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PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (--ETC(U)  
SEP 79 G MOROZ, N N KALLIO, T BAILEY

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# PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES

(Ottawa/Hull Area – Summer, 1979)

by

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S.A. Smith, C. DesBrisay

Division of Mechanical Engineering

OTTAWA  
SEPTEMBER 1979

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MECHANICAL ENGINEERING  
REPORT  
MP-74

PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE  
GASOLINES (OTTAWA/HULL AREA - SUMMER, 1979)

(PROPRIÉTÉS DES ESSENCES AUTO DE TYPES SANS PLOMB RÉGULIER ET SUPER  
(RÉGION OTTAWA/HULL - ÉTÉ, 1979))

by/par

G. MOROZ, N.N. KALLIO, T. BAILEY,  
S.A. SMITH, C. DES BRISAY

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## SUMMARY

↓  
Unleaded, automotive, summer grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality. They meet requirements of CGSB\* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline, except for some Reid vapour pressure values and one lead content that marginally exceed limits.

The tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.

\* Canadian Government Specifications Board

## RÉSUMÉ

Les essences auto de type sans plomb, régulier (type 2) et super (type 1), vendues dans la région Ottawa/Hull et distribuées par les principales compagnies pétrolières sont d'excellente qualité. Les essences se conforment aux normes 3-GP-5 et 3-GP-5Ma de la ONGC\* pour essence auto de type sans plomb, à l'exception de quelques pressions de vapeur et d'une quantité de plomb qui dépassent les valeurs limites de façon marginale.

La quantité de plomb et de phosphore contenue dans toutes les essences analysées est inexistante ou négligeable assurant une excellente protection contre l'empoisonnement du catalyseur. La plupart des essences contiennent du manganèse, probablement sous forme de tricarbonyl méthylcyclopentadienyl de manganèse, agent antidétonnant.

\* Office des normes du gouvernement canadien

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## PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (OTTAWA/HULL AREA – SUMMER, 1979)

### 1.0 INTRODUCTION

This survey of the physical, chemical and antiknock properties of unleaded automotive gasolines sold by the major oil companies in the Ottawa/Hull area in the summer of 1979 was made for two reasons: (1) To obtain data on unleaded gasolines used in the Environment Canada project employing cars in field service aimed at comparing the engine performance of two API service classification SE automotive oils, one formulated from virgin oil basestock and the other formulated from re-refined oil basestock (SAE viscosity grade: 20W-40). (2) To obtain and disseminate more widely this useful data on unleaded gasolines because of its general unavailability. An earlier report was issued covering winter grade gasolines (Ref. 1).

### 2.0 SAMPLES

Two gallon quantities of each of sixteen unleaded automotive gasolines (8 regular and 8 super) were obtained from eight major oil company service stations in the Ottawa/Hull area in July 1979. As the gasolines probably came from Quebec refineries, principally in Montreal, they are accordingly probably representative of gasolines sold in the Montreal/Quebec City as well as Ottawa/Hull regions. Care was taken to ensure that the samples were uncontaminated and promptly capped to minimize vapour losses. Subsequently, they were stored in a refrigerator in the NRC Fuels and Lubricants Laboratory maintained at 32-40° F before testing, the Reid vapour pressure being determined first.

### 3.0 OIL COMPANIES

The unleaded summer gasolines, as noted, were obtained from the service stations of eight different oil companies. The oil companies are listed in alphabetical order. This order is unrelated to the order or sample numbers shown in the Tables.

BP Canada  
Golden Eagle Canada Limited  
Gulf Oil Canada Limited  
Imperial Oil Limited  
Petrofina Canada Limited  
Shell Canada Limited  
Sun Oil Company Limited  
Texaco Canada Limited

### 4.0 TESTS AND RESULTS

Tests performed on the unleaded gasolines were in all instances standard ASTM laboratory tests as stated in CGSB Standards 3-GP-5 or 3-GP-5Ma for Unleaded Automotive Gasoline (Ref. 2). Tests used were the latest published versions except for sulphur content which was determined by an old version, D90-34T.

All tests specified in 3-GP-5 and 3-GP-5Ma were performed. In addition, though, for information, several other tests were done and data recorded. These were (1) API gravity and relative density, (2) hydrocarbon types, (3) evaporation residue as described in the gum test, and (4) research octane number. The laboratory considered checking two other important properties: vapour-liquid ratio (ASTM D2533) and carburettor cleaning ability (detergency test). The former is a requirement in ASTM D439, Specifications for Automotive Gasoline. It was not done because of lack of time. The latter was not done because of the absence of a standard test.

