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PROVISIONAL INTELLIGENCE REPORT

PETROLEUM IN THE SOVIET BLOC

AVIATION GASOLINE IN THE SOVIET BLOC

CIA/RR PR-17 (IV-B)

2 July 1952

Note

The data and conclusions in this report do not necessarily represent the final position of ORR and should be regarded as provisional only and subject to revision. Additional data or comments which may be available to the user are solicited.

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FOREWORD

This report is one of a series of provisional reports pertaining to petroleum in the Soviet Bloc. The entire series is intended to cover all phases of petroleum, natural gas, and synthetic liquid fuels in the Soviet Bloc. These reports are presented as an intermediate step in consolidating pertinent intelligence on the subject and not as a finished study. In the consolidation of the available information, various reports and documents representing research by other intelligence agencies were utilized along with the results of research and analysis by members of the staff of CIA.

It is intended that this series of reports will serve the following purposes:

a. Represent a base for contributions and additions by CIA and other agencies actively interested in petroleum intelligence.

b. Facilitate the selection of the specific and detailed gaps in intelligence warranting priority attention.

c. Provide the basis for a broad study on petroleum in the Soviet Bloc and various studies directed toward specific critical problems.

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(ORR Project 6-52)

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IV-B

AVIATION GASOLINE IN THE SOVIET BLOC

Summary

The production of high octane aviation gasoline involves the proper combination of three major types of components, namely, base stock, blending agents, and tetraethyl lead. The final composition of the avgas depends upon the specified lean and rich mixture ratings as well as the quantity of TEL permitted. In the USSR the aviation grades of gasoline are 100/130 with a maximum of 4.6 cc TEL/gallon, and the 95 grades (95/130 and 95/115) which are to contain a maximum of 5.5 cc TEL/gallon. The 100/130 grade is indicated to be used in long range operations while fighter aircraft are assumed to use the 95/130 grade. Ground support planes will probably utilize the 95/115 grade.

The potential availability of high octane aviation gasoline in the Soviet Bloc is derived from probable catalytic and synthetic facilities in existence from 1951 to 1953, assuming a maximum yield by the cross-shipment, i.e. pooling of Avgas components. The results of calculations based on this assumption are shown below for the years 1948 through 1952:

Thousand Metric Tons

Grade	1948	1949	1950	1951	1952
100/130	205	205	285	429	697
95/130	298	358	273	273	672
95/115	779	779	779	779	928
Total 95 #	1,282	1,342	1,337	1,481	2,297

For the first year of a war beginning 1 July 1952 the potential availability of high octane avgas is shown in the following tabulation, assuming three different bases of calculation. The first case assumes a maximum production of 95 grades with no 100/130 produced; the second case is based on meeting the military requirements as established by the Air Forces for the first year of a war; the third case assumes a maximum production of the 100/130 grade at the expense of the 95 grades. The first and third cases are hypothetical ones used to illustrate the great difference in volume which occurs in total availability by adjusting production of the 100/130 grade.

Thousand Metric Tons

Grade	Case 1	Case 2	Case 3
100/130	-	955	1,284
95/130	2,075	697	286
95/115	2,045	1,017	335
Total 95/	4,120	2,669	1,905

2. Composition and Formulation of Aviation Gasoline.

a. High octane aviation gasoline is comprised of three major types of components, namely, base stock, high quality blending agents, and tetraethyl lead. The quantity of each component in a finished blend is dependent upon the type of product desired.

b. Base stocks are essential in order to provide the basis for the proper volatility and boiling range of the fuel and to provide a means of reducing the effect of certain undesirable properties of blending agents used in compounding the finished gasoline. They were first obtained by the distillation of selected crude oils, followed by subsequent treatment to provide the best possible product. This type of product is known as a straight run base stock. Naphthenic and intermediate crude sources are now considered as the most suitable ones for the production of this straight run base. Conversion processes have also been developed which make possible the production of a high grade aviation base stock without requiring selected crudes. The most important of these processes is catalytic cracking which produces a base stock of a higher octane rating than the straight run base stock. This catalytic process is a keystone in the production of high octane aviation gasoline. The gases produced from catalytic cracking are the main source of charging stock to the alkylation plants which produce aviation-grade alkylate, considered as the heart of aviation gasoline grades of 100 octane and higher.

c. Blending agents, or high anti-knock hydrocarbons, are highly refined petroleum products produced by alkylation, polymerization, isomerization, aromatization and cyclization processes. 1/* Some of the more important compounds, such as toluene, xylenes, and cumene, are used as rich mixture additives while isopentane is used specifically as a vapor pressure corrector to elevate the vapor pressure of the blend within the limits of specifications.

d. The final composition of high octane aviation gasoline depends upon the specified lean and rich mixture ratings of the fuel as well as the quantity of tetraethyl lead permitted. In expressing grade designations the first number is the lean rating and the second the rich rating. In the US the aviation grades of gasoline are 115/145 and 100/130; in the USSR 100/130, 95/130, and 95/115 are the principal grades used. The lean rating of an aviation gasoline blend is defined as the octane rating of the fuel under normal cruising conditions of an aircraft. The rich rating is expressed as the rating utilized under maximum power conditions such as take-off, rapid climb, and other combat operations where full power is required. These ratings (known as knock ratings) are established in the laboratory on CRC test engines by the 1-C and 3-C methods, so that the values obtained are not absolute but only an indication of the performance characteristics of the fuel when used in multicylinder engines. These laboratory tests are essential in production control at refineries producing aviation gasoline. Further development of these test methods and blending values will be given in the third section of this study.

