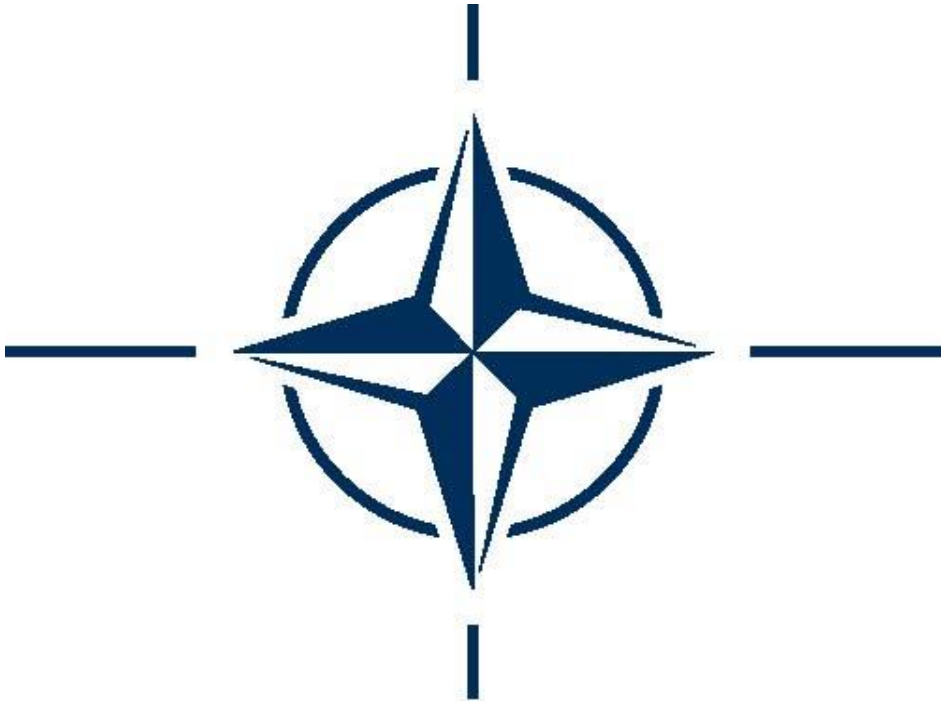
NATO STANDARD

AFLP-7093

GUIDE SPECIFICATION FOR NATO LAND SYSTEM AUTOMOTIVE FLUIDS

Edition C, Version 2

APRIL 2023



NORTH ATLANTIC TREATY ORGANIZATION

ALLIED FUELS AND LUBRICANTS PUBLICATION

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

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NATO LETTER OF PROMULGATION

14 April 2023

1. The enclosed Allied Fuels and Lubricants Publication AFLP-7093, Edition C, Version 2, GUIDE SPECIFICATION FOR NATO LAND SYSTEM AUTOMOTIVE FLUIDS, 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 7093.

2. AFLP-7093, Edition C, Version 2, is effective upon receipt and supersedes AFLP-7093, Edition C, Version 1, which shall be destroyed in accordance with the local procedure for the destruction of documents.

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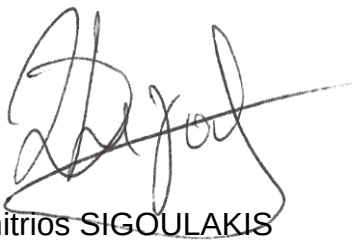
4. This publication shall be handled in accordance with C-M(2002)60.