Results of all tests are presented in four tables, two of which present the results in the new metric or SI units and the other two in the old non-metric or superseded units. For purposes of determining compliance with 3-GP-5 and 3-GP-5Ma specification limits, the limits are shown in the Tables.

The data are presented as follows:

- Table 1 — Properties of Regular Unleaded Gasolines — Metric Units
- Table 2 — Properties of Super Unleaded Gasolines — Metric Units
- Table 3 — Properties of Regular Unleaded Gasolines — Non-Metric Units
- Table 4 — Properties of Super Unleaded Gasolines — Non-Metric Units

### 5.0 COMPLIANCE WITH CGSB SPECIFICATION 3-GP-5 (3-GP-5Ma)

An examination of the data in the four tables reveals that all of the unleaded automotive gasolines surveyed are of high quality. All meet all of the requirements of CGSB Specification 3-GP-5 or 3-GP-5Ma, except for the lead content of a super gasoline which marginally exceeds the limit and the Reid vapour pressures of a number of gasolines which also marginally exceed the limit.

As noted both lead and phosphorus are either absent or present only in trace amounts in the gasolines indicating good protection for the anti-pollution catalyst. In large amounts, both of these elements would soon destroy the catalyst. It is interesting to note that practically all unleaded gasolines, regular and super alike, contain manganese as an antiknock agent, probably as methylcyclopentadienyl manganese tricarbonyl (MMT)\*. Sulphur levels are very low in all gasolines indicating good metal protection from corrosion due to sulphur combustion products.

All gasolines have good oxidation stability and negligible gum contents.

### 6.0 COMPARISONS WITH WINTER GRADE GASOLINES

A comparison of these data on summer grade gasolines with data obtained on winter grade gasolines (Ref. 1) reveals, apart from the expected volatility differences, some other notable differences, as shown in the following tables of average data.

#### REGULAR GASOLINES

	MP-74 Summer 1979	MP-73 Winter 1978/79
Final Boiling Point (Distillation) °F	393	373
Aromatics, % Vol.	34.7	33.2
Olefins, % Vol.	7.3	11.4
Saturates, % Vol.	58.0	55.4
Manganese, gMn/l.G.	0.03	0.05
R.O.N.	93.2	93.6
M.O.N.	83.8	84.9
Antiknock Index	88.5	89.3

#### SUPER GASOLINES

Final Boiling Point (Distillation) °F	388	369
Aromatics, % Vol.	44.2	41.4
Olefins, % Vol.	8.6	10.4
Saturates, % Vol.	47.2	48.2
Manganese, gMn/l.G.	0.04	0.06
R.O.N.	97.3	98.1
M.O.N.	86.3	86.9
Antiknock Index	91.8	92.5

\* Trade Mark of Ethyl Corporation

It is apparent that there is a slight reduction in the average antiknock quality, and correspondingly a reduction in the manganese content.

There is also an average increase in the final boiling point of the summer gasolines, probably due to the desire of the oil companies, and indeed the motoring public, to maximize gasoline volumes.

## 7.0 ACKNOWLEDGMENT

The authors acknowledge with thanks the motor octane number data provided by Messrs. J. O'Connor and J. Thompson of the Quality Engineering Test Establishment, DND. The authors also appreciate the valuable counsel given by Messrs. P.L. Strigner, R. Sabourin and G. Burton of the Fuels and Lubricants Laboratory.

## 8.0 REFERENCES

1. Strigner, P.L. *Properties of Regular and Super Unleaded Automotive Gasolines (Ottawa/Hull Area — Winter, 1978/79).*  
Moroz, G. NRC, DME Report MP-73, National Research Council Canada,  
Sabourin, R. Ottawa, Ontario, June 1979.  
Burton, G.  
Bailey, T.
2. Canadian Government Specifications Board (CGSB) Standard 3-GP-5Ma for Unleaded Automotive Gasolines issued in November 1978. It supersedes the non-metric Standard 3-GP-5 issued in July 1976. Standards are available from Canadian Government Specifications Board, Ministry of Supply and Services, Canada, Hull, Quebec, Canada K1A 0S5.

