

ENEMY OIL COMMITTEE
Western Axis Subcommittee

AXIS GROUND FORCE REQUIREMENTS OF PETROLEUM, 1942

CONFIDENTIAL

Represented on the
Enemy Oil Committee
Ministry of Economic Warfare
Navy Department
Office of Economic Warfare
Office of Strategic Services
Petroleum Administration for War
State Department
War Department.

June 10, 1942

SUBMITTED TO THE "ENEMY OIL COMMITTEE"
BY THE SUB-COMMITTEE ON MILITARY CONSUMPTION OF PETROLEUM

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PREPARED IN THE RESEARCH AND ANALYSIS BRANCH
OF THE OFFICE OF STRATEGIC SERVICES

I. SUMMARY

Axis Petroleum Requirements by Fronts and by Products

1. In 1942 Axis ground forces consumed 5.3 million tons of petroleum products. Of this total, 3.9 million tons or 74 percent were spent at the Eastern Front; 230,000 tons or 4 percent were needed for the North African campaign, and 1.1 million tons or 22 percent were required for the armies of occupation in conquered Europe for training purposes and for the TODT organization. Table 1 gives the breakdown of total consumption by fronts and by products.

Axis Petroleum Requirements by Fronts and by Months

2. Petroleum consumption during the months of the year fluctuated widely. Two factors were mainly responsible:

- a. The change in military activity at the Eastern Front and in North Africa during the year, and
- b. The higher vehicular rate of fuel consumption per mile under winter conditions of mud and snow at the Eastern Front. (See Table 2)

Comparison with British Estimates

3. The present estimate for total Axis army consumption of 5.3 million tons compares with the British estimate of about 4.6 million tons. Most of the difference between the two estimates can be attributed to the fact that the British figures do not include an allowance for increased vehicular consumption at the Russian front under winter conditions of snow and mud and that no account is taken of wastage and losses in the actual theatres of operation.

Methods of Estimation

4. The summaries (as presented in Table 1 and 2) are based on a detailed analysis of the Russian campaign, on less precise information of Axis military activity in North Africa, on the number of Axis divisions in conquered European countries, and on the size of the standing armies and divisions in training of the Axis powers. The methods of estimation are presented herewith.

TABLE 1

Axis Petroleum Consumption by Fronts and
by Products, 1942
(metric tons)

Front	Motor Fuel a/	Lubri-b/ cants	Total c/
Eastern Front			
Finland	161,340	8,067	169,407
Northern Russia	432,025	21,601	453,629
Central Russia	1,137,208	56,860	1,194,068
Southern Russia	1,617,870	80,694	1,698,564
Caucasus	<u>332,140</u>	<u>16,607</u>	<u>348,747</u>
Total Eastern Front	3,680,586	184,029	3,864,615
North Africa	220,776	11,040	231,816
Germany	117,000	5,856	122,856
Poland-Baltic States	56,160	2,805	58,965
Italy	70,200	3,516	73,716
Yugoslavia, Albania, Greece,) 171,600	8,380	180,180
Crete and Dodecanese			
Slovakia	6,240	312	6,352
Hungary	31,200	1,560	32,760
Rumania	31,200	1,560	32,760
Bulgaria	23,400	1,176	24,576
France	120,250	6,016	126,266
Low Countries	7,800	396	8,196
Denmark and Norway	34,320	1,716	36,036
Todt Organization	<u>475,000</u>	<u>25,000</u>	<u>500,000</u>
Total Axis	3,045,732	253,565	5,299,297

a/ Tentatively it may be estimated that 75 percent of total motor fuel or 3,735,000 tons are light motor fuel and 25 percent or 1,260,000 tons Diesel oil.

b/ Five percent of motor fuel consumption.

c/ Includes allowance for wastage and losses.

TABLE 2

Axis Monthly Petroleum Requirements by Fronts, 1942
(thousand metric tons)

