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PETROLEUM BOARD

ENEMY OILS AND FUELS COMMITTEE

RESULTS OF EXAMINATION OF ENEMY FUELS

FIFTH SUMMARY

TO

JUNE, 1943

ENEMY OILS AND FUELS COMMITTEE

APPOINTED BY THE PETROLEUM BOARD

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The examination of the oils described in this report was carried out in the following laboratories:-

Anglo-Egyptian Oilfields, Suez.
Anglo-Iranian Oil Co., Ltd., Sunbury-on-Thames.
I.C.I. (Fertilizer & Synthetic Products) Ltd., Billingham, Co. Durham.
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PETROLEUM BOARD ENEMY OILS AND FUELS COMMITTEE

EXAMINATION OF SAMPLES OF ENEMY FUELS

FIFTH SUMMARY TO JUNE, 1943.

I N D E X

RESULTS OF EXAMINATION OF ENEMY FUELS.

FIFTH SUMMARY TO JUNE 1943

INTRODUCTION

This report covers the period September 1942 - June 1943 inclusive and describes one hundred and sixty two fuels derived from Europe and the Middle East. The total number of samples is comprised of fifty seven aviation grade fuels, fifty two motor gasolines, forty five diesel fuels and eight kerosines and white spirits.

For convenience the results are tabulated under the following headings:-

1.	Aviation gasolines from Europe	- Appendix	I
2.	" " " the Middle East	- "	II
3.	Motor gasolines from Europe	- "	III
4.	" " " the Middle East	- "	IV
5.	Diesel fuels from Europe	- "	V
6.	" " " the Middle East	- "	VI
7.	Various (kerosines and white spirits) from all sources	- "	VII
8.	Detailed analyses of AIR.200, AIR.209, AIR.233 and AIR.259	- "	VIII
	[illegible]	"	IX

SUMMARY

1). Aviation Gasolines. An outstanding feature of the fifty seven samples examined is that none consists of a typical German C.3 "green" fuel. Subsequent to the tabulation data of this report however, samples of several "green" (C.3) aviation gasolines have been received. The properties of these fuels will be dealt with in a separate report.

Apart from a few exceptions, the aviation fuels group themselves into two classes representing German B.4 "blue" gasolines and what are considered to represent Italian aviation fuels. The quality of the former has been maintained and no significant changes in properties are exhibited, although the aromatic content appears to be at the rather higher level of 20%. The Italian fuels are characterised by a lower T.E.L. content (3.5 - 4.5 mls./I.G.) and octane number (average about 87) than the German B.4 type.

2). Motor Gasolines. Fifty two samples from all sources are described. Six of the fuels are alcohol blends with octane numbers in the range (excepting one of O.N. = 100) 75 - 83. Three fuels are leaded straight-run products (O.N. = 68 and 69) and one cracked spirit containing a small quantity of alcohol is described. The remainder are either fairly normal motor grades containing cracked spirit, which are generally of lower quality than Allied commercial types, or benzole mixtures. In both classes leaded fuels are encountered. The ordinary motor grade has an octane number in the range of 60 - 70 whilst the benzole mixtures are from 68 - 75 in this respect. A few very low octane numbers are reported and these may be attributable in some cases to peroxide formation.

In general, it may be concluded that close quality standards for enemy motor fuels are not maintained and this position may have some connection with the diverse types of basic fuels available to the enemy.

3). Diesel Fuels. Forty five samples from Europe and the Middle East have been examined and it may be stated that their properties show them in general to be of good ignition quality. Almost all the European samples were derived from fishing vessels and whilst they exhibit a fairly wide range of

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properties, it would appear that they have been blended to a minimum diesel index of 45. There is little or no correlation between the physical and chemical properties and the indications are that products from all sources including brown and bituminous coal distillates (straight or hydrogenated), hydrogenated shale oil and Fischer-Tropsch gas oil to raise the diesel index are utilised in blends. Petroleum gas oil with or without kerosine fractions may also be included in the diesel fuel blends or used voluntarily.

Diesel fuels from the Middle East have an average diesel index (50 - 55) higher than those from Europe and this may be attributable to the fact that the former were intended for service vehicles whilst the latter are mainly from fishing vessels. However, many of these fuels would function as satisfactory high speed diesels on engines which are not too sensitive to fuel requirements.

A feature of several samples from both sources is a low flash point which indicates either the addition of kerosine or the inclusion of a light fraction in the gas oil cut. This addition would not have harmful effects.

4). Various. The few kerosines and white spirits examined exhibit no abnormal quantities. The kerosines are of poor burning quality and may, in some cases, be intended for use as power kerosines, although their volatilities are generally rather low for this application.

ANALYSIS AND DISCUSSION OF RESULTS

AVIATION GASOLINES FROM EUROPE (For detailed results see Appendix I.)

Six samples only have been received for examination during the period under review. Of these five were taken from enemy aircraft shot down in the U.K. whilst one was derived from a petrol tank picked up in European waters. All six fuels may be classified as normal German B.4 Blue fuels with a T.E.L. content of 5.4 - 5.65 mls/I.G. and Octane No.89 - 91. The aromatic content of AIR.209(22.5%) was at first thought to be higher than normal but subsequent data have indicated that a definite increase to this level has occurred whilst the distribution of the individual aromatics is tending towards that found in the C.3 "green" type.(See last para. Appendix VIII.) The figure of 30% wt. obtained on AIR.210 is attributable to the fuel having weathered. An aromatic content range of 13.5 - 19.0 is presented by the remaining four samples. From its description (Alleged Priming Fuel) AIR 231 should have special properties for take off, but the results do not indicate that it is anything but a normal "blue" fuel. This sample has a fairly high "gum" of the "sticky" type associated with rubber in solution.

A detailed hydrocarbon analysis of AIR.209 has been carried out and the results are given in Appendix VIII. The slightly higher aromatic content of this fuel is similar to that found for previous samples of blue fuel such as AIR.177 and AIR.200 and it is possible that these three represent small variations in what is otherwise normal "blue" fuel. This tendency towards an average aromatic content approaching 20%, is noted in "blue" fuels from the Middle East. AIR.209 contains a small quantity (ca.3%) of synthetic octanes but there is no evidence to suggest the presence of hydropetrol.

AVIATION GASOLINES FROM THE MIDDLE EAST (For detailed results see Appendix II)

The results on fifty one samples of aviation gasoline from the Middle East are tabulated in Appendix II. Sixteen of these fuels (AIR.205, 227, 241, 242, TD.534, 536, 540, AIR.243, 245, 248, 250, 252, 256, 266, 268 and 309) are of the German B.4 blue type and have Octane Nos.varying from 89 - 93. T.E.L. contents vary from 5.25 - 6.0 mls/I.G. whilst with two exceptions (AIR.205 and 227, total aromatics 8.5% and 2.5% respectively) the aromatic content is in the range 17 - 27.5%. Excluding AIR.268 (27.5%) the range is 17 - 23.5%. Although their properties classify them as German B.4 fuels, the colours of TD.534, 536, 540 and AIR.241 (representing a batch of captured drums) are blue, yellow, fluorescent green and yellow-green respectively. The colour of AIR.248, which is also of the B.4 type, is green and so is that of AIR.309. In general it may be concluded that the tendency with German B.4 fuels is to maintain the aromatic content at approximately 20%, which is at a higher level than the average obtaining in the period prior to that under review.

Of the remaining thirty five fuels, twenty eight are considered to be Italian aviation gasolines, whilst seven (TD.525, AIR.217, AIR.233, AIR.240, AIR.257, AIR.267 and AIR.269) are not readily classifiable.

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The Italian aviation fuels examined exhibit the following variations in properties:-

Property	Range
Specific Gravity	0.729 - 0.754
Colour	Water White, yellow, green, blue
T.E.L.	3.6-4.5 mls./I.G.(one sample, probably weathered is 4.9)
Octane No.	85 - 89
Aromatics	4.5 - 20.5 (The range for the majority of the samples is 15 - 20%)

In general the Italian fuels are characterised by having a lower T.E.L. content and lower average Octane No. than the German B.4 fuels. It is interesting to note that although all the fuels are leaded some are found to be water white in colour, presumably due to fading of the dye, and it is possible that those appearing yellow were also fading. All the fuels are of aviation volatility.

On the seven "various" fuels the following comments may be made.

AIR.235. The T.E.L. content of this fuel is much lower than usual if it is a German B.4 fuel, but the figure of 3.85 mls/I.G. in conjunction with an Octane No. of 88 may classify it as an Italian aviation fuel.

AIR.217. This is not a typical German blue fuel in view of the T.E.L. figure of 4.2 mls/I.G. and it may be of Italian origin, but such fuels have not so far shown an Octane No. as high as 91.

AIR.233. This fuel has a relatively low T.E.L. content (3.0mls/I.G.) and Octane No. (82). Although green in colour, it is not a typical German C.3 green fuel since the aromatic content is only about 20%. An infra-red analysis of this fuel (see Appendix VIII) suggested that although of low T.E.L. content it might be classified as a typical blue fuel and it was observed that the residue from the Dufton Column distillation was distinctly blue in colour.

AIR.240. The chief characteristics of this sample are that whilst possessing certain properties of the German green fuel - colour and aromatic content of 35.5%-it has a relatively low T.E.L. content of 4.6 mls/I.G. and an Octane No. of 89 normally associated with the B.4 fuel. AIR.240 may be a blend of German C.3 with a highly aromatic fuel of lower lead content.

AIR.257 Although of aviation volatility, this fuel has an Octane No. (81) lower than that normally encountered for operational flying. The lead content is also relatively low (3.15 mls/I.G.). It is possible that the fuel was intended for other purposes.

AIR.267. This sample shows signs of having been weathered and it is to be assumed that the consequent increased T.E.L. content (7.0 mls/I.G.) accounts for the Octane No. of 99. The fuel is coloured green but the aromatic content is 19.5%.

AIR.269. While this sample has a higher lead content than usual for a German blue fuel and a rather lower octane number, it is probably of this type.

Italian documents captured in the Middle East during 1942 deal with specifications and handling instructions for various petroleum products. The more important points affecting aviation fuels may be summarised as follows:-

1. Nine grades of fuels used by the Italian Air Force are described. Four are alcohol blends (with and without T.E.L.) with octane numbers in the range 80-87. The remaining five are described as follows:-

Name	Composition	Octane No.
B.E.80	Petrol + 0.9-1.4 mls.T.E.L./I.G.	80
"	" + 3.6-4.0 mls.T.E.L./I.G.	87
B.	Pure "Avio" petrol	72-74
B.E.100 N.O.	"Avio" 50%; iso-octane 50%; 3.6 mls.T.E.L./I.G.	100
B.E.100 N.O.	"Avio"60%; isopropyl ether 40%; 3.6 mls.T.E.L./I.G.	100

The base "petrol" referred to above is presumably 'B' grade 'Avio' of 73 O.N. of which full specification requirements are given (with 3.6 mls.T.E.L./I.G. it must give 87 O.N.)

2. Various instructions are given that B.4 gasoline (quoted as having an O.N. = 87-92) must be adjusted to certain specific gravity limits by the addition of not more than 10% aviation benzol with the T.E.L. content maintained at 5.4 mls./I.G. These instructions appear incomplete but the latest, dated 28.7.42; give a specific gravity range of .730 - .735 and intimate that B.4 petrol may be either of German origin or prepared in Italy.

3. Full instructions are given for using German B.4 fuel in engines designed for the Italian 87 O.N. grade when either the latter or 73 O.N. 'Avio' (for blending with B.4 to reduce the T.E.L. concentration) are not available.

