
**Road vehicles — Environmental
conditions and testing for electrical
and electronic equipment —**

**Part 5:
Chemical loads**

*Véhicules routiers — Spécifications d'environnement et essais de
l'équipement électrique et électronique —*

Partie 5: Contraintes chimiques

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

This third edition cancels and replaces the second edition (ISO 16750-5:2010), which has been technically revised.

The main changes are as follows:

- integrating and harmonizing contents from ISO 19453-5:2018 (e.g. change of [Table 2](#));
- reorganization of test conditions and application methods in context ([4.6](#), [4.7](#));
- addition of application method ([4.6](#), [Table 1](#));
- reconsideration of chemical agents ([Clause 5](#), [Table 3](#)).

A list of all parts in the ISO 16750 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Road vehicles — Environmental conditions and testing for electrical and electronic equipment —

Part 5: Chemical loads

1 Scope

This document applies to electric and electronic systems and components for vehicles including electric propulsion systems and components with maximum working voltages according to voltage class B. It describes the potential environmental stresses and specifies tests and requirements recommended for the specific mounting location on/in the vehicle.

This document describes chemical loads.

This document is not intended to apply to environmental requirements or testing for systems and components of motorcycles and mopeds.

NOTE Conditions and testing for a continuous contact with chemical agents can be determined from other standards or upon agreement between the customer and the supplier.

Systems and their components released for production, or systems and their components already under development prior to the publication date of this document, can be exempted from fulfilling the changes in this edition compared to the previous one.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16750-1, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

ISO 16750-4, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16750-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Tests

4.1 General

Components and associated parts that can come into contact with the specified chemical agents shall be resistant to those agents. The components and associated parts shall be tested with all agents they are likely to come into contact with, except for those materials which can be shown by documentary evidence to be immune to the contaminant.

A material is considered to be immune to a contaminant if there is no change in properties sufficient to affect material performances over the time and at the temperature specified in this clause.

The documentary evidence of immunity shall be provided for any operating conditions that could be relevant for the DUT, also including the effects of operating temperature and self-heating if deemed necessary as agreed between the customer and the supplier.

The customer and the supplier shall agree on the type of chemical agents and the manufacturer.

Resistance to the specified chemical agents shall be considered as early as possible during the material selection process.

4.2 Purpose

The purpose of the test is to determine whether systems/components are unacceptably affected by temporary exposure to contaminating agents.

NOTE This test is not intended to be a life test.

4.3 General test conditions

Chemical agents shall be selected as defined in [Table 2](#), depending on the mounting location of the DUT.

Unless otherwise specified, one DUT per test agent shall be used.

The following tests describe one test cycle. Unless otherwise specified, one test cycle with one agent per DUT shall be performed. Any other number of cycles may be agreed between the customer and the supplier.

During test cycle, the DUT shall be in operating mode 1.2 as defined in ISO 16750-1. Operating mode 1.1 as defined in ISO 16750-1 with protection seals (e.g. sealed mating connector) can be used if agreed between the customer and the supplier.

NOTE 1 Operating mode with electrical operation can be used if agreed between the customer and the supplier, and if judged feasible from test setup perspective.

NOTE 2 If the size of the DUT is sufficient, multiple test agents can be applied partially on one DUT provided that these do not have any influence on each other.

NOTE 3 When only some part of the DUT (e.g. front panel part of audio) is exposed to chemicals, this test can be performed with the applicable part by agreement between the customer and the supplier. In this case, it is also relevant to consider sealings, barriers, or other parts of the system that is preventing the exposure of chemical agents to the hidden parts of the DUT.

4.4 DUT conditioning

Unless otherwise specified, the DUT shall be stored at a room temperature (RT) of $(23 \pm 5) ^\circ\text{C}$ and a relative humidity (RH) of between 25 % and 75 % until thermal equilibrium is reached.

The DUT shall be tested under conditions of normal use. If necessary, and unless otherwise specified, unrepresentative coatings or contaminations of the DUT shall be removed.

If a cleaning procedure is needed, the customer and the supplier shall agree on the methodology.