Front	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL YEAR
Eastern Front													
Finland	18.0	16.6	17.5	14.7	12.0	11.7	12.0	12.0	11.5	11.6	14.3	17.5	169.4
Northern Russia	41.3	31.4	33.8	33.5	28.8	25.3	29.6	37.4	37.7	36.6	51.7	66.5	453.6
Central Russia	123.5	90.4	101.8	79.4	89.2	90.4	99.0	112.2	94.0	71.9	94.1	148.2	1,194.1
Southern Russia	115.3	86.9	98.8	79.0	109.9	138.3	282.7	159.2	146.6	115.2	152.0	214.9	1,698.8
Caucasus	---	---	---	---	---	---	---	77.7	64.6	66.0	66.6	73.8	348.7
Total Eastern Front	298.1	225.3	251.9	206.6	239.9	265.7	423.3	398.5	354.4	301.3	378.7	520.9	3,864.6
Western Front													
North Africa	14.1	14.1	14.1	14.1	14.1	39.7	15.8	15.8	15.8	15.8	29.2	29.2	231.8
Germany	10.2	10.2	10.3	10.2	10.2	10.3	10.2	10.2	10.3	10.2	10.2	10.3	122.8
Poland-Baltic States	4.9	4.9	4.9	4.9	4.9	5.0	4.9	4.9	4.9	4.9	4.9	5.0	59.0
Italy	6.1	6.2	6.1	6.2	6.1	6.2	6.1	6.2	6.1	6.2	6.1	6.2	73.8
Yugoslavia, Albania, Greece, Crete and Dodecanese	15.1	15.0	15.0	15.0	15.0	15.0	15.1	15.0	15.0	15.0	15.0	15.0	180.2
Slovakia	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	6.6
Hungary	2.7	2.7	2.8	2.7	2.7	2.8	2.7	2.7	2.8	2.7	2.7	2.8	32.8
Rumania	2.7	2.7	2.8	2.7	2.7	2.8	2.7	2.7	2.8	2.7	2.7	2.8	32.8
Bulgaria	2.1	2.0	2.1	2.0	2.1	2.0	2.1	2.0	2.1	2.0	2.1	2.0	24.6
France	12.0	12.0	12.0	12.0	10.2	10.2	10.2	10.2	10.2	10.2	8.5	8.5	126.2
Low Countries	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.6	8.1
Denmark and Norway	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	36.0
Todd Organization	41.7	41.7	41.6	41.7	41.7	41.6	41.7	41.7	41.6	41.7	41.7	41.6	500.0
TOTAL AXIS	413.9	341.1	367.8	322.3	353.8	405.6	539.0	514.1	470.2	417.0	506.0	648.5	5,299.3

II. GROUND FORCE CONSUMPTION AT THE EASTERN FRONT

The German Army

5. Separate estimates were made for German troops and for Axis Satellite divisions. A detailed campaign analysis of the German army at the Eastern Front in 1942 was made by the Military Supplies Section of OSS and is presented in Table 3.

Following in principle the methods outlined in a previous COI study ^{1/}, six main categories of combat intensity were introduced: They are "major push", "heavy fighting", "localized fighting", "siege", "training" and "inactive and at rest". Their definitions correspond in general to that given in the above mentioned report except for the categories "localized fighting" and "inactive and at rest". The former category combines those of "slow advance" and mopping up" as defined in the COI study. "Inactive and at rest" includes all divisions for which no information on combat activity was available. Such divisions refer to those actually withdrawn from the front and at rest and those still stationed at the front, though not known to be engaged in active fighting operations. It was assumed that one-third of the total divisional strength at each front was at any one time actually withdrawn from the front and at rest. The number of inactive divisions still at the front was calculated by subtracting the number actually withdrawn and at rest from the total number of inactive divisions given in the campaign analysis.

The lowest rate of daily petroleum consumption was used for inactive divisions at rest, while a much higher rate of requirements was adopted for inactive divisions stationed at the front.

6. For each month of 1942 and for each front (Finland, Northern Front, Central Front, Southern Front, and Caucasian Front) the number of infantry, motorized and armored divisions engaged in the various degrees of activity have been established. The estimate for ground force petroleum consumption was broken down into two parts:

^{1/} COI Report #49, "An Estimate of Consumption of Petroleum on the Eastern Front by the German Army and Air Force." (June 22-Dec. 6, 1941).