Dimitrios SIGOULAKIS
Major General, GRC (A)
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]
ESP	Brake fluid H-542 used by the Spanish Armed Forces responds to the technical requirements set forth in specification SAE J1704.
FRA	France makes the following reservations: • the French specification for H-542 complies with SAE standard J1704 that does not impose any maximum upper limit for kinematic viscosity at 100 °C ; • the French specification for H-548 does not test miscibility with the product referenced in AFLP-7093, but with any H-548 hydraulic fluid and O-1179 synthetic engine oil approved by France.
GBR	H-542 OX-8 procured to SAE J 1704 without more stringent requirements detailed in the STANAG/ AFLP
LVA	LVA NAF does not use following technical liquids within mentioned minimum standards: S-750, S-757, C-635, H-544 and H-549.
POL	Implementation will only concern H-542 and S-1764 products. Other products are not used in Polish Army
SVK	The Slovak Republic reserves the right to implement only those paragraphs related to products with NATO Code Numbers as follows: H-540, H-542 and S-1750, which are used in the Armed Forces of the Slovak Republic.
USA	The U.S. cannot procure H-542 to the specification listed in Section 2 and does not implement or procure products to H-548, H-549, and S-757. MIL-PRF-6083G does not fully meet the C-635 requirement for evaporation. MIL-PRF-46170E does not fully meet the H-544 requirements for pour point, synthetic rubber swell, and corrosivity/oxidation stability test increase in TAN (end point) from original.
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. STANAG 1135/AFLP-1135, Section 4 lists under individual product descriptions of national specifications which have been agreed as interchangeable.

0102. Under previous agreements, a single national specification has been selected for each land systems product to provide the quality standard which other nations' specifications are expected to meet in order to achieve interchangeability. Since product development is constantly in progress and national specifications are frequently revised to take advantage of this, a nation whose specification is used as a guide may find it difficult to make such changes without altering the product quality standard in a manner unacceptable to other nations. Therefore, a nation that has made technical changes to a specification listed in Table-1 (page1-2), is to send it to the AC/112 – Petroleum Committee Staff Officer for distribution to the AC/112 Army Fuels and Lubricants Working Party (Army FLWP) delegates at least one month prior to discussion at the annual ARMY FLWP meeting.

0103. NATO guide specifications have therefore been prepared to define the minimum quality requirements of the most important products. Further specification may be prepared as considered necessary. The values specified in the sections of this AFLP shall also apply to stored product subject to re-inspection. The requirement, frequency and test parameters are specified in STANAG 4714/AFLP-4714 - Minimum quality surveillance of lubricants and associated products.

0104. The quality standards contained in this document are to be used by Member Nations (MNs) in the preparation and maintenance of their individual procurement specifications and standards. An MN’s individual procurement document may be more stringent depending upon its equipment. This document is not designed to be used in the direct procurement of products.

0105. The guide specifications at Sections 2 to 8 represent the minimum quality acceptable under the appropriate NATO code number.

0106. Nations’ specifications shall comply with these minimum requirements before being acceptable as providing standardized products under the appropriate NATO code number.

0107. In order to promote product development, any nation’s specification may include additional tests, or improved quality requirements to those in the relevant guide specification.

0108. Guide specifications shall be subject to review with the object of improving the product quality as required by operational use.

NO	NATO CODE	PRODUCT DESCRIPTION (AS LISTED IN STANAG 1135)	GUIDE SPECIFICATION (NOTE 1)
(a)	(b)	(c)	(d)
1	C-635	Corrosion preventive oil hydraulic system	see section 5
2	C-640	Lubricating oil engine : preservative, grade 10	MIL-PRF-21260
3	C-642	Lubricating oil engine : preservative, grade 30	MIL-PRF-21260
4	H-540	Hydraulic fluid petroleum	TL 9150-0035
5	H-542	Brake fluid automotive borate ester based	see section 2
6	H-544	Hydraulic fluid synthetic, less flammable	see section 6
7	H-547	Brake fluid, synthetic : silicone	MIL-PRF-46176
8	H-548	Hydraulic fluid, Automatic transmission	see section 3
9	H-549	Brake fluid automotive polyglycol base, DOT 3 - SAE J1703	see section 7
10	S-1750	multi purpose additive : diesel engine	DCSEA 751
11	S-757	Anti-freeze, inhibited ethandiol	see section 4
12	S-1764	NOx reduction agent – A queous Urea Solution AUS 32	ISO 22241-1/-2/-3 (Note 2)

Table - 1

Note 1 – Consult STANAG 1135 for the applicable version unless otherwise indicated herein
Note 2 – To avoid crystal precipitation or hydrolysis of the AUS 32, storage at normal conditions – optimum up to 25°C – is recommended! Keep above max. -5°C

