
**Road vehicles — Alarm systems for buses
and commercial vehicles of maximum
authorized total mass greater than 3,5 t**

*Véhicules routiers — Systèmes d'alarme pour autobus et véhicules
utilitaires de masses totales maximales autorisées supérieures à 3,5 t*



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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15763 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

Annex A of this International Standard is for information only.

Road vehicles — Alarm systems for buses and commercial vehicles of maximum authorized total mass greater than 3,5 t

1 Scope

This International Standard defines terms and specifies requirements and tests for vehicle alarm systems (VAS) intended for installation within buses and commercial vehicles (as defined in ISO 3833) having a maximum authorized total mass (code ISO-M08 as defined in ISO 1176) of greater than 3,5 t.

It is applicable to VAS designed to detect or sense, and to indicate, the unauthorized opening of a vehicle's doors, luggage-compartment lids, bonnet/hood and emergency exits, as well as the tilting of the driver's cabin and the disconnection of a trailer or of the power supply. It covers both VAS intended for installation as original equipment, and those intended to be installed after delivery of the vehicle.

NOTE Systems for volumetric protection, which are optional, have to be tested individually and — as a consequence and in accordance with this International Standard — against their own specifications. Examples of tests that can be performed are given in annex A.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 512:1979, *Road vehicles — Sound signalling devices — Technical specifications*

ISO 1176, *Road vehicles — Masses — Vocabulary and codes*

ISO 3833, *Road vehicles — Types — Terms and definitions*

ISO 7637-1, *Road vehicles — Electrical disturbances from conduction and coupling — Part 1: Definitions and general considerations*

ISO 7637-2:¹⁾, *Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only*

ISO 7637-3:1995, *Road vehicles — Electrical disturbance by conduction and coupling — Part 3: Vehicles with nominal 12 V or 24 V supply voltage — Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines*

ISO 10605, *Road vehicles — Test methods for electrical disturbances from electrostatic discharge*

1) To be published. (Revision of ISO 7637-2:1990)

ISO 11451 (all parts), *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy*

ISO 11452 (all parts), *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

IEC 60068-2-11:1981, *Environmental testing — Part 2: Tests. Test Ka: Salt mist*

IEC 60068-2-29:1987, *Environmental testing — Part 2: Tests. Test Eb and guidance: Bump*

CISPR²⁾ 12:2001, *Vehicles, boats and internal combustion engine driven devices — Radio disturbance characteristics — Limits and methods of measurement for the protection of receivers except those installed in the vehicle/boat/device itself or in adjacent vehicles/boats/devices*

70/388/EEC, *Audible warning devices for motor vehicles*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1 vehicle alarm system

VAS

system intended for installation on vehicles that when set will indicate actions such as attempted intrusion into, or interference with, the vehicle

3.2 control equipment

component of the VAS which processes the setting and unset commands, and which accepts the signals from the detector/sensors that allow an alarm condition to be indicated

3.3 detector [sensor]

device which detects [senses] that a predetermined limit or situation has been met and then generates an alarm condition signal

3.4 alarm condition

condition generated when an abnormal situation has been detected or sensed

3.5 set

state of the system in which an alarm condition can be indicated

3.6 unset

state of the system in which an alarm condition cannot be indicated

3.7 setting–unsetting device

device or component of the VAS used to set or unset the VAS

2) CISPR, the international special committee on radio interference, is a subcommittee of the IEC.

3.8**warning device**

system component that gives an indication of an alarm condition

3.9**deliberately operated device [panic alarm]**

facility that can cause the warning device to operate, irrespective of whether the VAS is in a set or unset state

3.10**status display**

component of the VAS which indicates the condition of the VAS

3.11**immobilizer**

device for preventing the use of the vehicle with its own engine

3.12**perimeter protection**

function of a device designed to detect and indicate the unauthorized opening of doors, luggage compartment lids, the bonnet/hood and emergency exits, the tilting of the driver's cabin, and the disconnection of a trailer or of the power supply

3.13**volumetric protection**

function of a device designed to detect the intrusion into, and movement within, the driver/passenger compartment

3.14**key**

device designed and constructed to provide a method of operating a system which is itself designed and constructed to be operated only by that device

3.15**scanner**

device designed to detect the intrusion into, and movement within, a defined area around a vehicle

4 Requirements**4.1 System description**

The VAS shall include a detector/sensor, or more than one, control equipment that includes a setting–unsetting device and indicating functions, a power supply, and a warning device or devices. All related legal requirements shall be complied with.

The VAS shall include at least one acoustic warning device and, additionally, may include optical warning devices or remote wireless signalling devices, or any combination of these, comprising

- optical indications providing information on the status of the VAS, or a change in that status,
- an immobilizer, and
- other facilities, provided such facilities comply with the provisions of this International Standard.

Figure 1 shows, schematically, the system components and the connections between them that are either required (solid lines) or recommended (broken lines) for the system.