TABLE 3

Campaign Analysis for the German Army at the Eastern Front in 1942

	J A N U A R Y							MP	F E B R U A R Y						MP	HF	M A R C H					TOTAL
	MPa/	HFb/	LFc/	SIId/	TRe/	INf/	TOTAL		HF	LF	SI	TR	IN	TOTAL			LF	SI	TR	IN	TOTAL	
Finland																						
Infantry Div.	--	--	1	--	--	7	8	--	--	--	--	--	8	8	--	--	--	--	--	8	8	
Northern Front																						
Infantry Div.	--	--	3	11	--	13	27	--	--	4	10	--	11	25	--	--	2	10	--	13	25	
Panzer Div.	--	--	--	--	--	2	2	--	--	--	--	--	1	1	--	--	--	--	--	1	1	
Motorized Div.	--	--	--	--	--	3	3	--	--	--	--	--	1	1	--	--	--	--	--	1	1	
Central Front																						
Infantry Div.	--	3	10	--	3	44	60	--	--	6	--	3	46	55	--	1	8	--	4	42	55	
Panzer Div.	--	--	1	--	--	7	8	--	--	1	--	--	5	6	--	--	1 1/2	--	--	5 1/2	6	
Motorized Div.	--	--	1	--	--	6	7	--	--	--	--	--	6	6	--	--	1 1/2	--	--	5 1/2	6	
Southern Front																						
Infantry Div.	--	2	6	--	2	35	45	--	1	5	--	2	34	42	--	1	7	--	3	31	42	
Panzer Div.	--	--	1	--	--	4	5	--	--	--	--	--	5	5	--	--	1 1/2	--	--	4 1/2	5	
Motorized Div.	--	--	1	--	--	4	5	--	--	--	--	--	5	5	--	--	1 1/2	--	--	4 1/2	5	
Caucasus Front																						
Infantry Div.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Panzer Div.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Motorized Div.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
All Fronts																						
Infantry Div.	--	5	20	11	5	99	140	--	1	15	10	5	99	130	--	2	15	10	7	96	130	
Panzer Div.	--	--	2	--	--	13	15	--	--	1	--	--	11	12	--	--	1	--	--	11	12	
Motorized Div.	--	--	2	--	--	13	15	--	--	--	--	--	12	12	--	--	1	--	--	11	12	
GRAND TOTAL	--	5	24	11	5	125	170	--	1	16	10	5	122	154	--	2	17	10	7	118	154	

- a/ "M.P." stands for "Major Push"
 b/ "H.F." stands for "Heavy Fighting"
 c/ "L.F." stands for "Localized Fighting"
 d/ "S.I." stands for "Siege"
 e/ "T.R." stands for "Training"
 f/ "IN." stands for "Inactive Divisions and Divisions at Rest"

TABLE 3 (cont)

Campaign Analysis for the German Army at the Eastern Front in 1942

	APRIL							MAY							JUNE						
	MP	HF	LF	SI	TR	IN	TOTAL	MP	HF	LF	SI	TR	IN	TOTAL	MP	HF	LF	SI	TR	IN	TOTAL
Finland																					
Infantry Div.	--	--	1	--	--	7	8	--	--	1	--	--	7	8	--	--	1	--	--	7	8
Northern Front																					
Infantry Div.	--	--	--	10	--	20	30	--	--	4	10	--	16	30	--	--	2	9	--	19	30
Panzer Div.	--	--	--	--	--	2	2	--	--	--	--	--	2	2	--	--	--	--	--	1	1
Motorized Div.	--	--	--	--	--	1	1	--	--	--	--	--	1	1	--	--	--	--	--	1	1
Central Front																					
Infantry Div.	--	--	5	--	10	45	60	--	3	5	--	15	42	65	--	2	7	--	10	48	67
Panzer Div.	--	--	--	--	2	5	7	--	--	1	--	--	10	11	--	--	1	--	3	7	11
Motorized Div.	--	--	--	--	2	5	7	--	--	--	--	--	10	10	--	--	2	--	3	6	11
Southern Front																					
Infantry Div.	--	--	4	--	5	33	42	2	9	10	3	5	23	52	1	12	10	3	5	24	55
Panzer Div.	--	--	--	--	1	5	6	1	1	--	--	1	5	8	--	2	1	--	1	4	8
Motorized Div.	--	--	1	--	1	5	7	--	1	1	--	1	7	10	1	2	1	--	1	5	10
Caucasus Front																					
Infantry Div.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Panzer Div.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Motorized Div.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
All Fronts																					
Infantry Div.	--	--	10	10	15	105	140	2	12	20	13	20	88	155	1	14	20	12	15	98	160
Panzer Div.	--	--	--	--	3	12	15	1	1	1	--	3	14	20	--	2	2	--	4	12	20
Motorized Div.	--	--	1	--	3	11	15	--	1	1	--	3	17	22	1	2	3	--	4	12	22
GRAND TOTAL	--	--	11	10	21	128	170	3	14	22	13	26	119	197	2	18	25	12	23	122	202

TABLE 3 (cont)

