INTERNATIONAL STANDARD

ISO 16750-4

Third edition
2010-04-15

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 third edition cancels and replaces the second edition (ISO 16750-4:2006), 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*

— *Part 5: Chemical loads*

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

Part 4: Climatic loads

1 Scope

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

This part of ISO 16750 describes 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 2-1: Tests — Test A: Cold*

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

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

IEC 60068-2-14, *Environmental testing — Part 2-14: 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 2-38: Tests — Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-52, *Environmental testing — Part 2-52: 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

The applicable operating 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	Minimum operating temperature T_{min} °C	Maximum operating temperature 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 the case of hot-soak requirements, add 15 °C to the maximum operating temperature, T_{max}. 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 test

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. the freezing of liquid crystal displays.

5.1.1.1.2 Test method

Perform the test in accordance with IEC 60068-2-1, Test A, 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

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

5.1.1.2 Operation test

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. the freezing of capacitors with liquid electrolyte.

5.1.1.2.2 Test method

Perform the test in accordance with IEC 60068-2-1, Test A, at the minimum operating temperature, 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 test

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. the warping of plastic housings.

5.1.2.1.2 Test method

Perform the test in accordance with IEC 60068-2-2, Test B, 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 test

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. the thermal degradation of components.

5.1.2.2.2 Test method

Perform the test in accordance with IEC 60068-2-2, Test B, at the maximum operating temperature, 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

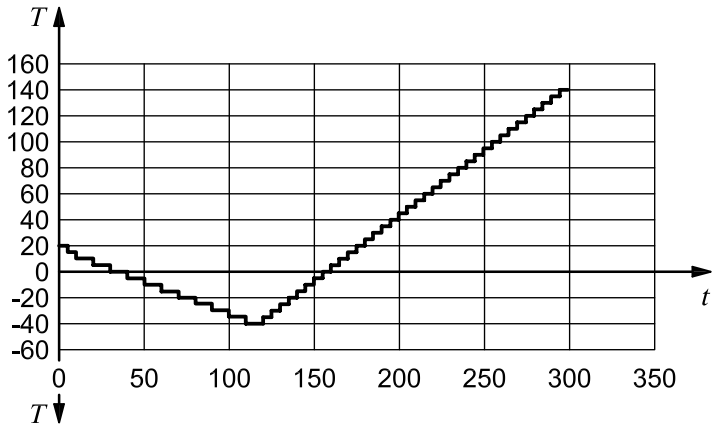
The functional status shall be class A, as defined in ISO 16750-1.

5.2 Temperature step test

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.

Figure 1 illustrates the temperature step test, using code Q as specified in Table 1.



Key

T temperature, in °C

t time, in min

Figure 1 — Example of temperature step test, using code Q in accordance with Table 1

5.2.2 Test method

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 in accordance with ISO 16750-1 at minimum supply voltage, U_{Smin}, and at maximum supply voltage, U_{Smax}, in accordance with the specified ISO 16750-2 code letter, 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 tests

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 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 in order 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 method

Perform the temperature cycling in accordance with IEC 60068-2-14, Test Nb.

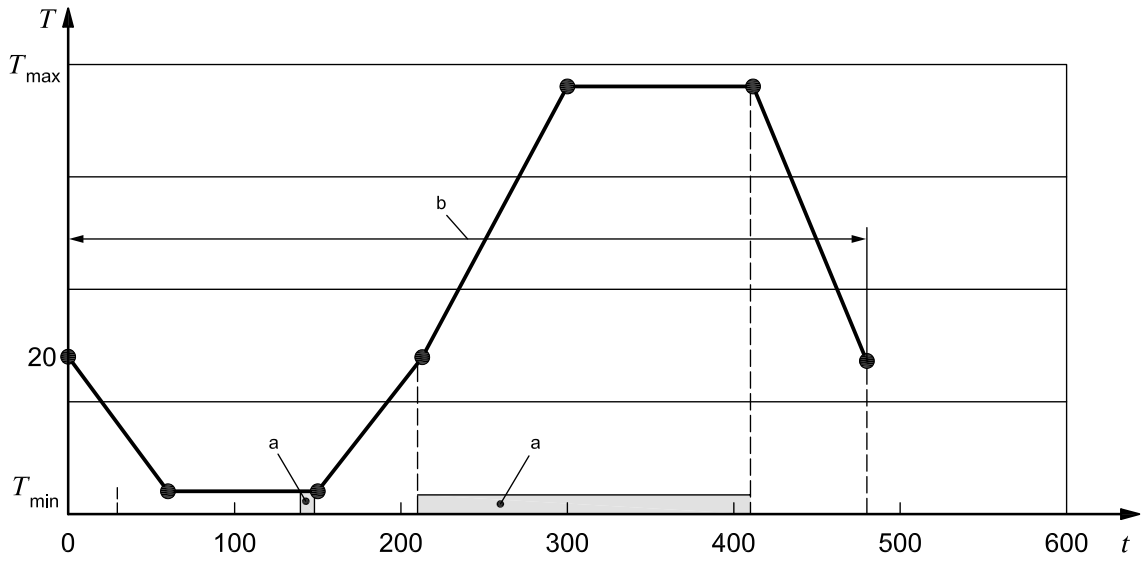
Operate the DUT electrically (functional test) after the whole device has reached T_{min} for the shortest possible duration in order to check the correct function of the device. In addition, operate it electrically between 210 min and 410 min of the cycle (see Figure 2). Use operating mode 3.2, as defined 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 Table 3. Figure 3 illustrates the temperature cycle with hot-soak phase, using code F as specified in Table 1.

