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ENTH OIL COMMITTEE

Western Axis Sub-Committee

AXIS GROUND FORCES' CONSUMPTION OF LIQUID FUELS AND LUBRICANTS, 1943

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AXIS GROUND FORCES AND AUXILIARY SERVICES -- CONSUMPTION OF
LIQUID FUELS AND LUBRICANTS, 1943

I. CONSUMPTION IN 1943

Total consumption of liquid fuels and lubricants by German and satellite ground forces and auxiliary services in 1943 is estimated at 4,940,000 metric tons. In addition, 382,000 tons of solid substitutes (in terms of liquid fuel) were used in military generator vehicles. German ground forces and auxiliary services consumed 4,552,000 tons of liquid fuels and lubricants and 352,000 tons of solid substitutes, while the corresponding figures for satellite ground forces are 341,000 tons and 10,000 tons. Eastern Front requirements represent more than 70 percent of the total. (See Tables I-IV for additional details.)

The average monthly rate of consumption of liquid fuels and lubricants by German ground forces and auxiliary services in 1943 was 383,000 tons. Satellites excluding Italy consumed an average of 18,000 tons a month, and Italian consumption during the first eight months of the year averaged 18,000 tons a month.

II. COMPARISON OF AMERICAN AND BRITISH ESTIMATES

The American estimate of 4,940,000 tons may be compared with the British estimate for eleven months of 4,222,000 tons. The British figure for the year, assuming consumption in December is the same as in November, will be about 4,380,000 tons, or 5 to 6 percent below the American.

Such a difference is well within the margin of error. It is interesting, however, to compare, so far as possible, the assumptions on which the two sets of estimates are based. Both include an allowance of 7½ percent of consumption for wastage and losses. Both include an allowance of 20 percent of consumption in the winter months on the Eastern Front for increased consumption under winter conditions.

A difference in assumptions which exerts a considerable influence on the totals is that the British assume a proportion of non-divisional vehicles to divisional vehicles in the German army of 60:100 (60:100 on the Eastern Front and 30-45:100 in other areas), whereas the American estimate puts the overall proportion at 40:100 (50:100 on the Eastern Front and 30-40:100 in other areas). An important difference arises in the case of lubricants (which, however, makes only a small difference in the total), for the British assume that lubricants should be calculated as 6 to 6½ percent of liquid motor fuel, while the American estimate for lubricants is only 3 percent of liquid motor fuel. The American estimate is based on U. S. Army experience.

It must be noted that the differences so far noted would tend to make the British estimates higher than the American. The apparent difference in the two estimates is therefore larger than the real difference and is probably to be explained chiefly by the following:

1. differences in the indices of intensity of vehicular use;
2. differences in the estimated mileages travelled under the various fighting conditions;
3. the fact that the British estimate assumes that every vehicle in a division (motorcycles, automobiles, light trucks, heavy trucks, tanks, etc.) travels the same mileage per day, while the American estimate assumes that the mileage varies with the type of vehicle.

III. CONSUMPTION IN 1944

Ignoring the possibility of a second front, consumption of liquid fuels and lubricants by German and satellite ground forces and auxiliary services during the first half of 1944 is tentatively estimated at 2,500,000 tons, or at about the average rate during 1943. This figure has been reached on the basis of the following assumptions and considerations:

1. a small increase in activity on the Russian front;
2. a small increase in activity by German forces on the Italian front;
3. continued conversion to substitute fuels by German standing armies, divisions in training, occupation forces, administrative divisions, etc.;
4. maintenance of average 1943 activity by satellite forces which are still active;
5. small decline in consumption by German auxiliary services (Todt and MSKK).

The additional ground force requirements of liquid fuels and lubricants in the six months following an Allied invasion may be very tentatively estimated, on the basis of various assumptions, as in the order of 350,000 tons to 450,000 tons.

IV. METHODOLOGY

The estimates of consumption of liquid fuels and lubricants and of solid substitutes (in terms of liquid fuel) by German and satellite ground forces and auxiliary services in 1943 were prepared as described below.