e. A major consideration in aviation gasoline production is the lead susceptibility. This term is expressed as the increase in anti-knock value imparted to a hydrocarbon compound or mixture of compounds by the addition of definite amounts

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of tetraethyl lead (TEL). In the US the maximum TEL content for all grades of aviation gasoline is about 4.6 cc/gallon. In the USSR the 100/130 grade has a maximum of 4.6 cc of TEL/gallon, but the two 95 grades have a maximum of approximately 5.5 cc/gallon. As the quantity of TEL in gasoline is increased, the effect of each additional volume (cc) decreases and at the 6 cc level, for example, the effect of adding more TEL is rather small. In addition, high lead concentrations can cause operating difficulties, particularly in long range operations.

f. Selection of grades of aviation fuel represents a compromise between quality and quantity. The higher the quality the lower the volume of fuel that can be produced from given facilities. Long range operations require fuel with a high lean rating and a lower TEL content than might be permissible for short range flights. The USSR grade 100/130 with about 4.6 cc of TEL per gallon is indicated to be the fuel assigned to planes designed for long range operations. The USSR grade 95/130 represents a sacrifice in potential range while retaining the high potential performance for full power operations such as required for interception. This grade is indicated to be the fuel assigned for fighter aircraft. The USSR grade 95/115 represents a compromise in both range and full power performance. It is probably assigned to the support of ground troops and other military operations which do not require maximum range and power. Grades lower than 95 octane are suitable for many training operations. The USSR grade 89 is generally comparable in quality to the US grade 91. While grades 95/130 and 95/115 represent some sacrifices in potential performance, there is a major gain in the volume of fuel from given refining facilities.

2. Facilities for High Octane Aviation Gasoline Production.

The capabilities for the production of high octane aviation gasoline should be based on the plant capacities for the individual components rather than the capacity of the plant as an integrated unit for a finished grade of aviation gasoline. Since it is possible to cross-ship components in order to attain maximum availability in production calculations, the components should be pooled. This leads to a greater availability than is revealed by calculations based on individual capacities of plants. While the U. S. does not employ this practice in peacetime, it was done during World War II.

In Section D (Survey of Probabilities and Potentials in Future Petroleum Refining) of Part I of Petroleum in the Soviet Bloc, technical data are correlated to develop an apparent logical program for the construction of high octane gasoline facilities by the Soviets. In accordance with this correlation, seven catalytic cracking and alkylation systems are assumed to have become available in the USSR by the beginning of 1953. These systems consist of the four lend-lease Houdry projects designed for Gurev, Orsk, Kuibyshev, and Krasnovodsk and three similar plants assumed to be located at Baku, Grozny, and Ufa respectively.

It is reasonable to assume that Gurev and Orsk were in operation by 1948 since the major portion of the construction on these plants was completed in late 1946. It is also assumed that the Ufa hydrogenation plant was operating in 1948. The above mentioned correlation also develops plausible completion dates for the remaining five catalytic systems in an unidentified order of completion with capacities assumed to be of the same order of magnitude. The tabulation of data showing the potential availability of components from each plant is given in the Appendix, Table 2.

In the European Satellites there are nearly 10 million tons of refinery capacity available, but most of it is old and badly in need of repair with only 1.5 million metric tons of thermal cracking in existence. There are no known facilities for the production of high octane aviation gasoline from crude oil. There are numerous reports of expansion and modernization in all of the Satellites, but there is no detailed information on the extent and type of installations under construction. Some of the construction is actually a relocation of refineries closer to the crude oil sources while other construction includes the removal of facilities from an existing plant to another to increase efficiency of operation. There is, however, considerable evidence (cf. Section D (Refinery Production of Petroleum in the European Satellites) of Part II of Petroleum in the Soviet Bloc) that the new equipment being installed does not include catalytic cracking.

3. Synthetic Facilities for High Octane Aviation Gasoline Production.

The production from synthetic fuel facilities in the USSR is in addition to the products refined from crude petroleum. Soviet interest in the production of liquid fuel from coal has been indicated by various contacts with German synthetic experts prior to World War II. Although they were qualified technically to comprehend the synthetic fuel industry, it is doubtful that any prewar synthetic plants in the USSR contributed to the availability of aviation gasoline during World War II. However, in 1946 and 1947 the Soviets dismantled and removed about 1,600,000 metric tons of capacity from the German synthetic fuel industry. It may be assumed that about 50% of such capacity can be reestablished within five or six years depending on the care and condition of the equipment when dismantled and upon arrival and storage at its destination. In this report the salvaged capacities of the dismantled plants as well as those of Soviet-designed plants are assumed to be available for the production of aviation gasoline in 1951, with increasing production rates through fiscal 1953.

The potential of aviation gasoline from non-crude sources is dependent upon coal hydrogenation. The gasoline obtained by the Fischer-Tropsch synthesis is a low octane product not directly suited for the manufacture of aviation gasoline. The initial product from oil shale is a heavy crude oil and upon further refining a gasoline is produced, but this process is not at present economically adapted for aviation gasoline production. There is considerable flexibility in the operations of coal hydrogenation facilities so that a high percentage of the total output can be converted to the gasoline boiling range. It is estimated that a fifty (50) percent yield of gasoline with a 70 to 75 octane number could be obtained, and that upon the addition of 4.0 cc of TEL the rating would be raised to the 85 to 91 octane range.