4.5 Test agent conditioning

All test agents shall be stabilised at an RT of (23 ± 5) °C when applied on the DUT.

4.6 Application method

The application method shall be such that the DUT is sufficiently wetted by the chemical agent in the areas to be tested. Possible application methods are listed in [Table 1](#) as code I to VI. Refer to [4.7](#) for the preferred application method (see also [Table 2](#)).

Unless otherwise specified, the application method shall be performed at an RT of (23 ± 5) °C and an RH of between 25 % and 75 %.

Table 1 — Application methods

Code	Method	Description of method
I	Spraying	Spray the chemical agent using for instance a spray bottle. Spray until DUT is wetted, agent not dripping off.
II	Brushing	Apply the chemical agent on a soft brush and then brush the DUT with low force, brushing until DUT is wetted, agent not dripping off.
III	Wiping	For example, wipe with chemical agent wetted but not dripping cotton cloth, wipe with light finger pressure. Wipe until DUT is wetted, agent not dripping off.
IV	Pouring	Sprinkle the chemical agent over the DUT using for instance a funnel or dropper. Sprinkle until DUT is wetted, agent not dripping off.
V	Dipping	Completely submerge the DUT for a very short time, i.e. brief immersion.
VI	Immersing	Completely submerge the DUT until no more air bubbles are emerging.

4.7 Test conditions

Test conditions are given as chemical loads for the DUT which are defined as chemical agent, application method, test temperature and test duration. The preferred application method in [Table 2](#) shall be selected depending on chemical agent and the mounting location of the DUT.

Unless otherwise specified, test temperature and test duration in [Table 2](#) shall be applied.

Table 2 — Test conditions for the DUT

ID	Chemical agent	Preferred application methods for the mounting location ^a				Exposure conditions	
		Engine/ electric motor compartment [A] ^b	Passenger compartment [B] ^b	Luggage compartment [C] ^b	Mounting on the exterior [D] ^b	Test temperature °C	Test duration
AA	Diesel fuel	I, III, IV, V	c	c	c	T_{max}^d	22 h
AB	“Bio” diesel	I, III, IV, V	c	c	c	T_{max}^d	22 h
AC	Petrol/gasoline unleaded	III, IV, V	c	c	c	RT	10 min
AD	Kerosene	c	c	II, III, IV, V	c	RT	10 min
AE	Methanol	II, III, IV, V, VI	c	c	c	RT	10 min
BA	Engine oil	II, III, IV, V	c	c	c	T_{max}^d	22 h
BB	Differential oil	II, III, IV, V, VI	c	c	c	T_{max}^d	22 h
BC	Transmission fluid	II, III, IV, V, VI	c	c	c	T_{max}^d	22 h
BD	Hydraulic fluid	II, III, IV, V	c	c	c	T_{max}^d	22 h
BE	Greases	II, III	c	c	c	T_{max}^d	22 h
BF	Silicone oil	I, II, III, V	I, II, III, V	I, II, III, V	c	T_{max}^d	22 h
CA	Battery fluid	III, V	III, V	III, V	c	RT	22 h
CB	Brake fluid	II, III, V	c	c	c	T_{max}^d	22 h
CC	Antifreeze fluid	I, III, IV, V, VI	c	c	c	T_{max}^d	22 h
CD	Urea NOx (reduc- tion agent)	II, III, V	c	c	II, III, V	T_{max}^d	22 h
CE	Cavity protection	c	c	c	II, III	RT	22 h
CF	Temporary pro- tective lacquer / transport wax	I, II	c	c	I, II	RT	22 h
CG	Temporary pro- tective lacquer re- mover / transport wax remover	I, III, IV, V	c	c	I, III, IV, V	T_{max}^d	22 h
DA	Windscreen washer fluid	II, III, IV, V	c	II, III, IV, V	II, III, IV, V	RT	2 h
DB	Vehicle washing chemicals	I, II, III, IV, V	c	c	I, II, III, IV, V	RT	2 h
DC	Interior cleaner	c	I, III	I, III	c	RT	2 h

^a Application methods (code I, II, III, IV, V and VI) corresponds to the codes in [Table 1](#).