A. Consumption on Active Fronts

1. Campaign analysis. An analysis of the daily communiques was made to show for each day of the year the intensity of fighting on each major sector of each front. Five degrees of fighting intensity were employed: most intense, intense, heavy, localized, and quiet. The Eastern Front

was divided into four fronts (Finland, Northern Russia, Central Russia, and Southern Russia) and was further subdivided into eleven sectors. The fighting in Africa was analyzed by the Libyan Front and the Tunisian Front, the latter being divided into three sectors. The fighting in Southern Europe was analyzed by two fronts, the Sicilian and the Italian, the latter being divided into two sectors.

2. Index of intensity of vehicular use. An index of intensity of vehicular use was then constructed for each front by assigning the following weights to the various degrees of fighting intensity; most intense, 175; intense, 150; heavy, 125; localized, 100; quiet, 75. The intensity of vehicular use by reserve divisions was put at 25.

3. Consumption of liquid fuel and lubricants per day by types of divisions under localized fighting conditions. From data on the vehicular composition of the various types of German and satellite divisions and on the consumption of liquid fuel per mile by the various kinds of vehicles and from assumptions (based in part on American experience as presented in EOC-59) as to the mileage travelled per day under localized fighting conditions by each of the various kinds of vehicles, basic daily consumption rates under localized fighting conditions (equals index 100) were established.

4. The order of battle. The last basic element in the estimates was the order of battle by fronts by months.

5. The calculation of consumption on active fronts. The process of calculating divisional consumption per front, given the materials described above, consisted merely of obtaining the product of the three factors: the number of divisions of each type, the appropriate basic daily consumption rates, and the index of intensity divided by 100. In calculating these requirements it was assumed that the Germans held, on the average, one division in four in reserve. The same assumption was made for Italian forces in Africa, but all satellite divisions on other fronts were assumed to be actively engaged.

6. Allowances. Once the divisional consumption had been secured, the following allowances were made:

a. An allowance for non-divisional consumption of 50 percent of divisional consumption on the Russian front and 40 percent in Africa, Sicily, and Italy. (It may be pointed out that on this basis the total truck strength in the German ground forces, excluding auxiliary services, amounts to 375,000 units.)

b. A winter allowance of 20 percent of normal liquid fuel consumption during the months, November through March, to account for increased consumption under conditions of snow and mud on the Eastern Front.

c. An allowance for wastage and losses of $7\frac{1}{2}$ percent of the total.

7. Conversion. It has been assumed (on the basis of numerous intelligence items) that a saving of 3 percent of the total liquid fuel consumption calculated for the Eastern Front was achieved by conversion to solid substitute fuels. Finnish forces on the Finnish front are estimated to have saved 25 percent of their calculated consumption of liquid fuel by conversion to solid substitutes.

8. Lubricants. Lubricants were calculated at three percent of liquid fuel consumption. The higher needs for lubricating oil in converted vehicles have been accounted for by a lubricating oil allowance of 5 percent for these vehicles.

B. Consumption by Standing Armies, Occupation Forces, Divisions in Training, etc.

The methodology described above was employed in estimating consumption by Axis ground forces not on active fronts. Intensity of vehicular use was put at 25 to 50, depending on the area and the task. These indices were applied to the appropriate basic consumption rates and to the number of divisions involved. In general, non-divisional consumption was taken as 30 percent of divisional. Wastage and losses were estimated at 2½ percent to 5 percent of total liquid fuel consumption. German forces were assumed to have saved 15 percent of calculated liquid fuel consumption as a result of conversion to solid substitute fuels; Italian forces in Italy were assumed to have saved 10 percent, Italian forces in France 15 percent, and Italian forces in the Balkans 5 percent; Slovakian and Croatian forces in their respective countries were assumed to have saved 15 percent.

C. Consumption by NSKK and Todt.

1. Consumption of liquid fuels and lubricants by NSKK was estimated on the basis of various intelligence items as to its vehicular strength and its tasks. Savings resulting from conversion to solid substitute fuels were assumed to be 10 percent of total liquid fuel consumption.

2. The estimate for consumption of liquid fuels and lubricants by the Todt Organisation is undoubtedly the least satisfactory. It is based on a study of the number of men employed by the organisation, an assumption that there is one piece of powered equipment for every 25 men, and an assumption that the average fuel consumption per unit may be estimated at 8 tons per year. Savings resulting from conversion to solid substitute fuel are put at one-third of total liquid fuel consumption.