4. A full list of Italian aero-engines and their fuel requirements are listed.

MOTOR GASOLINES FROM EUROPE
(For detailed results see Appendix III)

Twenty one samples are described under this heading. Of this total, two taken from a sailing boat are alcohol blends (MAR.55 and 59), one (MAR.56) is a cracked spirit containing a small amount of alcohol, another (MECH.127) is of doubtful origin and apparently an aviation grade, and six are benzole mixtures. (Of these six samples, two are "Group" samples representing five and nine samples each, respectively.) The remaining samples are motor gasolines of the cracked spirit type.

The two alcohol blends are practically identical and contain 16% alcohol. On the alcohol free base spirit an aromatic content of 21% is reported whilst the blends have an octane number of 75.

Sample No.MAR.56 taken apparently from the same boat as the two alcohol blends, is an average type of motor gasoline containing an appreciable quantity of unsaturateds (32.5%) and an octane number of 66. This fuel, however, contains 4% alcohol.

Sample No.MECH.127 is "thought to be possibly of Russian or Norwegian origin" but "it did not come from the aircraft Ju.88 but was obtained from a barrel on the ground". This information means little but the available experimental results, especially the distillation range and rubber like "gum", suggest it is an aviation grade.

The six benzole mixtures show aromatic hydrocarbon contents ranging from 33 - 41% whilst the two group samples MECH.155 etc. and MECH.156 etc. contain T.E.L. to the extent of 1.15 and 1.55 mls./I.G. respectively. Octane numbers, available on three of the six samples only, are between 71 and 73. Freezing points between -34 and -45°C. are reported on four samples, the other two being below -60.

The remaining eleven gasolines were derived from various sources including an armoured vehicle, a boat, private cars, etc. and exhibit fairly wide variations in properties. Octane Nos. where available, range from 48 - 72. Specific Gravity from 0.715 - 0.770 and aromatics from 2.5 - 13.6%. These variations are not, however, altogether reliable data since some samples show bad weathering and oxidation which may account, for example, for the low octane number of 48. The deleterious action of peroxides is not to be overlooked in this connection. Special comment is called for on the following samples.

MECH.115. Benzine Tourisme (Synthetic) ex Rhine. This is of considerable interest in view of its combined specific gravity (.7286), unsaturateds (42.5%) and high sulphur (0.52%). It might be a low temperature carbonisation material with some of the aromatics removed.

MECH.115(Second Sample) Believed to be from same source as first sample and stated to emanate from Mannheim. No sulphur figure is reported for this sample but figures of 0.715 for Specific Gravity and 39.5% for unsaturateds are obtained. The fuel has an octane number of 64.

MECH.266. Petrol "manufactured in Belgium for the Germans". This, a very small sample, was evidently deteriorating (50 mgms.gum) and had probably weathered. Despite the latter probability the end point is no higher than 165°C. It is possible that this is not a motor gasoline but a Special Boiling Point type of material having some special application.

MOTOR GASOLINES FROM THE MIDDLE EAST

(For detailed results see Appendix IV)

The thirty one gasolines tabulated possess wide variations in properties, but the majority of the samples may be conveniently divided into two main groups viz:- (a) motor fuels of relatively low aromatic content and containing varying proportions of cracked spirit (13 samples) and (b) benzole mixtures (11 samples). The fuels in the former class, of which three (MIS.33 and 36 and MECH.328) contain T.E.L., are largely captured drum samples and are mainly below both old and new Allied standards. Specific gravity varies between .732 and .745, octane number varies between 58 and 70, whilst the unsaturateds range from about 5 - 28%. The highes octane numbers in this group are given by MECH.139 (70 - no T.E.L. present) and the one leaded fuel for which a rating is available i.e.MECH.328 with an octane number of 68. Apart from the two latter fuels, the average octane number is about 60.

The incidence of a number of motor gasolines exhibiting variable and low octane ratings may be connected with the use by the enemy of portable ethylisators for raising the knock rating of such fuels in the field.

Of the eleven benzole mixtures, all but three contain lead tetra ethyl. These three (MECH.244,271 and 331) contain between 30 and 40% aromatics and the octane numbers of two are 69½ and 73½. In the leaded benzole mixtures, the T.E.L. content varies between 0.65 and 1.7 mls/Imperial Gallon whilst the knock rating ranges from 64 to 75. The aromatic content range is from 24.5 to 45% weight.

MECH.240 may be a straight run Roumanian fuel containing 1.55 mls.T.E.L./Imperial Gallon giving an octane number of 69.

MECH.257 also a straight run fuel, contains 2.45 mls T.E.L./ Imperial Gallon and has the relatively high octane number of 76.

MECH.330 is again a straight run fuel, but an octane number of 68 in conjunction with a T.E.L. content of 4.65 mls./Imperial Gallon indicates that unless there has been some deterioration which the analysis does not show, the base fuel must have been of low anti-knock value.

The four alcohol blends MECH.235, 245, 327 and 329 which are probably of Italian origin, have octane ratings of 100, 87, 83 and 83 respectively and corresponding alcohol contents of 40, 34% 42 and 19%. MECH.327 and 329 contain small amounts of T.E.L. (0.05 and 0.1 mls/I.G. respectively.)

Dealing with the types of motor fuel used by the Axis, No.1 Mobile Laboratory issued a report dated 18th May, 1943, in which, from a study of eight captured fuels, the suggestion was made that the German army in the Middle East used two types of motor spirit marked "1" and "2", the former being derived from the latter by the addition of 30% - 40% motor benzole. The two types were deduced to have octane ratings of about 75 and 70½ respectively, corresponding T.E.L. contents being 1.5 and 2.5 mls./I.G.

It is to be noted however, that only a very few of the thirty one samples described in this summary are in either of the suggested categories. Moreover, it is more likely that the final blending operation aiming at a definite octane number would consist in the addition of ethyl fluid rather than the addition of benzole. It may be that the numbers "1" and "2" were used by the Germans to differentiate between two types of fuel each nominally of 78 octane number. Type 1 contains about 35% added aromatics and 1.5 mls T.E.L./ I.G. and Type 2 has 2.5 ccs. T.E.L. and is made from a different base spirit.

This may be a suitable place to point out that any information which the Mobile Laboratory is able to obtain on the particular applications of definite types of fuels, e.g. the actual vehicles in which the fuels are used by the enemy, would be of great assistance to the Enemy Oils and Fuels Committee.

DIESEL FUELS FROM EUROPE AND THE MIDDLE EAST

(For detailed results see Appendices V and VI.)

With two exceptions only, the thirty samples of Diesel Fuel from Europe were derived from, or intended for, sea-going vessels. These show wide variations in specific gravity (0.82 - 0.87) although the large majority are in the range 0.84 - 0.85. Sulphur content varies from 0.05 - 0.85% but about 60% of the samples are below 0.3%. A variation of phenol content from < 0.01 to 1.5% is shown, whilst the diesel index ranges from 36 - 57.5 with the majority of the fuels being between 45 and 50. All the fuels can be considered as suitable for stationary or marine diesel engines other than the high speed type although quite a few could be used for this purpose, especially those high speed engines which are not particularly sensitive to the ignition quality of the fuel.

A number of the samples possess low or relatively low flash points which indicate the presence of kerosine or an even lighter fraction, but this inclusion would not materially affect performance.

P.T.O.

Generally speaking there is no correlation between any of the physical or chemical properties and in blending to an apparent minimum diesel index of 45 it is probable that all available sources of supply are represented. It may be concluded that whilst some fuels are almost certainly of petroleum origin, most are probably blends of such materials as low temperature brown coal distillate (possibly solvent extracted), hydrogenated brown or bituminous coal distillate, hydrogenated shale oil, together with Fischer Tropsch gas oil. Petroleum distillate may or may not be incorporated. MAR.79 which has a high phenolic content (1.5%) and low sulphur may be a hydrogenated Esthonian shale oil . Some information on brown and bituminous coal oils which may be components of German Diesel fuels is given in Appendix IX.

With a few exceptions only the fifteen diesel fuels derived from the Middle East were intended for land vehicles, which probably accounts for the higher average ignition qualities encountered. With the exceptions MAR.100, MECH.230 and MAR.118, the diesel index range is 45 - 63 with the majority between 50 and 60. The specific gravity variation is .833 - .912 but if MAR.118 and MAR.100 are excepted the upper limit is lowered to .887. Two of the fifteen samples (MECH.234 and MECH.217) show low flash points (50° and 60°F.) and with the exception of one sample (MECH.218) the highest sulphur figure is 0.36. The lowest sulphur content is < 0.01%.

The phenol content of most of the Diesel Fuels from Europe is high, usually 0.4 or 0.6% (one sample 1.47% and five samples out of 25 below 0.1%) whereas in the Middle East a much smaller proportion contains this high percentage of phenols. This may indicate that in the latter sphere petroleum Diesel oils are more largely used than in Europe.

Some experiments were carried out in a single-cylinder high-speed Gardner engine on behalf of the Committee by Messrs. Ricardo & Co. to examine the effect of phenolic substances on the performance of Diesel fuels. It was found that additions, up to 3%, of commercial phenol or cresol, to a petroleum Diesel fuel of about 40 cetane number reduced the ignition rating by 3 - 5 units. The addition of 1% cresol to the petroleum fuel did not affect the rate of wear either of the injector needle or of the piston rings over a period of 25 hours' running. A similar run, carried out on a fuel consisting of 7% MAR.71 (0.6% phenols) and 25% MAR.66 (0.6% phenols), showed reduced wear of the injector and piston rings. Since the direct addition of phenolic substances did not produce any improvement in the petroleum Diesel fuel the better performance of the German fuel must be due to other components than the phenols.

VARIOUS
(For details see Appendix VII)

Appendix VII lists six kerosines mainly of low quality as burning oils and two white spirits.

APPENDIX I

AVIATION GASOLINES FROM EUROPE.