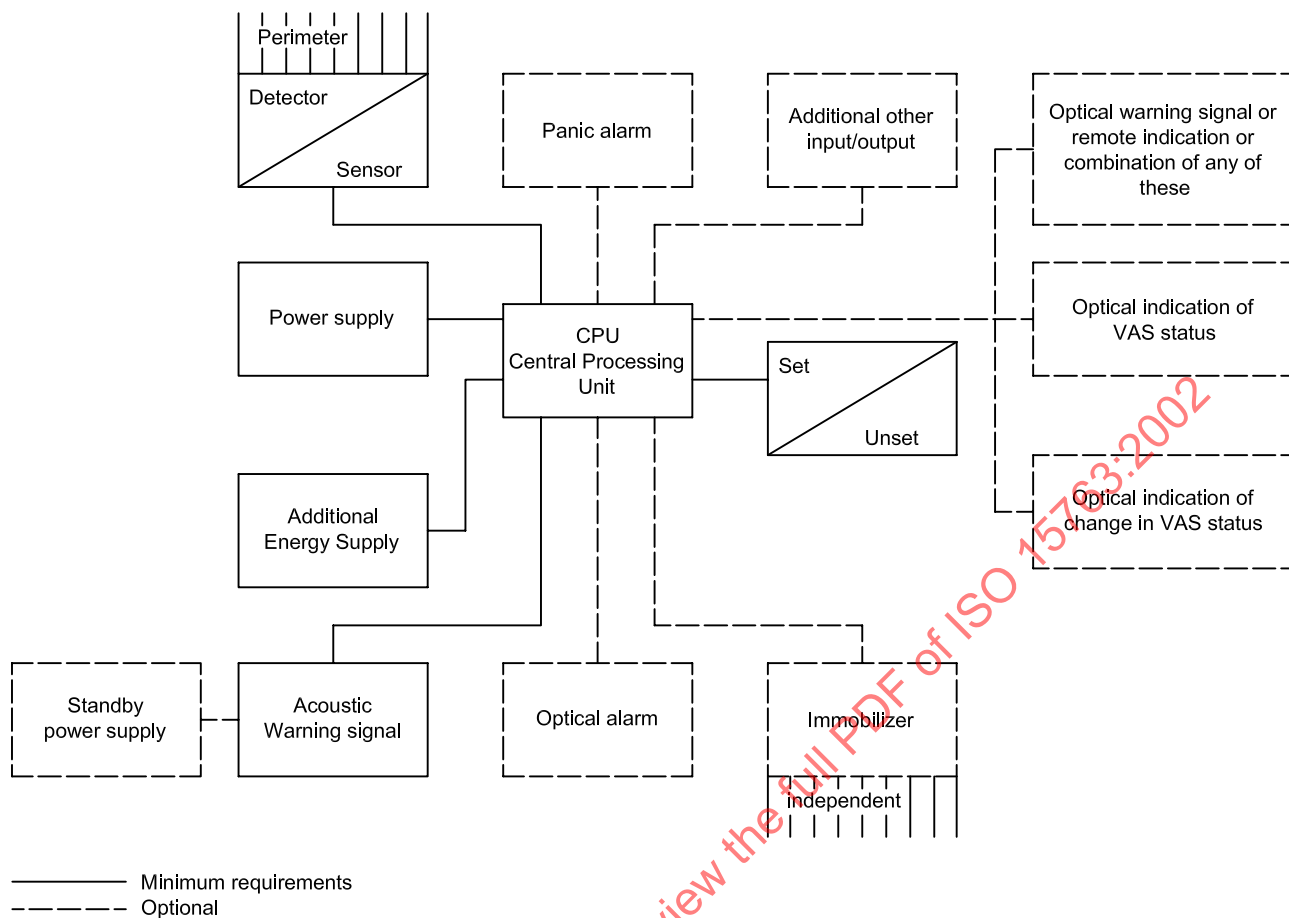


Figure 1 — VAS components and their connections

4.2 System design

4.2.1 General

In its set state, the VAS shall detect/sense and indicate any unauthorized

- a) opening of vehicle doors,
- b) opening of luggage compartment lids,
- c) opening of emergency exits,
- d) opening of the bonnet/hood,
- e) tilting of the driver's cabin,
- f) disconnection of the trailer, and
- g) disconnection of the power supply.

All components of the VAS shall be compatible with one another and, when installed, shall not affect the performance of the vehicle in the unset state.

Whether it is set or unset, the VAS shall not be able to have its state inadvertently changed nor shall any warning device be caused to operate or cease operation.

In the event of a power interruption, the VAS shall not change state on resumption of power.

The failure of any optical device or devices shall not affect the correct operation of the other parts of the VAS.

The VAS, its components and the parts controlled by them shall be designed, built and installed so as to minimize the possibility of false alarms.

All VAS shall be protected against easy and rapid access or tampering by any unauthorized person.

4.2.2 Detection

The VAS shall provide perimeter protection, and may include additional sensors for detecting other interference with, or intrusion into, the vehicle. The operation of such additional sensors may be disabled intentionally by the user. However, this disablement shall only be effective for one setting period of the VAS.

