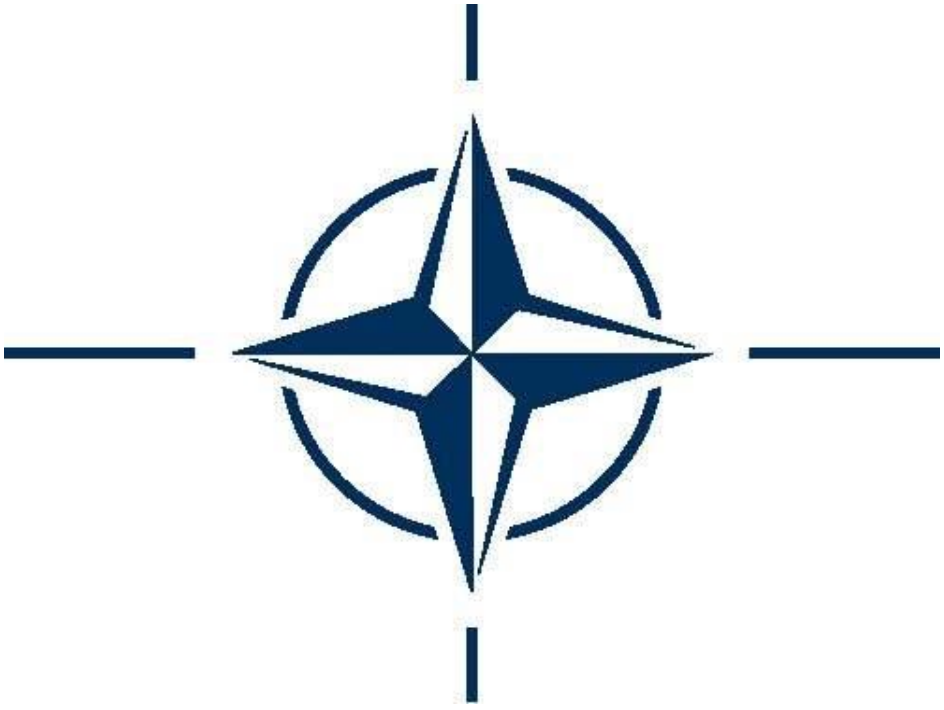
NATO STANDARD

AFLP - 3748

HYDRAULIC FLUID, PETROLEUM (H-515), POLYALPHAOLEFIN (H-537, H-538) AND PHOSPHATE ESTER FLUIDS (H-522, H-523, H-524)

Edition A Version 1

MAY 2015



NORTH ATLANTIC TREATY ORGANIZATION

ALLIED FUELS AND LUBRICANTS PUBLICATION

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1. The enclosed Allied Fuels and Lubricants Publication AFLP-3748, Edition A, Version 1, HYDRAULIC FLUID, PETROLEUM (H-515), POLYALPHAOLEFIN (H-537, H-538) AND PHOSPHATE ESTER FLUIDS (H-522, H-523, H-524), which has been approved by the nations in the Petroleum Committee, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 3748.

2. AFLP-3748, Edition A, Version 1 is effective upon receipt.

4. This publication shall be handled in accordance with C-M(2002)60.

Edvardas MAŽEIKIS
Major General, LTUAF
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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SECTION 1 GENERAL

0101. The guide specifications represent the minimum quality acceptable under the appropriate NATO code number (H-515, H-522, H-523, H-524, H-537 and H-538).

0102. Nation's specifications shall comply with these minimum requirements before being acceptable as providing a standardized product under the appropriate NATO code number ((H-515, H-522, H-523, H-524, H-537 and H-538).

0103. In order to promote product development, any nation's specification may include additional tests, or improved quality requirements, to those in the guide specifications.

0104. The guide specifications will be the subject to review with the object of improving products' quality as required by operational use.

0105. The quality standards contained in this document are to be used by member nations (MNs) in preparation and maintenance of their individual procurement specifications and standards. A MN's individual procurement document may be more stringent depending upon its equipment. This AFLP is not designed to be used in the direct procurement of products.

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SECTION 2 GUIDE SPECIFIATION FOR AVIATION HYDRAULIC FLUIDS H-515, H-522, H-523, H-524, H-537 and H-538

SCOPE

0201. Petroleum based hydraulic fluid H-515 and polyalphaolefin based hydraulic fluids H-537 and H-538 shall meet the minimum requirements detailed in Section 2 of this publication. Fire resistant phosphate ester-type hydraulic fluids for aircraft: H-522 (Type IV – low density), H-523 (Type IV – standard density), H-524 (Type V) shall meet the physical and chemical properties and the minimum tests of SAE AS 1241 specification. Deviations from this specification are not permitted for military use.