A.I.R.Sample No. Machine. Place of crash or source of fuel.	209 Ju88A-4 Ventnor I.O.W.	210 Bottle-boned tank nr. Hofn, Iceland	213 Do217E-4 Rochford	216 Do217E-4 Bench-borough, Lyminge, Kythe.	232 Ju88A-4 Upper Coulsdon Surrey	234 Do217E-2 Wrox-all I.O.W.
Date	19.8.42	23.8.42	16.10.42	5.11.42	18.1.43	7.2.43
S.G.@ 60/60°F	.751	.787	.744	.745	.744	.751
Colour	Blue	Blue	Blue	Blue	Green/ Blue (tendency to Blue)	Blue
Distillation						
I.B.P. (°C)	48	78	45	45	46	50
Rec.(%vol.)@75°C.	19	-	26	29	24	15.5
100°C	53.5	28	38	32	36	48.5
150°C	94.5	97.5	93.5	93.5	94	89.5 (140°C)
F.B.P.(°C)	164	161	163	164	155	162
Freezing Pt. (°C)	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F(lb/sq.in)	5.8	-	5.6	5.8	-	5.5
Free Sulphur (mgms/100 mls)	0.1	-	Absent	Pass	-	Absent
Total Sulphur (%w)	.02	.02	.025	.02	.02	.01
Existent Gum (mgms/100 mls)	3	-	10	4	15½ (sticky)	4
Potential Gum (mgms/100 mls)	1	-	5	1	-	
T.E.L.content (mls/I.G.)	5.55	Present	5.45	5.4	5.65	5.5
Ditto (mls/A.G.)	4.65	-	4.55	4.5	4.7	4.6
Octane No.(CFR.MM)	91	-	90	90	89	90
Octane No. of base fuel	73½	-	72	72	-	72
Bromine No.	1.5	1.8	1.9	1.9	2.5	1.9
Hydrocarbon Anal.						
Aromatics (% wt.)	22.5	30	16.0	16.0	19.0	16.5
Paraffins "	44.5	-	46.5	45.5	41.0	39.5
Naphthenes "	33.0	-	37.5	38.5	40.0	44.0
Individual Aromatics						
Benzene (% wt.)	5.5	-	3.0	3.0	-	2.5
Toluene "	8.5	-	5.5	5.5	-	6.1
Xylenes "	6.0	-	5.5	5.5	-	5.5
Higher Aromatics	1.5	-	2.0	2.0	-	2.0
Water Soluble (%v)	Nil	-	Nil	Nil	Nil	Nil
Iron Carbonyl	Undetected	-	Absent	Absent	-	Nil
Phenols (% wt.)	0.0035	-	0.0021	0.0067	-	0.0013

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST

A.I.R. Sample No. Source and Description	205 "W" Petrol from Ju88	217 Hellll crashed at Amriya 28.9.42	218 Hellll H-6 force landed 6 miles north of L.G.60 ≡	227 Ex auxilliary tank of captured Me. 109F. 12.9.42	≡233 Middle East through A.I.2(g)	237 Middle East through A.I.2(g)	238 Middle East through A.I.2(g)
Date of Report	17.9.42	24.11.42	24.11.42	20.1.43	8.3.43	2.3.43	2.3.43
S.G.@ 60/60°F.	.736	.741	.742	.753	.730	.752	0.720
Colour	Blue	Blue	Blue	Dark Blue	Olive Green	Yellow	Blue
Distillation							
I.B.P. (°C)	47	52	50	55	42	58	47
Rec.(%$_v$) @ 75°C.	23	22	24	12.5	17	10	32.5
100°C	58	61.5	68	58	46	52	69
150°C	95	97		95	93	97	-
F.B.P. (°C)	155	156		180	176	153	144
Freezing Pt.(°C)	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F(lb/sq.in)	-	4.6	5.3	4.6	5.9	3.2	5.6
Free Sulphur (≡gms/100 mls)	-	0.3	0.1	0.3	-	-	
Total Sulphur (%w)	.01	.01	.01	.01	.01	.02	.02
Existent Gum (mgms/100 mls)	7.6≡	8	Nil	Nil	Nil	Nil	Nil
T.E.L.Content (ml/I.G.)	5.5	4.2	5.45	5.7.	3.0	4.5	3.95
Ditto (mls/A.G.)	4.6	3.5	4.55	4.75	2.5	3.75	3.3
Octane No.(CFR.MM)	-	91	89.5	89	82	87	87
Bromine No.	1.5	1	1	1	2	2	2
Hydrocarbon Anal.							
Aromatics (% wt.)	8.5	20.5	7.0	2.5	18.5	19	4.5
Paraffins "	-	59.5	48.0	48.5	66.0	37	67.0
Naphthenes "	-	20.0	45.0	49.0	15.5	44	28.5
Water Solubles	Nil	Nil	Nil	Nil	Nil	Nil	Nil

≡Rubbery ≡9.6.42 ≡also reported as AIR. 258

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST (CONTINUED)

Sample No.	TD.523	TD.524	TD.525	TD.526	TD.528	TD.529	TD.530	AIR.239
Source and Description	Eight separate drums captured in Middle East and all labelled "R. Aeronautica - Metallici Milano Sapusti Imballage". One only (AIR.239) examined fully in view of general similarity AIR.237 and AIR.238 represent the remaining two of a total batch of ten drums.							
Date of Report	2.3.43							
S.G.@ 60/60°F.	.740	.739	.737	.7395	.739	.736	.739	.737
	Slight Green	Water White	Blue	Very slightly yellow	Water White	Slight Green	Slight Blue	Slight Yellow
Distillation								
I.B.P. (°C)	48	47.5	48	47	44	47	47	46
Rec.(%$_v$) @ 75°C.	28	27	28	28	30	29	27	23.5
100°C.	64	60	60	58	63	60	60	61
150°C.	97	96.5	97	96	96	95	96.5	96.5
F.B.P. (°C)	158	157.5	159	160	155	156	160	158
Freezing Pt.(°C)	-	-	-	-	-	-	-	Below -60
Vap.Press.(Reid) @ 100°F.(lb/sq.in)	5.1	5.2	5.3	4.0	5.0	3.0	5.2	5.3
Free Sulphur (mgms/100 mls)	-	-	-	-	-	-	-	-
Total Sulphur (%$_w$)	-	-	-	-	-	-	-	.02
Existent Gum (mgms/100 mls)	-	-	-	-	-	-	-	Nil
T.E.L.Content (Mls./I.G.)	4.1	3.45	3.9	3.55	3.55	3.7	3.95	3.6
Ditto (mls/A.G.)	3.4	2.9	3.25	3.0	3.0	3.1	3.3	3.0
Octane No. (CFR.MM)	87	86	86	87	88	87	88	87
Bromine No.	-	-	-	-	-	-	-	2
Hydrocarbon Anal.								
Aromatics (%$_v$)	-	-	-	-	-	-	-	14.0
Paraffins (")	-	-	-	-	-	-	-	46.0
Naphthenes(")	-	-	-	-	-	-	-	40.0
Water Solubles	-	-	-	-	-	-	-	Nil

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST (CONTINUED)

Sample No.	AIR.240	TD.534	TD.535	TD.536	TD.540	AIR.241	AIR.242	AIR.243
Source and Description	Seven captured drums marked "Kraftstoff" Short tests only carried out on TD.534, 535, 536 and 540 which were considered to be represented by AIR.241.							Ju.88
Date of Report	3.3.43							8.3.43
S.G.@ 60/60°F.	.777	.747	.739	.748	.746	.747	.740	.742
Colour	Strong Fluor-escent green	Blue	Blue	Yellow	Slight Fluor-escent green	Yellow green	Blue	Bluish-green
Distillation								
I.B.P. (°C)	52	47	47	50	51	50	49	45
Rec.(%$_v$) @ 75°C.	10	23	24	24	23	23	25	19
100°C.	44	62	62	63	61.5	63	62	56
150°C.	84	95	96	97	96	97	97.5	96
F.B.P. °C.	185	154	156	157	156	157	153	160
Freezing Pt.(°C.)	Below -60	-	-	-	-	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F.(lb/sq.in)	4.5	-	-	-	-	4.5	4.6	-
Free Sulphur (mgms/100 mls)	-	-	-	-	-	-	-	-
Total Sulphur (%wt.)	.02	-	-	-	-	.01	.01	.02
Existent Gum (mgms/100 mls)	4	-	-	-	-	Nil	Nil	18≠
T.E.L. Content (mls/I.G.)	4.6	5.5	3.85	5.95	5.8	5.95	5.4	5.5
T.E.L.Content (mls/A.G.)	3.85	4.6	3.2	4.95	4.85	4.95	4.5	4.6
Octane No. (CFF.MM)	89	89	88	91	91	92	90	90
Bromine No.	1	-	-	-	-	1	1	1
Hydrocarbon Anal.								
Aromatics (%w)	35.5	-	-	-	-	22.5	17	22
Paraffins "	32.5	-	-	-	-	37.0	40	56
Naphthenes "	32.0	-	-	-	-	40.5	43	22
Water Solubles	Nil	-	-	-	-	Nil	Nil	Nil

≠ Sticky- not true petroleum gum.

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST (CONTINUED)

A.I.R. Sample No.	244	245	246	247	249	251	253	254
Source and Description	Ex North West Installations. Tobruk		"R Aeronauti:a"	"R Aeronautica Lords"	E: drums washed ashore at Jaffa and marked :-			
Date of Report	8. 3.43.							
S.G. @ 60/60°F.	.754	.740	.739	.738	.728	.739	.740	.738
Colour	Blue-Green	Blue	Faint Yellow	Blue	Faint Green	Green Blue	Faint Yellow	Yellow Green
Distillation								
I.B.P. (°C.)	53	48	50	46	50	49	51	47
Rec.(%v) @ 75°C.	14	21	22	26	26	24	23	22.5
100°C.	55	60	57	60	66	60	57.5	58.5
150°C.	93	96	96	96.5	97.5	96	96	95.5
F.B.P. (°C.)	173	160	157	157	155	159	157	157
Freezing Pt.(°C.)	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F.(lb/sq.in)	4.2	4.8	4.0	5.2	5.8	5.3	5.4	4.1
Free Sulphur (mgms/100 mls)	0.3	0.2	-	-	-	-	-	-
Total Sulphur(%w)	0.07	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Existent Gum (mgs./100 mls)	Nil	nil	nil	nil	nil	nil	nil	nil
T.E.L. Content (mls/I.G.	4.05	5.25	3.85	3.9	4.2	3.9	3.45	3.7
T.E.L.Content (mls/A.G.)	3.4	4.4	3.2	3.2	3.5	3.2	2.9	3.1
Octane No. (CFR.MM)	84	90	87	87	86	86	85	87
Bromine No.	1	nil	1	2	2	2	2	2
Hydrocarbon Anal.								
Aromatics (%wt)	25.5	21.5	17.5	17.0	11.0	15.5	19.0	17.0
Paraffins "	46.0	51.5	39.5	41.5	48.5	43.0	38.5	39.5
Naphthenes "	28.5	27.0	43.0	41.5	40.5	41.5	42.5	43.5
Water Solubles	nil	nil	nil	nil	nil	nil	nil	nil

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST (CONTINUED)

A.I.R. Sample No.	255	248	250	252	256	257	260	261
Source and Description	Ex drum, marked with GREEK SCRIPT, washed ashore at Jaffa	Ex drums, washed ashore at Jaffa, marked:- R. Aero-nautica	-	-	Flugs-Krafts-toff	Ex drum washed ashore at Jaffa	Captured Enemy Benzine marked R. Aero.Banfi Canti-E.G. Saronne	
Date of Report	8.3.43						18.3.43	
S.G.@ 60/60°F.	.741	.744	.745	.748	.7455	.738	.720	.738
Colour	Faint Yellow	Faint Green	Faint Blue	Blue	Blue	Yellow	Blue	Sl.Blue
Distillation								
I.B.P. (°C.)	48	52	50	54	50	50	48	50
Rec.(%v) @ 75°C.	22.5	24	23	21.5	23.5	24	33	23.5
100°C.	58.5	63	63	60	61.5	56	70	58.5
150°C.	96.5	97.5	97	97.5	97	94	-	96.5
F.B.P. (°C.)	159	153	156	157	156	169	143	159
Freezing Pt.(°C.)	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F.(lb/sq. in)	3.9	4.9	4.9	5.2	3.95	4.0	4.8	4.6
Free Sulphur (mgms/100 mls)	-	-	-	-	-	-	-	-
Total Sulphur (%w)	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01
Existent Gum (mgms/100 mls)	nil	nil	nil	nil	nil	20 (lub.oil)	nil	nil
T.E.L.Content (mls/I.G.)	3.6	5.45	5.35	5.65	5.3	3.15	4.1	4.1
T.E.L.Content (mls/A.G.)	3.0	4.55	4.45	4.7	4.4	2.6	3.4	3.4
Octane No. (CFR.MM)	86	89	93	91	91	81	88	88
Bromine No.	?	2	2	2	2	5	?	2
Hydrocarbon Anal.								
Aromatics (%wt.)	19.5	21.0	22.0	21.0	23.5	18.5	6.0	17.0
Paraffins "	38.0	39.5	35.0	37.5	38.5	47.0	55.0	41.5
Naphthenes "	42.5	39.5	43.0	41.5	38.0	31.5	39.0	41.5
Unsaturateds"	-	-	-	-	-	3.0	-	-
Water Solubles	nil	nil	nil	nil	nil	nil	nil	nil

