

APPENDIX C

ACCEPTANCE CONDITIONS FOR THE AERO-ENGINE OILS.

S3 and V2

Military Name		S 3		V 2	
Filling Station Mark	VK, VB, NM, WD, WH, WN, WL, WR, WM, WY, WV, WF, WB, WG.	RG, HL, WD, WH, WN, WL, WR, WM, WG, WV, WF, WB, WG.		R G	
Technical Specific for Delivery (1)	TL 147-502 TL 147-503 TL 147-506	TL 147-(561-563) TL 147-(571-573) TL 147-(581-583)		TL 147-500	
Appearance	The lubricating oil must be clear, free from undissolved water and mineral acids and must contain no solid impurities.				
Refractive Index	Max.	1.4995	1.4990	1.5070	
Density @ 20°C. Kg/Ltr.	Max.	0.897	0.895	0.920	
Viscosity @ 50°C @ 100°C	Min.	cs. 125-137 18.5	OE (16.5-18.0) (2.70)	cs. 125-143 19.0	OE (16.5-18.8) (2.75)
				cs. 133-144 19.4	OE (17.5-19.0) (2.80)
Pole Height	Max.	2.04	1.95	1.9	
Slope	Max.	3.45	3.35	3.4	
Viscosity Index	Min.	92	98	95	

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Setting Point °C	Max.	-17(2)	-20	-25
Flash Point °C	Min.	260	225	235
Ignition Point °C	Min.	300	255	270
Acid Value mg.KOH/g.	Max.	0.06	0.06	0.1
Saponification Value mg.KOH/g.	Max.	0.2	0.2	8.0
Evaporation Test (Dr.Noack) (3) 250°C. % wt.	Max.	3.0(4)	11.0	5.0
Conradson % wt.	Max.	0.35	0.25	0.5
Ash Content % wt.	Max.	0.01	0.01	0.02
Hard Asphalt % wt.		0	0	0
Water Content % wt.		0	0	0

- Notes:
1. Constructional specifications for BVM Aero-Engines "Test Regulation for Aero-Engine lub. oils for use in Otto engines". Can be obtained from the Scientific Reports section (ZWB) of the DVL, Berlin-Adlershof, Rudower Chaussee 16/25.
  2. For S3, the filling station mark VK allows a max. setting point of -10°C.
  3. "Angewandte Chemie" 1936. Vol. 49, page 385.
  4. For S3--VK the max. Noack Test value is 5.0.
  5. The present sheet 7 supersedes the "Technical Acceptance Conditions for Aero-Engine Lub. Oils" issued by the RIMLC II 2e on 15.3.36. Copies still in existence should be destroyed.

Abbreviations: V--Vakuum K--Köln B--Bremen W--Wifo

Prepared by: Mineral Oil Section. Group GL/A-M II. This sheet is primarily intended for the suppliers. Thus there are two columns for S3 (to differentiate finished products from blended stocks)- see the other sheet 7 for military applications.

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MOTOR OIL SPECIFICATIONS FOR COMPONENTS OF AVIATION MOTOR OIL S-3

Code Designation Specification Number Appearance	<u>Low Viscosity Oil</u>			<u>High Viscosity Oil</u>		
	SS 607 TL 147-560	SS 707 TL 147-570	SS 807 TL 147-580	SS 906 TL 147-600	SS 1006 TL 147-610	SS 1106 TL 147-620
	The oil must be clear, free from undissolved water and mineral acids, and contain no solid impurities.					
Refractive Index Max.	1.4995	1.4935	1.5010	1.4770	1.4860	1.4816
Density @20°C Max.	0.905	0.895-0.897	0.905	0.862	0.875	0.870
Viscosity @50°C	cs 57.5-62.0 °E	cs 52.0-57.5 °E	cs 51.0-60.0 °E	cs 334-350 °E	cs 300-380 °E	cs 278 min. °E
@100°C Min.	7.6-8.2 cs	6.9-7.6 cs	6.8-7.9 cs	44-46 cs	40-50 cs	365 min. cs
	9.66 °E	9.35 °E	9.35 °E	42.3 °E	41.3-45.2 °E	38.0 °E
Pole Height Max.	1.80	1.77	1.77	5.63	5.5-6.0	5.1
Slope Max.	2.40	2.08	2.20	1.73	1.75	1.65
Viscosity Index Min.	3.80	3.66	3.75	3.05	3.05	3.00
Cloud Point °C Max.	70	88	80	107	105	107
Flash Point °C Min.	-15	-15	-16	-25	-20	-25
Ignition Point °C Min.	225	225	222	225	295	280
Acid Value Mg KOH/gm	265	258	258	263	325	330
Saponification No. mg KOH/gm	0.03	0.06	0.07	0.06	0.06	0.06
Noack Evap @250°C wt %	0.10	0.17	0.17	0.2	0.1	0.2
Conradson wt %	9.0	14.0	12	8	1	5.5
Ash wt %	0.2	0.25	0.30	0.2	0.45	0.25
Hard Asphalt wt %	0	0	0	0	0	0
Water Content wt %	0	0	0	0	0	0

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MOTOR OIL SPECIFICATIONS  
GROUND FORCE WINTER AND SUMMER OIL

	WEHRMACHT (SU) Summer	WEHRMACHT (WI) Winter
General Characteristics	The oil must be clear and contain no sediment	
Density @ 20°C Max.	0.91	
Evaporation Test	7-14%	20%
Viscosity		
Engler @ -15°C	1800° F	550° F
Engler @ 100°C	1.9-2.1	1.6° F
c.s. @ -15°C	18800	--
c.s. @ 100°C	10.8-12.8	--
Pole Height	2.1	2.0
Total Impurities		
Hard Asphalt	Free	Free
Benzol-alcohol solution	Free	Free
Solid Impurities	Free	Free
Combustibles	Free	Free
Ash	Trace	Trace
Acid Value mg KOH/gm	0.10	0.07
Saponification No. mg KOH/gm	0.25	0.25
Water	Free	Free
Flash Point °C		200
Pour Point °C		-25

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### MOTOR OIL SPECIFICATIONS GENERAL COMMENTS ON TEST TECHNIQUE

#### GENERAL:

1. The tests should be carried out with officially authorized standard testing equipment, either in the possession of the supplier or in that locality (at suppliers expense) or at the State Chemical Institute, Berline-Polotzensee.

