SAE INTERNATIONAL

SURFACE VEHICLE STANDARD

J3214™ JAN2021

Issued 2021-01

Breath-Based Alcohol Detection System

RATIONALE

This standard establishes the performance specifications for the zero-tolerance breath alcohol detection system to reduce the risks of driving under the influence of alcohol.

SAE J3214 specifies test methods and essential performance requirements for the directed-breath zero-tolerance breath alcohol detection system.

FOREWORD

To reduce the risks associated with driving under the influence of alcohol, vehicle owners with oversight responsibilities, such as fleet owners or parents with teenagers, may enact zero tolerance alcohol policies. The zero-tolerance breath alcohol detection system can support execution of such policies. This system measures the driver's breath alcohol concentration (BrAC) through a directed breath with or without a mouthpiece and use a setpoint to either provide a warning and/or restrict the driver's ability to operate a vehicle. This setpoint is based on applicable national and local laws as well as vehicle owners' policies. Thus, there is a need for a new specification adopted for such applications.

This standard defines the accuracy and precision requirements of the BrAC measurement, as well as the acceptability criteria and key parameters to test these requirements. Additionally, this standard sets the zero-tolerance breath alcohol detection system performance requirements for ethanol sensitivity, the measurement speed, and the long-term reliability (including different environmental and electrical conditions) the system may encounter throughout the lifespan of the vehicle.

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1. SCOPE

This standard establishes the performance specifications for the zero-tolerance breath alcohol detection system to reduce the risks of driving under the influence of alcohol. It defines the accuracy and precision requirements of the BrAC measurement, as well as the acceptability criteria and key parameters to test these requirements. Additionally, this standard sets the performance requirements of the system for ethanol sensitivity, the response time, and the electrical, mechanical, and environmental conditions the system may encounter throughout the lifespan of the vehicle.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. For undated references, the latest edition of the referenced document (including any amendments) applies. In the event of a conflict between the text of this specification and the documents cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained by the supplier.

2.2 CENELEC Publications

Available from CEN-CENELEC Management Centre, Rue de la science, 23, B-1040 Brussels, Tel: +32 2 550 08 11, https://www.cenelec.eu/.

EN 50436-1 Alcohol Interlocks - Test Methods and Performance Requirements Part 1: Instruments for Drink-Driving-Offender Programs

2.3 Government Publications

Available from European Union Law, https://eur-lex.europa.eu.

Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on Waste Electrical and Electronic Equipment (WEEE)

2.4 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 60068, 2, 78 Test Cab: Damp Heat, Steady State

IEC 60529 Degrees of Protection Provided by Enclosures (IP Code)

IEC CISPR 25 Vehicles, Boats and Internal Combustion Engines - Radio Disturbance Characteristics - Limits and Methods of Measurement for the Protection of On-Board Receivers

2.5 Industrial Publications

Available from American Chemistry Council, https://www.gadsl.org/.

Available from RoHS Guide, https://www.rohsguide.com/.

Available from Burea International des Poids et Mesure, Pavillon de Breteuil F-92312 Sèvres Cedex, France, https://www.bipm.org/en/publications/guides/.

Global Automotive Declarable Substance List (GASDL)

Restriction of Hazardous Substances Directives 2015/63

JCGM 100:2008 GUM 1995 with Minor Corrections: Evaluation of Measurement Data - Guide to the Expression of Uncertainty in Measurement

JCGM 200:2012 International Vocabulary of Metrology - Basic and General Concepts and Associated Terms (VIM), Third Edition

2.6 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 7637-2 Road Vehicles - Electrical Disturbances from Conduction and Coupling - Part 2: Electrical Transient Conduction Along Supply Lines Only

ISO 7637-3 Road Vehicles - Electrical Disturbances from Conduction and Coupling - Part 3: Electrical Transient Transmission by Capacitive and Inductive Coupling via Lines Other Than Supply Lines

ISO 9772 Cellular Plastics-Determination of Horizontal Burning Characteristics of Small Specimens Subjected to a Small Flame

ISO 10605 Road Vehicles - Test Methods for Electrical Disturbances from Electrostatic Discharge

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 16750-3 Road Vehicles - Environmental Conditions and Testing for Electrical and Electronic Equipment - Part 3: Mechanical Loads

ISO 16750-4 Road Vehicles - Environmental Conditions and Testing for Electrical and Electronic Equipment - Part 4: Climatic Loads

3. DEFINITIONS

3.1 ACCEPTED BREATH SAMPLE

Breath sample fulfilling the set requirements for volume, flow, exhalation time, and other human breath sample characteristics.