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST (CONTINUED)

A.I.R.Sample No.	262	263	264	265	266	267	268	269
Source and Description	Captured Enemy Benzines marked:- R. Aero. Banfi Centi- E.G. Saronne		R.A. Morgavre E Figlio Genova	R.A.- G. Pe Mig- ferense	Middle East Captured Enemy Benzines			Italian Aviation Benzine ex Tripoli
Date of Report	18.3.43.							
S.G.@ 60/60°F	.737	.750	.741	.737	.750	.740	.744	.747
Colour	Blue-Green	Slight Blue	Very Slight Blue	Water White	Blue	Green	Blue	Blue
Distillation								
I.B.P. (°C)	50	52	51	50	54	64	54	49
Rec.(%v) @ 75°C.	25	12.5	26.5	25	20	32	24.5	19
100°C.	60	56	62.5	60	60	32	61.5	56
150°C.	96.5	95	95.5	97	87	94.5	96	95
F.B.P. (°C.)	158.5	165	158	157	158	172	156	159
Freezing Pt.(°C.)	Below -60	Below -60	-	-	Below -60	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F.(lb/sq.in)	4.4	4.6	5.2	5.4	5.0	5.7	5.0	5.6
Free Sulphur (mgms/mls)	-	-	-	-	-	-	-	-
Total Sulphur (% wt.)	0.01	0.01	-	-	0.01	0.01	0.01	0.01
Existent Gum (mgms/100 mls)	Negligible		-	-	---	Negligible		6
T.E.L.Content (mls/I.G.)	3.75	3.55	4.1	3.7	6.0	7.0	5.55	5.9
T.E.L.Content (mls/A.G.)	3.15	2.95	3.4	3.1	5.0	5.85	4.6	4.9
Octane No. (CFR.MM)	88	89	88	87	91	99	91	87½
Bromine No.	2	2	2	4	2	2	2	1.6
Hydrocarbon Anal.								
Aromatics (%wt.)	17.0	19.0	-	-	23.0	19.5	27.5	17.5
Paraffins "	41.5	44.0	-	-	39.0	71.5	53.5	35.5
Naphthenes "	41.5	37.0	-	-	38.0	9.0	19.0	47.0
Water Solubles	Nil	Nil	-	-	Nil	Nil	Nil	Nil

APPENDIX II

AVIATION GASOLINES FROM THE MIDDLE EAST (CONTINUED)

A.I.D. Sample No.	306	307	308	309
Source and Description	Ex drums received from No.101 Salvage Depot at R.A.F. Station, Aboukir.			
	"I.N.F.R. A. GEN-OVA PEGLI" REGIA AERO-NAUTICA 26?267 200.LITRO		"I.N.F.R. A.GEN-OVA PEG-LI" "R.E." "GASSOLIO"	"KRAFTSTOFF
Date of Report	24.6.43			
S.G. @ 60/60°F.	.740	.742	.754	.747
Colour	Very Pale Yellow	Light Blue	Dark Green	Bright Green
Distillation				
I.B.P. (°C)	52	45	53	54
Rec. (%v.) @ 75°C.	26	27	20	25
100°C.	60	61	56	63
150°C.	97	97	89	97
F.B.P. (°C.)	162	158	221	158
Freezing Pt. (°C.)	Below -60	Below -60	Below -60	Below -60
Vap.Press.(Reid) @ 100°F.(lb/sq.in.)	5.7	5.7	5.0	5.2
Free Sulphur (mgms/100 mls.)	Nil	Nil	Nil	Nil
Total Sulphur (%wt.)	0.01	0.01	0.02	0.02
Existent Gum (mgms/100 mls.)	Nil	7(oily)	78(oily)	6(oily)
Potential Gum (mgms/100 mls.)	Nil	Nil	Nil	Nil
T.E.L. Content (mls/I.G.)	3.75	4.3	4.85	5.8
" " (mls/A.G.)	3½	3.6	4.05	4.85
Octane No.(C.F.R.M.M)	85½	88	83	90
Bromine No.	1.7	2.1	2.2	1.5
Total Aromatics (removable with 100% H_2SO_4)	15%	17.5%	20%	20%
Alcohol Content	Nil	Nil	Nil	Nil

APPENDIX VII

MOTOR GASOLINES FROM EUROPE

Sample No.	[illegible] MAR.56	MAR.59	MAR.83	MAR.117	MECH.108	MECH.114	MECH.115
Source and Description	From 18' half-decked sailing boat of the type used for Pedlarselling. Rec'd. through Security, Plymouth.		From French Ketch. "Belle Brittagne" which arr'd. in Barrow 18.8.42	Ex French auxiliary vessel arr'd. Plymouth 6.3.42	Ex German tank PZ. KW.III captured in Russia	Benzine Tourisme Prov. Roumanie (Ex Vienna)	Benzine Tourisme (Synthetic) ex Rhine.
Date of Report	10.9.42.	7.9.42.	10.9.42.	19.11.42	31.3.43	10.9.42	7.9.42	9.9.42
SP.GR.@ 60/60°F.	.736	.723	.750	.7215	.779	.746	.732	.7285
Colour	Orange	+ 15 Saybolt	Orange	Pale Yellow	Yellow	Yellow	+ 23 Saybolt	Yellow
Distillation								
I.B.P. (°C.)	49	34	49	46	53	51	31	50
Rec.(% vol.) @ 75°C.	42	33	42	5.5	36	5	19	9
100°C.	57	48	58	21.5	66	40	34	45
140°C.	80	75	79	66	83	83	63	65.5
F.B.P.(°C.)	194	194	197	220	181	197	204	172
Freezing Point (°C.)	Below -50	Below -30	-45	Below -60	Below -60	Below -60	Below -60	Below -60
Vap.Pres. (Reid) (lbs/sq.in.)	8.7	8.5	4.3	-	-	4.3	-	-
Corrosion	Poor	Passes	Poor	-	-	Passes	-	-
Total Sulphur (% wt.)	0.19	0.11	0.17	0.14	0.06	0.03	0.02	0.52
Exist.Gum (mgs/100 mls)	20(gum) 60(oil)	14(gum) 7(oil)	14(gum) 53(oil)	24(slightly oily)		13(Soft gum)		
Bromine No.	37	53	37	29.4	22	49	15.7	78.4
T.E.L.Cont. (mls/I.G.)	nil	nil	nil	Nil	-	nil	nil	nil
Octane No.	75.5	66	75	43	-	66.5	-	-
Water Solubles(%v)	16	4	16	--	-	nil	nil	nil
Hydrocarbon Analysis	=	=	=					
Aromatics(%v)	21.0	7.5	21.0	11.0	35	5.5	9.5	9.5
Paraffins(")	39.0	49.5	39.0	50.5	-	35.0	54.5	40.5
Naphthenes"	17.5	36.5	17.5	20.5	-	35.5	26.5	7.5
Un-Saturates"	22.5	36.5	22.5	16.0	-	24.0	9.5	42.5
Individual Aromatics								
Benzene (%v)	10.5	-	10.5	-	-	-	-	-
Toulusene "	4.5	-	4.5	-	-	-	-	-
Xylenes "	3.0	-	3.0	-	-	-	-	-
Higher Aromatics"	4.0	-	4.0	-	-	-	-	-

= On alcohol-free basis.

APPENDIX III

MOTOR GASOLINES FROM EUROPE (Contd.)

Sample No.	MECH.115	MECH.127	MECH.156 (i)	MECH.157 (ii)	MECH.167 (iii)	MECH.187
Source and Description	Further sample from Mannheim received through M.E.W.	From barrel on ground. Of Russian or Norwegian origin.	Received through Experimental Wing, Tank Design Department, Longcross.			From Pz. Kw.111. Received through Experimental Wing, Tank Design Dept. Longcross.
Date of Report	14.12.42	17.9.42	25.3.43			10.9.42
SP.GR.@ 60/60°F.	.715	.7385	.7895	.7765	.755	.785
Colour	Colour less	Green	-	-	-	Yellow/ Orange
Distillation						
I.B.P.(°C.)	35	46	63	58.5	58	60
Rec.(% vol.) @ 70°C.	25	15	1	2.5	1.5	3
100°C.	51	55	39	38	31	49
140°C.	90	91	73	75	78	77
F.B.P.(°C.)	181	150	196	209.5	210.5	184
Freezing Point (°C.)	Below -30	Below -60	-34	-39.5	Below -70	Below -60
Vap.Pres.(Reid) (lbs/sq.in)	-	-	3.4	3.9	1.8	4.0
Corrosion	Passes	-	Passes	Passes	Passes	Passes
Total Sulphur(%wt.)	-	0.03	0.07	0.08	0.04	0.09
Existent Gum (mgm/100 mls)	2	468 (Rubbery)	47 (Oily)	215 (Oily)	405 (Oily)	2
Bromine No.	56	2.5	6	11	24	30
T.E.L.Content (mls/I.G.)	Nil	5.1	1.55	1.15	0.95	Nil
Octane No.	64	-	73	71.5	70	73
Octane No.of Base Fuel	-	-	64	62	60	-
Hydrocarbon Analysis						
Aromatics(%w)	2.5	3.5	41.4	33.3	13.6	36.0
Paraffins "	46.0	-	41.7	45.6	51.2	16.5
Naphthenes "	12.0	-	13.5	14.8	21.5	28.5
Unsaturateds "	39.5	-	3.4	6.3	13.7	19.0
Individual Aromatics						
Benzene(%w)	-	-	25.6	18.9	4.9	-
Toluene(%w)	-	-	6.1	5.5	2.6	-
Xylenes "	-	-	5.4	5.0	3.4	-
Higher Aromatics"	-	-	5.0	5.2	3.2	-
Water Solubles	Trace	Nil	Nil	Nil	Nil	Nil
Iron Carbonyl	-	-	Nil	Nil	Nil	Nil
Phenols(%w)	-	-	0.03	0.02	0.01	-
Induction Period (S.I.L.)(Mins)	-	-	690	540	300	-

(i) Group Sample MECH.156, 158, 160, 162, 164 and 166, A, B, C, D
(ii) " " MECH.157, 159, 161, 163 and 165.
(iii) " " MECH.167, 184 (inc.)

APPENDIX III

MOTOR GASOLINES FROM EUROPE (Cont'd.)

