, per cent.	0·7	0·8– 2·0	2·8	0·6	0·8– 2·1	2·2	0·8	0·9– 2·1	2·1
Index No., °F.	1421	1444–1662	1705	1159	1523–1682	1768	1282	1290–1663	1689
Number of samples	.....	37	.....	.....	101	.....	.....	42	.....

TABLE VIII

Group* of 67 Brands of Gasoline Sold by 33 Companies in 1935

Group I	Group II	Group III	Company or Distributor and Head Office Address (or city from which samples originated)
	B.S.Q. Golden	B.M.L. White	Beach Motors, Ltd. (Ottawa).
		Bell and King Gas	Bell Refining Co., Ltd., Calgary.
	Benzolene and Benzogas	Commercial	Benzolene Corporation, Ltd. (Ottawa).
Peerless Ethyl	Nevr-Nox	British Motor	British American Oil Co., Ltd., Toronto.
	Bengal Green	White	Burlington Refineries, Ltd., Hamilton.
Canadian Ethyl	White Rose No Knock	White Rose	Canadian Oil Companies, Ltd., Toronto.
	Champlain "70" and Special White.		Champlain Oil Co., Ltd. (Montreal).
		White	Charlebois Garage (Ottawa)..
Cities Service Ethyl	Koolmotor	Cities Service	Cities Service Oil Co., Ltd., Toronto.
		Dominion	Crown Oil Co., Ltd. (Hamilton).
		Montana	Economy Oils, Ltd. (Calgary).
		Purity	Gas & Oil Products, Ltd. (Calgary).
	General		General Oil Co., Ltd., (Vancouver)
		Blue Star and Major	Good Rich Oil Co., Ltd., Toronto.
		Hi-way (2nd) and Hi-way (3rd).	Hi-way Refineries, Ltd., Regina.
	Home Gas and "Q" (Blue)		Home Oil Distributors, Ltd., Vancouver.
Esso (Imperial Ethyl)	Three Star and Special	Premier	Imperial Oil, Ltd., Toronto.
Irving Ethyl	Primrose	Primrose Purple	Irving Oil Co., Ltd. (Saint John).
	Red Crown		Island Pacific Oil Co., Ltd. (Victoria).
		Lion and Tiger	Lion Refining Co., Ltd., Calgary.
		Richtest	Mahoney & Rich (Ottawa).
Cyclo Ethyl	Marathon Blue	Frontenac and Standard White	McColl-Frontenac Oil Co., Ltd., Montreal.
	Nevr-Nox	3rd Grade (No brand)	Monarch Oil Co., Ltd. (Fort William).
	North Star Green and Economy.		North Star Oil, Ltd., Winnipeg.
	Regal Green		Regal Distributors, Ltd. (Edmonton).
		Joy	St. Lawrence Oil Co., Ltd. (Montreal).
Super-Shell Ethyl	Shell		Shell Oil Co. of Canada, Ltd., Toronto.
Super-Shell Ethyl	Super-Shell		Shell Oil Co. of B.C., Ltd., Vancouver.
Standard Ethyl	Red Crown and Standard		Standard Stations, Ltd. (Vancouver).
	Blue Sunoco		Sun Oil Co., Ltd., Toronto.
Supertest Ethyl	Wonder	Supertest Motor	Supertest Petroleum Corp., Ltd., London.
Texaco Ethyl	Fire Chief		Texas Co. of Canada, Ltd., Calgary.
Union Ethyl	Union "76"		Union Oil Co. of Canada, Ltd. (Vancouver).
Average octane No.....76	Average octane No.....68	Average octane No.....57	

* The group is determined from the average based on tests of a total of 179 samples collected in Canada in August 1935. The volatility of the individual samples in the three groups, with a few notable exceptions as shown in Table I, 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.