Except in the "Krasnoye" project near Lake Baikal which is designed to yield about 40-50% of finished aviation gasoline 2/, 3/, the synthetic 85 to 91 base stock probably requires blending with high quality components of other origin to make the finished 95 and 100 grades of avgas. In order to produce the latter components, the additional facilities and operations would be reasonably placed at petroleum refinery locations rather than at coal processing locations. This logic is based on the critical shortage of steel which is required for the construction of these facilities. This then means that the high quality non-crude blending components would be shipped to refineries where the final blending would be made.

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More efficient use would thereby be made of the specialty equipment necessary to produce high quality aviation gasoline, by locating it at the logical place for the maximum output of petroleum products. More complete information on synthetic production in the USSR is given in Section E (Synthetic Oil Industry in the USSR) of Part I of Petroleum in the Soviet Bloc. Table I shows the potential USSR synthetic plant productions in terms of B-89 avgas base stock and the 100/130 grade of avgas from 1951 through the first half of 1953.

The European Satellites synthetic fuel facilities are located in the Soviet Zone of Germany and in Czechoslovakia near the German border. Although the capacity of these synthetic plants was greatly reduced by war damage and Soviet dismantling, rehabilitation of the industry has been underway for several years. Dismantled plants are being rebuilt and the efficiency of operation is increasing, thereby increasing output steadily. From the plant at Boehlen, Germany, and Most, Czechoslovakia, the only potential European Satellite production of the 100/130 grade of high octane aviation gasoline is available at the present time, using existing facilities for the Bergius process. This potential is assumed to be 80% of the actual 95/130 grade production for these plants in order to account for blending of alkylate and isopentane with the DHD product. Table I shows the potential Satellite synthetic plant productions in terms of B-89 avgas base stock and the 100/130 grade of avgas from 1950 through the first half of 1953. Further information on this topic will be found in Section E (Production of Synthetic Liquid Fuels in the European Satellites) of Part II of Petroleum in the Soviet Bloc.

TABLE 1

Estimated Potential of High Octane Gasoline

Thousand Metric Tons

Year	USSR 100/130	USSR B-89	European Satellites 100/130	European Satellites B-89
150	--	-	80	320
1951	120	180	104	340
1952	159	346	128	365
1st half 1953	103	247	76	200

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4. Development of Aviation Gasoline Blends.

The blending of various components used in the manufacture of aviation gasoline is done principally to meet the lean and rich mixture octane ratings and the vapor pressure specifications as established by the Soviets. These values are 100/130 with 4.6 cc of TEL/gallon, 95/130 and 95/115 with 5.5 cc TEL/gallon for the octane ratings and a maximum of 7.0 lbs/sq. in. at 100°F for the vapor pressure of the fuel. Other quality specifications including volatility, sulfur content, stability, freezing point, thermal properties, lead susceptibility, etc., must also be met but the most important ones for basic calculation purposes are octane rating and vapor pressure.

At low power output (lean mixture) the theoretically correct ratio of fuel to air is supplied to the engine, but when full power output is required, the engine must run with a higher ratio of fuel to air (rich mixture) or else it would knock, overheat, and quickly be destroyed. The following simple chemical equations show why rich mixtures produce less heat, hence less knock.

a. Cruise or maximum economy lean mixture (Fuel/Air ratio = 0.067)

(Fuel) + (Air) → (Exhaust Gas)
$1\ CH_2 + 1.5O_2 \rightarrow CO_2 + H_2O$

Heat evolved = 19,000 BTU/lb fuel or 1,270 BTU/lb air

b. Take-off or full power rich mixture (Fuel/Air ratio = 0.10)
(Excess Fuel) + (Air) → (---- Exhaust Gas----)
$1.5\ CH_2 + 1.5O_2 \rightarrow 0.53\ CO_2 + 0.97\ H_2O + 0.97\ CO + 0.53\ H_2$

Heat evolved = 10,900 BTU/lb fuel or 1,090 BTU/lb air

These equations show that with rich mixtures the heat evolved per pound of fuel is reduced. This also permits an increase in air supplied to the engine by means of an added boost or supercharging, and added fuel. This in turn permits greater power outputs before knocking occurs again. 4/

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These knock ratings of the individual components of a blend are determined by CRC laboratory test engines under conditions designed to approximate the actual low and high power outputs of an aircraft engine. The F-3 or 1-C (lean) and F-4 or 3-C (rich) knock ratings are then based on the simple principle of averaging, in proportion to the volumetric concentration, the knock ratings of the constituents. While this principle holds in most cases, some deviations may be expected but they are usually within the accuracy of the test methods. Extensive data have been developed by various laboratories throughout the US on the common blending stocks used in aviation gasoline manufacture, and these data have been tabulated by the Petroleum Administration for War (PAW).