The VAS may include a deliberately operated device/panic alarm, which shall be activated from within the vehicle. Regardless of whether the VAS is set or unset, this device shall, at a minimum, operate the acoustic alarm, but may also operate an optical or radio alarm or both types of alarm. It shall be possible for the vehicle user to cancel the alarm or alarms. The operation of the panic alarm shall not affect the starting or running of the vehicle's engine, and the alarm's duration per activation shall not be restricted.

4.2.3 Control

Control equipment shall provide for the connection of circuits capable of accepting the detector(s)/sensor(s).

When the VAS is set, the control equipment shall monitor the detector(s)/sensor(s) and, in the event of an alarm condition being presented, shall provide outputs to the warning devices within 1 s maximum.

Unsetting the VAS by the normal means shall cancel the alarm condition and the warning signals within 1 s maximum.

4.2.4 Setting/unsetting

4.2.4.1 General

The VAS may include optical indications that provide

- information on the set/unset status of the VAS, and
- information on any change in the set/unset status of the VAS.

An optical signal for the indication of a change in the set/unset status of the VAS may also be produced by the direction indicators, the passenger compartment lamp or lamps, or the vehicle position lamps (including all lamps in the same circuit), or any combination of these. The duration of the signal shall not exceed 3 s.

4.2.4.2 Setting

Setting of the VAS may be achieved by any suitable means.

The perimeter protection shall be in the set condition within 10 s after completion of the VAS's setting procedure. Optional sensors shall be in the set condition within 60 s after completion of the setting procedure.

4.2.4.3 Unsetting

The code, or any instructions to unset the VAS, shall not be visible on any VAS component.

Unsetting of the VAS shall be achieved by any one, or a combination, of the following.

- a) A mechanical key switch, which may be either
- 1) an integrated key mechanism or switch or both, or
 - 2) the door-locking mechanism coupled to a separate switch, in which case it shall be impossible to unset the VAS using the internal door-locking mechanism.

The cylinder of this key switch shall not protrude by more than 1 mm from the cowling; the protruding part shall be conical or convex.

The joint between the cylinder core and the cylinder casing shall be able to withstand a tensile force of at least 600 N. It shall also, separately, be able to withstand a torque of at least 25 N·m.

The key switch shall be provided with a cylinder drill obstruction.

The key profile shall have at least 1 000 effective permutations, and the key switch shall be inoperable even by a key differing by only one permutation from the key matching the key switch.

The key aperture to an external key switch shall be shuttered or otherwise protected against the ingress of dirt or water.

- b) A coded key switch, which shall be fitted within the vehicle in conjunction with a timed entry period, and whose time period for unsetting shall be not less than 5 s and not more than 15 s. It shall comply with the same provisions as those specified in a), or else the coded switch shall have no less than 10 000 effective combinations.
- c) An electrical or electronic device [other than the switch specified in b)], for example, a remote-control switch, which shall have a coded transmitter signal with at least 50 000 effective combinations and a minimum scan time of 24 h per 5 000 variants, or else shall incorporate rolling codes such that the mathematical chance of obtaining the correct code within 24 h is less than 4 %.
- d) A mechanical key switch or an electrical/electronic device located within the protected cabin/passenger compartment, which, if fitted within the vehicle in conjunction with a timed entry period, shall allow a time to unset the VAS after the opening of the door of not less than 5 s and not more than 15 s.

4.2.5 Alarm signal

4.2.5.1 General

The alarm condition shall be indicated by an acoustic warning signal produced by either

- an acoustic warning device, or
- a sound signalling device in accordance with ISO 512, or
- both of these, in which case interference with one of the devices shall not affect the operation of the other.

The acoustic warning signal shall not cause any confusion concerning the reason for the warning and shall not have the same audible sound as other road traffic signals (e.g. those of emergency services).

The alarm condition may be indicated, additionally, by an optical warning signal or signals, or by remote wireless signalling, or any combination of these.

The warning signal shall be activated once for every detection, without limitation of the number of detections. For additional equipment, for example, volumetric protection, the number of activations of a warning signal shall be limited to a maximum of 10.

4.2.5.2 Acoustic warning signal

The duration of the acoustic warning signal shall be (25^{+5}_{-0}) s per detection; the signal shall be within the frequency band 1 800 Hz to 3 550 Hz.

The maximum sound pressure level of the acoustic alarm device shall not exceed 118 dB(A), while the minimum shall be not less than 105 dB(A), measured in accordance with 70/388/EEC.

The acoustic warning signals shall have the following characteristics:

- a) single frequency tone, intermittent, having
 - a frequency of $2 \text{ Hz} \pm 1 \text{ Hz}$, and
 - on-time equal to off-time $\pm 10 \%$;
- b) modulating tone.

The acoustic signal may comprise two or more frequencies or sweeps between frequencies.

4.2.5.3 Optical warning signals — Optional

If optical warning signals are provided, they shall be emitted by all the vehicle's direction indicators or position lamps (including all lamps connected to them) or both. In addition, an optical warning signal may be emitted by the passenger compartment lamp or lamps.

