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Aerospace series — Test fluids and test methods for electrical and optical components and sub-assemblies

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National foreword

This British Standard is the UK implementation of EN 3909:2016. It supersedes BS EN 3909:2007 which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Aerospace series - Test fluids and test methods for electrical and optical components and sub-assemblies

Série aérospatiale - Fluides d'essais et méthodes d'essai pour composants et sous-ensembles électriques et optiques

Luft- und Raumfahrt - Prüfflüssigkeiten und Prüfverfahren für elektrische und optische Bauelemente und Untergruppen

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European Foreword

This document (EN 3909:2016) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2016, and conflicting national standards shall be withdrawn at the latest by November 2016.

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1 Scope

This standard specifies the list of test fluids to be used to demonstrate that components and sub-assemblies will not be adversely affected by contamination by fluids types that they may typically be exposed to.

The fluids listed are representative of those commonly used and encountered in airborne and ground operations, and align with the requirements of fluids susceptibility of ISO 7137. This shall not be considered an exhaustive list and additional test fluids may be instructed in the product standard, against which compliance needs to be demonstrated. This standard, when used in conjunction with the test requirements defined in Clause 6 or the product standard shall be considered the starting point to test a component to determine its minimum performance capability when exposed to the fluids listed.

Test results obtained from a number of sources over a considerable period of time have shown that, in many cases, widely varying results can be obtained when using fluids that are used in service. The practice of specifying fluids based on performance criteria rather than their constituents can mean variations in test results between batches of the fluid obtained from different manufacturers, or even from the same manufacturer.

For this reason the EN 3909 Standard recommends the use of "standard test fluids" which are specified by their constituents and contain the chemicals that may be found in commonly used fluids.

Where equipment may be exposed to fluid types that are not covered by Table 1 or where specific test fluids are considered to be necessary, the product standard shall identify the particular fluid required. If a manufacturer chooses to include additional test fluids (e.g. to satisfy a customer requirement), they do so at their own risk.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2349-405, *Aerospace series — Requirements and test procedures for relays and contactors — Part 405: Fluid resistance*

EN 2591-315, *Aerospace series — Elements of electrical and optical connection — Test methods — Part 315: Fluid resistance*

EN 3475-411, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 411: Resistance to fluids*

EN 3745-411, *Aerospace series — Fibres and cables, optical, aircraft use — Test methods — Part 411: Resistance to fluids*

EN 3841-405, *Aerospace series — Circuit breakers — Test methods — Part 405: Fluid resistance*

EN 4057-303, *Aerospace series — Cable ties for harnesses — Test methods — Part 303: Resistance to fluids*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 7137, A*ircraft — Environmental conditions and test procedures for airborne equipment*

ISO 11075, *Aircraft — De-icing/anti-icing fluids — ISO type I*

ISO 11078, *Aircraft — De-icing/anti-icing fluids — ISO types II, III and IV*

MIL-PRF-87937, *Cleaning Compound, Aerospace Equipment*[1)]

AMS 1428G, *Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian, (Pseudoplastic), SAE Types II, III, and IV*[2)]

AMS 1476B, *Deodorant, Aircraft Toilet*[2)]

1) Published by: DoD National (US) Mil. Department of Defense (http://www.defenselink.mil/).

2) Published by: SAE National (US) Society of Automotive Engineers (http://www.sae.org/).

ASTM D740, *Standard Specification for Methyl Ethyl Ketone*[2)]

3 Test fluids

Unless specified in the relevant product standard, test specification or test method, all test fluids listed in Table 1, of this standard, are mandatory.

To ensure the optimum performance of all the test fluids, the shelf life and storage conditions must be maintained in accordance with the fluid manufacturer's recommendations.

4 Test samples

The test sample shall be either, a component or an assembly, as specified in the test method and/or product standard. The size and/or physical arrangement of each test sample or test assembly shall enable complete sample immersion into the test fluid in accordance with the test procedure.

5 Test procedures

Unless otherwise stated in the product standard, the following component types shall be tested in accordance with either; EN 2349-405 for relays and contactors, EN 2591-315 for electrical connectors and accessories, EN 3475-411 for cables, EN 3745-411 for fibre optic components, EN 3841-405 for circuit breakers or EN 4057-303 for cable ties, to confirm they are not susceptible to the fluids listed in Table 1.

For any other types of components requiring testing using the fluids listed in Table 1, the appropriate test procedures shall be as defined in the relevant product standard.

NOTE Unless otherwise specified in the product standard, the test specification shall control the complete test procedure including instructions such as cleaning the test samples and the choice of cleaning fluids (this should not result in further contamination).

6 Test temperatures

Test temperatures and flash point temperatures are as detailed in Table 1.

The test temperatures comprise a soak temperature in the test fluid; a conditioning period and a heat soak stage in air. The samples shall be inspected at ambient after the 3 stage cycle(s) as required by the product standard or technical specification.