^b The mounting location of the DUT corresponds to the category of location defined in ISO 16750-1. Depending on the mounting location, choose code A, B, C or D. Chemical loading can vary significantly depending on the type and use of the vehicle. For other requirements agreed between the customer and the supplier, choose code Z and mark all agents to be tested. Additional agents may be agreed between the customer and the supplier.

^c Chemical agents are not applied.

^d Test temperature: the maximum operating temperature, T_{max} , shall be in accordance with ISO 16750-4.

Table 2 (continued)

ID	Chemical agent	Preferred application methods for the mounting location ^a				Exposure conditions	
		Engine/ electric motor compartment [A] ^b	Passenger compartment [B] ^b	Luggage compartment [C] ^b	Mounting on the exterior [D] ^b	Test temperature °C	Test duration
DD	Glass cleaner	c	I, III	I, III	I, III	RT	2 h
DE	Wheel cleaner	c	c	c	I, II, III, IV	RT	2 h
DF	Cold cleaning agent	I, II, III, IV, V, VI	c	I, II, III, IV, V, VI	I, II, III, IV, V, VI	RT	22 h
DG	Acetone	c	I, II, III	c	c	RT	10 min
DH	Cleaning solvent white spirit	I, II, III	c	c	c	RT	10 min
DJ	Ammonium-containing cleaner	c	II, III, V	II, III, V	II, III, V	RT	22 h
DK	Denatured alcohol	I, II, III, IV, V	I, II, III, IV, V	I, II, III, IV, V	I, II, III, IV, V	RT	10 min
DL	Alkaline detergent	III, IV, V, VI	c	c	I, II, III, IV, V, VI	RT	22 h
EA	Contact spray	I, II, III	c	c	c	T_{\max}^d	22 h
EB	Transpiration	c	II, III, V	c	c	RT	22 h
EC	Cosmetic product	c	II, III	II, III	c	RT	22 h
ED	Refreshment containing caffeine and sugar	c	III, IV	c	c	RT	22 h
EE	Runway de-icer	I, II, IV	c	c	I, II, IV	RT	2 h
EF	Dairy product	c	III, IV	c	c	RT	22 h
YY	Additional agents ^b	—	—	—	—	—	—

^a Application methods (code I, II, III, IV, V and VI) corresponds to the codes in [Table 1](#).

^b The mounting location of the DUT corresponds to the category of location defined in ISO 16750-1. Depending on the mounting location, choose code A, B, C or D. Chemical loading can vary significantly depending on the type and use of the vehicle. For other requirements agreed between the customer and the supplier, choose code Z and mark all agents to be tested. Additional agents may be agreed between the customer and the supplier.

^c Chemical agents are not applied.

^d Test temperature: the maximum operating temperature, T_{\max} , shall be in accordance with ISO 16750-4.

4.8 Procedure

The DUT shall be exposed to the agent (see [Table 3](#)) as defined in the application methods (see [Table 1](#)) at RT. The DUT shall then be stored in a suitable chamber at the temperature and for the duration specified in [Table 2](#). If required, the DUT shall be cooled down to RT after storage and tested as specified below.

During the whole procedure, any safety and warning notes shall be observed.

- Perform a visual check and, if appropriate, a functional test and record data for comparison with post-test data.
- Condition the DUT (see [4.4](#)).

- c) Place the DUT in its specified test setup. The configuration may include appropriate electrical or mechanical connections.
- d) Stabilise the temperature of the specified agent(s) (see 4.5). Apply the specified agent(s) as defined in Table 2 and 4.6 to the surface of the DUT that is likely to be exposed.
- e) Allow the DUT to drain naturally. Shaking or wiping is not permitted. However, if representative of service conditions, it may be turned about any axis to allow for drainage from different positions.
- f) Maintain the DUT at the temperature and for the duration specified in Table 2.
- g) Stabilise the DUT at RT.
- h) For more than 1 cycle, repeat steps d) to g).
- i) Examine the DUT immediately as defined in the requirements in 4.9.

NOTE Remaining agents can be wiped off before examination to avoid the influence of residual agents.