TABLE 1  
PROPERTIES OF REGULAR UNLEADED GASOLINES - METRIC UNITS

	ASTM Method	FLO 79644	FLO 79645	FLO 79646	FLO 79647	FLO 79648	FLO 79649	FLO 79650	FLO 79651	3-GP-5Ma (1) Summer
Colour	Visual (2)	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Undyed
Reid Vapour Pressure, kPa	D323	71.0	73.8	76.5	71.0	74.5	71.0	75.8	71.0	76 max.
Relative Density at 15.56/15.56°C	D1298	0.7463	0.7440	0.7436	0.7408	0.7447	0.7447	0.7471	0.7420	No limit
Copper Strip Corrosion (3 hrs at 50 °C)	D130	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1
Distillation	D86	30	30	29	29	30	30	29	30	No limit
Initial Boiling Point, °C		48	47	47	48	49	47	47	48	57 max.
10% Evaporated, °C		94	102	97	101	107	103	102	99	118 max.
50% Evaporated, °C		151	161	163	162	169	170	163	153	185 max.
90% Evaporated, °C		193	203	202	201	208	210	197	189	No limit
Final Boiling Point, °C		97.5	97.0	97.0	97.1	96.6	97.1	96.8	97.1	No limit
Recovery, % Vol.		1.0	1.2	1.3	1.3	1.4	1.2	1.2	1.4	No limit
Residue, % Vol.		1.5	1.8	1.7	1.6	2.0	1.7	2.0	1.5	No limit
Loss, % Vol.										
Hydrocarbon Types	D1319									
Aromatics, % Vol.		37.2	35.1	34.8	32.9	33.2	33.1	37.2	33.8	No limit
Olefins, % Vol.		4.7	11.4	4.2	10.4	6.2	9.0	6.6	6.1	No limit
Saturates, % Vol.		58.1	53.5	61.0	56.7	60.5	57.9	56.2	60.1	No limit
Elements										
Lead, mgPb/L	D3237	2	2	2	7	2	4	2	0	13 max.
Phosphorus, mgP/L	D3231	0.4	0.2	0.3	0.5	0.2	0.2	0.3	0.2	1.3 max.
Manganese, mgMn/L	D3831	8	8	4	7	2	7	8	7	18 max.
Sulphur, % mass	D90-34T	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.15 max.
Gum and Stability										
Evaporation Residue, mg/100mL	D381	2.0	2.7	5.3	2.6	3.1	2.1	1.4	2.0	No limit
Existent Gum, mg/100mL (3)	D381	0.4	0.9	0.0	0.1	2.1	0.6	0.5	0.1	7 max.
Oxidation Stability, min.	D525	> 240	> 240	> 240	> 240	> 240	> 240	> 240	> 240	240 min.
Anti-Knock Quality										
Research Octane No. (R.O.N.)	D2699	92.5	93.4	92.7	93.5	92.8	93.1	93.5	93.7	No limit
Motor Octane No. (M.O.N.) (5)	D2700	83.9	83.9	83.9	83.8	83.9	83.7	83.3	83.7	82.0 min.
Anti-Knock Index	Note (4)	88.2	88.7	88.3	88.7	88.4	88.4	88.4	88.7	87.0 min.

NOTES: (1) Specification issued in November 1978 (type 2, unleaded automotive gasoline).  
 (2) During the visual examination the gasolines were examined for clarity and visible contaminants. All were clear. No visible contaminants were observed.  
 (3) Existent gum is the solvent-washed residue.  
 (4) R.O.N. plus M.O.N. divided by 2.  
 (5) Determined courtesy of the Knock Laboratory, QETE, DND.