SECTION 2 NATO GUIDE SPECIFICATION FOR BRAKE FLUID, AUTOMOTIVE, BORATE ESTER BASED, H-542

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
1	General	-	SAE J 1704	As required in SAE J 1704	
	Additional to SAE J 1704				
2	Original Equilibrium Reflux Boiling Point (ERBP)	°C	SAE J 1704	260 min	Note (1)
3	Wet Equilibrium Reflux Boiling Point (ERBP)	°C	SAE J 1704	180 min	Note (2)
4	Kinematic Viscosity - at minus 40 °C - at 100 °C	 mm²/s mm²/s	SAE J 1704 with ISO 3104	 1500 max 3,0 max	 Note (3) Note (4)

REQUIREMENTS of SAE J 1704:
Note (1) : 230 °C min.
Note (2): 155 °C min.
Note (3): 1800 max.
Note (4): 1,5 min

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SECTION 3 NATO GUIDE SPECIFICATION FOR HYDRAULIC FLUID, AUTOMATIC TRANSMISSION, H-548

NO	REQUIREMENTS	UNITS	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
1	Colour	-	ISO 2049	from 6,0 to 8,0	ASTM D 1500
2	Homogeneity and Miscibility	-	FTM 791C Method 3470.1	No separation or colour change at end of test using reference fluid	
3	Flash Point	°C	ISO 2592	190 min.	ASTM D 92
4	Brookfield Viscosity		ASTM D 2983		
4.1	at – 20 °C	cP		1500 max.	
4.2	at – 30 °C	cP		5000 max.	
4.3	at – 40 °C	cP		20000 max.	
5	Cu Corrosion Test, 3h, + 150 °C		ISO 2160	1b max.	ASTM D 130
6	Corrosion Test		ISO 7120, Proc. A	pass	ASTM D 665
7	Load Carrying Capacity (FZG) Note(1)	Load Stage	CEC L-07 A-95	10 min.	Failure Load Stage
8	Air Release Value Note(1)	Minutes	ISO 9120	10 max.	ASTM D 3427 techn. eq.
9	Foaming Characteristics Note(1) Seq. I / II / III	mL	ISO 6247	20 / 50 / 20	ASTM D 892
10	Performance			Comparable to GMN 10055	

Note (1): not part of Dexron III.

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SECTION 4 NATO GUIDE SPECIFICATION FOR ANTIFREEZE, INHIBITED ETHANEDIOL, S-757

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
1	Composition			The product shall consist essentially of ethane-diol, di-sodium sebacate and benzotriazole	
2	Colour			The product shall be blue-green	
3	Density at 15 °C	kg/l	ISO 3675	1123 to 1128	
4	Flash Point	°C	ISO 2592	110 min.	
5	Freezing Point of a 25% v/v aqueous solution	°C	BS 5117 Section 1.3	- 10 max.	or method agreed between supplier and customer
6	Boiling Point	°C	BS 5117 Section 1.2	150 min.	or method agreed between supplier and customer
7	pH value of 25% v/v aqueous solution		BS 5117 section 1.1	7,0 to 7,8	or method agreed between supplier and customer
8	Water Content	wt %	ASTM D1123	5,0 max.	
9	Di-Sodium Sebacate Content	wt %	Any suitable analytical method (1)	4,0 to 4,50	
10	Benzotriazole Content	wt %	Any suitable analytical method (1)	0,25 to 0,30	

Note (1) In case of dispute, the method shall be agreed by supplier and customer.