Optical warning signals shall be in compliance with statutory limitations.

An optical warning signal shall be of a duration of between 25 s and 300 s per detection, intermittent, and have

- a frequency of $2 \text{ Hz} \pm 1 \text{ Hz}$, and
- on-time equal to off-time $\pm 10 \%$.

In relation to the acoustic warning signal, the optical warning signal may be synchronous or asynchronous. Any interference or damage to an optical warning device shall not affect the correct operation of the acoustic warning device and vice versa.

4.2.6 Immobilization — Optional

The vehicle shall be automatically immobilized within 1 s of setting the VAS, unless immobilization has already been implemented by an independent immobilizer.

If an existing immobilizer is already incorporated, it shall meet the requirements of this International Standard.

Immobilization shall not take place if the engine is running or if the ignition key is in the engine-running position.

The immobilizer shall include one independent means of preventing movement of the vehicle under its own power.

EXAMPLE Original mechanical protective device against unauthorized use, interruption of starter motor circuit, interruption of ignition, interruption of fuel supply.

The design, manufacture and installation of an immobilizer shall be such that any malfunction of that facility will not affect

- the safe function of the vehicle, regardless of whether the VAS is in the set or unset condition, and
- the performance of the vehicle or its components when the VAS is in the unset condition.

4.2.7 Power supply

4.2.7.1 Main power supply

The main source of power for the VAS shall be the vehicle battery. The supply voltage, in the environmental temperature range (see 4.2.8), shall be as follows:

- a) nominal supply voltage, $U_n = 12\text{ V}, 24\text{ V}$;
- b) supply voltage range for
 - 1) 12 V systems, $9\text{ V} < U < 15\text{ V}$, and
 - 2) 24 V systems, $18\text{ V} < U < 32\text{ V}$.

The current consumption of the VAS in the set state, including all its sensors, shall not exceed 10 mA (mean value) at nominal voltage. However, for existing alarm systems, values of up to 20 mA are permitted.

4.2.7.2 Standby power supply for VAS — Optional

Where a standby power supply for the VAS is provided, it may consist of a rechargeable battery and charger or, alternatively, of high-quality primary batteries. The capacity of the standby power supply for the VAS shall be sufficient to operate the VAS in the quiescent condition for at least 120 h, followed by an alarm condition of at least 300 s duration.

4.2.7.3 Self-powered acoustic device — Optional

If a self-powered sounder is provided, it shall be operated by a rechargeable battery and charger or, alternatively, by high-quality primary batteries. The battery capacity shall be sufficient to operate the sounder for at least 300 s.

The sounder shall operate automatically if the main power supply is interrupted or run down, or if any or all of the wires connected to it are cut or disconnected.

4.2.8 Construction

The VAS and its components shall be designed, built and installed to withstand the environment within the vehicle.

Two ranges of environmental temperature are defined:

- a) $(-40 \pm 2)^\circ\text{C}$ to $(+85 \pm 2)^\circ\text{C}$ for parts to be fitted in the passenger or luggage compartment;
- b) $(-40 \pm 2)^\circ\text{C}$ to $(+125 \pm 2)^\circ\text{C}$ for parts to be fitted in the engine compartment, unless otherwise specified.

The following degrees of protection, in accordance with IEC 60529, shall be provided:

- IP 40 for parts to be fitted in the driver's cabin/passenger compartment;
- IP 54 for all covered parts;
- IP 67 for all uncovered parts.

The VAS manufacturer shall specify in the installation instructions any restrictions on the positioning of any part of the installation with respect to dust, water and temperature.

4.3 Documentation

The VAS manufacturer or importer shall supply, for each system,

- instructions for use,
- instructions for maintenance,
- details of energy consumption,
- an installation certificate,
- the supplier's name and contact details, and
- warranty details.

In the case of a VAS intended for installation after delivery of the vehicle, a list of the vehicles and models for which the VAS is intended, as well as installation instructions, shall be provided. This list may be specific, or generic (e.g. "all trucks with diesel engine and 24 V negative earth batteries").

5 Tests

5.1 General

The complete system as supplied shall be assembled in accordance with the instructions provided by the manufacturer. Each component, unless otherwise specified, shall be mounted on a test rig in an orientation appropriate for normal use, by the means recommended by the manufacturer.

The inputs to the VAS shall be connected to devices or circuitry able to supply or simulate the presence of the appropriate input signals.

Each output from the VAS shall be connected to suitable monitoring equipment.

Unless specified otherwise, the VAS shall be powered from the nominal 12 V or 24 V supply voltage, as appropriate.

Unless specified otherwise, during testing, the temperature and atmospheric conditions in accordance with Table 1 shall apply.

Table 1 — Temperature and atmospheric conditions

Temperature °C	Relative humidity %	Air pressure kPa
15 to 35	25 to 75	86 to 106

Variations in temperature and humidity should be kept to a minimum during a series of measurements carried out as part of one test on a single specimen.

