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AMENDMENT 1

AMENDEMENT 1

Environmental testing – Part 2-74: Tests – Test Xc: Fluid contamination

Essais d'environnement – Partie 2-74: Essais – Essai Xc: Contamination par des fluides

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Environmental testing – Part 2-74: Tests – Test Xc: Fluid contamination

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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FOREWORD

This amendment has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

The text of this amendment is based on the following documents:

CDV	Report on voting
104/739/CDV	104/791/RVC

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

2 Normative references

Replace the reference to ISO 1817:1985 with the following new reference:

ISO 1817:2015*, Rubber, vulcanized or thermoplastic – Determination of the effect of liquids*

3.1 Specification of test fluid

Replace the existing text with the following new text:

The relevant specification (see Clause 12) shall specify the required test fluids which shall wherever possible be selected from the list given in Table 1. Each fluid has been specified as being representative of a group of fluids. (See Clause A.2.) The actual composition of some of the fluids specified in Table 1 are provided for information in Table 2 and Table 3.

The relevant specification shall also specify any additional fluids not listed in Table 1 for which a test is required.

3.2 Precaution

Table 1 – Major contaminant fluid groups and test fluids

Replace Table 1 with the following new Table 1:

Table 1 – Major contaminant fluid groups and test fluids

Contaminant fluid group (See Annex A for description of contamination fluids including environmental and toxicological aspects.)		**Test fluid reference**	**Test fluid** [d] [e]	**Test temperature** (± 2 °C) [c]
Fuels	Kerosene (turbine) fuel	(a)	ISO 1817:2015, Test liquid F (see Table 2)	70 [a]
	Diesel fuel			
	Gasoline (piston engine) fuel	(b)	ISO 1817:2015, Test liquid B (see Table 2)	40[a]
Hydraulic fluids	Mineral oil based	(c)	NATO H-520 (ON-18) (or as an alternative NATO H-515)	70
	Phosphate ester based (synthetic)	(d)	ISO 1817:2015, Test liquid 103 (see Table 3)	70
	Silicone based	(e)	Dimethyl silicone fluid grade 10 (10 mm^2/s (cSt) at 25 °C) NATO S-1714 (Joint Service designation ZX-42)	70
Lubricating oils	Mineral based	(f)	SAE 10W/30 NATO O-1176 (Joint Service designation OMD 90)	70
	Ester based (synthetic)	(g)	ISO 1817:2015, Test liquid 101 (see Table 3)	150
Solvents and cleaning fluids		(h)	Propan-2-ol (isopropyl alcohol); CAS No 67-63-0, (BS 1595-1, ASTM D770 and DIN 53245)	50 [a]
		(i)	Denatured alcohol (methylated spirits)	23
		(j)	Detergent	23
De-icing and antifreeze fluids		(k)	Inhibited ethanediol (ethylene glycol) CAS No 107-21-1 with a volume fraction of 80 % in water	23
		(l)	Inhibited ethanediol (ethylene glycol) CAS No 107-21-1 with a volume fraction of 50 % in water	23
Runway de-icers		(m)	Ethylene glycol CAS No 107-21-1 (25 % urea / 25 % ethylene glycol in water)	23
		(n)	Potassium acetate CAS No 127-822-2 50 % inhibited potassium acetate in water	23
Insecticides		(o)	Dichlorvos (DDVP) pyrethrum based, CAS No 62-73-7 (2 % solution in kerosene CAS No 8008-20-6)	23
		(p)	D – phenothrin CAS No 26002-80-2 2 % solution in kerosene CAS No 8008-20-6	23
Coolant dielectric fluids		(q)	Silicate ester dielectric heat transfer fluid (commercial product "Coolanol 25R™" [b])	70

Contaminant fluid group (See Annex A for description of contamination fluids including environmental and toxicological aspects.)	**Test fluid reference**	**Test fluid** [d] [e]	**Test temperature** (± 2 °C) [c]
Fire extinguishants	(r)	Fluoroprotein foam (NATO Stock #4210 99 224 6854)	23
	(s)	Aqueous film forming foam (AFFF) containing fluorochemical surfactants	23

[a] The indicated temperature exceeds the critical flash point temperature.

[b] Coolanol 25R™ is the tradename of a product supplied by ExxonMobil. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[c] See Clauses 8, 9, 10 and A.7.

[d] Wherever possible the fluid given is specified in an international standard or is described by its constituent chemicals. In some cases a NATO identification has been used in preference to a commercial identification. Reference to the relevant commercial literature can correlate to the NATO number with commercially available fluids.

[e] CAS No. refers to Chemical Abstracts Service Number (www.cas.org).