The test temperatures listed in Table 1 comprise the recommended immersion fluid temperature followed by the recommended oven circulated air temperature. E.G. A sample to be tested in test fluid 'Gasoline' to ISO 1817 Liquid B (test fluid ref 1a), shall be immersed for 15 min to 20 min at 40 °C in the gasoline and removed. Stored for 7 h to 7,5 h at 23 °C. Placed in the oven for 16 h to 16,5 h at the relevant third phase temperature (refer to the product standard technical specification or test specification for the oven temperature).

7 Health and safety

It is the responsibility of the user to ensure all local and industrial health and safety requirements are followed during and after the test program. i.e. storage, use and disposal of test fluids.

The relevant Material Safety Data Sheet shall be consulted to establish safe handling of each fluid listed and tested. If there is any doubt the fluid supplier/manufacturer shall be consulted.

If the test temperature results in the fluid becoming a gas, the test authority shall determine the applicability of the test and the test facility shall ensure all health and safety measures are adhered to.

8 Information to be supplied in the product standard

The following information shall be supplied in the product standard:

1 Test procedures/method(s) to be used;

2 The quantity and sizes (including styles, etc.) of test samples;

3 Any departures from the test fluids and/or test protocol listed in this standard and the test procedure;

4 The test sample configuration (if not described by the relevant test procedure);

5 The pass/fail criteria for the characteristics under assessment.

Table 1 makes reference to a test fluid number. This reference may appear in the relevant test instruction as a numeric or a numeric and alpha. The new test reference numbers have been adopted to allow the selection of new fluids in accordance with changing environmental and business needs.

The old test fluid references shall not be used for test fluid call-up in new specifications. It is recommended that, wherever practical the test fluid shall be referred to by its full name or specification.

9 List of test fluids

For test fluids refer Table 1.

The relevant Material Safety Data Sheet (and the fluid supplier/manufacturer if necessary) shall be consulted to establish the characteristics and any special handling requirements associated with each fluid listed and tested. This includes establishing if a fluid is conductive or not. The fluid manufacturer shall be consulted if there are any doubts about a fluid or its characteristics.

Table 1 — List of test fluids

Test fluid No.		**Fluid family**	**Type**	**Test fluid to be used** (Consider Note 1)	**Fluid in service** (for reference)		**Test temperature ± 2 °C**	**Flash point °C**
New	**Old**							
1a	1	Fuels	Gasoline Toluene 30 % Isooctane 70 % v/v	ISO 1817 Liquid B	AVGAS-100LL	NATO-F-18	40	4
1b	2	(Hydro Carbon)	Kerosene	ISO 1817 Liquid F	AVTUR/FSI	NATO-F-34 (JP-8)	70	40
					AVTUR	NATO-F-35		
					AVTAG/FSII	NATO-F-40 (JP-4)		
					AVCAT/FSII	NATO-F-44 (JP5)		
1c	n/a	Biofuel	As specified in the product standard.	As specified in the product standard.	–	–	See Note 2.	See Note 3.
2a	3	Hydraulic Fluids	Phosphate based	ISO 1817 Liquid 103	Synthetic Fluid H580	Skydrol 500B4 Skydrol 5	70	160
2b	4		Silicone Based	NATO-S-1714	NATO-S-1714, ZX-42	–	80	140
2c	5		Mineral Based	NATO-H-520 OM-18	NATO-H-515, OM-15	NATO-H-520	80	80
3a	6	Oils	Mineral Based	–	NATO–O-1176, OMD-90	–	125	200
3b	7			NATO-O-142	NATO-O-142, OM-12	–	70	120
3c	8		Synthetic Oil Diester	ISO 1817 Liquid 101	NATO-O-147, OX-14	–	150	260
					NATO-O-149, OX-38	–	See Note 2.	See Note 3.
3d	9		Synthetic Oil Polyol ester	NATO-O-160, OX-26	NATO-O-156, OX-27	–	See Note 2.	See Note 3.
					NATO-O-148, OX-9	–	See Note 2.	See Note 3.
					NATO-O-160, OX-26	–	See Note 2.	See Note 3.
4a	10	Cleaning Fluids	Solvent	Isopropanol. See Note 4	NATO-S-737, AL-11	–	50	12
4b	n/a		See Note 1.	Ethanol. See Note 4.	NATO-S-738	–	See Note 2.	See Note 3.

Test fluid No.		**Fluid family**	**Type**	**Test fluid to be used** (Consider Note 1)	**Fluid in service** (for reference)		**Test temperature ± 2 °C**	**Flash point °C**
New	**Old**							
4c	11			Propanol 25 % + White spirit 75 % v/v	NATO-S-752 + NATO-S-753	–	25	See Note 3.
4d	12		Solvent	Methylethylketone ASTM-D740	Methylethylketone ASTM-D740	–	25	4
4e	13		Detergent	MIL-PRF-87937 Type IV	–	–	25	See Note 3.
4f	16		Sullage	AMS 1476B 5 % solution	AMS 1476B	–	See Note 2.	See Note 3.
5a	14	De-icing	Runway De-icers.	50 % Inhibited Potassium Acetate in Water	–	–	25	See Note 3.
5b	15	–	Aircraft De-icers. On Ground	Ethylene Glycol 80 % + Water 20 % v/v AMS 1428. See Note 4.	NATO-S-742	–	25	200
5c	n/a	–	–	Mono-propylene Glycol. See note 4 ISO 11075 ISO 11078	–	–	See Note 2.	See Note 3.
5d	–	–	Aircraft De-icers. In Flight	NATO-S-745 AL-5	NATO-S-745 AL-5	–	See Note 2.	177
6a	17/18	Fire Extinguishant	See Notes 5 & 6.					
7a	19	Cooling	Avionic Cooling	ISO 1817 Liquid 103	Polyalphaolefin PAO	NATO-S-1748	70	177