3.2 ALCOHOL

Ethanol or ethyl alcohol with a defined chemical composition of C_2H_5OH.

3.3 BREATH ALCOHOL CONCENTRATION (BrAC)

The primary means of expressing the breath alcohol concentration. The mass concentration of ethanol, expressed in mg/L (milligram of ethanol per liter breath air), in a breath sample delivered to the system.

3.4 BREATH SAMPLE

A breath air sample taken under forced expiration.

3.5 BREATH TEST

Providing a breath sample to the system.

3.6 BYPASS

Operating the vehicle without providing a breath sample or without engaging an override function.

3.7 CALIBRATION

The process of comparing the system breath alcohol concentration measurements against reference standards.

3.8 CALIBRATION INTERVAL

Time period between calibrations during which the system fulfils the stability requirements for the measurement of the breath alcohol concentration.

3.9 CIRCUMVENTION

An intentional attempt to bypass the system, whether by providing samples other than the natural unfiltered breath of the driver or by engaging the vehicle's motive power without first providing an accepted breath test.

3.10 CONTACTLESS DIRECTED BREATH SAMPLE

A breath sample for analysis that is expelled from the driver in the direction of the system without making physical contact between the driver's mouth and the inlet of the system.

3.11 CONTROL UNIT

If included, the part of the system that is connected to the vehicular system(s) that directs the operation of the system and maintains data.

NOTE: A control unit is not necessarily a separate piece of hardware; rather, its functionality can be managed via different individual components.

3.12 DATA

All events that are detected by the system and recorded in a secured format harmonized to applicable local laws.

3.13 DATA MEMORY

Record of breath test results and other events with date and time stored in the internal memory of the system.

3.14 DIRECTED BREATH SAMPLE USING MOUTHPIECE

A breath sample for analysis that is expelled from the driver into the system using a mouthpiece to connect the driver's mouth and the inlet of the system.

3.15 ELECTROMAGNETIC COMPATIBILITY (EMC)

A state that is achieved when two or more electrical devices function in close proximity to another and do not influence each other's performance.

3.16 ELECTROMAGNETIC INTERFERENCE (EMI)

When the electromagnetic field of one device interferes with the normal operation of another device by coming into proximity with the other device.

3.17 ENCRYPTION

The method of encoding the data so that it can only be read but not altered by the intended recipient or intercepted.

3.18 EXPERIMENTAL TARGET CONCENTRATION

The measured concentration when attempting to achieve the nominal target concentrated stated in this standard.

3.19 FILTERED SAMPLES

Breath samples that are passed through some form of a filter or other device to remove alcohol from the breath sample.

3.20 INITIAL TEST

A breath test provided before the vehicle can be moved.

3.21 LITERS PER MINUTE (L/min)

A unit of volumetric flow for a gas or liquid.

3.22 MOUTHPIECE

The hygienic interface between the breath alcohol device and the driver delivering the breath sample. The mouthpiece's function is to ensure that the breath sample is not mixed with ambient air.

NOTE: In contactless operating modes, the system shall not require the use of a mouthpiece.

3.23 NON-PASSING STATE

State in which the system sends a signal to warn the driver and/or restricted vehicle operation.

3.24 PARTS PER MILLION (ppm)

A definition of concentration, this expression illustrates the ratio of one gas in a diluent gas. This unit is expressly used for the concentration of the calibration gas. This unit is not the primary unit for the system alcohol measurements.

3.25 PASSING STATE

A state in which the vehicle can be moved without warning and/or restriction.