Since no systematic data on lead susceptibilities of individual hydrocarbons and hydrocarbon types are available, PAW has prepared the special TEL charts reproduced in Figures 1 and 2. These charts are also derived from data obtained from a large number of laboratories in the US, based primarily on the ethylization characteristics of commercial aviation gasoline components and blends. Since the majority of blending data on aviation gasoline constituents have been observed at the 4.0 cc TEL/gallon level, the attached figures have correlated the F-3 and F-4 ratings on blends containing 3.0 to 6.0 cc TEL/gallon with the ratings on the same stocks containing 4.0 cc TEL/gallon. Thus, it is possible to calculate the F-3 and F-4 ratings of known composition containing 4.0 cc TEL/gallon and by means of Figures 1 and 2, to estimate the ratings of the same blend when containing 3.0 to 6.0 cc TEL/gallon 5/. With the aid of these charts for calculation purposes, the octane ratings of the Soviet aviation gasoline blends converted back to 4.0 cc TEL/gallon were given as follows:

a. 100/130 with 4.6 cc TEL - 99/125

b. 95/130 with 5.5 TEL cc - 93/120

c. 95/115 with 5.5 cc TEL - 93/103

In order to prepare the specific blends, the PAW data previously mentioned were utilized and the following values for the most common of the available Soviet blending stocks were selected after discussion with qualified representatives from the Petroleum Administration for Defense.

Blending Stocks Used in USSR Aviation Gasoline Manufacture

	Blending Values (4 cc TEL/gallon)	
Stocks	F-3 Octane Number	F-4 Index Number
Alkylate	105	138
Isopentane	109	136
Houdry Cat-Cracked		
2 - pass paraffinic	95	110
Aromatics		
Mixed Xylenes	100	210
Cumene	100	280
Straight run naphtha	88	76
Iso-octane	113	154

From the foregoing data the potential availability of high octane aviation gasoline in the Soviet Bloc is calculated as follows:

a) Peace conditions are assumed from 1948 through the first half of 1952 making use of the probable Houdry-type catalytic plants in existence. Table 3, Appendix shows the availability results assuming that the ratio of the 100/130 grade to the total requirements is the same as in a war year, as specified by the Air Forces military requirements. However, for the peace years the quantity of the 100/130 grade potentially available is insufficient to meet these requirements. The data used for calculation in each time period are shown in Tables 4 through 9, Appendix.

b) The first year of a war beginning in fiscal 1953 is assumed. Table 10, Appendix presents the potential availability of the high octane grades utilizing the probable catalytic facilities, on three bases:

1) Maximum availability of the 95 grades with no production of the 100/130 grade (data given in Table 11, Appendix).

2) Normal distribution of the 100/130 and 95 grades to meet Air Force requirements (data shown in Table 12, Appendix).

3) Maximum availability of the 100/130 grades at the expense of the 95 grades (data in Table 13, Appendix).

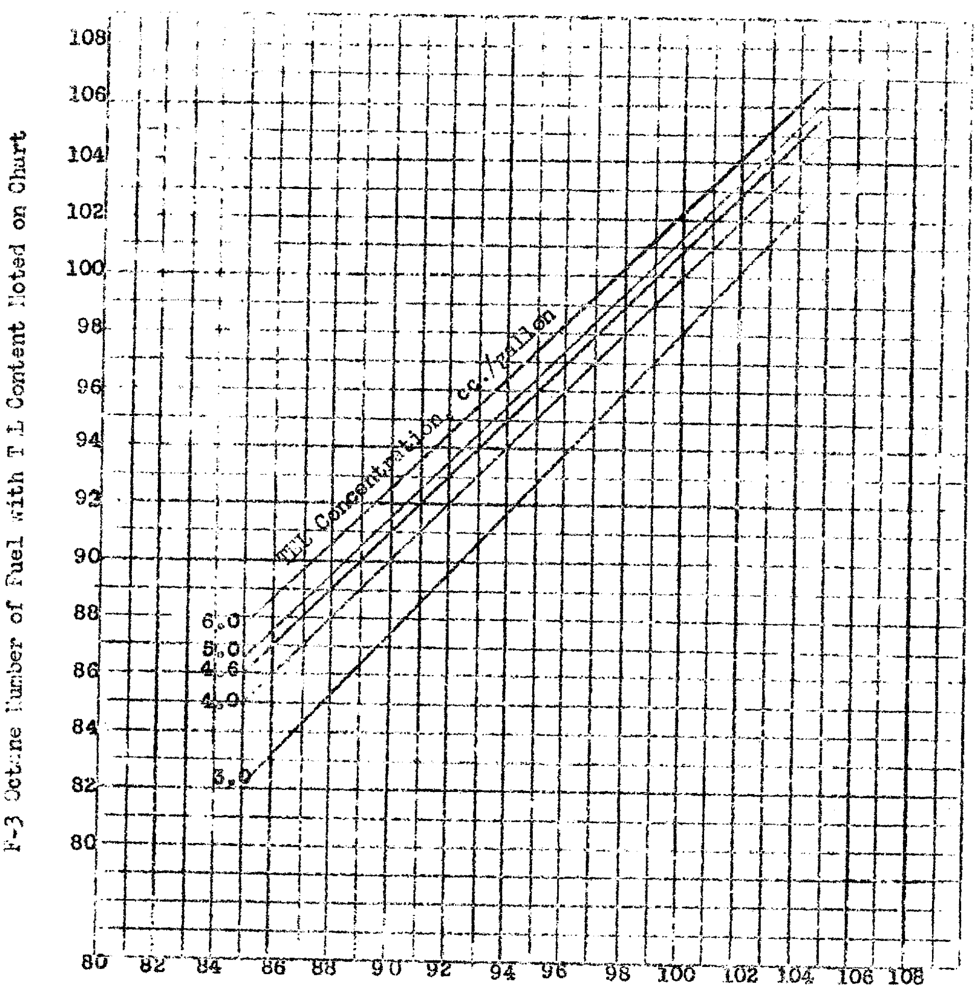
The results obtained by calculating the maximum and minimum potential availability of the 100/130 grade represents a hypothetical case which illustrates the significant volumetric changes which can occur in the total availability of 95 + Avgas by adjusting the production of the 100/130 grade.