Add, after Table 1, the following new Table 2 and Table 3:

Table 2 – Standard simulated fuels

ISO 1817:2015 Test fluid	**Liquid constituents**	**Content** % (by volume)	**CAS Registry Number**	**Application**
B	2,2,4-trimethylpentane	70	540-84-1	Liquid B is intended to simulate petroleum-derived fuels without oxygen compounds.
	toluene	30	108-88-3	
F	straight-chain paraffins (C12 to C18)	80	68476-34-6	Liquid F is intended to simulate diesel fuel, domestic heating oils and similar light furnace oils.
	1-methylnaphthalene	20	90-12-0	

Table 3 – Simulated service liquids

ISO 1817:2015, Test fluid	**Liquid constituents**	**Content** % (by mass)	**CAS Registry Number**	**Application**
101	di-2-ethylhexyl sebacate	99,5	122-62-3	Intended to simulate synthetic diester-type lubricating oils.
	phenothiazine	0,5	92-84-2	
103	tri-*n*-butyl phosphate	100	126-73-8	Intended to simulate phosphate-ester hydraulic oils used in aircraft.

Annex A

A.2 Contaminating fluids and their effects

Replace Clause A.2 with the following new Clause A.2:

A.2 Contaminating fluids and their effects

A.2.1 General

Components and equipment may be subject to contamination by fluids, either through normal operation, accidental spillage or through leakage, for example from faulty pipes or pipe joints.

The contaminating fluid may not be at an elevated temperature, but a component or equipment may become contaminated whilst it is at its elevated working temperature or it may attain such a temperature after having been contaminated. Any effect may thus depend upon the behaviour of the contaminant at elevated temperature, for example if it is volatile it may disappear rapidly. If it is non-volatile and oxidizes slowly, a hard residue may remain.

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

A number of standards exist which, although not referred to in this part of IEC 60068 in a normative capacity, may be used in an informative capacity by specification writers (see Clause A.10).

A.2.2 Fuels

Fuels vary widely in composition even within the same grade and from the same source. Hydrocarbon-based fuels will, for the most part, be of the gasoline or kerosene type. The grade of gasoline is improved by adding aromatic or oxygen-containing compounds, but these additives increase the effect of fuels on normally fuel-resistant material. The composition varies with the situation on the gasoline market, with the geographical area and can change rapidly. Gasoline may be expected to evaporate rapidly, possibly with few permanently harmful effects. However, kerosene may be more persistent and damage elastomers, particularly at elevated temperatures. Fuels do not normally affect paints and most plastics, but silicone resin bonded boards may tend to de-laminate after prolonged exposure. Some fuels may have additives to inhibit icing or to dissipate static charges. Where there is reason to believe that these additives may increase the severity of the test, they may be included.

The standard fuels historically used for contamination test purposes are test liquids B and F of ISO 1817:2015, representing gasoline and diesel/kerosene respectively. ISO 1817:2015 recommends several test liquids of which those in ISO 1817:2015, Table A.1 represent fuels without oxygen compounds and those of ISO 1817:2015, Table A.2 represent fuels with oxygen compounds. Analytical reagent quality materials should be used in making up the test liquids. Test liquids containing alcohol should not be used if the fuels involved are known to be free of alcohol.

Fuels and oils can ignite and, under certain circumstances, will cause explosion. The flash points of kerosene and gasoline are 46 °C and -18 °C respectively. The open burning of fuel and oils will produce environmental pollution. Fuel and oils, when in contact with skin, can promote de-fatting. Spillage of fuel and oils may result in contamination of waterways and underground water supplies. Three hundred litres of gasoline has the capacity to produce a surface film over 1 km^2 of water. Carcinogenic chemicals such as benzene are present in fuels; oils often contain other toxic elements. Spillage can cause toxic pollution of waterways and underground water supplies.

A.2.3 Hydraulic fluids

Commonly used hydraulic fluids may be of the natural or synthetic types, see A.2.4 for the former; and may be at elevated temperatures in their working states. Phosphate ester based hydraulic fluids are especially damaging to these materials and to paint finishes. The hydraulic fluids used for contamination test purposes encompass mineral oil based (using NATO H-520 or NATO H-515), phosphate ester based synthetic fluids (using test liquid 103 from ISO 1817:2015 – see ISO 1817:2015, Table A.3) and silicone based synthetic fluids (using NATO S-1714 which are dimethyl silicone based). The latest issue of ASTM D471 indicates that some constituents of hydraulic test fluids, common to ISO 1817:2015, are no longer available and suggests alternatives.