Campaign Analysis for the German Army at the Eastern Front in 1942

	J U L Y							A U G U S T							S E P T E M B E R						
	MP	HF	LF	SI	TR	IN	TOTAL	MP	HF	LF	SI	TR	IN	TOTAL	MP	HF	LF	SI	TR	IN	TOTAL
Finland																					
Infantry Div.	--	--	1	--	--	7	8	--	--	1	--	--	7	8	--	--	1	--	--	7	8
Northern Front																					
Infantry Div.	--	5	9	--	--	16	30	--	2	10	--	--	18	30	--	2	11	--	--	19	32
Panzer Div.	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	--	1	--	--	--	1
Motorized Div.	--	--	--	--	--	1	1	--	--	1	--	--	1	2	--	1	--	--	--	--	1
Central Front																					
Infantry Div.	--	10	7	--	10	35	62	--	10	14	--	5	31	60	--	5	11	--	5	34	55
Panzer Div.	--	2	--	--	2	5	9	--	1	2	--	--	7	10	--	1	1	--	--	7	9
Motorized Div.	--	1	--	--	2	8	11	--	2	1	--	--	7	10	--	1	2	--	--	7	10
Southern Front																					
Infantry Div.	30	5	8	--	--	17	60	5	5	10	--	--	32	52	--	20	12	--	--	18	50
Panzer Div.	7	1	--	--	--	3	11	1	2	2	--	--	3	8	--	4	1	--	--	3	8
Motorized Div.	9	--	--	--	--	1	10	2	1	2	--	--	4	9	--	2	3	--	--	3	8
Caucasus Front																					
Infantry Div.	--	--	--	--	--	--	--	5	3	5	--	--	2	15	--	8	6	--	--	6	20
Panzer Div.	--	--	--	--	--	--	--	1	2	--	--	--	--	3	--	1	1	--	--	2	4
Motorized Div.	--	--	--	--	--	--	--	1	1	1	--	--	--	3	--	2	1	--	--	2	5
All Fronts																					
Infantry Div.	30	20	25	--	10	75	160	10	20	40	--	5	90	165	--	35	40	--	5	85	165
Panzer Div.	7	3	--	--	2	8	20	2	5	5	--	--	10	22	--	6	4	--	--	12	22
Motorized Div.	9	1	--	--	2	10	22	3	4	5	--	--	12	24	--	7	6	--	--	11	24
GRAND TOTAL	46	24	25	--	14	93	202	15	29	50	--	5	112	211	--	48	50	--	5	108	211

TABLE 3 (cont)

Campaign Analysis for the German Army at the Eastern Front in 1942

	O C T O B E R							N O V E M B E R							D E C E M B E R						
	MP	HF	LF	SI	TR	IN	TOTAL	MP	HF	LF	SI	TR	IN	TOTAL	MP	HF	LF	SI	TR	IN	TOTAL
Finland																					
Infantry Div.	--	--	--	--	--	8	8	--	--	--	--	--	8	8	--	--	--	--	--	8	8
Northern Front																					
Infantry Div.	--	3	5	5	--	22	35	--	2	4	--	--	34	40	--	5	8	--	--	27	40
Panzer Div.	--	--	--	--	--	1	1	--	1	--	--	--	--	1	--	--	1	--	--	--	1
Motorized Div.	--	1	--	--	--	--	-1	--	--	1	--	--	--	1	--	--	1	--	--	--	1
Central Front																					
Infantry Div.	--	2	5	--	5	38	50	--	8	8	--	5	19	40	--	10	12	--	5	13	40
Panzer Div.	--	--	--	--	--	9	9	--	--	2	--	--	6	8	--	2	2	--	--	4	8
Motorized Div.	--	--	1	--	--	9	10	--	--	1	--	--	9	10	--	2	1	--	--	8	11
Southern Front																					
Infantry Div.	--	5	15	--	--	27	47	--	10	15	--	--	9	42	--	10	5	19	--	16	43
Panzer Div.	--	2	2	--	--	4	8	--	2	2	--	--	4	8	--	4	1	--	--	2	8
Motorized Div.	--	1	2	--	--	5	8	--	2	2	--	--	4	8	--	3	2	--	--	2	8
Caucasus Front																					
Infantry Div.	--	5	10	--	--	5	20	--	5	3	--	--	10	20	--	5	5	--	--	5	15
Panzer Div.	--	1	2	--	--	1	4	--	1	1	--	--	2	4	--	--	1	--	--	1	3
Motorized Div.	--	1	2	--	--	2	5	--	1	1	--	--	3	5	--	--	1	--	--	2	4
All Fronts																					
Infantry Div.	--	15	35	5	5	100	160	--	25	30	8	5	80	150	--	30	30	10	5	69	146
Panzer Div.	--	3	4	--	--	15	22	--	4	5	--	--	12	21	--	6	5	--	--	7	20
Motorized Div.	--	3	5	--	--	16	24	--	3	5	--	--	16	24	--	5	5	--	--	12	24
GRAND TOTAL	--	21	44	5	5	131	206	--	32	40	8	5	103	195	--	41	40	10	5	88	190

- a. Oil requirements at the front for fighting.
- b. Oil requirements for the transportation of supplies from the railheads to the front.

Oil consumption at the front was computed from the number of division-months in each sort of activity multiplied by the consumption per division-month in that sort of activity. The consumption per division-month associated with any given degree of activity was estimated largely on the basis of daily mileage figures for each type of vehicle in each type of activity for each type of division as given in the previously cited report. The daily mileage for "localized fighting" of an infantry division closely corresponds with figures for "field service" given in U.S.A.F.M. 101-10 "The Staff Officers Field Manual" (Par. 88).