Where the relevant specification recognizes the impracticality of carrying out measurements under the standard atmospheric conditions given in Table 1, a note stating the actual conditions shall be added to the test report.

The tests shall be carried out on a complete system, which shall be in a fully operational state. Unless otherwise specified, the VAS shall be in the set condition.

5.2 Full functional test

The VAS shall be tested to demonstrate the compliance with the requirements of clause 4. This test shall be performed prior to all other tests as well as following completion of all other tests.

Outputs from the first functional test shall be recorded and used as a comparison for subsequent basic tests.

During this test, the VAS shall not, whether set or unset, inadvertently change its state nor cause any warning device to operate or cease operation.

5.3 Basic test

The basic test shall be carried out on completion of each test program and, additionally, during the test procedure wherever specified, according to the following procedure.

- a) Check that the VAS is in the unset condition.
- b) Set the VAS.
- c) If an immobilizer is fitted, check that the output to the immobilizer circuit has been activated within 1 s.
- d) Initiate an alarm condition by operating a sensor/detector.
- e) Check that the output to the circuit of the warning device or devices has been activated in accordance with 4.2.3
- f) Unset the VAS.
- g) If an immobilizer is fitted, check that the output to the immobilizer circuit has been deactivated.
- h) Check that the output to the warning devices is not active.

During this test, the VAS shall not, whether set or unset, inadvertently change its state nor cause any warning device to operate or cease operation.

5.4 Electrical tests

5.4.1 Lamps — Testing not required

The lamps used as part of the optical warning device, included in the standard car lighting system, are not required to be submitted to the following tests.

5.4.2 Overvoltage

5.4.2.1 Submit the VAS, in both the set and unset states, to overvoltage as follows:

- a) for 12 V nominal supply voltage — $(18 \pm 0,2)$ V for 1 h;
- b) for 24 V nominal supply voltage — $(36 \pm 0,5)$ V for 1 h.

The VAS shall then meet the requirements of the basic test (see 5.3).

5.4.2.2 For 12 V nominal supply voltage only, submit the VAS, in both the set and unset states, to an overvoltage of $24 \text{ V} \pm 0,2 \text{ V}$ for 1 min.

The VAS shall then meet the requirements of the basic test (see 5.3).

5.4.3 Short circuit

Apply a short circuit to each individual electrical connection of the VAS, in turn, for each polarity of the power supply. Any and all blown fuse links shall be replaced.

The VAS shall then meet the requirements of the basic test (see 5.3).

5.4.4 Reverse polarity

Apply a voltage of

- $(13 \pm 0,2)$ V, for a 12 V nominal supply voltage, and
- $(27 \pm 0,5)$ V, for a 24 V nominal supply voltage,

to the supply lines of the VAS with reversed polarity for 1 min. Any and all blown fuse links shall be replaced.

The VAS shall then meet the requirements of the basic test (see 5.3).

5.4.5 Voltage reduction or removal or both

Any optional standby power supply or self-powered sounder shall be disconnected during this test, performed using the following procedure.

- a) Disconnect the power supply from the VAS in the unset condition for $300 \text{ s} \pm 10 \text{ s}$.
- b) Reconnect the power supply: the state of the VAS shall not change.
- c) Repeat the test with the VAS in the set condition. Then reduce the supply voltage from the nominal voltage down to the following:
 - 1) for a 12 V nominal voltage supply — 7,5 V at a rate of $(1 \pm 0,1)$ V/h;
 - 2) for a 24 V nominal voltage supply — 15 V at a rate of $(1 \pm 0,1)$ V/h.

The state of the VAS and its outputs shall not change.

- d) Reconnect the power supply: the state of the VAS shall not change.

5.4.6 Temperature and supply voltage

The VAS shall meet the requirements of the basic test (see 5.3) when subjected to the conditions given in 4.2.8 and in accordance with Table 2.

Table 2 — Temperature and voltage

	Test temperature °C	Test voltage V	
		12 V nominal supply	24 V nominal supply
Normal condition	23 ± 5	$12 \pm 0,2$	$24 \pm 0,5$
Low temperature/voltage	-40 ± 2	$9 \pm 0,2$	$18 \pm 0,5$
High temperature/voltage	85 ± 2	$15 \pm 0,2$	$32 \pm 0,5$
	125 ± 2		

All tests shall be conducted after a 4 h soak of the components at the respective temperatures.

5.5 Temperature/humidity accelerated ageing

5.5.1 The VAS shall meet the requirements of the basic test (see 5.3) when subjected to the following conditions and in accordance with 5.5.5.

5.5.2 Except for the batteries, those components of the VAS designed for an environmental temperature of -40°C to $+85^{\circ}\text{C}$ shall be tested at an upper temperature of $+85^{\circ}\text{C}$, and those designed for an environmental temperature of -40°C to $+125^{\circ}\text{C}$ shall be tested at an upper temperature of $+125^{\circ}\text{C}$.