D. Product Breakdown (Diesel oil and gasoline)

The product breakdown for German ground forces has been estimated on the basis of various intelligence items as to the use of Diesel equipment. Diesel oil is estimated at 25 percent of total liquid fuel consumption. The same percentage has arbitrarily been used for satellite ground forces. The product breakdown for the auxiliary services is based on assumptions as to the number of heavy, medium, and light trucks in the two services and on information as to the percentage of Diesel trucks in each category in the German civilian economy.

TABLE I

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CONSUMPTION OF LIQUID FUELS, LUBRICANTS, AND SUBSTITUTES (IN TERMS OF LIQUID FUEL) BY
GERMAN AND SATELLITE GROUND FORCES, 1943

(Thousand metric tons)

	<u>Gasoline</u>	<u>Diesel Oil</u>	<u>Lubricants</u> ²	<u>Total</u> (Liquid Products)	<u>Substitutes</u> (in terms of liquid fuel)	<u>Grand Total</u> (Liquid products and substitutes)
I. ACTIVE FRONTS						
A. Eastern Front						
1. Germany	2508	836	106	3450	104	3554
2. Satellites	<u>105</u>	<u>35</u>	<u>4</u>	<u>144</u>	<u>3</u>	<u>147</u>
TOTAL ..	2613	871	110	3594	107	3701
B. Africa, Sicily, Italy						
1. Germany	175	58	7	240	-	240
2. Italy ¹	<u>17</u>	<u>6</u>	<u>1</u>	<u>24</u>	<u>-</u>	<u>24</u>
TOTAL	192	64	8	264	-	264
II. STANDING ARMIES, OCCUPA- TION FORCES, TRAINING, etc.						
A. Germany	309	103	16	428	73	501
B. Satellites	<u>126</u>	<u>42</u>	<u>5</u>	<u>173</u>	<u>7</u>	<u>180</u>
TOTAL	435	145	21	601	80	681
III. AUXILIARY SERVICES						
A. Todt Organisation	160	160	18	338	160	498
B. NSKK	<u>28</u>	<u>110</u>	<u>5</u>	<u>143</u>	<u>15</u>	<u>158</u>
TOTAL	188	270	23	481	175	656
IV. GRAND TOTAL	3428	1350	162	4940	362	5302

¹ Italy for 6 months.² Includes lubricating oil requirements of converted vehicles.

TABLE II

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CONSUMPTION OF LIQUID FUELS, LUBRICANTS, AND SUBSTITUTES (IN TERMS OF LIQUID FUEL)
BY GERMAN GROUND FORCES, 1943

(Thousand metric tons)

	<u>Gasoline</u>	<u>Diesel Oil</u>	<u>Lubricants¹</u>	<u>Total</u> (Liquid Products)	<u>Substitutes</u> (in terms of liquid fuel)	<u>Grand Total</u> (Liquid products and substitutes)
I. ACTIVE FRONTS						
A. Eastern Front						
1. Finland	35	12	2	49	2	51
2. Russia, North	289	96	12	397	12	409
3. Russia, Center	923	308	39	1270	38	1308
4. Russia, South	<u>1261</u>	<u>420</u>	<u>53</u>	<u>1734</u>	<u>52</u>	<u>1786</u>
TOTAL	2508	836	106	3450	104	3554
B. Africa, Italy, Sicily	175	58	7	240	-	240
TOTAL (Active Fronts)	2683	894	113	3690	104	3794
II. STANDING ARMIES, OCCUPATION FORCES, TRAINING, etc.						
A. Western & Central Europe						
1. Germany (incl. Poland)	40	13	2	55	9	64
2. Norway & Denmark	26	9	1	36	6	42
3. France & Lowlands	<u>146</u>	<u>49</u>	<u>8</u>	<u>203</u>	<u>35</u>	<u>238</u>
B. Italy and Balkans						
1. Italy	26	8	1	35	6	41
2. Balkans	<u>71</u>	<u>24</u>	<u>4</u>	<u>99</u>	<u>17</u>	<u>116</u>
TOTAL	309	103	16	428	73	501
III. AUXILIARY SERVICES						
A. Todt Organisation						
1. France & Lowlands	91	91	9	191	91	282
2. Norway & Denmark	21	21	3	45	21	66
3. Italy & Balkans	21	21	3	45	21	66
4. Eastern Europe	27	27	3	57	27	84
B. NSKK						
1. Germany & Poland	<u>28</u>	<u>110</u>	<u>5</u>	<u>143</u>	<u>15</u>	<u>158</u>
TOTAL	188	270	23	481	175	656
IV. GRAND TOTAL	3180	1267	152	4599	352	4951