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SECTION 5 NATO GUIDE SPECIFICATION FOR CORROSION PREVENTIVE OIL HYDRAULIC SYSTEM, C-635

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
1	Appearance		Visual	clear, homogenous, free from visible impurities	
2	Colour		Visual	red	Compare with standard prepared with one part red dye and 10000 parts of an oil not darker than ASTM D 1500
3	Solid particles either				
3 a	Gravimetric method or	mg / 100 ml	ASTM D 4898	1,0	
3 b	Number of particles	Nb / 100 ml	STANAG 3713		The figures quoted refer to those obtained using automatic particle counter calibrated with
	5 µm up to 25 µm > 25 µm up to 50 µm > 50 µm up to 100 µm > 100 µm			14000 500 120 35	(1) ISO 4402, ACFTD or
	6 µm up to 21 µm > 21 µm up to 38 µm > 38 µm up to 70 µm > 70 µm			14000 500 120 35	(2) ISO 11171, ISO MTD

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
4	Evaporation	wt %	In accordance with ASTM D 972 exception: temperature +71 °C	20	6 hrs @ 71 °C
5	Kinematic Viscosity	mm^2/s	ISO 3104		ASTM D445
	@ +100 °C			4,0 min.	
	@ + 40 °C			13,0 min.	
	@ - 40 °C			800 max.	
	@ - 54 °C			3500 max.	
6	Flash point	°C	ISO 2719	82 min.	ASTM D93
7	Pour point	°C	ISO 3016	- 59 max.	ASTM D97
8	Low temperature stability at – 54 °C for 72h		FTM 791 Method 3458	No gelation, precipitation or separation of solid or liquid phases	
9	Foaming at +24 °C		ISO 6247		ASTM D892
	Foam volume at end of				
	- 5 min blowing period	ml		65 max.	
	- 10 min setting period	ml		0	
10	Total acid number (TAN) at end point	mg KOH / g	ISO 6619	0,2 max	ASTM D664 technical equivalent

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
11	Corrosivity / oxidation stability		ASTM D4636 Procedure 2		168 hrs @ +121 °C Qualification test only
11 a	Weight change of test piece - Steel - Al alloy - Mg alloy - Cd plated steel - Cu	 mg / cm² mg / cm² mg / cm² mg / cm² mg / cm²		 + / - 0,2 + / - 0,2 + / - 0,2 + / - 0,2 + / - 0,6	
11 b	Appearance of test pieces			No pitting, etching or visible corrosion on the surface of any of the metals observed with 20x magnification. Cu corrosion not greater than classification 3	Slight discolouration of Cd will be permitted
11 c	Change in viscosity at +40 °C from original	%		- 5 min. 20 max.	
11 d	Increase in TAN (endpoint) from original	mg KOH / g		0,2 max.	
11 e	Appearance of the fluid after test			No visible separation of insoluble material or gumming	

NO	REQUIREMENTS	UNITS	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
12	Corrosion Protection (Humidity Cabinet)	-	ASTM D1748 (48,9 °C, 100 hrs)	No more than three (3) corrosion dots, no one of which is larger than 1 millimeter (mm) in diameter, occur on any of the surfaces of the prepared panels.	Other tests of corrosion protection in moisture are allowed (e.g. ISO 6270-2)
13	Corrosiveness (Bimetallic Couple)	-	ASTM D6547	Prevent corrosion, etching, pitting or staining on steel disks covered with a brass clip	The fluid shall be deemed failing if either one of the following are met: a. the test areas of more than one disk show signs of corrosion, pitting, or other attack. b. if two disks are free of corrosion, but the third shows more than three affected spots
14	Synthetic rubber swell (NBR-L according to SAE AMS 3217/2)	vol %	ISO 1817	19,0 min. 31,0 max.	168 hrs @ +70 °C
15	Shear stability Decrease in viscosity from original at +40 °C	%	ASTM D2603	not more than 2,0 percent greater than the decrease in viscosity of the reference fluid	Use 30 ml of fluid, test period is 30 minutes at 0 °C. Viscosity decrease of reference fluid is about 15% at 40 °C Note (1)
16	Steel on steel wear, average diameter of scar	mm	ASTM D4172 test condition B	1,0 max.	
17	Water content	mg / kg	ISO 10337	500 max.	