APPENDIX

Figure 1

Effect of TEL Concentration

on F-3 Ratings of Aviation Fuels

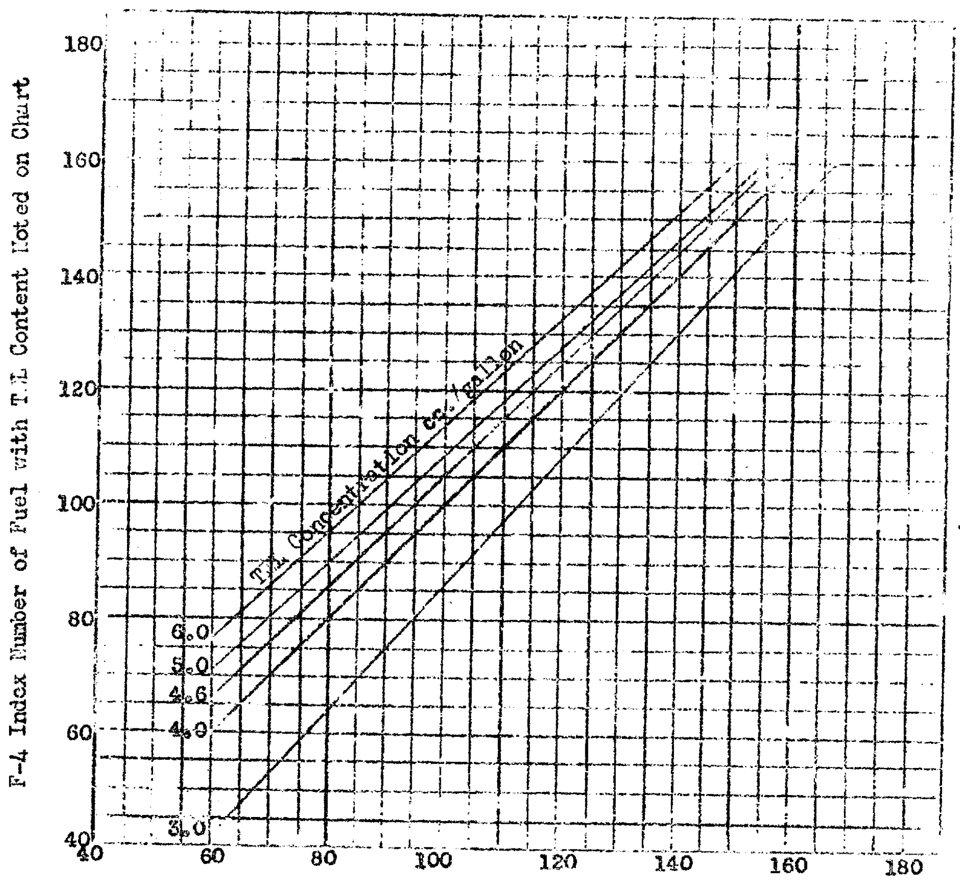


F-3 Octane Number of Fuel with 4.0 cc./gallon TEL

Figure 2

Effect on TEL Concentration

on F-4 Ratings of Aviation Fuels



F-4 Index Number of Fuel with 4.0 cc/gallon TEL

TABLE 2. Potential Availability of Aviation Gasoline Components Assuming Logical Development of Industry

USSR and European Satellites

Barrels per Day

Refinery	Isopentane	Alkylate	Iso-Octane	Cat. Cracked Stocks	Straight Run from Crude	Total Crude available	89 AVGAS from Synthetics	100/130 AVGAS from Synthetics
				CALENDAR YEAR - 1948				
UFA (Hydrogenation)			1,900					
GUREV	225	950		2,200				
ORSK	225	1,000		2,200				
Total	450	1,950	1,900	4,400	24,200	695,000		
Synthetics (Germany, Czechoslovakia, USSR)							5,366	610
GRAND TOTAL	450	1,950	1,900	4,400	24,200	695,000	5,366	610
				CALENDAR YEAR - 1949				
UFA (Hydrogenation)			1,900					
GUREV	225	950		2,200				
ORSK	225	1,000		2,200				
Total	450	1,950	1,900	4,400	27,705	792,400		
Synthetics (Germany, Czechoslovakia, USSR)							5,268	1,463 610
GRAND TOTAL	450	1,950	1,900	4,400	27,705	792,400	5,268	2,073

TABLE 2. Potential Availability of Aviation Gasoline Components (Continued)