The average daily mileage of tactical vehicles in localized fighting for infantry, motorized, and panzer divisions is shown in Table 4.

TABLE 4

Average Daily Mileage of Tactical Vehicles
in Localized Fighting
(miles)

Vehicle	Infantry Division	Motorized and Panzer Divisions
Motor Cycles	75	112.5
Automobiles	75	112.5
Trucks		
Personnel, light and medium	50	75
Heavy	30	45
Miscellaneous	50	
Tractors	12	15
Armored Cars		
Light	40	60
Heavy	-	45
Tanks		
Panzer-kraftwagen II	--	18
Panzer-kraftwagen III and IV	--	18

The daily mileage per vehicle for the other types of activity has been defined as a percentage of the mileage operated under conditions of localized fighting. The percentages are again based on COI report No. 49.

TABLE 5

Average Daily Mileage of Tactical Vehicles
(percent of mileage for localized fighting)

	Infantry Division	Motorized and Panzer Division
Major Push	150	166
Heavy Fighting	125	133
Localized Fighting	100	100
Siege	75	--
Training	50	33
Inactive at Front	75	50
Rest	25	16

The number of vehicles in each type of division and the motor fuel consumption per vehicle-mile was obtained from German military handbooks and from British sources. One-third of the divisional light and medium trucks have been excluded from the computation on the grounds that they would be used for transportation of supplies from railheads to the front rather than for transportation at the front.

In Tables 6, 7, and 8, the daily petroleum consumption for an infantry division, motorized division, and panzer division during a major push has been calculated.

TABLE 6
Daily Petroleum Requirements of an Infantry Division During
a Major Push

Vehicle	Number of Vehicles	Consumption per Vehicles per File (in litres)	Consumption of all Vehicles per Mile (in litres)	<u>Major Push</u>	
				Average Mileage	Petroleum Requirements (in litres)
Motor Cycles	400	0.11	44.0	112.5	4,950
Motor Cars	65	0.37	22.2	112.5	2,498
Trucks					
Personnel	67	0.56	37.5	75.0	2,813
Light	170	0.48	54.4 <u>a/</u>	75.0	4,080
Medium	388	0.64	165.5 <u>a/</u>	75.0	12,413
Heavy	33	0.80	26.4	45.0	1,188
Miscellaneous	222	0.60	133.2	75.0	9,990
Tractors	147	0.97	142.6	18.0	2,567
Armored Cars	23	0.80	18.4	60.0	1,104
Total daily (litres)					41,603
Total daily (metric tons)					30.6

a/ One-third of total number of trucks assumed to be employed in supply services.

TABLE 7

Daily Petroleum Requirements of a Motorized Division During
a Major Push

Vehicle	Number of Vehicles	Consumption per Vehicle per Mile (in litres)	Consumption of all Vehicles per Mile (in litres)	<u>Major Push</u> Average Mileage	Petroleum Requirements (in litres)
Motor Cycles	1,200	0.11	132.0	187.5	24,750
Motor Cars	88	0.37	32.6	187.5	6,105
Trucks					
Personnel	900	0.56	504.0	125.0	63,000
Light	360	0.48	115.2 a/	125.0	14,400
Medium	675	0.64	288.0 a/	125.0	36,000
Heavy	58	0.80	46.4	75.0	3,480
Tractors	240	0.97	232.8	26.0	6,053
Armored Cars	50	0.64	32.0	100.0	3,200
Total daily (litres)					156,988
Total daily (metric tons)					115.4

a/ One-third of total number of trucks assumed to be employed in
supply services.

TABLE 6

Daily Petroleum Requirements of a Panzer Division During a Major Push

Vehicle	Number of Vehicles	Consumption per Vehicle per Mile (in litres)	Consumption of all Vehicles per Mile (in litres)	Major Push Average Mileage	Petroleum requirements (in litres)
Motor Cycles	1,400	0.11	154.0	187.5	28,875
Automobiles	410	0.37	151.7	187.5	28,444
Trucks					
Personnel	420	0.56	235.2	125	29,400
Light	453	0.48	145.0 a/	125	18,125
Medium	208	0.64	88.7 a/	125	11,088
Heavy	34	0.80	67.2	75	5,040
Unclassified	1,000	0.56	373.3 a/	100	37,330
Tractors	313	0.97	303.6	26	7,894
Armored Vehicles					
Command	27	4.83	130.4	30	3,912
Light	38	0.56	21.3	100	2,130
Heavy	12	0.80	9.6	75	720
Tanks					
Pz-Kw II	70	2.41	168.7	30	5,061
Pz-Kw III and IV	132	4.83	637.6	30	19,128
Total daily (litres)					197,147
Total daily (m. tons)					144.9

a/ One-third of tanks assumed to be employed in supply services.