¹ Includes substitutes

TABLE III

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CONSUMPTION OF LIQUID FUELS, LUBRICANTS, AND SUBSTITUTES (IN TERMS OF LIQUID FUEL)
BY SATELLITE GROUND FORCES, 1943
(Thousand metric tons)

	<u>Gasoline</u>	<u>Diesel Oil</u>	<u>Lubricants²</u>	<u>Total</u> (Liquid Products)	<u>Substitutes</u> (in terms of liquid fuel)	<u>Grand Total</u> (Liquid products and substitutes)
I. ACTIVE FRONTS						
A. Eastern Front						
1. Italian (S. Russia)	11	4	(	15	-	15
2. Rumanian (S. Russia)	34	12	(2	46	-	46
3. Slovakian (S. Russia)	19	6	(	25	-	25
4. Hungarian (C. Russia)	- 32	10	(2	42	-	42
5. Finnish (Finland)	9	3	(	12	3	15
TOTAL	105	35	4	144	3	147
B. Africa, Sicily, Italy						
1. Italian ¹	17	6	1	24	-	24
TOTAL (Active Fronts)	122	41	5	168	3	171
II. STANDING ARMIES, OCCUPATION FORCES, TRAINING, etc.						
A. Western & Southern Europe						
1. Italian (France)	4	2	(	6	1	7
2. Italian (Italy)	24	8	(1	33	3	36
B. Balkans & Central Europe						
1. Italian (Yugoslavia)	32	11	1	44	2	46
2. Rumanian	11	4	1	16	-	16
3. Hungarian	40	13	(2	55	-	55
4. Bulgarian	10	3	(	13	-	13
5. Slovakian & Croatian	5	1	(	6	1	7
TOTAL	126	42	5	173	7	180
III. GRAND TOTAL	248	83	10	341	10	351

¹ Italian forces for 8 months.

² Includes lubricating oil requirements of converted vehicles.

TABLE IV

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AXIS EUROPEAN GROUND FORCES' AND AUXILIARY SERVICES' CONSUMPTION OF LIQUID FUELS,
LUBRICANTS, AND SUBSTITUTES (IN TERMS OF LIQUID FUEL) BY AREAS AND BY FORCES, 1943

(Thousand metric tons)

	<u>Gasoline</u>	<u>Diesel Oil</u>	<u>Lubricants</u>	<u>Total</u> (Liquid Products)	<u>Substitutes</u> (in terms of Liquid fuel)	<u>Grand Total</u> (Liquid products and substitutes)
I. AREAS						
A. Finland	44	15	2	61	5	66
B. Russia	2596	883	111	3590	129	3719
C. Germany & Central Europe	68	123	7	198	24	222
D. Norway & Denmark	47	30	4	81	27	108
E. France & Lowlands	241	142	17	400	127	527
F. Africa, Sicily, Italy	252	90	11	353	20	373
G. Balkans	180	67	10	257	30	287
TOTAL	3428	1350	162	4940	362	5302
II. FORCES						
A. German	3180	1267	152	4599	352	4951
B. Italian	88	31	3	122	6	128
C. Finnish ¹	9	3	-	12	3	15
D. Rumanian	45	16	3	64	-	64
E. Hungarian	72	23	1	96	-	96
F. Bulgarian ¹	10	3	-	13	-	13
G. Slovakian & Croatian ¹	24	7	-	31	1	32
TOTAL	3428	1350	162	4940	362	5302

¹ Finnish, Slovakian, Croatian, and Bulgarian lubricants included with Hungarian.