USSR and European Satellites

Barrels per Day

Refinery	Isopentane	Alkylate	Iso-Octane	Cat. Cracked Stocks	Straight Run from Crude	Total Crude available	89 AVGAS from Synthetics	100/130 AVGAS from Synthetics
CALENDAR YEAR - 1950								
UFA (Hydrogenation)			1,900					
GUREV	225	950		2,200				
ORSK	225	1,000		2,200				
Total	450	1,950	1,900	4,400	32,630	888,000		
Synthetics – Germany								
Synthetics – Czechoslovakia							7,805	1,366
Synthetics – USSR								585
GRAND TOTAL	450	1,950	1,900	4,400	32,630	888,000	7,805	1,951
CALENDAR YEAR - 1951								
UFA (Hydrogenation)			1,900					
GUREV	225	950		2,200				
ORSK	225	1,000		2,200				
Total	450	1,950	1,900	4,400	38,160	966,200		
Synthetics – Germany								
Synthetics – Czechoslovakia							8,292	1,756
Synthetics – USSR								781
							4,391	2,926
GRAND TOTAL	450	1,950	1,900	4,400	38,160	966,200	12,613	5,463

TABLE 2. Potential Availability of Aviation Gasoline Components (Continued)

USSR and European Satellites — Barrels per Day

Refinery	Isopentane	Alkylate	Iso-Octane	Cat. Cracked Stocks	Straight Run from Crude	Total Crude available	89 AVGAS from Synthetics	100/130 AVGAS from Synthetics
FIRST HALF OF YEAR - 1952								
UFA (Hydrogenation)			950					
GUREV	113	475		1,100				
ORSK	113	500		1,100				
Plant #3	113	500		1,100				
Plant #4	138	500		1,100				
Total	477	1,975	950	4,400	19,562	521,200		
Synthetics — Germany							4,451	1,074
Synthetics — Czechoslovakia								488
Synthetics — USSR							3,500	1,500
GRAND TOTAL	477	1,975	950	4,400	19,562	521,200	7,951	3,062
SECOND HALF OF YEAR - 1952								
UFA (Hydrogenation)			950					
GUREV	112	475		1,100				
ORSK	112	500		1,100				
Plant #3	112	500		1,100				
Plant #4	137	500		1,100				
Plant #5	137	500		1,100				
Total	610	2,475	950	5,500	19,563	521,200		
Synthetics — Germany							4,451	1,074
Synthetics — Czechoslovakia								488
Synthetics — USSR							4,939	2,378
GRAND TOTAL	610	2,475	950	5,500	19,563	521,200	9,390	3,940
TOTAL FOR YEAR - 1952	1,087	4,450	1,900	9,900	39,125	1,042,400	17,341	7,002

TABLE 2. Potential Availability of Aviation Gasoline Components (Continued)

USSR and Satellites

Barrels per day

Refinery	Isopentane	Alkylate	Iso-Octane	Cat. Cracked Stocks	Straight Run from Crude	Total Crude available	89 AVGAS from Synthetics	100/130 AVGAS from Synthetics
FIRST HALF OF YEAR - 1953								
UFA (Hydrogenation)			950					
GUREV	113	475		1,100				
ORSK	113	500		1,100				
Plant #3	113	500		1,100				
Plant #4	138	500		1,100				
Plant #5	138	500		1,100				
Plant #6	138	600		1,100				
Plant #7	137	500		1,100				
Total	890	3,575	950	7,700	20,955	557,500		
Synthetics: Germany							4,878	1,268
Synthetics: Czechoslovakia								586
Synthetics: USSR							6,037	2,500
GRAND TOTAL	890	3,575	950	7,700	20,955	557,500	10,915	4,354
TOTAL FOR FISCAL YEAR - 1953	1,500	6,050	1,900	13,200	40,518	1,078,700	20,305	8,294

TABLE 3.

Summary of Potential Availability of Aviation Gasoline in the USSR and European Satellites for 1948 through 1952

Thousand Metric Tons

Grade	1948	1949	1950	1951	1st half of 1952	2nd half of 1952	Total for 1952
A. 100/130							
Synthetics			80	224	125	162	287
Crude	205	205	205	205	205	205	410
Total			285	429	330	367	697
B. 95/130							
Synthetics	25	85					
Crude	273	273	273	273	273	399	672
Total	298	358					
C. 95/115	779	779	779	779	390	538	928
TOTAL HIGH OCTANE	1,282	1,342	1,337	1,481	993	1,304	2,297
D. B-89	494	634	940	1,363	702	607	1,309
GRAND TOTAL AVGAS	1,776	1,976	2,277	2,844	1,695	1,911	3,606

TABLE 4. Potential Availability of Aviation Gasoline in USSR and European Satellites

Calendar Year - 1948 — Barrels per day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail. from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	450	450	-							
	Alkylate	31	1,550	1,950	400							
	Cat Cracked	40	2,000	4,400	2,400							
	Aromatics	8	400			400						
	St. Run	12	600	29,566	28,966			600				
			5,000									
Blend B 95/130	Alkylate	6	400	400	-							
	Cat Cracked	36	2,400	2,400	-							
	Aromatics	12	800			800						
	Cumene	6	400				400					
	St. Run	40	2,667	28,966	26,299			2,667				
			6,667									
Blend C 95/115	Iso-Octane	10	1,900	1,900	-							
	Aromatics	15	2,850			2,850						
	St. Run	75	14,250	26,299	12,049			14,250				
			19,000									
1948 TOTAL						4,050	400	17,517	24,200	5,366	29,566	12,049

TABLE 5. Potential Availability of Aviation Gasoline in USSR and European Satellites