NOTE 1 It is no longer possible to obtain some materials prohibited by the Montreal Protocol for testing purposes in commercial test houses. However aerospace have been granted exemption for the continued use of these fluids. The user must satisfy them-selves regarding the compatibility of the materials used and the prohibited substance.

NOTE 2 At the time of preparing this standard, there is no indication of a preferred test temperature. It is recommended that users advise ASD-STAN if this test fluid is used and the procedure adopted, to encourage standardization of a test temperature where practical.

NOTE 3 If there is any doubt, it is recommended the test fluid manufacturer shall be consulted to confirm the relevant flashpoint (if applicable) of the test solution.

NOTE 4 Alternatives; either test fluid may be used from those indicated in the relevant fluid family.

NOTE 5 Due to restrictions and applicable by local laws, fire extinguishant shall not be discharged in non-critical situations.

NOTE 6 It is not possible to perform fluid immersion tests in a liquid state (on this gas) under standard Laboratory conditions.

10 General guidance

Components and equipment used in aircraft may be subjected to contamination by fluids, either through normal operation, accidental spillage or through leakage from faulty pipes or pipe joints.

The contaminating fluid may not be at an elevated temperature, but a component or equipment may become contaminated while at an elevated working temperature or after having been contaminated. Any effects may depend on the behavior of the contaminant at elevated temperature (e.g. if it is volatile it may disappear rapidly, but if it is non-volatile it may slowly oxidizes and a residue may remain).

Contamination effects may include packaging failure, crazing or swelling of plastics and rubbers, leaching of anti-oxidants and other soluble materials, seal failures, adhesion failures, paint/legend removal and corrosion.

Fuel (Fluid type 1)

In most cases fuels will be gasoline or kerosene.

Gasoline is expected to evaporate rapidly, possibly with few permanently harmful effects.

Kerosene is more persistent and damaging to many elastomers, particularly at elevated temperature.

Fuels do not normally affect paints and most plastics, but silicone resin bonded boards may tend to de-laminate after prolonged exposure.

Fuels may include additives to inhibit icing, or to dissipate static charges. Additives may increase the severity of the fuel and this shall be considered when selecting the fuel for a fluid test.

Hydraulic fluid (Fluid type 2)

In most cases hydraulic fluids, will be mineral oil or ester-based synthetic fluid.

Ester-based synthetic fluids are damaging to most elastomers and plastics.

Phosphate based ester synthetic fluids are especially damaging to elastomers, plastics and paint finishes.

Lubricating oil (Fluid type 3)

Lubricating oils will be either mineral or synthetic based.

Mineral oil is damaging to natural rubber, but not as aggressive on synthetic rubbers (e.g. polychloroprene, chloro-sulphonated polyethylene and silicone rubbers). Mineral oil may affect some plastics.

Synthetic lubricants are extremely damaging to plastics (e.g. polyvinyl chloride and elastomers).

Cleaning fluids (Fluid type 4)

Aircraft or vehicles, especially engines and their immediate surroundings, will need dirt and grease removed. The fluids listed in Table 1 are representative of those in current use.

Sullage appears within this fluid type but it is not solely a ‘cleaning fluid’, it refers to waste liquid from galleys and toilet compartments, where a leaky pipe or connection may permit contamination of adjacent components. The primary contaminating agent is likely to be the disinfectant used.

De-Icing fluid (Fluid type 5)

These fluids may often be applied at elevated temperature and under pressure, to leading edges, intakes, etc. These fluids are typically based on ethanediols (ethylene glycols).

Runway de-icers depress the freezing point of water.

Fire extinguishant

If a fire extinguishant has been discharged in the vicinity, it is unlikely that the components will be reused without a thorough examination and cleaning. The period of exposure to this contaminant is also rare.

Cooling (Fluid type 7)

This is a synthetic hydrocarbon base oil with additives. It may affect some plastics but may be more problematic with elastomers.

Other fluids (Not included in Table 1)

Aircraft and vehicles may be subjected to regional operational processes not covered by the test fluids in this standard. It is not possible or practical for this standard to address all the fluids used in aerospace applications. It is the responsibility of the customer to ensure that the products used are fit for their environmental applications.

A typical example of other fluid types is insecticides.

Aircraft flying in and through the tropics may be treated with insecticide sprays as a routine precaution. While it is unlikely that these will have a directly adverse effect on components or equipment, it may be necessary to make exploratory tests using a proprietary insecticide.

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