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, in °C

t time, in min

T_{min} minimum operating temperature, in °C (see Table 1)

T_{max} maximum operating temperature, in °C (see Table 1)

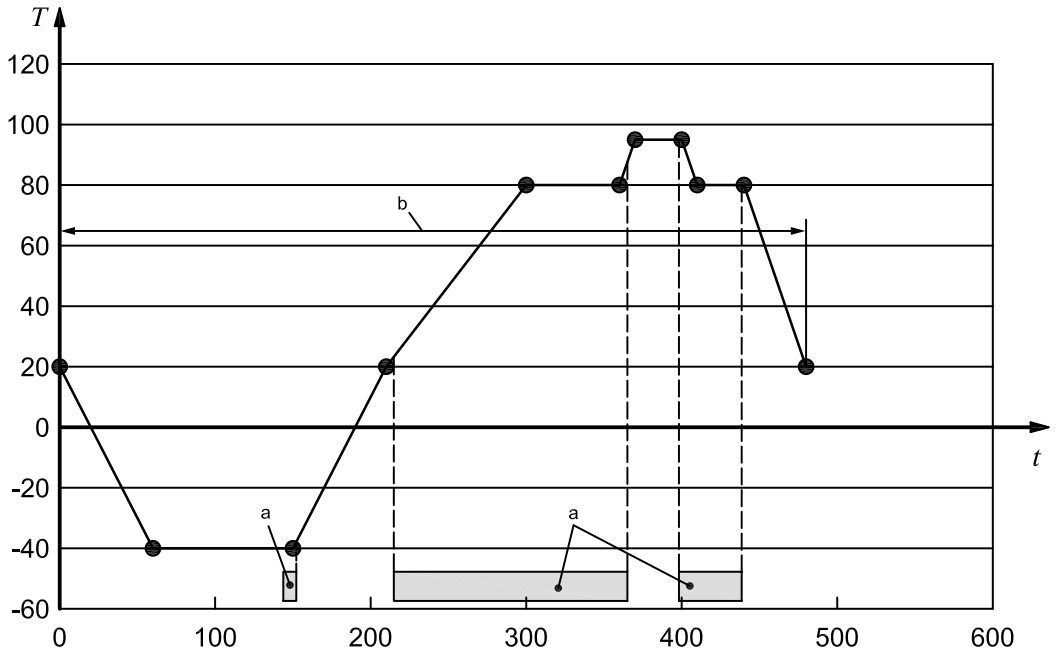
a Operating mode 3.2 in accordance with ISO 16750-1.

b One cycle.

Figure 2 — Temperature cycles with specified change rate

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

Time min	Temperature °C
0	20
60	T_{min}
150	T_{min}
210	20
300	T_{max}
410	T_{max}
480	20
NOTE Codes are in accordance with Table 1 (codes A to T). In the vehicle environment, some equipment might experience different conditions regarding temperatures, temperature gradients and duration: in all these cases, code Z is used.	



Key

T temperature, in °C

t time, in min

a Functional test operating mode 3.2 in accordance with ISO 16750-1.

b One cycle.

Figure 3 — Example of a temperature cycle with hot-soak phase, using code F in accordance with Table 1

Table 3 — Temperatures and time duration for temperature cycling with hot-soak phase (see Figure 3)

Time min	Temperature °C
0	+20
60	–40
150	–40
210	+20
300	+80
360	+80
370	+95[a]
400	+95[a]
410	+80
440	+80
480	+20
NOTE This table illustrates code F as specified in Table 1.	
[a] Hot-soak temperature.	