Sample No.	MECH.196	MECH.200	AIR.228	MECH.236	MECH.242	MECH.266	MECH.267
Source and Description	Drawn from military truck (German) in Zurich. Truck driven from France for repairs in summer 1942.	Experimental Wing F.V.P.E. Chobham via D.T.D. Egham.	Ex Condor Swift landed near Hythe 7.12.42	"Benzin used in Norway"	Secured in Trondheim Feb. 1943 Petrol supplied for German and Quisling cars	M.E.W. Petrol "manufactured in Belgium for the Germans"	M.E.W. CX12119/ RC 262. 29.3.43 Car Petrol for inside Germany
Date of Report	8.12.42	12.12.	2.2.43	14.5.43	31.3.43	20.4.43	15.4.43
SP.GR.@ 60/60°F.	.761	.795	.770	.730	.7285	.769	.752
Colour	-	Yellow ("oxidised" odour)	Green	Pale Lemon	Yellow	Faint Yellow	Faint Yellow
Distillation							
I.B.P.(°C)	33	77	78	34	34	90	50
Rec.(% vol.)							
@ 70°C.	21	-	3(60°C)	16	19	-	8
100°C.	58	34	29	41	41	14	28
140°C.	80	70	76	76	74	93	65
F.B.P. (°C.)	187	190	192	191	189	165	210
Freezing Point (°C.)	-45	-35	Below -60	Below -60	Below -60	-	-
Vap.Pres.(Reid) (lbs/sq.in)	-	2.2	-	6.2	-	-	-
Corrosion	-	Passes	-	-	-	-	-
Total Sulphur (% wt.)	0.06	0.17	0.04	0.04	0.05	-	-
Exist.Gum (mgm/100 mls)	-	37	-	-	-	50	-
Bromine No.	-	8.3	21	23.6	58	11.3	45
T.E.L.Cont. (mls/I.G.)	-	Nil	Present	Nil	-	Nil	Nil
Octane No.	-	62	-	69	-	-	-
Octane No.of Base Fuel	-	-	-	-	-	-	-
Hydrocarbon Analysis							
Aromatics(%wt)-		39.5	5.5	13.0	6.9	6.5	12.0
Paraffins " -		32.5	33.0	49.5	-	35.5	40.0
Naphthenes" -		23.0	49.5	22.0	-	50.5	19.0
Unsaturateds" -		5.0	12.0	15.5	-	7.5	29.0
Individual Aromatics							
Benzene(%wt) -		-	-	-	-	-	-
Toluene " -		-	-	-	-	-	-
Xylenes " -		-	-	-	-	-	-
Higher Aromatics" -		-	-	-	-	-	-
Water Solubles	Nil	Nil	-	-	-	Nil	Nil
Iron Carbonyl -		-	-	-	-	-	-
Phenols(%wt) -		-	-	-	-	-	-
Induction Period (S.I.L.)(Mins) -		-	-	-	-	-	-

APPENDIX IV

MOTOR GASOLINES FROM THE MIDDLE EAST

Sample No.	MECH.139	MECH.232	MECH.233	MECH.234	MECH.235	MECH.240	MECH.241
Source and Description	Petrol from latest PZ.Kw.III tank captured in Libya	Captured Enemy Benzines from Middle East, Samples marked "Kraftstoff"			Captured Enemy Benzine from Middle East. Sample marked "R.E."	Middle East Samples marked:- Benzine S.C.1. 52	Benzine Drum No. 122348 F.H.R.E.
Date of Report	17.9.42	3.3.43				8.3.43	
Sp.Gr.at 60/60°F.	.745	.737	.790	.782	.758	.718	.745
Colour	Orange	Yellow-Brown	Orange-Yellow	Orange-Yellow	Slight Yellow	Pink	Yellow
Distillation							
Initial B.P. (°C.)	49	47	62	55	56	42	50
Rec.(%vol.) @ 70°C.	7.5	11.5	2	5	21	15	4
100°C.	35	38	33	50	74	42	27
140°C.	74	74	65	80	84.5	78	68
F.B.P. (°C.)	193	194	223	177	185	182	227
Freezing Point (°C.)	Below -60	-	-	-40	Below -60	-	-
Vapour Press.(Reid) (lbs/sq.in)	6.8	5.0	4.0	4.1	4.0	6.4	4.0
Corrosion Test	Pass	-	-	-	-	-	-
Corrosive Sulphur (mgms/100 mls)	-	-	-	-	-	-	-
Total Sulphur (% wt.)	0.07	0.035	0.10	0.095	0.035	0.01	0.20
Existent Gum (mgms/100mls)	7(gum) 170(oil)	34	8	Nil	2	Nil	298(oil)
Bromine No.	45	23	8	5	4	3	16
T.E.L.Content (mls/I.G.)	Nil	Nil	3.60	1.65	Nil	1.6	Nil
Octane No.	70	60	69	75	100	69	58
Hydrocarbon Analysis							
Aromatics(%wt)	13.5	11.0	34.0	40.0	8.0	11.5	11.0
Paraffins(")	18.5	48.5	34.0	35.0	29.0	71.5	49.9
Naphthenes(")	41.0	35.5	27.5	22.0	21.0	17.0	30.1
Unsaturateds (% wt)	26.0	13.0	4.5	3.0	42.0 (alcohol)	-	9.0
Water solubles (% vol.)	Nil	Nil	Nil	Nil	40	Nil	Nil

APPENDIX IV

MOTOR GASOLINES FROM THE MIDDLE EAST (Contd.)

Sample No.	M.CH. 244	M.CH. 245	M.CH. 246	M.CH. 247	M.CH. 248	M.CH. 249	M.CH. 250	M.CH. 251
Source and Description	[illegible] No. [illegible] recd. on 9.2.43 [illegible], of a [illegible] 3 ton half track captured German [illegible]	Middle East Sample marked R.E.	Captured Enemy Benzines. None	None	None	"Kraftstoff"	Markings:- R.A. Banfi Canti- [illegible] Saramo	Italian M.T. Benzine ex El Daba Sealed barrels marked "Benzina"
Date of Report	[illegible].3.43	18.3.43	18.3.43	18.3.43	18.3.43	18.3.43	18.3.43	25.5.43
SP.GR. @ 60/60°F.	.797	.7565[x]	.772	.758	.757	.7635	.7685	.737
Colour	Orange	Yellow	Brown	Orange Yellow	Orange Yellow	Light Brown	Brown	Yellow
Distillation								
I.B.P. (°C)	74	54	61	47	45	52	62	38
Rec.%v.								
@ 70°C.	-	-	-	-	-	-	-	12
@ 75°C.	-	44	4.5	13	17	12.5	6	-
@ 100°C.	42	73.5	35	37	40	41	35.5	31
@ 110°C.	75	-	-	-	-	-	-	67
@ 150°C.	-	90	80	80	81	81.5	79	-
F.B.P. (°C)	189	185	202	202	101	198	199	208
Freezing Point (°C)	-35	Below -60	-	-	-	-	-	Below -60
Vapour Pres. (Reid) (lbs/sq.in)	-	7.6	2.9	6.8	6.2	4.4	4.2	5.5
Corrosion Test	-	-	-	-	-	-	-	-
Corrosive Sulphur (mgms/100 mls)	-	-	-	-	-	-	-	-
Total Sulphur (% wt.)	0.12	0.03	0.02	0.03	-	0.10	0.10	0.03
Existent Gum (mgms/100 mls)	-	2	44	42	-	40	35	10 (gum 35 (oil
Bromine No.	33	4	12	23	-	13	12	25
T.E.L.Content (mls./I.G.)	Nil	Nil	0.95	Nil	Nil	0.85	0.9	Nil
Octane No.	54	67	64	60	60	67	64	59½
Hydrocarbon Analysis								
Aromatics(%w)	40	7.0	35.5	14.0	-	24.5	25.0	9.0
Paraffins "	-	34.0	52.5	41.5	-	31.5	31.5	50.0
Naphthenes "	-	23.0	35.5	31.5	-	36.5	36.5	25.5
Unsaturateds"	-	1.5	7.0	13.0	-	7.5	7.0	15.5
Alcohol	-	34.5	-	-	-	-	-	-
Water Solubles (% vol)	-	32.8	Nil	Nil	-	Nil	Nil	Nil
Phenols(% wt.)	-	-	-	-	-	-	-	0.02
	Highly "[illegible]" odour"	x .736 on alcohol-free [illegible]						

APPENDIX IV

MOTOR GASOLINES FROM THE MIDDLE EAST (Contd.)

Sample No.	MECH. 255	MECH. 257	MECH. 271	MECH. 277	MECH. 278	MECH. 292	MECH. 327	MECH.3 328
Source and Description	German M.T.Benz. El Daba 7.2.43 Markings: Kraft-stoff 200 L Fehrmarkt Feuerge-fahrlich 1942	German M.T.Ben-zine. El Daba 7.2.43 Markings: Numai Pentru Trans-portol Petroli-ferelor Nulse Fol Transact 11.	Ex Fuel tank of German Tank, PZ.Kw 111 recd. through Dept.of Tank Design Chobham	Sal-vaged Enemy Benz-ine ex Jaffa 077140M RE Metol-graf. Milano	Sal-vaged Enemy Benz-ine ex Jaffa. Schmidts Feierge-faerlich Kraft-stoff 200 L.	Sal-vaged Enemy bena-ine ex Jaffa, 1941 Kraft-stoff Feuerge-faer-lich, Heer, 200 L.	Ex No. 101. Sal-vage Depot at RAF Station Aboukir Marked: "IN.F.R.A" Genova Pegli"	Ex No. 101 Salvage Depot at RAF Station Aboukir Drum Marked: "I.H.O.
Date of Receipt	16.5.43	18.5.43	21.6.43	24.6.43	24.6.43	24.6.43	24.6.43	24.6.43
S.G. @ 60/60 F	.787	.744	.784	.732	.786	.788	.764	.748
Colour	Purple	Purple	Yellow-Orange	Brown-Yellow (Odour bad)	Violet	Violet	Yellow	Red.
Distillation								
I.B.P.(°C)	61	47	65	44	53	54	53	69
Rec.(%v)								
@ 70°C	2	5	1	15	2	3.5	-	-
@ 75°C	-	-	-	-	-	-	44	-
@ 100°C.	48	30	36	37.5	46	51	77	22.5
@ 140°C.	78	76.5	72	71.5	75	80	-	-
@ 150°C.	-	-	-	-	-	-	87	87
F.B.P.(°C)	178	182	202	202	175	171	210	186
Freezing Point (°C)	-	Below -60	-	Below -60	-38	Below -30	Below -60	Below -60
Vapour Pres. (Reid) (lbs/sq.in)	3.9	4.9	-	6.6	3.1	3.5	4.5	2.3
Corrosion test	-	-	-	No Stain	No Stain	No Stain	-	
Corrosive sulphur (mgms/100 mls)	-	-	-	-	-	-	0.2	Nil
Total Sulphur (% wt.)	0.08	0.01	0.06	0.04	0.07	0.10	0.11	0.03
Existent gum (mgms/100 mls)	9(gum) 120(oil)	3	12	100	Nil	Nil	29 (oily)	4 (oily)
Bromine No.	3.5	0.9	5.7					
T.E.L.-con-tent(mls/IG)	0.8	2.45	Nil	Nil	0.65	0.65	0.05	2.3
Octane No.	68	76	69.5	59	68	71	83	68.5
Hydrocarbon Analysis								
Aromatics(%w)	41.5	11.5	37.0	12.0	44.0	45.0	47	10
Paraffins "	36.5	48.5	37.0	50.5	21.0	9.5	(Extracted with 100% H_2SO_4)	
Naphthenes "	22.0	40.0	22.5	22.5	35.0	43.5		
Unsats. "	-	-	3.5	15.0	-	2.0		
Alcohol	-	-	-	-	-	-	42%v	Nil
Water Solubables	-	Nil	Nil	Nil	Nil	Nil	-	-
Phenols (%w)	?	0.002	0.027	-	-	-	-	-
Potential Gum	-	-	-	-	-	-	-	-

APPENDIX IV

MOTOR GASOLINES FROM THE MIDDLE EAST (Contd.)