Note (1) ASTM Reference Fluid B may be obtained from Evonik, Rohmax USA, 723 Electronic Drive, Horsham, PA 19044-2228

SECTION 6 NATO GUIDE SPECIFICATION FOR HYDRAULIC FLUID, SYNTHETIC, LESS FLAMMABLE, H-544

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
1	Appearance		Visual	Clear, homogenous, free from visible impurities	
2	Colour		Visual	Yellow	
3	Solid particles either				
3 a	Gravimetric method or	mg / 100 ml	ASTM D4898	1,0	
3 b	Number of particles	Nb / 100 ml	STANAG 3713		The figures quoted refer to those obtained using automatic particle counter calibrated with
	5 µm up to 25 µm > 25 µm up to 50 µm > 50 µm up to 100 µm > 100 µm			14000 500 120 35	(1) ISO 4402, ACFTD or
	6 µm up to 21 µm > 21 µm up to 38 µm > 38 µm up to 70 µm > 70 µm			14000 500 120 35	(2) ISO 11171, ISO MTD
4	evaporation	wt %	ASTM D972	20	6,5 hrs @ +200 °C

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
5	Kinematic Viscosity @ +100 °C @ + 40 °C @ - 40 °C	mm^2/s	ISO 3104	 3,4 min. 19,5 max. 2600 max.	ASTM D445
6	Flash point	°C	ISO 2719	205 min.	ASTM D93
7	Pour point	°C	ISO 3016	- 55 max.	ASTM D97
8	Low temperature stability at –40 °C		FTM 791 Method 3458	No gelation, precipitation or separation of solid or liquid phases	
9	Foaming at +24°C Foam volume at end of - 5 min blowing period - 10 min setting period	 ml ml	ISO 6247	 65 max. 0	ASTM D892
10	Total acid number (TAN) at end point	mg KOH / g	ISO 6619	0,2 max.	ASTM D664
11	Synthetic rubber swell (NBR-L according to SAE AMS 3217/2)	vol %	ISO 1817	18,0 min. 30,0 max.	168 hrs @ +70 °C
12	Steel on steel wear, average diameter of scar	mm	ASTM D4172, test condition B	0,65 max.	
13	Water content	mg / kg	ISO 10337	500 max.	

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
14	Corrosivity / oxidation stability		ASTM D4636 Procedure 2		168 hrs @ +121 °C Qualification test only
14 a	Weight change of test piece - Steel - Al alloy - Mg alloy - Cd plated steel - Cu	 mg / cm² mg / cm² mg / cm² mg / cm² mg / cm²		 + / - 0,2 + / - 0,2 + / - 0,2 + / - 0,2 + / - 0,6	
14 b	Appearance of test pieces			No pitting, etching or visible corrosion on the surface of any of the metals observed with 20x magnification. Cu corrosion not greater than classification 3	light discolouration of Cd will be permitted
14 c	Change in viscosity at +40 °C from original	%		- 10 min. 10 max.	
14 d	Increase in TAN (endpoint) from original	mg KOH / g		0,2 max.	
14 e	Appearance of the fluid after test			No visible separation of insoluble material or gumming	
15	Corrosion Protection (Humidity Cabinet)	-	ASTM D1748 (48,9 °C, 100 hrs)	No more than three (3) corrosion dots, no one of which is larger than 1 millimeter (mm) in diameter, occur on any of the surfaces of the prepared panels.	Other tests of corrosion protection in moisture are allowed (e.g. ISO 6270-2)

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
16	Corrosiveness (Bimetallic Couple)	-	ASTM D6547	Prevent corrosion, etching, pitting or staining on steel disks covered with a brass clip	The fluid shall be deemed failing if either one of the following are met: a. the test areas of more than one disk show signs of corrosion, pitting, or other attack. b. if two disks are free of corrosion, but the third shows more than three affected spots

SECTION 7 NATO GUIDE SPECIFICATION FOR BRAKE FLUID, AUTOMOTIVE, POLYGLYCOL BASED, H-549

NO	REQUIREMENTS	UNITS OF MEASUREMENT	TEST METHODS	LIMITS	NOTES
(a)	(b)	(c)	(d)	(e)	(f)
1	General	-	SAE J 1703	As required in SAE J 1703	

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