INTERNATIONAL STANDARD

ISO 16750-4

Second edition
2006-08-01

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

Part 4: Climatic loads

Véhicules routiers — Spécifications d'environnement et essais de l'équipement électrique et électronique —
Partie 4: Contraintes climatiques

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16750-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 16750-4:2003), which has been technically revised.

ISO 16750 consists of the following parts, under the general title *Road vehicles — Environmental conditions and testing for electrical and electronic equipment*:

— *Part 1: General*

— *Part 2: Electrical loads*

— *Part 3: Mechanical loads*

— *Part 4: Climatic loads*

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

Part 4: Climatic loads

1 Scope

ISO 16750 applies to electric and electronic systems/components for road vehicles. It describes the potential environmental stresses and specifies tests and requirements recommended for the specific mounting location on/in the vehicle.

This part of ISO 16750 describes the climatic loads.

2 Normative references

The following referenced documents are indispensable for the application 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 16750-2, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads*

ISO 20653, *Road vehicles — Degrees of protection (IP-Code) — Protection of electrical equipment against foreign objects, water and access*

IEC 60068-2-1, *Environmental testing — Part 2: Tests. Tests A: Cold*

IEC 60068-2-2, *Environmental testing — Part 2: Tests. Tests B: Dry heat*

IEC 60068-2-11, *Environmental testing — Part 2: Tests. Test Ka: Salt mist*

IEC 60068-2-14, *Environmental testing — Part 2: Tests. Test N: Change of temperature*

IEC 60068-2-30, *Environmental testing — Part 2-30: Tests. Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-38, *Environmental testing — Part 2: Tests. Test Z/AD: Composite temperature/humidity cyclic test*

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

IEC 60068-2-60, *Environmental testing — Part 2: Tests — Test Ke: Flowing mixed gas corrosion test*

IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

3 Terms and definitions

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

4 Operating temperature ranges

Table 1 defines operating temperature ranges. The applicable temperature ranges shall be chosen from Table 1 and shall be given in the specification of the *device under test* (DUT).

Table 1 — Operating temperature ranges

Code	T_{min} °C	T_{max} °C
A	–20	65
B	–30	65
C	–40	65
D		70
E		75
F		80
G		85
H		90
I		95
J		100
K		105
L		110
M		115
N		120
O		125
P		130
Q		140
R		150
S		155
T		160
Z	as agreed upon	

In case of hot-soak requirements (T_{maxHS}), add 15 °C to T_{max}. For details see 5.3.1.

The paint repair temperature (T_{maxPR}) can be higher than the operating temperature and shall be given in the specification of the DUT. An applicable test shall be agreed between supplier and vehicle manufacturer.

5 Tests and requirements

5.1 Tests at constant temperature

5.1.1 Low-temperature tests

5.1.1.1 Storage

5.1.1.1.1 Purpose

This test simulates the exposure of the DUT to low temperatures without electrical operation, e.g. during shipment of the system/component. Failure mode is insufficient frost resistance, e.g. freezing of liquid crystal displays.

5.1.1.1.2 Test

Perform the test according to IEC 60068-2-1 cold at a temperature of –40 °C for a duration of 24 h unless otherwise specified in the DUT specification. The operating mode of the DUT is 1.1 as defined in ISO 16750-1.

5.1.1.1.3 Requirement

Functional status shall be class C as defined in ISO 16750-1.

5.1.1.2 Operation

5.1.1.2.1 Purpose

This test simulates the exposure of the DUT to low temperatures with electrical operation, e.g. the use of the system/components at very low ambient temperature. Failure mode is electrical malfunction caused by low temperature, e.g. freezing of capacitors with liquid electrolyte.

5.1.1.2.2 Test

Perform the test according to IEC 60068-2-1 cold at a temperature of T_{min} for a duration of 24 h. The operating mode of the DUT is 3.2 as defined in ISO 16750-1.

5.1.1.2.3 Requirement

The functional status shall be class A as defined in ISO 16750-1.

5.1.2 High-temperature tests

5.1.2.1 Storage

5.1.2.1.1 Purpose

This test simulates the exposure of the DUT to high temperatures without electrical operation, e.g. during the shipment of the system/component. Failure mode is insufficient heat resistance, e.g. warping of plastic housings.

5.1.2.1.2 Test

Perform the test according to IEC 60068-2-2 dry heat at a temperature of 85 °C for a duration of 48 h unless otherwise specified in the DUT specification. The operating mode of the DUT is 1.1 as defined in ISO 16750-1.

5.1.2.1.3 Requirement

The functional status shall be class C as defined in ISO 16750-1.

5.1.2.2 Operation

5.1.2.2.1 Purpose

This test simulates the exposure of the DUT to high temperatures with electrical operation, e.g. the use of the system/components at very high ambient temperature. Failure mode is electrical malfunction caused by high temperature, e.g. thermal degradation of components.