3.26 PASSING TEST

An accepted breath sample that is delivered to the system that has been determined the alcohol concentration is lower than the setpoint.

3.27 POWER FAILURE

Any time a part of the system is deactivated by power being removed.

3.28 READY FOR TEST

An indication that the operating parameters of the system are met.

3.29 SETPOINT

A customer and manufacturer agreed defined value of breath alcohol concentration below which the vehicle's operation shall be in the "passing state."

3.30 SUPPLY VOLTAGE

Voltage from the electric power source of the vehicle for operation of the system.

3.31 SYSTEM PARAMETERS

Programmable, configurable variables used in the operation of the system that may be modified only by the manufacturer or the service provider.

3.32 TAMPERING

Intentional unauthorized change to or interference with the functioning of the system or its installation in the vehicle.

3.33 ZERO TOLERANCE BREATH ALCOHOL DETECTION SYSTEM

A device which is normally in the “non-passing state” and which can be brought into the “passing state” only after the presentation and analysis of the driver’s breath sample with an alcohol concentration below the customer-specified threshold or set limit.

4. GENERAL REQUIREMENTS

4.1 Passing and Non-Passing

The system shall send an encrypted signal of the “non-passing state” or “passing state” if the alcohol measurement is above or below a set limit. The system shall start and remain in a “non-passing state.” After a sufficient test is successfully provided by the vehicle operator and the alcohol measurement is equal to or below the setpoint, the system shall change to a “passing state.” If the driver’s alcohol measurement is above the setpoint, the system shall remain in a “non-passing state.”

4.2 Tampering

The system shall be designed, manufactured, and installed to reduce the risk of being put out of service, rendered ineffective, or destroyed without visible changes to the system. In addition, the system shall be designed to deter unauthorized or inadvertent interference to access to the data and/or system parameters.

4.3 Mouthpiece

If the system does not require a mouthpiece, then all tests shall be conducted without a mouthpiece for each sectional test.

If a mouthpiece is required, then all tests shall be conducted with a new mouthpiece for each sectional test.

NOTE: The mode of operation must be clearly denoted on the system to minimize inadvertent misuse.

4.4 Readiness

The system shall provide an indication when it is “ready for test.” A breath test shall only be accepted after the system indicate it is “ready for test.”

4.5 Response Time

A result shall be produced by the system within 15 seconds or less from the completion of the breath sample. This time shall not depend on the concentration of alcohol that has been applied to the system.

4.6 Retests

The system shall be capable of requesting retests.

4.7 Service

The system shall be capable of requesting service if certain events occur such as, but not limited to, failed self-diagnostics, failed initial test, or bypassing.

4.8 Electrical Power Failure

If the supply power to any component of the system power fails, then the system shall enter the “non-passing state.” Upon power restoration, it shall require an initial test. The system shall have an internal power backup to maintain the clock and memory for a minimum of 6 months.

4.9 Data Collection

The system may store the following data in nonvolatile encrypted memory with controlled access:

- Vehicle power start up and shut down
- System start up GMT date and time
- System shut down (both, planned and unplanned) GMT date and time
- System errors
- Manipulation and circumvention detection
- Data associated with an initial test or retest
- System serial number
- System hardware, firmware, and/or software version(s)
- Last calibration date
- GMT date and time
- Measured alcohol concentration

4.10 Basic Functionality

Basic functionality of the user guidance includes all means necessary to lead the user through the measuring procedure and to perform an accepted measurement. This includes all indications to signal each step of the procedure and the correct interpretation of the result. The following may be indicated:

- Ready to accept a test
- Testing
- Test accepted
- Test not accepted
- Test passed
- Test failed
- Test to be repeated

The indication may be audible and/or visible.

5. GENERAL TEST METHODS

5.1 Laboratory Accreditation

The testing laboratory shall be ISO/IEC 17025 accredited for conducting this standard.