5.5.3 Components having to operate at $+125^{\circ}\text{C}$ shall be tested in accordance with e) to h) of 5.5.5, using the class test temperature of $+125^{\circ}\text{C}$. They shall then be assembled into a complete VAS and submitted to all steps of 5.5.5, using the class test temperature of $+85^{\circ}\text{C}$ (i.e. testing at $+85^{\circ}\text{C}$).

5.5.4 The test shall consist of 10 cycles of 24 h each, carried out in a suitable test chamber in the following test sequence (see Figure 2 for a graphic representation).

5.5.5 Test cycle

- a) Hold the chamber temperature at $t_c = 23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the relative humidity (RH) at 45 % to 75 % for 4 h.
- b) Raise t_c to $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ at 95 % to 99 % RH within 0,5 h.
- c) Hold t_c at $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ at 95 % to 99 % RH for 10 h.
- d) Lower t_c to $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ within 2,5 h.
- e) Hold t_c at $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 2 h.
- f) Raise t_c to the applicable test temperature in accordance with 4.2.8 and Table 2 within 1,5 h.
- g) Hold t_c at the applicable test temperature in accordance with 4.2.8 and Table 2 for 2 h.
- h) Allow t_c to return to room temperature $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ within 1,5 h.

5.5.6 The last cycle shall be stopped when the dew point is reached.

The VAS shall then meet the requirements of the basic test (see 5.3).

NOTE During the periods specified in d), e), f), g) and h) of 5.5.5, the relative humidity is uncontrolled.

5.5.7 If the chamber needs more than 1,5 h to reach class test temperature, the duration of period f) of 5.5.5 may be extended, and that of period a) reduced, accordingly.

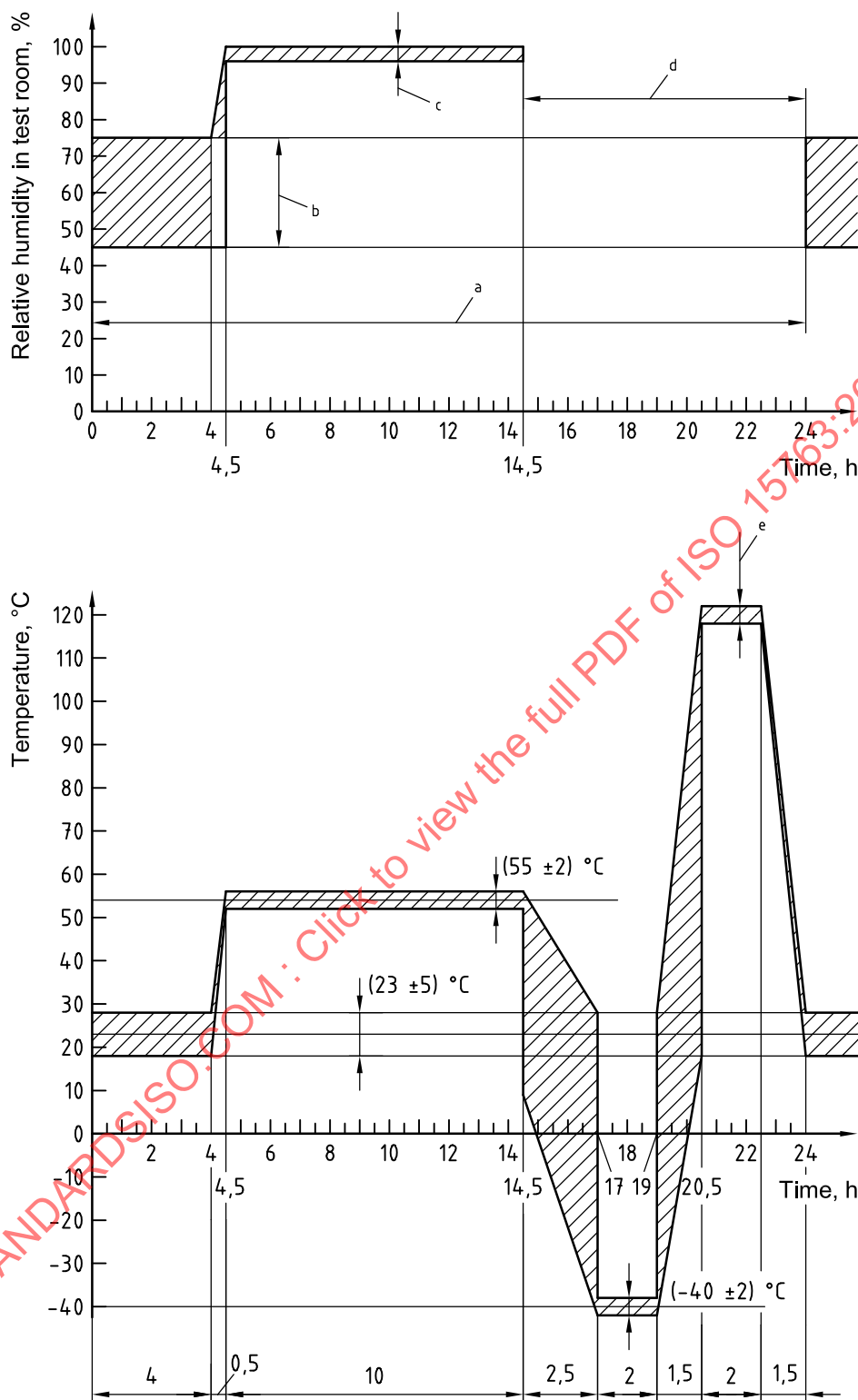
5.5.8 At the end of a cycle, the test may be interrupted. During the interruption, the test samples shall remain under ambient conditions in accordance with 5.5.3. The interruption time shall be noted in the test report.