Sample No.	MECH. 329	MECH. 330	MECH. 331	MISC. 27	MISC. 33	MISC. 34	MISC. 35	MISC. 36
Source and Description	Ex No. 101 Salvage Depot at RAF Station, Aboukir. Marked "A.G.P.U." and "Benzina S-1".	Ex No.1 101 Salv-age Depot at RAF Station Aboukir. Drum marked "G.de Michali Firenze" "F.E.O. 125048 D.M." "55"	Ex No. 101 Salv-age Depot at RAF Station Aboukir. Drum marked "Kraft-stoff 200.L. Kehr-macht Heer" "KH" & "41"	German Benz-ine from Trip-oli . con-tained in 200 Litre Barrels 8.2.43	From Malta "Kraft-stoff" 200.L. 1942	From Malta Sample marked "Gas Oil"	"Benz-ina 35331" from Malta	From Malta "Kraft-stoff" 1941
Date of Report	24.6.43	24.6.43	24.6.43	28.5.43	31.5.43	31.5.43	28.5.43	31.5.43
SP.GR. @ 60/60°F.	.769	.719	.786	.742	.751	.736	.740	.753
Colour	Green	Orange	Pale Violet	Brown	Purple	Yellow Orange	Orange	Red-Brown
Distillation								
I.B.P.(°C.)	50	40	54	41	49	40	42	55
Rec. (% vol.)								
@ 70°C.	-	-	-	9	4	13	10	4
@ 75°C.	-	17	9	-	-	-	-	-
@ 100°C.	60	37	50	28	24	33	31.5	25
@ 140°C.	-	-	-	63.5	65	67.5	69.5	68
@ 150°C.	90	83	86.5	-	-	-	-	-
F.B.P.(°C.)	197	176	174	202	198	208	200	183
Freezing Point (°C.)	Below -60	Below -60	-53	Below -60	-		Below -60	-
Vapour Pres.(Reid) (lbs/sq.in)	5½	6.5	4.0	5.4	-		-	-
Corrosion Test	-			-	-		-	-
Corrosive Sulphur (mgms/100 mls)	Nil	Nil	Nil	-	-		-	-
Total Sulphur(%wt)	0.08	0.03	0.10	0.06	0.02	0.04	0.03	0.03
Existent Gum (mgms/100 mls)	61 (oily)	6 (oily)	8 (oily)	191	-	21(gum) 126(oil)	17(gum) 107(oil)	-
Bromine No.	4.8	0.7	1.0	29.7	19	34	33.5	14
T.E.L.Content (mls/I.G.)	0.1	4.65	Nil	Nil	2.4	Nil	Nil	2.5
Hydrocarbon Analysis								
Aromatics(%v)	32.5	5	40	13.5	11.0	8.5	8.5	9.0
Paraffins "	(Extracted with 100%			52.0	42.5	46.5	44.0	42.5
Naphthenes "	H_2SO_4)			16.5	35.0	24.5	27.0	40.0
Unsaturateds"	-	-	-	18.0	11.5	20.5	20.5	8.5
Alcohol(%v)	19	Nil	Nil	-	-	-	-	-
Water Soluble	-	-	-	-	-	-		-
Phenols(%w)	-	-	-	-	-	-	Nil	-
							0.019	

APPENDIX V

DIESEL FUELS FROM EUROPE

M.A.R. Sample No.	54	60	62	66	68	71	73	75
Source and Description	Ex Fuel Tk. of German Fishing vessel arrived S.Coast from Newport on 8.6.42	From Danish Fishing-ing boat "Mari tana"	From Danish fishing vessel. "Evy"	"Gurli"	"Chr. Smed"	"Alice"	"Risager"	"Staus holm"
Date of Report	10.9.42/	11.12.42						
S.G. @ 60/60°F.	.837 6 HPA	.835 6(P) Union	.8425 Union 3 (R) Minus	.8425 Union 3(R) Minus	.850 Union 5(O) Minus	.8435 Union 6(P) Minus	.852 Union 6(P) Minus	.846 Union 4(M)
Flash Pt.Cl.sd. (°F.)	160	99	94	91	132	104	132	83
Visc.Red.I @ 100°F.(secs)	32	30	30	30	32	31	33	30
Distillation								
I.B.P. °C.)	188	135	130	129	164	140	162	133
Rec. @ 150°C.(%v)	-	-	3	2	-	1.5	-	3
200°C.(")	4.5	30.5	34	33	15.5	25	11	36
250°C.(")	52	65	63	64	57	56.5	45	73
300°C.(")	96	98.5	88	88.5	86	85.5	81	96
350°C.(").	-	97.5	97.5	97.5	96	97	96	-
Total Recovery"	98	98.5	99	99	98	99	99	99.5
F.B.P.(°C.)	346	365	362	362	371	365	369	334
Pour Point (°F.)	45	-15	-15	0	-10	0	Flowing @ -20	Flowing @ -20
Cloud Point(°C.)	-	-	-	-	-	-	-	-
Sulphur (%w)	0.24	0.85	0.5	0.45	0.1	0.3	0.2	0.1
Conradson Chr.(%w)	0.02	0.05	0.05	0.05	0.02	0.03	0.03	0.02
Hard Asphalt(%w)	Nil	-	-	-	-	-	-	-
Ash (%w)	Trace	0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01
Water(%v)	Trace	Nil	Nil	Nil	Trace	< 0.05	< 0.05	Nil
Sediment (%w)	0.01	-	-	-	-	-	-	-
Phenols (%w)	0.52	0.45a	0.62a	0.62a	1.4a	0.62a	0.63a	0.50a
Aniline Point(°C)	65.2	-	-	-	-	-	-	-
Diesel Index	52.7	48.5	44	44	47	47.5	48	42.5
Cetane No.	-	-	-	-	-	-	-	-
Odour	Strongly phenolic	-	-	-	-	-	-	-
Neutralisation Value	-	-	-	-	-	-	-	-
Calorific Value (B.T.U./lb.)	19,650		-	-	-	-	-	-
Bromine No.	-	5	8	8	3	3	2½	1

a As cresols.

APPENDIX V.

DIESEL FUELS FROM EUROPE (CONTINUED)

M.A.P.Sample No.	76A	76B	79	82	85	86	88	89
Source and Description	From Danish Fishing Vessels:- "Smant"	"Smant"	German 'Synthetic' Diesel Oil as supplied in Sept. '42 to vessels in Stettin.	Auxiliary Fishing Ketch D.3139 arrived in Barrow from overseas.	Ex M.V. "Smart"	"Synthetic Diesel Oil from Swedish m.s. "Sigrid Rinder" under German Charter	As supplied to a Dutch steamer at Delfzijl in Middle of Oct.'42	Motor Fuel Oil as supplied to coasting vessels in Holland. Obtained from Delfzijl at end of July'42
Date of Report	----11.12.42 ----		18.11.42	8.12.42	16.12.42	21.12.42	29.12.42	19.11.42
S.g.@ 60/60°F.	.861	.847	.848	.8465	.845	.846	.839	.839
Colour	Union 3½ Minus. (L Minus)	Union Darker than 8(R) (Dil.)	6-7 NPA	Union Darker than 8	Opague	V.Dark red practically opague	5-6 NPA	Brown-Black
Flash Pt.Cl.s.d.°F	162	124	122	174	135	165	115	-
Visc.Red.I @ 100°F.(secs.)	36	32	30	34	32	35	30	-
Distillation								
I.B.P. (°C.)	192	156	168	200	175	190	154	163
Rec.@ 150°C.(%v)	-	-	-	-	-	-	-	-
200°C. "	1	13	13	-	9	6	24	17.5
250°C. "	19.5	47	60	35	43	58	69	56
300°C. "	72.5	80	90	77	75	91	-	82
350°C. "	93.5	94	-	93.5	-	-	-	94
360°C. "	-	-	-	-	-	-	-	-
Total Recovery"	99	97	98	96	90.5	94½	94.5	-
F.B.P. (°C.)	370	359	348	352	334	300	297	-
Pour Point (°F.)	-5	-15	Fluid @ 0	Fluid @ 0	Fluid @ 0	Fluid @ 0	Fluid @ 0	-
Cloud Point (°F)	-	-	-	-	-	-	-	-
Sulphur (%w)	0.25	0.4	0.04	0.34	0.53	0.38	0.13	-
Conradson Con.(%w)	0.07	0.32	0.02	0.09	0.27	0.14	0.01	-
Hard Asphalt (%w)	-	0.08	Nil	Nil	-	-	-	-
Ash (%w)	0.01	0.01	0.01	0.01	-	-	-	-
Water (%v)	0.05	0.05	Nil	0.05	Trace	Trace	0.01	-
Sediment (%w)	-	-	Nil	Trace	Trace	Trace	Trace	-
Phenols (%w)	0.11*	0.17*	1.47	0.0015	-	0.74	Nil	-
Aniline Point(°C)	-	-	51.8	67.4	63.6	-	-	57.8
Diesel Index	49	51	44.3	54.6	53	45	46.0	49.5
Cetene No.	-	-	42	-	-	-	-	-
Odour	-	-	V.Strongly phenolic	-	Sl. phenolic	Sharp Phen.	Strongly Phenolic	-
Neutralisation Value	-	-	-	-	-	-	-	-
Calorific Value (B.T.U./lb.)	-	-	-	19060	-	-	-	-
Bromine No.	2	3½	-	-	-	-	-	-

* as cresols.

APPENDIX V

DIESEL FUELS FROM EUROPE (CONTINUED).

M.A.R.Sample No.	92	95	97	101	110	122	123	128
Source and Description	Drawn from tk. of Dutch M.F.V. "Frans Hals" arrived Ramsgate 2.10.42 from Flushing	Fuel ex M.V. "Dagmar" arrvd. at Grimsby from Continent 19.11.42.	Fuel ex m.v. "Valib" arrvd. at Grimsby from Continent. 19.11.42	Diesel Fuel reported supplied at Delfzilj in Oct. 1942 to small Dutch vessel.	Ex' Danish M.V. "Vestfart" arrvd. at Grimsby from Denmark 25.1.43	From Naval Attache S'holm stated to be supplied to U-boats, 'Prinz Eugen" etc.in March 1943	From Danish m.v. "Lorley"	As MAR 122 but as supplied in late March 1943.
Source and Description	8.12.42	19.1.43	----------	----------	12.4.43	23.5.43	21.6. '43.	3.5.43
S.G.@ 60/60°F.	.842	.848	.848	.852	.849	.8535	.8495	.848
Colour	6-7 NPA	5-6 NPA	5-6 NPA	5-6 NPA	5 NPA	3½ NPA	4 NPA	3½ NPA
Flash Pt.Clsd. F.	145	106 (open 135)	122 (open 158)	-	134	-	136	-
Visc.Red.I @ 100°F. (secs)	34	30	30	31	33	33	32	33
Distillation								
I.B.P. (°C)	148	147	158	-	161	170	166	200
Recov. @ 150°C(%v)	-	1	-	-	-	-	-	-
200°C "	7.5	22.5	22	-	10.5	2.5	11	-
250°C "	63	62	60	-	45	37	43.5	21.5
300°C "	82	85	90	-	80	75	76	75
350°C "	94.5	-	-	-	94	93	94	95
360°C "	-	-	-	-	-	-	-	-
Total Recov. "	96	96	97	-	96.5	98.5	98	98.5
F.B.P. (°C)	358	340	340	-	368	365	364	363
Pour Point(°F)	+5	Fluid @ 0	Fluid @ 0	Fluid @ 0	0	0	0	+10
Cloud Point (°F)	-	-	-	-	+2	+6	+12	+12
Sulphur (%wt)	0.34	0.32	0.20	0.16	0.1	0.07	0.22	0.10
Conradson Cbn.(%w)	0.09	0.01	0.02	-	0.04	-	0.02	-
Hard Asphalt (%w)	Nil	Nil	Nil	-	-	-	Nil	-
Ash(%w)	0.02	<0.01	<0.01	-	<0.01	-	Trace	-
Water (%v)	Nil	0.2	0.30	-	Trace	-	0.2	-
Sediment (%w)	Nil	Trace	Trace	-	-	-	-	-
Phenols (%w)	0.065	0.39	0.40	-	0.25	0.54	0.018	0.25
Aniline Pt.(°C.)	-	50.2	-	-	-	64.2	62.2	68
Diesel Index	54	45.0	45.0	44	52.4	50.6	50.2	54.6
Cetane No.	50	-	-	-	-	-	-	-
Odour	-	Phenolic	Phenolic	of creosote	-	Phenolic	Phenolic	Phenolic
Neutralisation Value	-	-	-	-	0.2	-	0.2	-
Calorific Value (B.T.U./lb)	-	-	-	-	-	-	-	-
Bromine No.	-	-	-	-	-	-	-	-