Calendar Year - 1949

Barrels per Day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail. from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	450	450	-							
	Alkylate	31	1,550	1,950	400							
	Cat. Cracked	40	2,000	4,400	2,400							
	Aromatics	8	400			400						
	St. Run	12	600	32,973	32,373			600				
			5,000									
Blend B 95/130	Alkylate	6	400	400	-							
	Cat Cracked	36	2,400	2,400	-							
	Aromatics	12	800			800						
	Cumene	6	400				400					
	St. Run	40	2,667	32,373	29,706			2,667				
			6,667									
Blend C 95/115	Iso-Octane	10	1,900	1,900	-							
	Aromatics	15	2,850			2,850						
	St. Run	75	14,250	29,706	15,456			14,250				
			19,000									
1949 TOTAL						4,050	400	17,517	27,705	5,268	32,973	15,456

TABLE 6. Potential Availability of Aviation Gasoline in USSR and European Satellites

Calendar Year - 1950

Barrels per day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. from Crude	St. Run Avail from Crude	St. Run Avail from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	450	450	-							
	Alkylate	31	1,550	1,950	400							
	Cat Cracked	40	2,000	4,400	2,400							
	Aromatics	8	400			400						
	St. Run	12	600	40,435	39,835			600				
			5,000									
Blend B 95/130	Alkylate	6	400	400	-							
	Cat Cracked	36	2,400	2,400	-							
	Aromatics	12	800			800						
	Cumene	6	400				400					
	St. Run	40	2,667	39,835	37,168			2,667				
			6,667									
Blend C 95/115	Iso-Octane	10	1,900	1,900	-							
	Aromatics	15	2,850			2,850						
	St. Run	75	14,250	37,168	22,918			14,250				
			19,000									
1950 TOTAL						4,050	400	17,517	32,630	7,805	40,435	22,918

TABLE 7. Potential Availability of Aviation Gasoline in USSR and European Satellites

Calendar Year - 1951 — Barrels per day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	450	450	-							
	Alkylate	31	1,550	1,950	400							
	Cat Cracked	40	2,000	4,400	2,400							
	Aromatics	8	400			400						
	St. Run	12	600	50,773	50,173			600				
			5,000									
Blend B 95/130	Alkylate	6	400	400	-							
	Cat Cracked	36	2,400	2,400	-							
	Aromatics	12	800			800						
	Cumene	6	400				400					
	St. Run	40	2,667	50,173	47,506			2,667				
			6,667									
Blend C 95/115	Iso-Octane	10	1,900	1,900	-							
	Aromatics	15	2,850			2,850						
	St. Run	75	14,250	47,506	33,256			14,250				
			19,000									
1951 TOTAL						4,050	400	17,517	38,160	12,613	50,773	33,256

TABLE 8. Potential Availability of Aviation Gasoline in USSR and European Satellites

First Half of Year - 1952

Barrels per day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	450	477	27							
	Alkylate	31	1,550	1,975	425							
	Cat Cracked	40	2,000	4,400	2,400							
	Aromatics	8	400			400						
	St. Run	12	600	27,513	26,913			600				
			5,000									
Blend B 95/130	Alkylate	6	400	425	25							
	Cat Cracked	36	2,400	2,400	-							
	Aromatics	12	800			800						
	Cumene	6	400				400					
	St. Run	40	2,667	26,913	24,246			2,667				
			6,667									
Blend C 95/115	Iso-Octane	10	950	950	-							
	Aromatics	15	1,425			1,425						
	St. Run	75	7,125	24,246	17,121			7,125				
			9,500									
TOTAL FIRST HALF OF YEAR - 1952						2,625	400	10,392	19,562	7,951	27,513	17,121

TABLE 9. Potential Availability of Aviation Gasoline in USSR and European Satellites

Second Half of Year - 1952

Barrels per Day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	450	610	160							
	Alkylate	31	1,550	2,475	925							
	Cat Cracked	40	2,000	5,500	3,500							
	Aromatics	8	400			400						
	St. Run	12	600	28,953	28,353			600				
			5,000									
Blend B 95/130	Alkylate	6	583	925	342							
	Cat.Cracked	36	3,500	3,500	-							
	Aromatics	12	1,167			1,167						
	Cumene	6	583				583					
	St. Run	40	3,889	28,353	24,464			3,889				
			9,722									
Blend C 95/115	Iso-Octane	10	950	950	-							
	Aromatics	15	1,425			1,425						
	St. Run	75	7,125	24,464	17,339			7,125				
			9,500									
Blend D 95/115	Isopentane	6	160	160	-							
	Alkylate	8	213	342	129							
	Aromatics	14	373			373						
	St. Run	72	1,920	17,339	15,419			1,920				
			2,666									
Blend E 95/115	Alkylate	15	129	129	-							
	Aromatics	14	120			120						
	St. Run	71	611	15,419	14,808			611				
			860									
TOTAL SECOND HALF OF YEAR - 1952						3,485	583	14,145	19,563	9,390	28,953	14,808

TABLE 10. **Summary of Potential Availability of Aviation Gasoline in the USSR and European Satellites**

During the First Year of a War (Fiscal 1953)

Thousand Metric Tons

Grade	Basis 1 Maximum Availability of 95 Grades	Basis 2 Availability of All Grades to meet AF Requirements	Basis 3 Maximum Availability of 100/130 Grade
A. 100/130			
Synthetics	–	340	340
Crude	–	615	944
Total		955	1,284
B. 95/130			
Synthetics*	390	–	–
Crude	1,685	697	286
Total	2,075		
C. 95/115	2,045	1,017	335
Total High Octane	4,120	2,669	1,905
D. B-89	289	1,409	2,019
GRAND TOTAL AVIATION GASOLINE	4,409	4,078	3,924

* Assuming all synthetic production to be 95/130 Grade (thereby increasing yield 15% above 100/130 potential).