Daily consumption figures for the other degrees of combat activity are calculated on the basis of the relation between the vehicular mileage for a major push and the other degrees of activity (as shown in Table 5) and are presented in Table 9.

TABLE 9

Daily Petroleum Requirements of German Divisions by Degree of Combat Activity
(metric tons)

	Infantry Division	Motorized Division	Parzer Division
Major Push	31	115	145
Heavy Fighting	25	92	116
Localized Fighting	20	69	87
Siege	15	--	--
Training	10	23	29
Inactive Front	15	34.5	43.5
Rest	5	11.5	14.5

7. By using the data of the campaign analysis in Table 3 and the estimates for daily divisional petroleum consumption as given in Table 9, total combat requirements can be computed by fronts and by months. For the winter months, from the middle of November to the middle of April, an addition of 50 percent was made to the calculated fuel consumption of all vehicles employed at the Eastern Front, in order to allow for the large rise of fuel consumption per mile under conditions of mud and snow.

This total was then increased by 66 percent, to account for all non-divisional petroleum requirements in rough proportion to the ratio of non-divisional to divisional troops. The lower combat requirements of non-divisional troops are balanced by the service function of these troops.

Wastage and losses unavoidably suffered in military operations were estimated at an additional 10 percent of the total. This includes the losses from enemy operations, from soldiers' carelessness, theft, etc.

Lubricating oil requirements have been estimated throughout as 5 percent of the motor fuel used.

TABLE 10
Combat Petroleum Requirements for German Divisional and Non-Divisional Troops at the Eastern Front, 1942
(metric tons)

Front	Motor Fuel	Lubricants	Total
Finnish Front	77,343	3,867	81,210
Northern Front	415,101	20,755	435,856
Central Front	1,074,212	53,711	1,127,923
Southern Front	1,240,159	62,009	1,302,168
Caucasus Front	<u>273,424</u>	<u>13,671</u>	<u>287,095</u>
Total	3,080,239	154,013	3,234,252

Petroleum Requirements for Supply Services from Railhead to Front

8. Oil requirements for the transportation of supplies from the railheads to the front were calculated on the basis of (a) the supply tonnage required every month for each kind of division in each type of activity and (b) the distance between the front and the railheads. The daily divisional tonnage which has to be transported from the railheads via the distribution points to the front has been estimated in COI report No. 49. Some later revisions referring mainly to ammunition, fuel expenditure, and requirements for fortifications have been incorporated in the present report. Requirements for all general headquarter troops have been included with the tonnage for infantry divisions except in the case of rotor fuel. Self-propelled ordnance is not included in these figures as it moved under its own power.

TABLE II

Daily Supply Tonnage by Division
(metric tons)

	Infantry + GHQ	Motorized	Panzer
Major Push	439	560	608
Heavy Fighting	809	521	560
Localized Fighting	397	468	495
Siege	346	---	---
Training	129	73	61
Inactive Front	167	106	117
Rest	90	42	43

The quantities of material which have to be hauled from the railheads to the distribution points differ somewhat from those which have to be hauled from the distribution points to the front. But the difference in weight is so small (as shown in COI report No. 49) that it can be ignored. The same tonnage figures have thus been used for transportation from the railheads to the distribution points and from the distribution points to the front. Allowance was made for the fact that general headquarters supplies, and supplies for divisions at rest or in training are not all transported to the front line. It was assumed that on the average these supplies are carried only half the distances between railheads and front.

For the whole of 1942 the distance from the railheads to the front was more or less constant in the case of the Finnish Front and in that of the Northern and Central Fronts. Great changes in the supply distances took place, however, in the case of the Southern and Caucasus Fronts during the second half of 1942.

TABLE 12

Distance from Railheads to Fronts
(miles)

Period	Finnish Front	Northern Front	Central Front	Southern Front	Caucasus Front
Jan-June 15	15	15	30	30	---
June 15-30	"	"	"	100	---
July	"	"	"	150	---
August	"	"	"	100	125
September	"	"	"	50	75
October	"	"	"	30	50
November	"	"	"	30	30
December	"	"	"	30	30

The composition of the truck fleet, available for supply services was established on the basis of the assumption that one-third of the divisional trucks were used for such service. The average petroleum consumption per one million ton truck miles would then amount to 163 tons. Allowing for the return trips from the front to the railheads, the petroleum requirements for the transportation of one million tons would thus amount to 366 tons of petroleum per mile. Here again a 50 percent addition was made during the winter months to account for higher unit consumption and another 10 percent was added for wastage and losses. Lubricating oil consumption was put at 5 percent of motor fuel requirements.