TABLE IX

Group of 66 Brands of Gasoline Sold by 33 Companies in 1936**

Group I	Group II	Group III	Company or Distributor and Head Office Address (or city from which samples orignated)
	B.S.Q. Golden	B.M.L. White	Beach Motors, Ltd., Ottawa.
Benzolene and Champlain Ethyl	Citadel	Tower	Benzolene Corp., Ltd., Ottawa.
Peerless Ethyl	Nevr-Nox	*British Motor	British American Oil Co., Ltd., Toronto.
Canadian Ethyl	White Rose No Knock	*White Rose	Canadian Oil Company, Ltd., Toronto.
	Champlain Plus "70" and Special White.		Champlain Oil Co., Ltd., Montreal.
Cities Service Ethyl	Koolmotor	Cities Service	Cities Service Oil Co., Ltd., Toronto.
	Green Flash	Dominion	Crown Dominion Oil Co., Ltd., Hamilton.
		Montana	Economy Oils, Ltd. (Calgary).
		Purity and Blue Flash	Gas & Oil Products, Ltd. (Calgary).
	General		General Oil Co., Ltd. (Vancouver).
	Blue Star		Good Rich Oil Co., Ltd., Toronto.
	Powerite	Reliance	Great West Distributors, Ltd. (Edmonton)
	Hi-way and Q.C. Blue		Home Oil Distributors, Ltd., Vancouver.
		Home 60	Home Oil Refining Co., Ltd. (Regina).
Esso (Imperial Ethyl)	Three Star	*Premier	Imperial Oil, Ltd., Toronto.
	Mohawk		Independent Gasoline Corp., Ltd. (Vancouver).
	Primrose Purple and Primrose		Irving Oil Co., Ltd. (Halifax).
	Red Crown		Island Pacific Oil Co., Ltd. (Victoria).
	Red Imp	Lincoln	Lincoln Service Station, Ltd. (Hamilton).
	Richtest		Mahoney and Rich (Ottawa).
Cyclo Ethyl	Marathon Blue	*Frontenac	McColl-Frontenac Oil Co., Ltd., Montreal.
	North Star Green	Economy	North Star Oil, Ltd. (Winnipeg).
	Perfection Blue		Perfection Petroleum Co., Ltd., Toronto.
	Pep	Hi-way	Puritan Oil Co., Ltd. (Regina).
Super-Shell Ethyl	Golden Shell		Shell Oil Co. of Canada, Ltd., Toronto.
	Super-Shell		Shell Oil Co. of B.C., Ltd., Vancouver.
Signal Ethyl	Signal		Signal Oil Co., Ltd. (Vancouver).
Standard Ethyl	Standard and Red Crown		Standard Oil Co., Ltd., Vancouver.
	Benzolene	More Power	Stares Service Station (Hamilton).
	Blue Sunoco		Sun Oil Co., Ltd., Toronto.
Supertest Ethyl	Wonder	*Supertest Motor	Supertest Petroleum Corp., Ltd., London.
Fire Chief Ethyl	Fire Chief	Texaco White	Texas Co. of Canada, Ltd., Calgary.
Union Ethyl	Union "76"		Union Oil Co. of Canada, Ltd., Vancouver.
Average octane No.....77	Average octane No.....69	Average octane No.....60	

* 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 180 samples collected in Canada in August 1936. The volatility of the individual samples in the three groups, with a few notable exceptions as shown in Table 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.

TABLE X

Octane Numbers of 31 of the 1935 Gasoline Samples as Determined in Two Different Knock-Testing Engines

Sample No.—1935	Octane No.		Difference in octane No. due to change in engine and method
	"C.F.R." engine	Series 30B engine	
162	76	78	2
30	76	77	1
96	76	77	1
176	75	77	2
4	75	76	1
145	75	75	0
46	72	74	2
164	70	72	2
179	70	71	1
10	69	69	0
33	69	69	0
82	69	68	1
149	69	68	1
20	68	68	0
5	68	67	1
31	66	66	0
69	65	66	1
174	65	65	0
3	65	64	1
32	62	59	3
155	62	59	3
40	60	57	3
62	59	57	2
153	58	57	1
92	58	55	3
124	58	54	4
138	57	53	4
136	56	53	3
80	53	50	3
143	52	49	3
109	50	46	4

TABLE XI

Tetraethyl Lead Content of Gasoline Samples in 1935 According to Two Groups

City	Number of samples	Group I (Ethyl Gasoline) Tetraethyl lead, c.c. per Imp. gallon			Number of samples	Group II ("Q" Gasoline) Tetraethyl lead, c.c. per Imp. gallon		
		Maximum	Minimum	Average		Maximum	Minimum	Average
Halifax	2	1·70	1·51	1·61	3	1·04	0·41	0·62
Saint John	2	1·69	1·67	1·68	3	0·77	0·46	0·64
Quebec	2	2·47	1·63	2·05	3	0·79	0·51	0·69
Montreal	2	2·49	1·70	2·10	5	1·79	0·18	0·81
Ottawa	7	2·42	1·64	2·05	7	1·58	0·53	0·77
Toronto	2	2·64	2·55	2·60	4	1·37	0·45	1·14
Hamilton	2	3·15	3·15	3·15	3	1·67	0·75	1·08
London	2	3·38	3·01	3·20	3	1·69	1·31	1·51
Fort William	2	3·22	3·15	3·19	5	1·84	0·70	1·16
Winnipeg	2	3·30	2·97	3·14	3	1·57	0·75	1·20
Regina	2	3·44	3·40	3·42	4	1·88	0·87	1·60
Calgary	2	3·72	3·63	3·68	3	1·83	0·86	1·41
Edmonton	1	3·58	3·58	3·58	1	1·73	1·73	1·73
Vancouver	3	1·92	1·50	1·67	5	1·23	0·36	0·60
Victoria	3	2·88	1·52	2·21	5	1·41	0·42	0·70
Total number of samples	36	.....	.....	.....	57	.....	.....	.....
Average (for all samples in group)	.....	.....	.....	2·48	.....	.....	.....	0·98