2. No additional payment will be made to the supplier for the testing, check testing, packing and shipping of the samples.

3. If the tests are not performed by the government institution preliminary recognition by the consignee of the testing equipment used is essential. The consignee will instruct the responsible testing department representative regarding test technique. The supplier will be responsible for his own equipment and test personnel. The consignee has the privilege of retesting any sample at the state institute.

4. Only firms authorized by the High Command may supply motor oil (winter or summer) to the German Ground Forces. Information of the suppliers production technique must be made known to the High Command and also to the state institute. Any changes in composition of the product must be authorized.

5. The motor oil must be supplied in sealed containers which can be readily opened for spot testing.

#### ACCEPTANCE:

6. A sample of 1.5 kgms is required in each of the tests. After removing sample the container will be properly sealed.

7. Tests will be made on each sample. If any one of the tests is unsatisfactory the sample will be rejected.

a. The density @ 20°C will be determined in accordance with German Industrial Standards DVM 3653. It is satisfactory to use a hydrometer.

b. The volatility will be determined by the Noack Method described in "Avg. Chemie 49,385 (1936)" and in "Alud Kohle 1942".

c. The viscosity will be determined by the Vogel-Ossag-Viscosimeter using a sensitive thermostat, calibrated capillaries, thermometers calibrated to  $1/10^{\circ}\text{C}$ , and calibrated stop watches. All the above apparatus should be calibrated by the State Physical Technical Institutes.

Capillaries will not be used interchangeably as erroneous results will be obtained. Additional calibration is required from time to time using calibrated oils as standards.

The minimum time of flow is dependant upon the diameter of the capillary as shown in the following table.

<u>K</u>	<u>t (s)</u>
2- 0.8	30
0.6	34
0.4	42
0.2	60
0.1	85

A time of flow of 90 seconds should not be exceeded if possible. Measurements will be made at  $20^{\circ}\text{C}$ ,  $50^{\circ}\text{C}$  and  $90^{\circ}\text{C}$ . The values for  $-15^{\circ}\text{C}$ ,  $100^{\circ}\text{C}$  and VP are calculated from E20 and E90 according to the Uble Code Weather formula, or directly from the next issue of CTR tables. The measurement of the  $50^{\circ}\text{C}$  value is a control for the  $20^{\circ}\text{C}$  &  $90^{\circ}\text{C}$  values.

d. To estimate total impurities mix 5 gms of oil with 50 c.c. of normal (standard) gasoline in an iodine bottle. Stopper, and allow to stand for three hours in the dark and filter the normal gasoline solution through a pre-treated Jemar IG 4 glass filter crucible mounted on a vacuum flash. The residue is washed with cold normal gas to free it of oil, and then with warm normal gas to dissolve possible paraffin and ceresin. It is then dried for  $\frac{1}{2}$  hour at  $105^{\circ}\text{C}$ , left to cool in a dessicator and then weighed. The gain in weight represents the content of hard asphalt, alcohol, soluble benzol and solid impurities. The contents of the crucible should then be washed with benzol on the vacuum flash until the filtrate is colorless; dry, cool and weigh as above; the difference of the two weights is the hard asphalt content. Wash crucible contents with a 1:1 benzol alcohol mixture, treat as above; difference in weight is the alcohol soluble benzol. The final residue represents the solid impurities.

#### Preparation for use of the I.G. 4 crucible

The crucible is cleaned with chromic acid ( $\text{H}_2\text{SO}_4$ ), washed with water till neutral; 5 gms of pure cryolite powder are put in, the crucible is mounted on a vacuum flash and the powder is tamped down (fast)

under vacuum with a flattened glass rod. The crucible is then washed out with 20 ccs of a benzol-alcohol mixture and some normal gasoline. Air is then sucked through for 1 to 2 minutes and the crucible is dried for  $\frac{1}{2}$  hour in a desicator at 105°C. After adequate cooling it is weighed in a weighing glass. The weighing glass should not be used with a rapid analytical balance. Without such a balance, weighing glasses are to be used for all the above mentioned weighings.

Ash content is determined according to "German Industrial Standards" DVM 3657, with one alteration, namely that 100 gms of oil are weighed out. The difference between the solid impurities and the ash is the combustible matter.

e. The acid-value is determined according to DIN, DVM 3658. To be able to titrate dark colored oils without trouble, the DVM procedure is deviated from in the preparation of the solvent mixture. This is prepared according to Wizoff as follows: 33.8 gms analytical alkali blue 6 B are added to a mixture of 3 litres pure benzol and 1.5 litres 90% (at least) alcohol. The mixture is then agitated for a few hours, left to stand over night, and filtered. The solution is then ready for use.

f. The saponification number is determined according to DIN DVM 3659. Solvent mixture as for acid-value.

g. H<sub>2</sub>O content is determined by a visual test on the sample after vigorous shaking up and pouring into a calibrated test tube. It is essential to carry out the heating test for presence of water.

High Command of the Army  
Army Ordnance Office (Wa Chief Engineer)