The use of generator motors and of horse drawn vehicles could not be evaluated separately. It is known, however, that increasing use is made of generator vehicles behind the front and that part of the distribution services depend on horse transportation. In any case, the estimates are not affected by the use of horse transportation as the calculations are principally based on the actual number of motor vehicles used. The number of generator vehicles in military use in 1942 was small. None of them was probably used in the transportation from the railheads to the front which alone was considered here.

9. Petroleum requirements for self-propelled ordnance vehicles were estimated on the basis of United States ordnance replacement rates. For active infantry, motorized, and panzer divisions, monthly replacement rates have been put at 8 percent for motor cars and trucks and 14 percent for armored cars, tractors and tanks. For inactive divisions, the replacement rate was put at 4 percent. One-third of the total number of divisions at each front was assumed to be inactive at any one time. Assuming that ordnance replacements for active divisions have to move from railheads to the front and that those for inactive divisions and GHQ troops half that distance, total ordnance requirements (including a 50 percent addition from mid-November to mid-April and 10 percent for wastage) would amount to 9,500 tons. These quantities were added to the amounts needed for the supply service. (See Table 13).

TABLE 13

Eastern Front Supply Service Petroleum Requirements of the
German Army from Railheads to Fronts, 1942
(metric tons)

Front	Motor Fuel	Lubricants	Total
Finnish Front	2,519	126	2,645
Northern Front	16,927	846	17,773
Central Front	62,996	3,150	66,146
Southern Front	152,919	7,647	160,566
Caucasus Front	<u>37,731</u>	<u>1,888</u>	<u>39,619</u>
Total	273,092	13,655	286,749

Petroleum Requirements of Axis Satellite
Divisions at the Eastern Front

10. A considerable number of Satellite divisions, most of them infantry, were employed at the Eastern Front during 1942. All the year round there were about 14 Finnish Divisions stationed at the Finnish Front. The strength of Rumania's divisions was built up to about 22 by August 1942. At the same time, Hungary and Italy employed about 10 each and Slovakia, Spain, and other small countries about three to four. It was assumed that only one of the 14 Finnish divisions was engaged in localized fighting and that 13 were inactive all the year round. The other Satellite divisions were exclusively engaged at the Southern Front through July. From August to December, it was assumed that 15 percent of their total number operated at the Caucasian Front and 85 percent at the Southern Front. The number of divisions employed by all Axis Satellite countries at the Eastern Front together with a campaign analysis is presented in Table 14.

TABLE 14

Axis Satellite Divisional Strength at the Eastern Front,
by Degree of Activity, 1942

Period	Major Push	Heavy Fighting	Localized Fighting	Inactive and At Rest	Total
January	---	---	1	38	39
February	---	---	1	38	39
March	---	---	1	38	39
April	---	---	1	38	39
May	---	2	1	36	39
June	---	4	1	37	42
July	5	---	6	37	48
August	3	5	8	44	60
September	4	10	11	39	60
October	---	5	11	43	59
November	---	10	11	35	56
December	---	15	6	31	52

In view of the fact that Axis Satellite divisions are smaller in size and probably less motorized than German divisions, their combat consumption was put at two-thirds of that of German divisions. A 50 percent addition for requirements of non-divisional troops was made and another 50 percent was

added to account for the higher mileage consumption during the winter months. Wastage and losses were assumed to amount to an additional 10 percent of total requirements. Lubricating oil consumption has been put at 5 percent of motor fuel requirements.

Petroleum requirements for the transportation of supplies from the railheads to the front for Satellite troops have been calculated at the same percentage of combat consumption as that of the German army at the various fronts, i.e. 3.2 percent for the Finnish front, 12.3 percent for the Southern Front, and 13.3 percent for the Caucasian Front.

Total Eastern Front consumption of Axis Satellite troops by combat and supply requirements at the various fronts is shown in Table 15.

TABLE 15

Satellite Ground Force
Petroleum Requirements at the Eastern Front, 1942
(metric tons)

Front	Motor Fuel	Lubricants	Total
<u>Finnish Front</u>			
Combat	78,954	3,947	82,901
Supply	<u>2,524</u>	<u>125</u>	<u>2,649</u>
Total Finnish Front	81,478	4,072	85,550
<u>Southern Front</u>			
Combat	200,150	10,008	210,158
Supply	<u>24,642</u>	<u>1,233</u>	<u>25,875</u>
Total Southern Front	224,792	11,241	236,033
<u>Caucasian Front</u>			
Combat	18,515	926	19,441
Supply	<u>2,470</u>	<u>124</u>	<u>2,594</u>
Total Caucasian Front	20,985	1,050	22,035
<u>Total All Fronts</u>			
Combat	297,619	14,881	312,500
Supply	<u>29,636</u>	<u>1,482</u>	<u>31,118</u>
Grand Total	327,255	16,363	343,618

III. AXIS GROUND FORCE PETROLEUM CONSUMPTION OUTSIDE THE EASTERN FRONT

11. Estimates for Axis oil requirements in areas other than the Eastern Front are based on the number of divisions fighting, in reserve, or in training.