APPENDIX V

DIESEL FUELS FROM EUROPE (CONTINENT)

Sample No.	MAR. 132	MAR. 138	MAR. 141	MECH. 113	MECH. 118	MECH. 238
Source and Description	Diesel Fuel from 17 ton Coastal vessel arrived from Norway 13.3.43	Reported produced from Estonian Shale and used by U-boats fuelling at Gdynia	Diesel Fuel thought to be from German Merchant Vessel in North ern Waters	From Russian sources by MEW; despatched from Markony-Koshtorg, U.S.S.R.	Diesso-line. Prov. Roumania through M.E.W.	Diesel Fuel used in Norway
Date of Report	21.6.43	16.6.43	21.6.43	7.9.42	7.9.42	11.5.43
S.G. @ 6 0/60°F.	.8305	.8495	.871	.8205	.834	.842
Colour	Orange (Diluted)	3½ NPA	6 NPA	3½ NPA	4½ NPA	4½-5 NPA
Flash Point (closed) °F.	92	-	-	-	-	(open 118 145)
Visc.Red.I @ 100°F. (secs)	31	29	33	29	31	31
Distillation						
I.B.P. (°C.)	116	-	168	85	156	153
Rec. @ 150°C. (%v)	5.5	-	-	14	-	-
200°C. "	26.5	-	9.5	36	15	18
250°C. "	70.5	-	41	71.5	49	52
300°C. "	85	-	76	92.5	81	82.5
350°C. "	96.5	-	93	-	95.5	94.5
Total Recov. "	97	-	98	98	97.5	97
F.B.P. (°C.)	352	-	376	329	358	364
Pour Point (°F.)	-10	+10	0	Fluid @ 0	0	0
Cloud Point(°F.)	-	+14	14	-	-	+6
Sulphur (%w)	0.31	0.15	0.10	0.04	0.06	0.06
Conradson Cb.(%w)	0.02	0.03	0.01	Trace	0.01	0.03
Hard Asphalt (%w)	-	-	Nil	Nil	Nil	Nil
Ash (%w)	Nil	Trace	Trace	Nil	0.01	Trace
Water (%v)	0.05	0.4	0.05	Nil	Nil	Nil
Sediment (%v)	0.05	-	-	Nil	Nil	Nil
Phenols (%v)	0.008	0.019	-	0.95	0.21	0.25
Aniline Point(°C.)	50	68.3	47	52.8	65.9	61.0
Diesel Index	51	54.5	36.1	52	57.5	51.8
Cetane No.	-	-	-	39	-	48
Odour	Phenolic	Slightly phenolic	phenolic	phenolic	slightly phenolic	phenolic
Neutralisation Value	0.25	0.1	0.3	-	-	0.3
Calorific Value (B.T.U./lb)	-	-	-	19720	19710	-
Bromine No.	-	-	-	-	-	-

APPENDIX VI

DIESEL FUELS FROM THE MIDDLE EAST

MECH. Sample No.	217	218	219A	219B	223	224	230	251
Source and Description	Captured oil from Middle East.	Captured Diesel fuel from Middle East	Light coloured Diesel fuel captured in Middle East	Dark coloured Diesel fuel captured in Middle East	Diesel oil of Enemy Origin Middle East (Period April '42) Ex 101 Salvage Depot (P.T.D)	Gas Oil of Enemy origin Middle East (Period April '42 ex 101 Salvage Depot (P.T.D)	Middle East captured in original sealed "Jerrican"	Diesel fuel captured in Md. East drum 028867 DRE barrel "G"
Date of Report	22.2.43	23.2.43	----------	----------	20.1.43 ----------		5.2.43	18.3.43.
S.G.@ 60/60°F	.8329	.838	.8615	.8425	.839	.838	866	.833
Colour	Darker than 8 NPA	8 NPA	2-2½ NPA	drkr. than 8 NPA	1½ minus (H minus)	drkr. than "H"	3½(L) (minus)	Union 2(1) minus
Flsh.Pt.Abl. °F	90(open 107)	156	172	158	202	60	170	142
Visc.Red.I @ 100°F (secs)	34	35	36	36	40 ≡	38 ≡	38 ≡	34
Distillation:								
I.B.P. (°C)	99	205	176	192	207	93	195	176
Recov.@ 170°C (%)	3.5	-	-	-	-	-	-	-
200°C "	2.5	-	1	0.5	-	10.5	-	4
250°C "	25	13	18.5	16.5	14.5	27	31	43
300°C "	67	66	63	66	67	70	79.5	83
350°C "	93	95.5	90.5	92	96	95	97	97
Total Recov. "	97	97	97.5	97	-	-	-	-
F.B.P. (°C)	370	358	377	373	-	-	357	384
							below	below
Pour Point(°F)	25	+20	+15	+15	+15	+15	15	15
Cloud Point (°F)	-	+18	+22	-	-	-	-	-
Sulphur (%w)	0.16	0.8	0.05	0.27	0.33	0.01	0.24	0.20
Conradson Chn.(%w)	0.16	0.02	0.03	0.09	0.11(on 10% res)	0.18	0.05 (on 10% res)	0.38 (on 10% res.)
Hard Asphalt (%w)	-	-	-	-	-	-	0.01	-
Ash (%w)	0.06	Trace	Trace	0.01	-	-	-	Neg.
Water (%w)	0.05	0.1	Trace	Trace	Trace	Trace	Neg.	Trace
Sediment (%w)	0.16	0.11	Trace	Trace	-	-	-	Trace
Phenols (%w)	0.046	0.011	0.00015	0.74	-	-	-	-
Anilline Point(°C)	-	-	-	-	76	72	56.7	69.2
Diesel Index	58.8	61.4	58.3	57.7	63	61	43	60
Cetane No.	53	60	52	56	-	-	-	-
Neutralon.Value	0.45	0.15	0.15	0.5	Neg.	0.4	0.2	0.4
Cal.Value(BTU/lb)	-	-	-	-	19600	19600	-	-
Bromine No.	-	-	-	-	-	-	-	-

≡ @ 70°F

APPENDIX VI.

DIESEL FUELS FROM THE MIDDLE EAST (CONTINUED)

Sample No.	MECH. 252	MECH 290	MAR. 100	MAR. 118	MISC. 20	MISC. 29	MISC. 30
Source and Description	Diesel Fuels captured in Md. East Drum 0277 B.C.R.E. Barrel marked with yellow flash	M.E.W. "Eschantellon Huile"	Middle East A.C.I.P. Diesel Fuel	Ital. or Ger. "Diesel Oil" "Karamanli" Mole, Tripoli 11.2.43	Ital. Gas Oil Tripoli 7.2.43 in 200 l. markings:- "Markdo Italien"	Tripoli 7.2.43 German or Ital. Heavy Gas Oil in 200 l. Bbls.	Ger. or Ital. Lt.Gas Oil in bbls. at Tripoli 8.2.43
Date of Report	18.3.43	4.6.43	4.12.42	4.6.43	28.5.43	31.5.43	4.6.43
S.G. & 60/60°F.	.840	.887	.890	.912	.8435	.870	.865
Colour	Union 6 (P) minus	3 NPA	Dk.red oil-brown bloom	Black	3½ NPA	Darker than 8 NPA	1½ NPA
Flash Pt.Clsd.°F.	134	-	194	195	150	174	186
Visc.Red.I @ 100°F. (secs)	33	-	43	87	31	38	37
70°F. "	37	-	-	-	-	-	-
Distillation							
I.B.P. (°C)	162	-	208	198	186	202	213
Recov. @ 200°C.(%v)	8	-	-	-	10.5	-	-
250°C. "	30	-	21	13.5	69	16	17
300°C. "	71	-	59	38	96	62	64
350°C. "	93.5	-	82.5	58	-	91.5	94.5
Total Recovery "	-	-	-	Dist. stopped @ 375	98.5	98.5	98.5
F.B.P. (°C.)	-	-	-	-	314	377	367
Pour Point (°F)	Below 15	-	Below 15	+15	-20	-15	+10
Cloud Point(°F)	-	-	-	-	-16	+ 2	+22
Sulphur (%w)	0.08	-	0.48	0.36	0.03	0.06	0.03
Conradson Cbn.(%w)	..74(on 10% res)	-	1.13	4.2	Trace	0.04	Trace
Hard Asphalt (%w)	-	-	0.57	1.77	-	-	-
Ash (%w)	Neg.	-	0.09	0.09	Trace	Trace	Trace
Water (%v)	0.1	-	0.1	2.8	Nil	Trace	Trace
Sediment (%w)	Trace	-	0.1	-	-	-	-
Phenols (%w)	-	-	-	0.003	0.74	0.01	0.003
Aniline Point(°C)	70	78.1	60.6	-	-	-	-
Diesel Index	58.5	48.5	39	38	45.5	47.5	49.5
Cetane No.	-	-	-	42	43	47	57
Odour	-	Normal not phenolic	-	-	-	-	-
Neutralisation Value	0.55	-	0.55	1.5	0.1	0.25	0.2
Cal.Val.(BTU/lb)	-	-	-	-	-	-	-
Bromine No.	-	-	-	-	-	-	-