4.9 Requirements

The minimum functional status shall be class C as defined in ISO 16750-1. If necessary, other requirements shall be agreed between the customer and the supplier.

Marking and labelling shall remain visible and legible (e.g. high voltage caution labels).

5 Documentation

For documentation, Table 2 specifies the codes for chemical load, and the designations outlined in ISO 16750-1 shall be used.

Table 3 — Chemical agents

Group	ID	Chemical agent	Description of active substance ^a
Fuels	AA	Diesel fuel	See EN 590
	AB	“Bio” diesel	See EN 14214
	AC	Petrol/gasoline unleaded	See EN 228
	AD	Kerosene	See ASTM D 1655 ^b
	AE	Methanol	CAS 67-56-1 ^c

^a Suppliers or trademarks are given for certain chemical agents in this table.

^b ASTM: American Society for Testing and Materials.

^c CAS: Chemical Abstract Service.

^d SAE: Society of Automotive Engineers.

^e API: American Petroleum Institute.

^f Also known as “ad blue”.

^g The referenced agent can be used or a distinct agent shall be agreed between the customer and the supplier.

^h These products are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

Table 3 (continued)

Group	ID	Chemical agent	Description of active substance ^a
Oils and lubricants	BA	Engine oil	Multigrade oil (SAE 0W40d, API SL/CFe, SAE 5W30d, SAE 0W20d)
	BB	Differential oil	Hypoid gear oil (SAE 75W140d, API GL-5e)
	BC	Transmission fluid	e.g. ATF Dexron III ^{g,h}
	BD	Hydraulic fluid	See DIN 51524-3 (HVLV ISO VG 46)
	BE	Greases	See DIN 51502 (KP2K-30)
	BF	Silicone oil	CAS 63148-58-3 (AP 100) ^c
Other operating agents	CA	Battery fluid	37 % H ₂ SO ₄ + 63 % distilled water
	CB	Brake fluid	See ISO 4925
	CC	Antifreeze fluid	Ethylene glycol (C ₂ H ₆ O ₂) - water mixture 1:1
	CD	Urea NO _x (reduction agent) ^f	See ISO 22241-1
	CE	Cavity protection	e.g. Teroson Underbody Coating Spray ^{TM,g,h}
	CF	Temporary protective lacquer /transport wax	e.g. W550 TM (supplied by Pfinder Chemie) ^{g,h} Dinitrol 81 TM (supplied by Dinitrol) ^{g,h}
CG	Temporary protective lacquer remover / transport wax remover	Water with addition of 5 % low-aromatic white spirit	
Cleaning agents	DA	Windscreen washer fluid	5 % anionic tenside, deionized water e.g. Antifrost + Klarsicht TM (supplied by Sonax) ^{g,h}
	DB	Vehicle washing chemicals	CAS 25155-30-0 ^c ; CAS 9004-82-4 ^c
	DC	Interior cleaner	e.g. Motip Cockpit Spray ^{TM,g,h}
	DD	Glass cleaner	CAS 111-76-2 ^c ; CAS 9003-13-8 ^c
	DE	Wheel cleaner	e.g. Sonax Xtreme ^{TM,g,h}
	DF	Cold cleaning agent	e.g. BONDERITE C-SO 101(supplied by Henkel) ^{g,h}
	DG	Acetone	CAS 67-64-1 ^c
	DH	Cleaning solvent white spirit	See DIN 51635
	DJ	Ammonium-containing cleaner	e.g. Bendurol forte TM (supplied by Ecolab) ^{g,h}
	DK	Denatured alcohol	CAS 64-17-5 (ethanol) ^c
DL	Alkaline detergent	e.g. mixture of Vorreiniger B TM (supplied by Koch Chemie) ^{g,h} with water 1:3	

^a Suppliers or trademarks are given for certain chemical agents in this table.

^b ASTM: American Society for Testing and Materials.

^c CAS: Chemical Abstract Service.

^d SAE: Society of Automotive Engineers.

^e API: American Petroleum Institute.

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^g The referenced agent can be used or a distinct agent shall be agreed between the customer and the supplier.

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