Axis Petroleum Requirements in North Africa

12. The number of Axis divisions employed during 1942 in the African theatre of war has been estimated as follows:

TABLE 16

Axis Divisions in North Africa, 1942

Period	Germany	Italy ^{a/}
Jan.-June	3b/	10-11
July-Oct.	4c/	10-11
Nov.-Dec.	4c/	5

a/ Includes two armored and two motorized divisions.

b/ Two armored and one motorized divisions.

c/ Two armored and two motorized divisions.

No detailed analysis of the campaign was available; but it is known that after a period of relative inactivity during the first five months of the year, Axis divisions were very active from May 27 to July 1 during the advance from Gazala to El Alamein. Early in September, the Germans attempted to break through the British lines, but without success. On October 24, the British started their offensive which resulted in the decisive victory at El Alamein and the retreat of the German army from Egypt and ultimately North Africa.

It has been assumed that from January to May and from July to October 1942 the petroleum requirements of two-thirds of the number of divisions in North Africa corresponded to that of divisions stationed at the front. The consumption of the remaining one-third is assumed to correspond to the requirements of divisions at rest. The petroleum requirements in June and for the period October to December were calcu-

lated on the basis of the maximum degree of combat activity.

The basic consumption rates for Italian divisions were again put at two-thirds of the rate of corresponding German divisions. An addition of 50 percent to the consumption thus calculated was made to account for the requirements of non-divisional troops, and of the supply services. As the mileage performance per gallon in the desert is considerably lower than that under average conditions, another 20 percent was added to the calculated consumption. Finally to account for wastage and losses, including those quantities lost in shipping to North Africa, another 25 percent was added to the above figures. Lubricating oil requirements were put at five percent of motor fuel demand. (See Table 17.)

TABLE 17

Axis Petroleum Requirements in North Africa, 1942

(metric tons)

	Motor Fuel	Lubricants	Total
German Divisions	112,990	5,650	118,640
Italian Divisions	107,786	5,390	113,176
Total	220,776	11,040	231,816

Axis Occupation Divisions, Standing Armies,
and Armies in Training

13. Estimates for the petroleum requirements of the Axis divisions in occupied countries, for the standing armies, and armies in training in Axis countries are based on average figures for the number of Axis divisions thus engaged during 1942. The monthly petroleum consumption of German divisions in Germany and in Eastern Europe was estimated at 300 tons, the figure calculated in Table 9 is for training requirements. For German divisions stationed in the Low Countries and Northern Europe and for Axis Satellite divisions, the rate of consumption was put at two-thirds of that quantity, or at 200 tons per month. A figure of 250 tons for the German divisions in France was used as some of the divisions stationed there were motorized or panzer divisions. The figure of 250 tons was also used for divisions stationed in the Balkans, especially in Yugoslavia where intermittent guerilla fighting took place during the year. Requirements for divisions in Bulgaria, which was not actually involved in the war, were put at 150 tons a month. The petroleum consumption of non-divisional troops, including a small allowance for wastage and losses, was put at an additional 30 percent of the above figures. Lubricating oil requirements were estimated at five percent of motor fuel consumption. The British estimate of 500,000 tons, for the petroleum requirements of the Todt organization, was used. Table 18 summarizes these estimates.

TABLE 18

Axis Petroleum Consumption Occupation Divisions, Standing
Armies, and Divisions in Training, 1942
(metric tons)

	Average number of Divisions	Petroleum Consumption		
		Motor Fuel	Lubricants	Total
Germany	25	117,000	5,856	122,856
Poland-Baltic	12	56,160	2,808	58,968
Italy	22.5	70,200	3,516	73,716
Slovakia	2	6,240	312	6,552
Hungary	10	31,200	1,560	32,760
Rumania	10	31,200	1,560	32,760
Bulgaria	10	23,400	1,176	24,576
France	31	120,250	6,016	126,266
Holland-Belgium	2.5	7,800	396	8,196
Denmark-Norway	11	34,320	1,716	36,036
) Yugoslavia, Albania,)) 171,600) 8,580) 180,160
) Greece, Crete, and) 44 <u>a/</u>)))
) Dodecanese))))
Total		669,370	33,496	702,866
Todt Organization		<u>475,000</u>	<u>25,000</u>	<u>500,000</u>
GRAND TOTAL		1,144,370	58,496	1,202,866

a/ 30 Italian, 9 German, and 5 Bulgarian Divisions.