0202. Petroleum based hydraulic fluid H-515 and polyalphaolefin based hydraulic fluids H-537 and H-538 are intended to be essentially used in vented and non-vented reservoirs as follows:

FLUID	VENTED	NON-VENTED
H-515	-54ºC to +90ºC	-54ºC to +135ºC
H-538	-54ºC to +90ºC	-54ºC to +200ºC
H-537	-40ºC to +90ºC	-40ºC to +205ºC

COMPOSITION

0203. The material shall consist of a mixture of hydrocarbons from petroleum origin (H-515) or of polyalphaolefin (H-537 and H-538) and of approved additives to ensure compliance with the requirements for viscosity, resistance to oxidation and anti-wear properties of the finished product. These fluids chemistry are different than phosphate ester-type hydraulic fluids and are not allowed to be mixed.

ADDITIVES

0204. The only authorized additives and their required content must be approved by the national authorities in charge of the qualification:

a. Viscosity index improver (H-515): 20% m/m max. of active ingredient.

b. Oxidation inhibitors: 2.0% m/m max. H-537 specifies phenolic-type.

c. Anti-wear agent shall not exceed 3.0% m/m of tri-aryl phosphate. If tricresylphosphate (TCP) is used, the TCP additive shall contain less than 1 per cent of the ortho-isomer, hence no more than 0.03 weight per cent of the ortho-isomer in the finished product for H-515, H-537 and H-538.

d. Rubber swell agent (H-537 and H-538): between 25 and 35% m/m of diester.

e. Red dye (liquid or solid) in sufficient quantity for the finished material to comply with the colour requirements given in Table 1, item 2.

f. Copper passivator: 0.03% m/m max.

PHYSICO-CHEMICAL REQUIREMENTS

0205. For H-515, H-537 and H-538 see Table 1. For H-522, H-523 and H-524, see SAE AS 1241 standard.

QUALIFICATION

0206. The fluid has to meet at least all the requirements of this guide specification and must be suitable to the use for which it is designed (if necessary, function tests may be required). It is necessary that the fluid is compatible with all other products already qualified to equivalent national specifications. The characteristics obtained during qualification shall be available for subsequent identification of the product.

QUALITY ASSURANCE

0207. A representative sample of each batch of finished oil shall be tested for compliance at least with the Items 1-11 and 15 of Table 1. The results obtained during quality control may be compared with results obtained during qualification.

TABLE 1: PHYSICO-CHEMICAL REQUIREMENTS FOR H-515, H-537 AND H-538

ITEM	PROPERTY	UNIT	LIMITS, H-515		LIMITS, H-537		LIMITS, H-538		TEST METHOD (a)	REMARKS
			MIN	MAX	MIN	MAX	MIN	MAX		
1	Appearance		Satisfactory (b)		Satisfactory (b)		Satisfactory (b)		Visual Examination	Clear, homogeneous free from visible impurities.
2	Colour	Lovibond Red Units	20	40	20	40	20	40	IP 17 Method A 1' Cell	The colour of the material may also be defined by comparison with a national standard (c).
3	Solid particles either			1.0		1.0		1.0		
	a. Gravimetric method	mg/100 mL							ASTM D4898	
	or									
	b. Number of particles	Nb/100 mL							STANAG 3713 (d)	The figures quoted refer to those obtained using automatic particle counter calibrated with (1) ISO 1192, latex sphere, (2) ISO 4402, ACFTD or (3) ISO 11171, ISO MTD.
	Applicable to (1) and (2)			(1)		(1)		(1)		
	5 up to 15 µm			10000		10000		10000		
	15 up to 25 µm			1000		1000		1000		
	25 up to 50 µm			150		150		150		
	50 up to 100 µm			20		20		20		
	≥ 100 µm			5		5		5		
				(2)		(2)		(2)		
				16000		16000		16000		
				2850		2850		2850		
				506		506		506		
				90		90		90		
				16		16		16		
	Applicable to (3)			(3)		(3)		(3)		
	6 up to 14 µm			16000		16000		16000		
	14 up to 21 µm			2850		2850		2850		
	21 up to 38 µm			506		506		506		
	38 up to 70 µm			90		90		90		
	≥ 70 µm			16		16		16		**Differential count**