5.1.2.2.2 Test

Perform the test according to IEC 60068-2-2 dry heat at a temperature of T_{max} for a duration of 96 h. Use operating mode 3.2 as defined in ISO 16750-1.

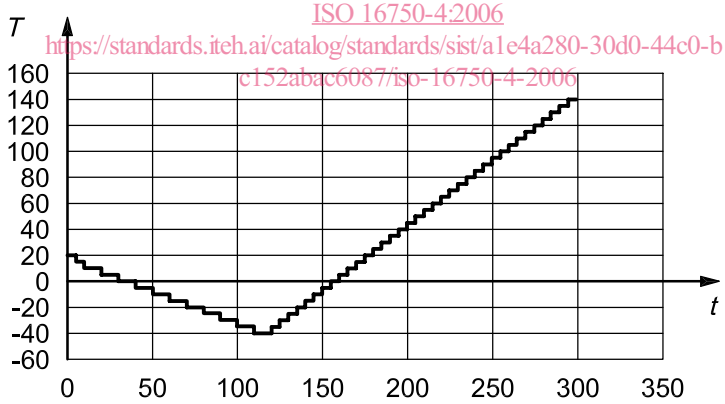
5.1.2.2.3 Requirement

The functional status shall be class A as defined in ISO 16750-1.

5.2 Temperature steps

5.2.1 Purpose

This test checks the mechanical and electrical device for malfunctions which may occur within a small section of the operating temperature range. See Figure 1.



Key

T temperature, °C

t time, min

Figure 1 — Temperature step test (example illustrates code "Q" according to Table 1)

5.2.2 Test

Install the DUT in a temperature chamber, decrease the temperature in steps of 5 °C from 20 °C to T_{min} and then increase the temperature in steps of 5 °C from T_{min} to T_{max} (see Table 1). Wait at each step until the DUT has reached the new temperature. Perform functional tests operating mode 3.2 according to ISO 16750-1 at U_{Smin} and U_{Smax} according to the specified code letter ISO 16750-2 at each new temperature step. Switch the DUT off during transition to the next temperature.

5.2.3 Requirement

The DUT shall take up its normal function at each temperature between T_{min} and T_{max}, i.e. the functional status shall be class A as defined in ISO 16750-1.

5.3 Temperature cycling

5.3.1 Temperature cycle with specified change rate

5.3.1.1 Purpose

This test simulates varying temperatures with electrical operation of the DUT, e.g. during the use of the system/components at fast-changing ambient temperature. If a system/component is exposed to hot-soak temperatures (e.g. engine-mounted systems/components), an additional short temperature peak is added during the high temperature phase of the profile to ensure proper function during short temperature peaks. The electrical operation is switched off during phases of decreasing temperature to avoid electrical heat dissipation of the system/component which would inhibit reaching T_{min} inside the system/component. Failure mode is electrical malfunction during temperature change.

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

5.3.1.2 Test

Perform the temperature cycling according to IEC 60068-2-14, Nb.

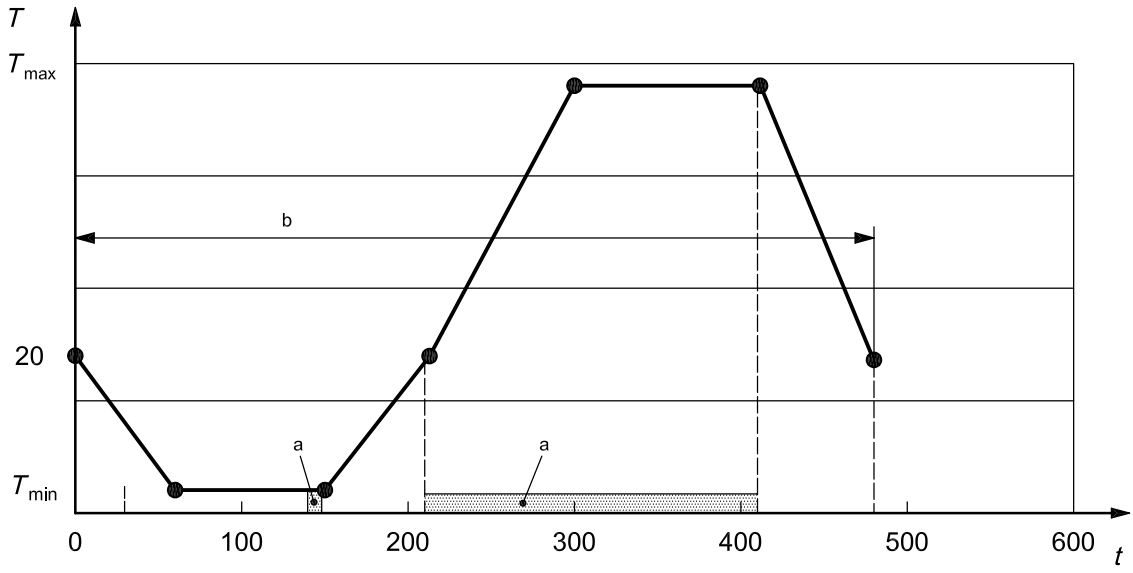
Operate the DUT electrically (functional test) after the whole device has reached T_{min} for the shortest possible duration to check the correct function of the device. In addition, operate it electrically between 210 min and 410 min of the cycle (see Figure 2). Use operating mode 3.2 as defined in ISO 16750-1 for the phases with electrical operation.