TABLE 2  
PROPERTIES OF SUPER UNLEADED GASOLINES - METRIC UNITS

ASTM Method	FLO 79636	FLO 79637	FLO 79638	FLO 79639	FLO 79640	FLO 79641	FLO 79642	FLO 79643	3-GP-5Ma (1) Summer
Colour	Green	Green	Green	Green	Green	Green	Green	Green	Green
Reid Vapour Pressure, kPa	75.8	75.8	78.6	69.6	74.5	78.6	73.1	73.1	76 max.
Relative Density at 15.56/15.56°C	0.7599	0.7563	0.7645	0.7599	0.7519	0.7620	0.7579	0.7547	No limit
Copper Strip Corrosion (3 hrs at 50°C)	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1
Distillation									
Initial Boiling Point, °C	31	30	29	30	30	28	30	29	No limit
10% Evaporated, °C	50	48	49	50	51	47	49	49	57 max.
50% Evaporated, °C	110	109	117	108	108	114	106	100	118 max.
90% Evaporated, °C	162	168	173	151	162	169	153	167	185 max.
Final Boiling Point, °C	197	206	203	192	200	204	187	192	No limit
Recovery, % Vol.	96.1	96.1	95.7	97.1	96.1	96.1	96.8	97.0	No limit
Residue, % Vol.	1.0	1.2	1.3	1.0	1.1	1.1	1.2	1.1	No limit
Loss, % Vol.	2.9	2.7	3.0	1.9	2.8	2.8	2.0	1.9	No limit
Hydrocarbon Types									
Aromatics, % Vol.	44.7	42.5	43.8	45.3	39.5	44.2	45.0	48.7	No limit
Olefins, % Vol.	11.0	10.0	10.8	11.1	2.7	7.7	8.3	7.0	No limit
Saturates, % Vol.	44.3	47.5	45.4	43.6	57.8	48.1	46.7	44.3	No limit
Elements									
Lead, mgPb/L	2	2	2	2	15	2	7	2	13 max.
Phosphorus, mgP/L	0.0	0.0	0.2	0.3	0.3	0.4	0.4	0.2	1.3 max.
Manganese, mgMn/L	7	8	4	13	8	4	8	15	18 max.
Sulphur, % mass	0.02	0.01	0.02	0.01	0.01	0.00	0.01	0.02	0.15 max.
Gum and Stability									
Evaporation Residue, mg/100mL	2.6	4.5	3.3	1.4	2.8	2.9	2.7	7.9	No limit
Existent Gum, mg/100mL (3)	0.3	0.0	0.5	1.3	0.3	3.0	0.0	1.8	7 max.
Oxidation Stability, min.	> 240	> 240	> 240	> 240	> 240	> 240	> 240	> 240	240 min.
Anti-Knock Quality									
Research Octane No. (R.O.N.)	97.5	97.7	97.5	97.6	96.9	97.5	97.3	96.4	No limit
Motor Octane No. (M.O.N.) (5)	86.3	86.4	86.5	86.1	87.3	86.2	86.1	85.4	No limit
Anti-Knock Index	91.9	92.1	92.0	91.9	92.1	91.9	91.7	90.9	90.0 min.

NOTES: (1) Metric specification issued in November 1978 (type 1, unleaded automotive gasoline).  
 (2) During the visual examination the gasolines were examined for clarity and visible contaminants. All were clear. No visible contaminants were observed.  
 (3) Existent gum is the solvent-washed residue.  
 (4) R.O.N. plus M.O.N. divided by 2.  
 (5) Determined courtesy of the Knock Laboratory, QETE, DND.

TABLE 3  
 PROPERTIES OF REGULAR UNLEADED GASOLINES - NON-METRIC UNITS

ASTM Method	FLO 79644	FLO 79645	FLO 79646	FLO 79647	FLO 79648	FLO 79649	FLO 79650	FLO 79651	3-GP-5 (1) Summer
Colour	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	No limit
Reid Vapour Pressure, psi	10.3	10.7	11.1	10.3	10.8	10.3	11.0	10.3	11 max.
API Gravity at 60° F	58.1	58.7	58.8	59.5	58.5	58.5	57.9	59.2	No limit
Specific Gravity at 60/60° F	0.7463	0.7440	0.7436	0.7408	0.7447	0.7447	0.7471	0.7420	No limit
Copper Strip Corrosion (3 hrs at 122° F)	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1
Distillation									
Initial Boiling Point, ° F	86	86	84	85	86	86	84	86	No limit
10% Evaporated, ° F	119	117	117	119	121	117	116	119	135 max.
50% Evaporated, ° F	202	216	206	214	224	217	216	211	245 max.
90% Evaporated, ° F	303	322	325	323	337	338	325	308	365 max.
Final Boiling Point, ° F	379	398	395	394	406	410	386	373	No limit
Recovery, % Vol.	97.5	97.0	97.0	97.1	96.6	97.1	96.8	97.1	No limit
Residue, % Vol.	1.0	1.2	1.3	1.3	1.4	1.2	1.2	1.4	No limit
Loss, % Vol.	1.5	1.8	1.7	1.6	2.0	1.7	2.0	1.5	No limit
Hydrocarbon Types									
Aromatics, % Vol.	37.2	35.1	34.8	32.9	33.2	33.1	37.2	33.8	No limit
Olefins, % Vol.	4.7	11.4	4.2	10.4	6.2	9.0	6.6	6.1	No limit
Saturates, % Vol.	58.1	53.5	61.0	56.7	60.5	57.9	56.2	60.1	No limit
Elements									
Lead, gPb/l.G.	0.01	0.01	0.01	0.03	0.01	0.02	0.01	0.00	0.06 max.
Phosphorus, gP/l.G.	0.002	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.006 max.
Manganese, gMn/l.G.	0.04	0.04	0.02	0.03	0.01	0.03	0.04	0.03	0.08 max. (3)
Sulphur, % mass	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.15 max.
Gum and Stability									
Evaporation Residue, mg/100mL	2.0	2.7	5.3	2.6	3.1	2.1	1.4	2.0	No limit
Existent Gum, mg/100mL (4)	0.4	0.9	0.0	0.1	2.1	0.6	0.5	0.1	7 max.
Oxidation Stability, min.	> 240	> 240	> 240	> 240	> 240	> 240	> 240	> 240	240 min.
Anti-Knock Quality									
Research Octane No. (R.O.N.)	92.5	93.4	92.7	93.5	92.8	93.1	93.5	93.7	No limit
Motor Octane No. (M.O.N.) (6)	83.9	83.9	83.9	83.8	83.9	83.7	83.3	83.7	82.0 min.
Anti-Knock Index	88.2	88.7	88.3	88.7	88.4	88.4	88.4	88.7	87.0 min.