5.2 Test Systems

5.2.1 The system manufacturer shall provide:

- Four systems (with all required accessories), clearly labeled, for testing
- All the tests shall be carried out on the systems clearly labeled “System A” and “System B”
- “System C” shall be the third system required for the free-fall test
- “System D” shall be a spare system if needed used at the discretion of the testing laboratory due to a laboratory accident
- Additional systems may be requested and tested at the laboratory’s discretion if not considered to affect the results of the tests
- Installation and operating instructions or manuals
- Any required software to control, decrypt, view, and download alcohol measurements data from the system
- Power supply specifications
- Wiring harnesses and/or connectors
- User serviceable parts (such as fuses and the required tools)
- Bill of materials
- Certificates of compliance for materials or components

5.2.2 Integrated batteries may be replaced or recharged before individual tests unless otherwise stated.

5.2.3 The system may be calibrated prior to testing commencement. Once the sequence of tests has commenced, the system cannot be recalibrated or serviced.

5.3 Sequence of Tests

Components for the system intended to be used in the vehicle during operation (according to the manufacturer) shall be tested according to this specification. Examples of these components may include, but are not limited to, cameras or GNSS systems generating data related to event data of the system, as well as accessory devices handling or transferring data.

The testing of the system shall be conducted in the order specified below with the system labeled “Sensor A” and “Sensor B” being sequentially subjected to all of the tests in Groups 1 through 7.

- Group 1: Electrical tests (see Section 6)
- Group 2: Calibration curve (see Section 7)
- Group 3: Durability tests (see Section 8)
- Group 4: Environmental tests (see Section 9)

- Group 5: Analytical specificity (see Section 11)
- Group 6: Manipulation and circumvention (see Section 12)
- Group 7: Design and construction (see Section 10)

5.4 Normal Conditions for Tests

All tests shall be performed with the system connected to the power supply and powered-on under the following normal conditions, unless otherwise stated.

5.4.1 Voltage

The required voltage shall be specified by the system manufacturer (nominal operating voltage ±5%) or the system shall be operated with sufficiently charged integrated batteries.

5.4.2 Test Environment Properties

The testing ambient temperature shall be +23 °C ± 5 °C. The testing ambient pressure shall be 98000 Pa ± 20000 Pa.

5.4.3 Humidified Calibration Gases

5.4.3.1 Temperature

The temperature of humidified gases shall be +34 °C ± 5 °C.

5.4.3.2 Concentration Units

The primary unit for concentration of the calibration gas alcohol concentration shall be in parts per million (ppm) for added congruency with gas manufacturers and traceability with gas standards. The secondary unit shall be mg/L.

5.4.3.3 Uncertainty of Calibration Gas

The calibration gas shall have metrological traceability. At the test conditions stated in 5.4.2, the Type A (refer to JCGM 100:2008) experimentally collected data as directly reported by the instrument or unit (minimum 30 data points) mean shall be ±2 ppm or 1.00% of the respective target ppm value, whichever is greater. See Equation 1 for the formula to calculate mean.

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n} \quad \text{(Eq. 1)}$$

where:

n = the number of measurements collected in the test

$\overline{x}$ = calculated mean

x_i = a single measurement result

The relative standard deviation (using Equations 2 and 3) of the secondary measurement standard (refer to JCGM 200:2012) calibration gas (including the measuring system used to quantitate the calibration gas) shall be equal to or less than ±1.5% of the experimental concentration as calculated.

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}} \quad \text{(Eq. 2)}$$

where:

σ = experimental standard deviation

n = the number of measurements collected in the test

$\overline{x}$ = calculated mean

x_i = a single measurement result

$$\%RSD = 100 \text{ x } \frac{\sigma}{\overline{x}} \quad \text{(Eq. 3)}$$

where:

%RSD = relative standard deviation

σ = experimental standard deviation

$\overline{x}$ = calculated mean

5.4.3.4 Humidity

The calibration gas applied to the system shall have a humidity between 50 to 100% RH at 34 °C and 100000 Pa.

5.4.3.5 Tracer Gas

If deemed necessary by the system manufacturer, tracer gas(es) may be included in the calibration gas mixture. The presence and concentration of this tracer shall be substantiated by the manufacturer with pertinent and/or applicable rational.