The changes in temperature shall correspond to the specifications given in Table 2. For tests including hot-soak temperature (T_{maxHS}), see Figure 3 and Table 3.

The long period of electrical operation is started at 20 °C in order to allow possible condensation of humidity on the DUT. A permanent operation starting at T_{min} would prevent this due to the electrical power dissipation.

Additional drying of the test chamber air is not permitted.

Perform 30 test cycles as specified.



Key

T temperature, °C

t time, min

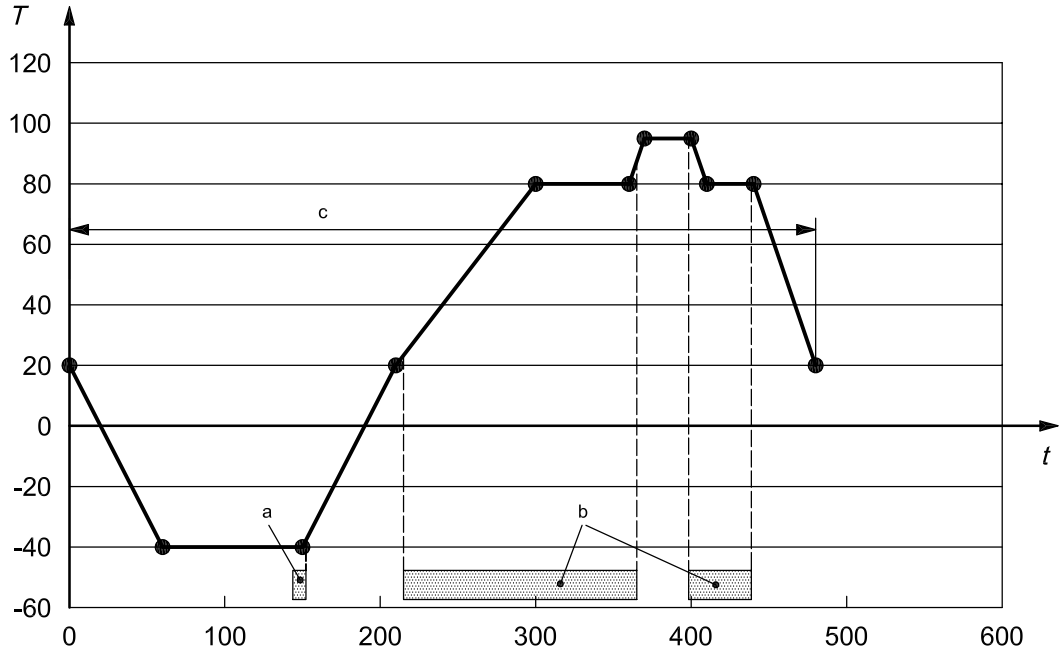
a Operating mode 3.2 according to ISO 16750-1.

b One cycle.

Figure 2 — Temperature cycles with specified change rate (T_{min} and T_{max} see Table 1)

Table 2 — Temperatures and time duration for temperature cycling (see Figure 2)

Time min	**Code according to Table 1**
	Temperature °C
0	20 °C
60	T_{min}
150	T_{min}
210	20 °C
300	T_{max}
410	T_{max}
480	20 °C
NOTE In the vehicle environment, some equipment might experience different conditions regarding temperatures, temperature gradients and duration. In all these cases, use code Z.	



Key

T temperature, °C

t time, min

a Functional test operating mode 3.2 according to ISO 16750-1.

b Operating mode 3.2 according to ISO 16750-1.

c One cycle.

Figure 3 — Example for a temperature cycle with hot-soak phase (illustrates code "F" according to Table 1)

Table 3 — Temperatures and time duration for temperature cycling with hot-soak phase (see Figure 3) (illustrates code "F" according to Table 1)

Time min	Temperature °C
0	20
60	–40
150	–40
210	20
300	80
360	80
370	95 (T_{maxHS})
400	95 (T_{maxHS})
410	80
440	80
480	20