5.5.9 The temperatures quoted are not the highest that may be experienced by components mounted within the engine compartment. When components are intended to be installed under the bonnet/hood, in close proximity to the engine, the temperature of 125°C shall be increased by 15°C .

5.6 Corrosion

Subject all components not intended for installation in the passenger compartment to the corrosion test given in IEC 60068-2-11 for a duration of 144 h. This test shall be performed in the unpowered condition.

The VAS shall then meet the requirements of the basic test (see 5.3).



NOTE Hatched areas indicate allowed temperature/humidity tolerance.

- a One cycle.
- b (45 to 75) %.
- c (95 to 99) %.
- d Uncontrolled humidity.
- e Test temperature (see Table 2).

Figure 2 — Temperature/humidity cycling

5.7 Vibration

For this test, the components are categorized into three types:

- type 1 are components normally mounted within the vehicle (driver's compartment);
- type 2 are those intended for attachment to the engine;
- type 3 are those mounted on the chassis.

Submit the components/VAS to a sinusoidal vibration mode having the following characteristics:

- a) for type 1 — a frequency sweep of 10 Hz to 50 Hz with a maximum amplitude of $\pm 0,5$ mm, and 50 Hz to 500 Hz with a maximum acceleration of 50 m/s^2 ;
- b) for type 2 — a frequency sweep of 20 Hz to 62 Hz with a maximum amplitude of ± 2 mm, and 62 Hz to 300 Hz with a maximum acceleration of 300 m/s^2 (0 to maximum);
- c) for type 3 — a frequency sweep of 5 Hz to 16 Hz with a maximum amplitude of ± 10 mm, and 16 Hz to 500 Hz with a maximum acceleration of 100 m/s^2 .

In each case:

- the frequency variation shall be 1 octave/min;
- the number of cycles shall be 10 (with the test being performed along each of the three mutually perpendicular axes);
- the vibrations shall be applied at low frequencies at a maximum constant amplitude and, at high frequencies, at a maximum constant acceleration.

The VAS shall then meet the requirements of the basic test (see 5.3).

5.8 Bump

The test apparatus and procedure for this test shall be in accordance with IEC 60068-2-29.

Mount the VAS on the test rig. Ensure that all external cables and connections are included and fastened to simulate their condition in normal use. Any remote-control (hand-held) device is to be included.

Apply the values given in Table 3 using the waveform shown in Figure 3.

Table 3 — Severity of conditioning

Parameter	Severity
Acceleration (m/s^2) (g)	196,2 (20)
Duration (ms)	30
Directions	Three: mutually perpendicular
Number of bumps per direction	one

After bumping in all three directions, subject the VAS to the basic test (see 5.3) and inspect visually for mechanical damage.

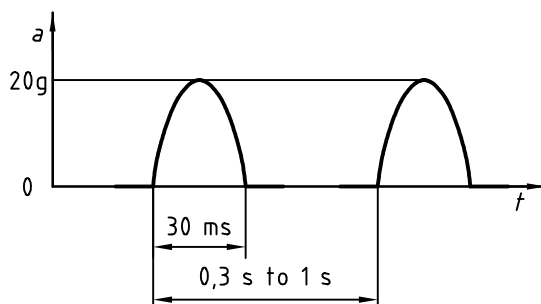


Figure 3 — Bump test waveform

5.9 Drop

Submit all hand-held devices, for example, remote-control keys, to a free-fall test of $1\text{ m} \pm 0,1\text{ m}$ onto a concrete surface. Repeat the test five times.

After this test the device shall function correctly and shall be unbroken.

5.10 Electromagnetic compatibility

5.10.1 Immunity against disturbances conducted along supply lines

Apply the test pulses 1, 2, 3a, 3b, 4 and 5, according to ISO 7637-1 and ISO 7637-2, as applicable, to the supply lines as well as to other VAS connections that could be operationally connected to supply lines.

- With the VAS in the unset state, apply all test pulses at the severity level III and with the functional status A.
- With the VAS in the set state, apply the test pulses in accordance with Table 4.

Table 4 — Test level/functional status (for supply lines)

Test pulse number	Test severity level	Functional status
1	III	C
2	III	A
3a	III	C
3b	III	A
4	III	B
4	I	A
5	III	A

5.10.2 Immunity against disturbances coupled on signal lines

Leads not connected to supply lines (e.g. special signal lines) shall be tested in accordance with ISO 7637-3 and Table 5.