APPENDIX

CANADIAN GOVERNMENT PURCHASING STANDARDS COMMITTEE—SPECIFICATION FOR GASOLINE—No. 3-GP-1

1. *Definition*

This specification applies to volatile hydrocarbon fuel suitable for use in internal combustion engines. It does not apply to materials known as aviation fuel nor to heavier fuels in the classes known as kerosene, engine distillate, etc.

Blends of gasoline with benzol and/or alcohol which fail to meet the requirements enumerated below shall be approved by the National Research Council before being accepted in competition with fuels satisfying this specification.

2. *General Requirements*

(*a*) *Appearance*

The gasoline shall be clear, i.e. free from undissolved water and suspended matter.

(*b*) *Sulphur*

The total sulphur content shall not exceed 0·10 per cent by weight. The test shall be conducted in accordance with A.S.T.M. Procedure D90-34T.

(*c*) *Corrosion*

The fuel shall pass the test for corrosion in accordance with A.S.T.M. Procedure D130-30.

(*d*) *Freezing Point* (For winter grade)

The freezing point of the fuel as indicated by the initial formation of solid matter shall not be higher than minus 60°C. (minus 76°F.).

The test shall be made by cooling the sample in a test tube equipped with a suitable thermometer and stirrer, and jacketed by a second test tube, the whole being immersed in a carbon dioxide ether mixture.

(*e*) *Vapour Pressure*

The vapour pressure of the fuel shall not exceed 10 pounds per square inch for the summer grade and 13 pounds per square inch for the winter grade. The test shall be conducted in accordance with A.S.T.M. Procedure D417-35T.

(*f*) *Gum*

The increase in weight in the test according to A.S.T.M. Procedure D381-34T shall be limited to 15 mg. per 100 c.c. Any increase in weight shall be considered as gum. In the case of gasolines stated to contain top-cylinder lubricant, allowance may be made for any increase in weight due to the pressure of such lubricant, at the discretion of the testing authority.

3. *Grading Requirements*

(*a*) *Distillation Range*

The gasoline shall be classified in two grades as defined below:

	Summer	Winter
Grade 1 Gasoline	°F.	°F.
Not less than 10 per cent of the fuel shall be recovered at	155	145
" 50 " " "	265	265
" 90 " " "	370	370
Grade 2 Gasoline		
Not less than 10 per cent of the fuel shall be recovered at	165	155
" 50 " " "	284	284
" 90 " " "	392	392

The distillation range shall be determined in accordance with A.S.T.M. Procedure D86-35.

(*b*) *Octane Number*

Fuels having an octane number not less than 75 shall be rated H.
Fuels having an octane number not less than 66 shall be rated M.
Fuels having an octane number below 66 shall be rated L.

The octane number shall be determined by the "C.F.R." motor method in accordance with A.S.T.M. Procedure D357-34T.

4. *Testing Methods*

The methods of test in all cases shall be those specified in the foregoing clauses, or such methods as may from time to time be specified by the Committee.

Use of Gasoline Specification No. 3-GP-1

Attention is drawn to the fact that in Specification No. 3-GP-1 the requirements of clause 2 are general ones and apply to all gasoline coming within the scope of the specification. Clause 3 provides a means whereby the user may select the fuel most suited to the type of equipment used, and the conditions under which it will be operated.

The distillation range, as laid down in clause 3(*a*), is a measure of such factors as ease of starting, accelerating ability, and freedom from undesirable " heavy ends," tending to cause crankcase dilution.

In this connection, it is now customary to consider that the lower the temperature at which 10 per cent of the fuel is distilled, the more readily does the engine start under low temperature conditions; the lower the 50 per cent point, the more readily does it respond to the throttle for acceleration; the lower the 90 per cent point, the greater the assurance that high boiling fractions will not condense on cylinder walls and tend to dilute the crankcase oil.

From the foregoing, it might be assumed that all such points in the distillation range should be as low as possible. This, however, would be undesirable for a number of reasons, the chief of which possibly is the fact that reduction in distillation temperature tends to result in increased vapour pressure which if too high would cause danger of " vapour lock " in the feed lines. In addition, on very light gasolines, loss through evaporation becomes a significant factor.