NOTES: (1) Specification issued in July 1976.  
 (2) During the visual examination the gasolines were examined for clarity and visible contaminants. All were clear. No visible contaminants were observed.  
 (3) Limit calculated from the recently issued metric specification, 3-GP-5Ma.  
 (4) Existent gum is the solvent-washed residue.  
 (5) R.O.N. plus M.O.N. divided by 2.  
 (6) Determined courtesy of the Knock Laboratory, QETE, DND.

TABLE 4  
PROPERTIES OF SUPER UNLEADED GASOLINES -- NON-METRIC UNITS

	ASTM Method	FLO 79636	FLO 79637	FLO 79638	FLO 79639	FLO 79640	FLO 79641	FLO 79642	FLO 79632	3-GP-5 (1) Summer
Colour	Visual (2)	Green	Green	Green	Green	Green	Green	Green	Green	Green
Reid Vapour Pressure, psi	D323	11.0	11.0	11.4	10.1	10.8	11.4	10.6	10.6	11 max.
API Gravity at 60°F	D287	54.7	55.6	53.6	54.7	56.7	54.2	55.2	56.0	No limit
Specific Gravity at 60/60°F	D287	0.7599	0.7563	0.7645	0.7599	0.7519	0.7620	0.7579	0.7547	No limit
Copper Strip Corrosion (3 hrs at 122°F)	D130	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1
Distillation	D86									
Initial Boiling Point, °F		87	86	84	86	86	82	86	84	No limit
10% Evaporated, °F		122	118	121	122	124	116	121	120	135 max.
50% Evaporated, °F		230	228	243	226	226	238	222	212	245 max.
90% Evaporated, °F		324	334	334	304	324	336	307	332	365 max.
Final Boiling Point, °F		386	403	397	377	392	399	369	377	No limit
Recovery, % Vol.		96.1	96.1	95.7	97.1	96.1	96.1	96.8	97.0	No limit
Residue, % Vol.		1.0	1.2	1.3	1.0	1.1	1.1	1.2	1.1	No limit
Loss, % Vol.		2.9	2.7	3.0	1.9	2.8	2.8	2.0	1.9	No limit
Hydrocarbon Types	D1319									
Aromatics, % Vol.		44.7	42.5	43.8	45.3	39.5	44.2	45.0	48.7	No limit
Olefins, % Vol.		11.0	10.0	10.8	11.1	2.7	7.7	8.3	7.0	No limit
Saturates, % Vol.		44.3	47.5	45.4	43.6	57.8	48.1	46.7	44.3	No limit
Elements										
Lead, gPb/l.G.	D3237	0.01	0.01	0.01	0.01	0.07	0.01	0.03	0.01	0.06 max.
Phosphorus, gP/l.G.	D3231	0.000	0.000	0.001	0.001	0.001	0.002	0.002	0.001	0.006 max.
Manganese, gMn/l.G.	D3831	0.03	0.04	0.02	0.06	0.04	0.02	0.04	0.07	0.08 max.
Sulphur, % mass	D90-34T	0.02	0.01	0.02	0.01	0.01	0.00	0.01	0.02	0.15 max.
Gum and Stability										
Evaporation Residue, mg/100mL	D381	2.6	4.5	3.3	1.4	2.8	3.0	2.7	7.9	No limit
Existent Gum, mg/100mL (3)	D381	0.3	0.0	0.5	1.3	0.3	3.0	0.0	1.8	7 max.
Oxidation Stability, min.	D525	> 240	> 240	> 240	> 240	> 240	> 240	> 240	> 240	240 min.
Anti-Knock Quality										
Research Octane No. (R.O.N.)	D2699	97.5	97.7	97.5	97.6	96.9	97.5	97.3	96.4	No limit
Motor Octane No. (M.O.N.) (5)	D2700	86.3	86.4	86.5	86.1	87.3	86.2	86.1	85.4	No limit
Anti-Knock Index	Note (4)	91.9	92.1	92.0	91.9	92.1	91.9	91.7	90.9	90.0 min.