A.2.4 Lubricating oils

Mineral or synthetic-based lubricating oils may be at elevated temperatures in their working states. Mineral oil is damaging to natural rubber but less so to synthetics such as polychloroprene, chloro-sulphonated polyethylene and silicone rubber. Synthetic lubricants are extremely damaging to plastics such as PVC as well as many elastomers. The lubricating oils used for contamination test purposes encompass mineral oil (NATO O-1176) and synthetic oil (using ester based test liquid 101 of ISO 1817:2015).

A.2.5 Solvents and cleaning fluids

Many areas of aircraft or vehicles may require dirt or grease removal before servicing can begin. The test fluids given in Table 1 are representative of the solvents and cleaning fluids utilized which can encompass denatured alcohol, isopropyl alcohol (specifically propan-2-ol) and trans-1-2 dichloroethylene (which is a replacement for trichloroethane which has been withdrawn because of its safety and environmental concerns). The solvents and cleaning fluids used for contamination testing purposes also encompass a detergent cleaning compound used on aircraft surfaces.

Propan-2-ol is flammable. Denatured alcohol is both toxic and flammable. It consists of a mixture of approximately 95 % ethyl alcohol, 5 % methyl alcohol and minor ingredients such as pyridine. Detergent manufactured from biodegradable phosphates, sodium sulphate and sodium carboxy methyl cellulose is a conventional laundry substance. However, untreated discharge of such substances into waterways may be prohibited by national regulations.

A.2.6 De-icing and anti-freeze fluids

De-icing and anti-freeze fluids may be applied, often at elevated temperatures, to the leading edges, intakes, etc., of aircraft and may penetrate areas where they can contaminate components and equipment. Runway de-icers are used on runways and other areas to lower the freezing point of water. They may penetrate undercarriage and equipment bays of aircraft as a fine mist. Such de-icing and anti-freeze fluids are based, typically, on inhibited ethylene glycols. This document does not encompass de-icing fluids arising from the use of salt (NaCl), for example as used on roads, because appropriate test procedures can be found in IEC 60068-2-52:2017.

All aqueous solutions of ethylene glycol are toxic and the inclusion of urea will promote the growth of algae. A 50 % inhibited aqueous potassium acetate solution is commercially marketed and reputed to be a completely safe alternative to the ethylene glycols. However, its interaction with aluminium alloys is less than satisfactory.

A.2.7 Insecticides

In the tropics equipment may be treated with insecticide sprays as a routine precaution. This can include aircraft flying in and through the tropics. 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. The insecticides used for test purposes are: DDVP

(dichlorvos pyrethrum based, 2 % solution in kerosene) and d-phenothrin 2 % solution in kerosene.

Most insecticides may be considered toxic to man. If the delivery medium for the insecticide is a kerosene type (fuel/oil) spray or mist, many of the features referred to for fuels above will also apply.

A.2.8 Coolant dielectric fluids

Coolant dielectric fluids are used as thermal transfer liquids to assist cooling of certain equipment. They are usually based on silicate ester materials, and their effects on materials may be considered to be similar to the phosphate ester hydraulic fluids, although not quite as severe. The coolant dielectric fluid historically used for contamination evaluation purposes is the commercial product "Coolanol 25R™" which is a silicate ester fluid. Phosphate ester hydraulic fluids are no longer in use in some countries.

In the event of fire or leakage of silicate ester fluids onto a hot surface, they will emit fumes that are irritating, noxious and possibly toxic. The most recent coolants are based on polymerised alpha olefines which are both non-toxic and generally inert.

A.2.9 Fire extinguishants

Halon (chlorobromofluorohydrocarbon) or similar compounds are likely to be used on aircraft, but are short-lived. Ground-based extinguishants are aqueous foams derived from fluoro chemicals or fluoroproteins. Their effects will be mainly due to water or build up of trapped residues. The necessity for testing with these products will only be required if there is a need to maintain equipment operation after release of the extinguishant. The extinguishant that may be considered for test purposes are: protein (NATO Stock #4210 99 224 6855), fluoroprotein foam (NATO Stock #4210 99 224 6854) and aqueous film forming foams (AFFF) containing fluorochemical surfactants.

Add the following new Bibliography:

Bibliography

ASTM D471, *Standard Test Method for Rubber Property – Effect of Liquids*

ASTM D770, *Standard Specification for Isopropyl Alcohol*

BS 1595-1, *Propan-2-ol (isopropyl alcohol) for industrial use – Specification for propan-2-ol (isopropyl alcohol)*

DIN 53245, *Solvents For Paints, Varnishes And Similar Coating Materials – Alcohols – Requirements And Test Methods*

IEC 60068-2-52:2017, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

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