TABLE 1: PHYSICO-CHEMICAL REQUIREMENTS FOR H-515, H-537 AND H-538

ITEM	PROPERTY	UNIT	LIMITS, H-515		LIMITS, H-537		LIMITS, H-538		TEST METHOD (a)	REMARKS
			MIN	MAX	MIN	MAX	MIN	MAX		
	Applicable to (3) ≥ 4 µm(c) ≥ 6 µm(c) ≥14 µm(c)	Nb/100 mL		(3) - 19500 3460		(3) - 19500 3460		(3) - 19500 3460		**Cumulative count**
	>4 > 6 >14 µm(c)			-/15/12		-/15/12		-/15/12		**ISO 4406**
4	Evaporation	% m/m		20		20		20	ASTM D972 FTM 791 Method 350	H-515: 6 hrs @ 71°C H-537: 6.5 hrs@ 205 °C H-538: 6.5 hrs @ 135 °C
5	Kinematic Viscosity @ +100 °C @ +40 °C @ -40 °C @ -54 °C	cSt	 4.90 13.2 	 600 2500	 3.45 14.0 	 2200 	 2.0 6.7 	 550 2500	ASTM D445	
6	Flash point	°C	82						ASTM D93	
					205		160		ASTM D92	
7	Pour point	°C		-60		-55		-60	ASTM D97, D5949	
8	Low temperature stability		No gelation, precipitation or separation of solid or liquid phases. Turbidity not greater than standard.						FTM 791 Method 3458.1	H-515:72 hrs@-54 °C H-538:72 hrs@-54 °C H-537:72 hrs@-40 °C
9	Foaming at 24 °C – Foam Volume at end of - 5 min blowing period - 10 min setting period	ml		 65 0		 65 0		 65 0	ASTM D892	A ring of small bubbles around the edge of the graduate shall be considered satisfactory. H-537 is performed at 25°C.

TABLE 1: PHYSICO-CHEMICAL REQUIREMENTS FOR H-515, H-537 AND H-538

ITEM	PROPERTY	UNIT	LIMITS, H-515		LIMITS, H-537		LIMITS, H-538		TEST METHOD (a)	REMARKS
			MIN	MAX	MIN	MAX	MIN	MAX		
10	Total acid number at buffer endpoint	mg KOH/g		0.20		0.20		0.20	ASTM D664	
11	Copper corrosion 72 hr at 135 °C			2e		report		report	ASTM D130	Use the ASTM copper corrosion standards described in paragraph 3.2 of ASTM D 130. Alternate apparatus described in national specification may be used (e).
12	Synthetic rubber (NBR-L) swell	volume %	19.0	30.0	18.0	30.0	19.0	30.0	ASTM D4289 168 hr at 70 °C	Qualification test only. NBR-L iaw SAE AMS 3217/2C
13	Corrosivity/ oxidation stability								ASTM D4636 168 hr at 135 °C,	
	a. Weight change of test piece	mg/cm^2								
	- Steel			+/- 0.2		+/- 0.2		+/- 0.2		
	- Al alloy			+/- 0.2		+/- 0.2		+/- 0.2		
	- Mg allow			+/- 0.2		+/- 0.2		+/- 0.2		
	- Cd plated steel			+/- 0.2		+/- 0.2		+/- 0.2		
	- Cu			+/- 0.6		+/- 0.6		+/- 0.6		
	b. Appearance of test pieces		No pitting, etching or visible corrosion under a magnitude of 20 diameters. Cu corrosion not greater than classification 3 (ASTM D 130)							Slight discolouration of Cd will be permitted.
	c. Change in 40 °C viscosity from original	%	-5	20	-10	10	-10	10		

TABLE 1: PHYSICO-CHEMICAL REQUIREMENTS FOR H-515, H-537 AND H-538

ITEM	PROPERTY	UNIT	LIMITS, H-515		LIMITS, H-537		LIMITS, H-538		TEST METHOD (a)	REMARKS
			MIN	MAX	MIN	MAX	MIN	MAX		
13 Cont.	d. Increase in total acid Nb from original	mg KOH/g	-	0.2	-	0.2	-	0.2		
	e. Appearance of the fluid after test		Satisfactory (b)		Satisfactory (b)		Satisfactory (b)			No visible separation of insoluble matter. No gumming.
14	Shear stability Decrease in viscosity from original at 40°C	 %	Not greater than the per cent decrease in the reference fluid		N/A	N/A	N/A	N/A	ASTM D2603	Use 30 ml of fluid (f), for 30 minutes @ 0°C. Viscosity decrease of reference fluid is 15%.
15	Steel-on-steel wear, average diameter of scar	mm	-	1.0	-	0.65	-	0.65	ASTM D4172 Condition A (H-538), B (H-515)	No specific condition for H-537
16	Storage stability a. Appearance of the fluid after time period		Item 1 remarks and Item 8 limits						FTM 791 Method 3465	
	b. Tests to be performed again on the fluid		Must meet the requirements of Items 3b, 8, 10, 11 and 13							STANAG 4714 (re-test certification)

(a) The test methods given in the column are put as a reference (ASTM, FTM, etc.); each national equivalent can be used.
(b) See remarks column.
(c) Compare with standard prepared with one part red dye and 10,000 parts of an oil not darker than ASTM D 1500 # 1.
(d) FTM 791/3009 may be used in lieu of STANAG 3713. Maximum number of particles: 5 to 15 : 2500, 16-25 : 1000, 26-50 : 150, 51-100 : 25, over 100 : 10.
(e) A test tube equipped with an air condenser fitted with a cork may be used in lieu of the bomb specified in ASTM D 130.
The dimensions are: Test tube: 300 x 30 mm OD, Condensor tube: 500 x 7 mm OD.
(f) ASTM Reference Fluid B may be obtained from Rohm and Haas Co., Research Laboratories, Spring House, PA 19477.

AFLP 3748