In respect to octane number, it may be said that the higher the rating under this heading, the less the tendency of the fuel to detonate under operating conditions. Detonation, as is well known, results in over-heating and loss of power. Consequently, with modern high compression engines, octane number becomes of paramount importance. While other factors enter into the question, generally speaking, for ordinary engines, the higher the compression ratio, the higher the octane number required of a fuel.

The following suggestions are offered as a guide to users of gasoline under different conditions, although necessarily they do not cover every type of service.

1. *Automobiles, Motorcycles, and Light Duty Trucks*

At the present time the majority of vehicles in this class do not necessarily require fuel of anti-knock quality equivalent to Grade "H." A fuel of Grade 1M is preferable for general purposes. Manufacturers of certain high compression engines are prepared to indicate when a fuel corresponding in knock rating with class "H" is required; in other cases, the need for it will have to be decided from operation.

2. *Tractors, Buses, and Heavy Duty Trucks*

This class of vehicle generally operates over comparatively long periods of time and consequently starting characteristics are not so important as efficiency in operation. Fuels of Grade 2 distillation range would give satisfactory performance and in general an octane rating in class "M" would be suitable.

Where separate starting fuel tanks are fitted, or when the vehicle is to be used in very cold weather, a Grade 1M fuel might be used to advantage.

3. *Stationary Engines*

In general, engines of this class would operate quite satisfactorily on fuel of Grade 2M and it may be possible to run them on Grade 2L. In cases where they are being used for work that is highly important, as in the case of fire pumps, Grade 1H or 1M would be desirable.

4. *Portable Fire Pump Engines*

For this class of service, it is desirable that fuel of Grade 1H be used, unless there is definite information that Grade 1M would be satisfactory under the particular conditions of operation.

5. *Rail Cars* (Motor-driven hand-car type)

Fuel of Grade 1M should be provided for this class of service.

6. *Marine Engines* (Including outboard motors)

With the exception of the newer high compression engines which are as yet used to a comparatively limited extent, marine engines do not require a fuel of very high anti-knock quality. While octane ratings of "L" grade would be suitable for a large number of engines, it is probable that more consistent satisfaction would be obtained from the use of fuel of Grade "M." A distillation range corresponding to that of Grade 1, would similarly be expected to give improved results over Grade 2 in motor boat engines. It is therefore recommended that fuel of Grade 1M be used for general service.

7. *Blow-torches, Stoves, Fire-pots, Lamps, etc.*

When gasoline blow-torches, stoves, or fire-pots are used, a fuel of Grade 2L is recommended. It is desirable that gasoline containing tetra-ethyl lead not be used owing to the health hazard in handling as well as from the products of combustion. Lead is most likely to be found in Grades "H" and "M," and for this reason fuels of these grades should be avoided.

It is recommended that lighting naphtha, rather than gasoline, be used in lamps.

8. *Illuminating and Heating Gas Apparatus*

Gasoline is not recommended for this purpose as special fuels of low end point are desirable from the point of view of safety.

9. *Cleaning Purposes*

Gasoline should not be used for cleaning purposes; only approved dry cleaning solvents should be employed.

10. *Test Samples*

When samples of fuel for testing are required, a one-gallon can, clean, and free from water, should be obtained. Prior to filling it with the sample, it should be rinsed out with some of the fuel to be tested. Cans to be used for gasoline samples should preferably be new ones, and should not have been used previously for oils or other materials.

The sample should be siphoned into the can or in the case of samples taken from filling station pumps, the nozzle of the hose should be inserted in the can. If gasoline is poured into the can there is danger that loss of volatile components of the fuel will seriously affect the accuracy of the test results. Hose, funnels, etc., should be thoroughly cleaned before they are used to draw the test sample.

It is not advisable to use glass bottles for shipments of samples as, apart from the danger of breakage, sunlight sometimes has a very appreciable effect on the properties of the gasoline.

Before samples are shipped, reference should be made to regulations in force by the carrier governing the shipment of gasoline.

11. *Storage*

When stored over comparatively long periods of time, modern cracked gasolines have a tendency to form gum. This gum deposits on valves of engines and may cause serious trouble. The use of a "straight run" gasoline minimizes this risk and is therefore recommended when storage over long periods is contemplated.

At the present time fuels filling the specification of Grade 1H tend to be of the "straight run" type, and if this quality is used, danger will be largely avoided. In addition, the harmful effect of gum is minimized in certain gasolines by the addition of top-cylinder lubricants. Specification of the latter, in many instances, would be sufficient precaution.

These precautions would apply mainly to fuel stored in caches or where a supply is kept in a storage tank for stand-by engines over periods of six months or more.

12. *New Engines*

When purchasing new equipment, it is desirable to obtain from the manufacturer, when such is available, information as to octane number, vapour pressure, and distillation range of the fuel most suitable for use in his product.

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