NOTES: (1) Metric specification 3-GP-5Ma for type 1 unleaded issued in November 1978.  
Limits converted to non-metric units.  
(2) During the visual examination the gasolines were examined for clarity and visible contaminants.  
All were clear. No visible contaminants were observed.  
(3) Existent gum is the solvent-washed residue.  
(4) R.O.N. plus M.O.N. divided by 2.  
(5) Determined courtesy of the Knock Laboratory, QFTE, DND.

<p>NRC, DME, MP-74 National Research Council Canada, Division of Mechanical Engineering.</p> <p>PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (OTTAWA HULL AREA - SUMMER, 1979). Moroz, G., Kallio, N.N., Bailey, T., Smith, S.A., Desbrosay, C. September 1979. 10 pp. (incl. tables).</p> <p>Unleaded, automotive, summer grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality. They meet requirements of CGSB* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline, except for some Reid vapour pressure values and one lead content that marginally exceed limits.</p> <p>The tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.</p> <p>* Canadian Government Specifications Board</p>	<p>NRC, DME, MP-74 National Research Council Canada, Division of Mechanical Engineering.</p> <p>PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (OTTAWA HULL AREA - SUMMER, 1979). Moroz, G., Kallio, N.N., Bailey, T., Smith, S.A., Desbrosay, C. September 1979. 10 pp. (incl. tables).</p> <p>Unleaded, automotive, summer grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality. They meet requirements of CGSB* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline, except for some Reid vapour pressure values and one lead content that marginally exceed limits.</p> <p>The tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.</p> <p>* Canadian Government Specifications Board</p>	<p>NRC, DME, MP-74 National Research Council Canada, Division of Mechanical Engineering.</p> <p>PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (OTTAWA HULL AREA - SUMMER, 1979). Moroz, G., Kallio, N.N., Bailey, T., Smith, S.A., Desbrosay, C. September 1979. 10 pp. (incl. tables).</p> <p>Unleaded, automotive, summer grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality. They meet requirements of CGSB* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline, except for some Reid vapour pressure values and one lead content that marginally exceed limits.</p> <p>The tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.</p> <p>* Canadian Government Specifications Board</p>	<p>NRC, DME, MP-74 National Research Council Canada, Division of Mechanical Engineering.</p> <p>PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (OTTAWA HULL AREA - SUMMER, 1979). Moroz, G., Kallio, N.N., Bailey, T., Smith, S.A., Desbrosay, C. September 1979. 10 pp. (incl. tables).</p> <p>Unleaded, automotive, summer grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality. They meet requirements of CGSB* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline, except for some Reid vapour pressure values and one lead content that marginally exceed limits.</p> <p>The tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.</p> <p>* Canadian Government Specifications Board</p>	<p>NRC NO. 17828</p> <p>UNCLASSIFIED</p> <p>1. Gasoline.</p> <p>I. Moroz, G. II. Kallio, N.N. III. Bailey, T. IV. Smith, S.A. V. Desbrosay, C. VI. NRC, DME, MP-74</p>	<p>NRC NO. 17828</p> <p>UNCLASSIFIED</p> <p>1. Gasoline.</p> <p>I. Moroz, G. II. Kallio, N.N. III. Bailey, T. IV. Smith, S.A. V. Desbrosay, C. VI. NRC, DME, MP-74</p>	<p>NRC NO. 17828</p> <p>UNCLASSIFIED</p> <p>1. Gasoline.</p> <p>I. Moroz, G. II. Kallio, N.N. III. Bailey, T. IV. Smith, S.A. V. Desbrosay, C. VI. NRC, DME, MP-74</p>	<p>NRC NO. 17828</p> <p>UNCLASSIFIED</p> <p>1. Gasoline.</p> <p>I. Moroz, G. II. Kallio, N.N. III. Bailey, T. IV. Smith, S.A. V. Desbrosay, C. VI. NRC, DME, MP-74</p>
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