TABLE 11. **Potential Availability of Aviation Gasoline in USSR and European Satellites Assuming Maximum Production of 95 Grades**

Fiscal Year - 1953 — Barrels per Day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail from Synthetics	Total St. Run	Excess
Blend A 95/130	Isopentane	3	600	1,500	900							
	Alkylate	6	1,200	6,050	4,850							
	Cat Cracked	28	5,600	13,200	7,600							
	Aromatics	11	2,200			2,200						
	Cumene	7	1,400				1,400					
	St. Run	45	9,000	60,823	51,823			9,000				
			20,000									
Blend B 95/130	Alkylate	6	1,267	4,850	3,583							
	Cat Cracked	36	7,600	7,600	-							
	Aromatics	12	2,533			2,533						
	Cumene	6	1,267				1,267					
	St. Run	40	8,444	51,823	43,379			8,444				
			21,111									
Blend C 95/115	Iso-Octane	10	1,900	1,900	-							
	Aromatics	15	2,850			2,850						
	St. Run	75	14,250	43,379	29,129			14,250				
			19,000									
Blend D 95/115	Isopentane	6	900	900	-							
	Alkylate	8	1,200	3,583	2,383							
	Aromatics	14	2,100			2,100						
	St. Run	72	10,800	29,129	18,329			10,800				
			15,000									
Blend E 95/115	Alkylate	15	2,383	2,383	-							
	Aromatics	14	2,224			2,224						
	St. Run	71	11,279	18,329	7,050			11,279				
			15,886									
TOTAL FISCAL YEAR - 1953						11,907	2,667	53,773	40,518	20,305	60,823	7,050

TABLE 12. Potential Availability of Aviation Gasoline in USSR and European Satellites **To Meet AF Requirements**

						Fiscal Year - 1953					Barrels per Day	
	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail. from Crude	St. Run Avail. from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	9	1,350	1,500	150							
	Alkylate	31	4,650	6,050	1,400							
	Cat Cracked	40	6,000	13,200	7,200							
	Aromatics	8	1,200			1,200						
	St. Run	12	1,800	60,823	59,023			1,800				
			15,000									
Blend B 95/130	Alkylate	6	1,020	1,400	380							
	Cat Cracked	36	6,120	7,200	1,080							
	Aromatics	12	2,040			2,040						
	Cumene	6	1,020				1,020					
	St. Run	40	6,800	59,023	52,223			6,800				
			17,000									
Blend C 95/115	Iso-Octane	10	1,900	1,900	-							
	Aromatics	15	2,850			2,850						
	St. Run	75	14,250	52,223	37,973			14,250				
			19,000									
Blend D 95/115	Cat Cracked	33	1,080	1,080	-							
	Aromatics	12	392			392						
	St. Run	55	1,800	37,973	36,173			1,800				
			3,272									
Blend E 95/115	Alkylate	15	380	380	-							
	Aromatics	14	355			355						
	St. Run	71	1,798	36,173	34,375			1,798				
			2,533									
TOTAL FISCAL YEAR - 1953						6,837	1,020	26,448	40,518	20,305	60,823	34,375

TABLE 13. Potential Availability of Aviation Gasoline in USSR and European Satellites Assuming Maximum Production of 100/130 Grade

Fiscal Year - 1953

Barrels per day

	Blend	Vol %	Requirement	Availability	Excess	Total Req. Mixed Aromatics	Total Req. Cumene	Total Req. St. Run	St. Run Avail from Crude	St. Run Avail from Synthetics	Total St. Run	Excess
Blend A 100/130	Isopentane	8	1,500	1,500	-							
	Alkylate	22	4,125	6,050	1,925							
	Isooctane	9	1,688	1,900	212							
	Cat Cracked	34	6,375	13,200	6,825							
	Aromatics	9	1,688			1,688						
	St. Run	18	3,375	60,823	57,448			3,375				
			18,750									
Blend B 100/130	Alkylate	45	1,925	1,925	-							
	Cat Cracked	15	642	6,825	6,183							
	Aromatics	12	513			513						
	St. Run	28	1,198	57,448	56,250			1,198				
			4,278									
Blend C 95/130	Cat Cracked	60	4,183	6,183	2,000							
	Aromatics	5	349			349						
	Cumene	5	349				349					
	St. Run	30	2,091	56,250	54,159			2,091				
			6,972									
Blend D 95/115	Cat-Cracked	33	2,000	2,000	-							
	Aromatics	12	727			727						
	St. Run	55	3,334	54,159	50,825			3,334				
			6,061									
Blend E 95/115	Iso-Octane	10	212	212	-							
	Aromatics	15	318			318						
	St. Run	75	1,590	50,825	49,235			1,590				
			2,120									
TOTAL FISCAL YEAR - 1953						3,595	349	11,5[illegible]	40,518	20,305	60,823	49,235