APPENDIX VII

VARIOUS

	KEROSINE						WHITE SPIRIT	
Sample No.	MECH. 116	MECH. 117	MAR 70	MAR 108	MECH. 239	MAR 125	MAR 115	MECH 237
Source & Description	Received through M.E.W. Petrole Lumpant Prov. Roumanie	Petrole Tract-eur Prov. Roumanie.	Oil used for blow lamps for pre heating ex M.F.V. "Chr. Smed"	Kerosine taken from Danish m.v. "Westfort" arr. Grimsby from Denmark 25.3.43	"Petroldest" now used in Norway	"Paraffin" ex Danish m.v. "Lorley" arr. recently from Denmark	"Turpentine" used for paint" Alleged taken by Swedish "T.B.IV" Chartered by German Navy, from Naval Stores Gdynia.	White Spirit now used in Norway
Date of Report	7.9. 42	7.9. 42	17.9. 42	12.4. 43	14.5. 43	21.6. 43	25.3. 43.	31.3. 43
SP.GR.	.818	.817	.823	.823	.812	.822	.781	.782
Colour	Yellow	Yellow	Orange	Worse than -16 Saybolt	+2 saybolt	1½ N. P.A.	-	Yellow
Distillation							(on 10 mls)	
I.B.P.(°C)	139	185	147	151	170	151	129	142
Rec$_{o}$ @ 150°C. (%v)	1	-	0.5	-	-	-	15	7
200 "	24	-	25	28	14.5	25	96	94 (190°C)
250 "	74	77	70.5	75	85	73	-	-
300 "	-	96	-	96.5	-	96	-	-
Total Rec.	97	97.5	96	97.5	98	97½	97	97.5
F.B.P.(°C)	298	300	296	308	274	309	210	208
Hydrocarbon Analysis								
Aromatics %w	17.0	16.0	18.5	20.0	-	18.5	-	-
Paraffins "	56.5	62.0	55.0	52.5	-	52.0	-	-
Naphthenes "	22.0	17.5	22.0	27.5	-	26.0	-	-
Unsaturateds "	4.5	3.5	4.5	-	-	3.5	-	-
Freezing Point (°F)	-	-	-	-	-	-35	-	-
Sulphur %w	0.06	0.04	0.04	0.02	0.02	0.04	-	0.01
Bromine No.	5.3	4.4	5.	2.5	2.2	4	2	12
Smoke Point	20½	19½	18	19	23½	20	-	-
Phenols %w	-	-	-	-	-	0.004	-	-
Flash Point (°F)	Below 66	155	101	109	130	-	-	78
R.I. @ 70°F.	-	-	-	-	-	-	1.438	-
Corrosion Test	-	-	-	-	-	-	-	Pass

APPENDIX VIII

[illegible] ANALYSIS OF FOUR [illegible] FUELS BY FRACTIONATION AND SPECTROGRAPHIC MEANS

[illegible] Analysis

Results expressed as vol. % on original petrol corrected for distillation loss

Sample No.	Range °C	AIR.200 (See 4th Comment)	AIR.209
Colour		Green-blue	Blue
Paraffins			
Iso-butane	0-30	nil	nil
n-butane		nil	0.64
Iso-pentane		6.54	6.45
n-pentane		5.70	4.17
Methyl pentanes	20-65	7.21	6.70
n-hexane	65-80	3.55	4.00
Methyl hexanes	80-95	4.63	5.00
n-heptane (& [illegible])	95-102	0.95	4.70
Multiple branched octanes	102-111	3.02	2.05
Single " "	111-123	3.00	2.55
n-octane	123-129	0.80	0.61
Double branched nonanes	129-137	0.80	0.62
Branched nonanes	137-153	1.10	1.16
Branched decanes etc.	>155	0.19	1.61
Total		41.89	40.44
Naphthenes			
Cyclopentanes	0-60	1.05	0.96
Methyl cyclopentanes	60-75	5.90	6.22
Cyclo hexane	75-82	7.36	4.47
Dimethyl cyclopentanes	[illegible]-95	2.72	3.11
[illegible] ([illegible])	95-110	10.9?	9.40
[illegible] ([illegible])	110-125	4.45	4.54
	125-137	2.52	3.96
	137-157	2.94	3.64
	>155	1.25	3.56
Total		37.75	39.86
Aromatics			
Benzene	0-90	7.80	5.70
Toluene	90-118	6.63	5.83
Xylenes (& ethyl benzene)	118-145	4.07	4.80
	145-163) >166)	1.86	3.37
Total		20.36	19.70
[illegible] C.H. Ratio		1.10	1.39
[illegible]		52.3	58.2

A P P E N D I X VIII (contd.)

CONSLUSIONS

	AIR.200	AIR.209
Aromatics	High for a blue fuel of 90 O.N. and distribution different from that of previous samples. High C_6 and low C_8 aromatics previously found mainly in certain fuels containing hydropetrol.	High compared with most previous "blue" fuels but similar to AIR.200
Octanes	Considered no appreciable amount of synthetic octanes present.	About 3% present. Probably richer in 2.2.4 T.M.P. than in higher boiling T.M.P.s.
Hydropetrol	Data suggests no appreciable amount present.	None present
Base Fuel	Considered that fuel consists of petroleum base to which benzol has been added to raise O.N. to 90	Similar to AIR.177 (See 4th Summary)

Examination of AIR.200 and AIR.209 By Dr.Sutherland and Dr.Thompson

	AIR.200		AIR.209	
	Oxford (1)	Cambridge (3)	Oxford (2)	Cambridge (4)
Uncut Fuel				
Hydropetrol	some, not large		Very little, if any	
Octanes	Not detected	Not detected	not detected	
Aromatics total%	20	17.4	18.6	
Benzine	9	8	7	
Toluene & mono-alkyl	9	8.2	8.4	
Xylenes + di-alkyl	2	1	3.2	
hydrindene	Not detected	0.25	Trace	
Spectra Analysis of I.C.I. Fractions				
benzene			5.61	
ethyl benzine	2.18		1.76	
m xylene	1.72		2.88	
p "	0.36		0.39	
o "	0.07		0.08	
n-propyl benzene		1.0		1.5
hydrindene		0.23		0.5

APPENDIX VIII (contd.)

	AIR 203		AIR 209	
	Oxford (1)	Cambridge (3)	Oxford (2)	Cambridge (4)
2,2,4 trimethyl pentane		1.0		3.6
2,2,3 " "		nil		nil
2,3,4 " "		2.0		1.0
2,3,3 " "		0.5(?)		nil
Cyclopentane			0.96	
2 methyl pentane	3.35		2.69	
3 " "	2.6		3.30	
2,3 dimethyl butane			0.69	
N - hexane	3.85		1.38	
methyl cyclopentane	6.45		5.77	
cyclohexane	4.89		4.26	

See (1) Oxford Report No.14 Oct. 22nd, 1942.

(2) " " No.18 Dec. 22rd, 1942.

(3) Cambridge report Sept. - Oct. 1942.

(4) "Summary of Work of Infra Red Panel" Dec. 1942.

These blue fuels and also AIR 177 (See 4th Summary) which have 20% aromatic content contain small amount of hydrindenes and somewhat more ethyl benzene than did the earlier blue fuels. The composition of aromatics in 20% aromatic blue fuel is thus tending in the direction of the composition for green fuel although still quite distinct from the actual green fuel.

APPENDIX VIII

HYDROCARBON ANALYSIS OF FOUR ENEMY FUELS BY FRACTIONATION AND SPECTROGRAPHIC MEANS (Contd.)

Spectrographic Analysis carried out at Cambridge and Oxford on AIR.233 (green) from the Middle East and AIR 259 (German motor spirit obtained from Germany. On label: "9249 a 17/12-42 X"JORDELJEBEIN")

AIR 233	Cambridge	Oxford
Uncut Fuel		
Aromatics		
Benzene	2%	2.9%
Toluene and mono-substituted benzene	.8	8.3
Xylenes etc. (m-/p- ration 4/1)	7	8.3
Hydrindene	0.1	trace
Total (ca.)	17%	19.5%
Iso Octanes Total (ca.)	5%	Not more than few %
Dufton column distillation showed:	2.3.4. + 2.2.4	More 2.3.4. than 2.2.4.
Rough Fractionation (500 mls. at 50 mls/hr.)		
Aromatics		
Benzene		1.6%
Toluene		5.0
Eth.Benzene		1.5
m-Xylene		3.8
p-Xylene		1.0
o-Xylene		0.8
4-cumene		0.3
Total		14.0%
Iso-Octane		
2.2.4. T.M.P.		3.0%
2.2.3 "		Trace
2.3.4. "		4.2
2.3.3. "		1.5
Total		8.7%
M.C.Pentane		1.7%
Cy.Hexane		2.5%
M.C.P./C.H. Ratio		0.7

CONCLUSIONS

AIR.233 is not of the "green" class but probably a "blue" fuel. M.C.P./C.H. ration shows it is not a hydropetrol on the I.C.I. classification. Low benzene content confirms this. Evidence is that added octane is of hydrocodimer type. No hydrindene present and unlikely that much aromatic has been added.

APPENDIX VIII

HYDROCARBON ANALYSIS OF FOUR ARMY FUELS BY FRACTIONATION AND SPECTROGRAPHIC MEANS (Contd.)

Spectrographic analysis continued.

AIR 259

A very small sample of enemy blue arctic fuel was obtained on which the following best information was available from Norway.

"Initial B.P.	46°C
25% Recovery at	94°C
50% " "	106°C
75% " "	135°C
End Point	165°C

All fractions contain unsaturated benzine "clearly synthetic petrol plus benzol". Probably contains T.E.L."

Infra Red Examination

Aromatics	Cambridge	Oxford
Benzene	7.0	6.5
Toluene, etc.	7.5	7.0
Xylenes, etc.	3.5	3.5
Hydrindene	traces?	none
Total	18.0%	17.0%
Iso Octanes	Small proportion only.	None
Remarks	Does not seem to contain appreciable hydropetrol. Would appear to be aromatic blend rich in benzene.	Exceptionally high proportion of benzene in aromatic hydrocarbons. Absence of hydropetrol not certain.

APPENDIX IX

Brown Coal Oils

Information supplied by Dr.P.O.Rosin indicates that brown coal oils are produced only by low-temperature distillation at 450 - 650°C.

Brown coal distillates require either chemical refining treatment to remove phenolic substances, Edeleanu treatment or hydrogenation to give satisfactory Diesel fuels. The following table gives the properties of brown coal Diesel fuels made by various processes:

	1. "High-Speed" Diesel fuel made by chemical refining	2. "Low-Speed Diesel fuel made by chemical refining	3. "High-Speed Diesel fuel made by Edeleanu treatment	4. "High-Speed" Diesel fuel made gas-phase hydrogena-tion
Density at 20°C.	.880 - .894	.900 - .930	.877	.881
Solidifying Point °C.	-10°	0°- 5°	-17°	-18°
Flash point °C.	80 - 100°	90 - 130°	-	-
Phenolic substances %v.	1 - 3	3	0	0.3
Viscosity °E/20°C.	1.2 - 1.4	1.5 - 2.5	1.59	1.26
Initial boiling point °C.	180°	230°	-	-
Final boiling point °C.	>350°	35% at 300°C.	-	337°
Calorific Value (Gross) cal./Kg.	10,250	10,250	10,000	-
Cetane number	-	-	56	53
Sulphur %w	-	-	0.4	-

The properties of captured German Diesel fuels indicate that they do not contain important proportions of number 2 fuel which has a high density and solidifying point and apparently a high boiling range as well as an appreciable phenolic content. The properties of the remaining three fuels from brown coal are, however, consistent with their being components, to the extent of about 50%, of many samples of captured German Diesel fuels.

Bituminous Coal and Fischer-Tropsch Oils

Low temperature distillation process have little application to bituminous coals in Germany, except in the Krupp plant coupled with synthesis plant. The following data relate to Diesel fuels made from fractions taken from high temperature tar and blended with Fischer-Tropsch gas oils:-

	55% Tar Oil 45% Fischer Oil	60% Tar Oil 40% Fischer Oil
d/20°C.	0.860	0.866
Colour	Yellow-blue	Brown
Cetane Number	71	49
Viscosity °E/20°C.	1.20	1.28
Flash Point °C.	94	68
Solidifying point	-20°C.	-16°C.
Ash	0.001%	

(continued)

	55% Tar Oil 45% Fischer Oil	60% Tar Oil 40% Fischer Oil
Carbon content	86.6% w.	
Hydrogen "	12.2% w.	
Sulphur "	0.22% w.	
Net Calorific Value	10,080 Kcal/Kg	
Conradson Carbon	0.004	
Alkali soluble		2%

Blends of the above type might be important components of the captured German Diesel fuels.