Table 5 — Test level/functional status (for signal lines)

Test pulse number	Test severity level	Functional status
3a	III	C
3b	III	A

5.10.3 Immunity against radiated high-frequency disturbances

Testing of the immunity of a VAS in a vehicle may be performed according to one of the methods given in ISO 11451. Alternatively, laboratory testing may be performed according to one of the methods given in ISO 11452.

In either case, apply test level II and maintain functional status A during and after the test.

NOTE For values of test severity levels, see the relevant part of ISO 11451 or ISO 11452. A description of functional status is given in ISO 11451-1 and ISO 11452-1.

5.10.4 Electrical disturbances from electrostatic discharges

Immunity against electrical disturbances shall be tested in accordance with ISO 10605. Limits shall be in accordance with the requirements of the vehicle manufacturer.

5.10.5 Radio frequency interference (RFI) suppression

Tests shall be according to the relevant clauses of CISPR 12.

5.11 Durability of acoustic alarm device

The acoustic alarm device shall be activated 20 times for (30 ± 1) s, with a rest period of (10 ± 1) s between activations.

After this test, the device shall comply with the requirements given in 4.2.5.2.

5.12 Durability of VAS

The standard test cycle shall be

- a) set,
- b) trigger alarm system,
- c) unset, (2 ± 1) s after the acoustic device has started to sound.

Repeat this cycle 5 000 times, at every 20 cycles unsetting the VAS after the acoustic device has stopped sounding automatically.

The alarm shall be triggered by all sensors/detectors in rotation, for example, if there are 10 sensors/detectors, including non-perimeter types as options, each sensor/detector will operate 500 times.

5.13 Volumetric protection system functionality

Volumetric protection systems, which are optional, need to be tested individually; as a consequence, they are not required to be tested other than by testing of the actual sensor/detector against its own specifications.

See annex A for examples of possible test methods for installed VAS fitted with volumetric protection systems.

5.14 Acoustic warning signal

The maximum sound level (see 4.2.5.2) shall be measured in accordance with 6.1, 6.2 and 6.3 of ISO 512:1979.

5.15 Test sequence

The numbered test samples shall be tested in accordance with Table 6. Where a sample is subjected to more than one test, the test shall be completed in the sequence given.

The number of test samples may be reduced, provided all test requirements are fulfilled.

Table 6 — Test sequence

Title	Clause/subclause	Test sample number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Overvoltage	5.4.2	X	X											
Short circuit	5.4.3							X	X					
Reverse polarity	5.4.4					X	X							
Voltage reduction and/or removal	5.4.5			X	X									
Temperature and supply voltage	5.4.6										X	X		
Temperature/humidity accelerated aging	5.5				X	X	X							
Corrosion	5.6													X
Vibration	5.7							X	X	X				
Bump	5.8	X						X	X					
Drop	5.9										X	X	X	
Electromagnetic compatibility	5.10	X		X		X		X		X		X		X
Durability of the acoustic alarm device	5.11				X	X		X	X		X	X		
Durability of the VAS	5.12		X	X										

6 Marking and labelling

The VAS control unit shall be marked with the following information such that the information is not visible from outside the vehicle:

- name or trade mark of VAS manufacturer;
- model number;
- batch number or manufacturing date;
- nominal voltage and current.

Annex A (informative)

Functional tests for volumetric protection systems — Examples

A.1 Example 1

This is a test of whether the system is able to detect and signal intrusion into, and movements inside, the vehicle.

To simulate such intrusion, move a 15 cm diameter ball at a speed of 0,1 m/s to 1,0 m/s in the X or Y direction along the side windows (with the windows closed).

For testing the detection of movements inside the vehicle, move a 15 cm diameter ball at a speed of 0,1 m/s to 1,0 m/s from the centre of the vehicle between the driver /passenger seat to the window opening (the window closed).

A.2 Example 2

The warning device is to activate when a ball of $165 \text{ mm} \pm 10 \text{ mm}$ diameter is introduced by at least 0,3 m into the passenger compartment through any open window of the vehicle (see Figure A.1).

The ball shall consist of any material able to be detected by the sensors and shall be fixed to a rod of maximum 3 cm diameter.

NOTE Wood or plastic material cannot be detected by infrared or microwave sensors.

Perform this test at a speed of between 0,1 m/s and 0,4 m/s and at an angle of $45^\circ \pm 2^\circ$ to the longitudinal medial plane of the vehicle.

A.3 Example 3

A.3.1 Test set-up

A plate shall be mounted on a linear step motor which is in turn mounted in the vehicle's passenger compartment.

The plate shall have a height of 150 mm and a width of 100 mm, and be covered with rubber skin. The placement of the linear step motor shall be as shown in Figure A.2.

A.3.2 Test sequence

A.3.2.1 Phase 1

Adjustment of the system (only applicable where the sensitivity of the system is manually adjustable):

- a) determine the lowest speed at which the passenger compartment detection triggers an alarm (the plate moving in both directions);
- b) where the lowest speed is in line with the requirements, start phase 2; otherwise, adjust the sensitivity until the lowest speed is in line with the requirements.