5.4.3.6 Testing Chemicals and Components

All components of the calibration gas (including, but not limited to, ethanol, nitrogen, oxygen, and carbon dioxide) shall be of high purity (i.e., assay purity >99.5%).

5.4.3.7 Flow Rate

A flow rate of the calibration gas presented to the system shall range between 10 to 60 L/min pulsed in a manner that simulates directed human respiration.

5.4.3.8 Volume

The volume of each pulse shall be between 0.67 to 1.67 L.

5.4.3.9 Non-Mouthpiece Samples

For systems not requiring a mouthpiece, the gas pulses shall be delivered from a distance of 10 cm ± 1 cm (from the sample generator gas exit port to the inlet of the system). The exit port should be a straight tube with an inner diameter between 0.5 to 1.2 cm and a length of between 10 to 12 cm to provide a uniform flow rate cross section.

5.5 Functional Test

5.5.1 The alcohol limit value at or above which the system is in the “non-passing state” shall be adjusted to 0.095 mg/L for these tests.

NOTE: This test type shall verify the system enters a “passing state” and “non-passing state” below and above a specified setpoint. 0.095 mg/L was chosen as the setpoint to use for this test type to represent one implementation of zero-tolerance alcohol systems. The actual setpoint shall be set in agreement between the customer and manufacturer.

5.5.2 Calibration gases with an alcohol concentration of 0.140 mg/L shall be applied to the system successively ten times in intervals a minimum of one minute between breath samples. The system shall remain in a “non-passing state” in each test.

5.5.3 Calibration gases with an alcohol concentration of 0.048 mg/L shall be applied to the system successively ten times in intervals a minimum of one minute between breath samples. The system shall go into a “passing state” in each test.

5.6 Test Stoppage and Restart

If testing is stopped, the reason for the test stoppage shall be clearly recorded.

If a test failure occurs due to a laboratory accident, the system under test can be replaced by the spare System D (at the discretion of the testing laboratory) and the testing shall restart at the beginning of the test section. The testing shall be considered a pass if the system has completed the entire test section from start to finish and passed all tests.

If there is a second failure on any device, the test shall be considered a failure.

5.7 Test Reports

A tests report shall include a pass/fail result for each device and at a minimum:

- Name, address, and accreditation(s) of the facility that performed the tests, as well as the date, time, and ambient conditions of each test
- Information relating to the tested devices including, but not limited to, test equipment and apparatuses that were used
- Test procedures that were followed, including any deviations from the approved test plan
- Results, observations, and if applicable, anomalies that have occurred

6. ELECTRICAL TESTS

6.1 General

If the system is combined with other vehicle systems or integrated into them, the vehicle manufacturer may provide these test results.

For the system with 12 to 24 V nominal operating voltage for one power input, the tests shall be performed with the most severe or extreme thresholds of the voltage conditions.

6.2 Supply Voltage

The system shall be tested for the influence of the supply voltage with the following test conditions (refer to ISO 16750-2 Section 4.2.)

- Systems with 12 V nominal operating voltage: code C (9 V and 16 V)
- Systems with 24 V nominal operating voltage: code F (16 V and 32 V)

The system shall fulfill functional status A (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.3 Excess Supply Voltage

6.3.1 Systems with 12 V nominal operating voltage shall be subjected at +65 °C ambient temperature to an excess supply voltage of 18 V for 60 minutes (refer to ISO 16750 Section 4.3.1.1).

6.3.2 Systems with 12 V nominal operating voltage shall be subjected at room temperature to an excess supply voltage of 24 V for 60 seconds ± 6 seconds (refer to ISO 16750-2 Section 4.3.1.2).

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of each test condition.

6.3.3 Systems with 24 V nominal operating voltage shall be subjected at +65 °C ambient temperature to an excess supply voltage of 36 V for 60 minutes (refer to ISO 16750-2 Section 4.3.2).

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.4 Short Circuit

6.4.1 The system shall be tested for the short circuit protection of signal circuits with the following test conditions (refer to according to ISO 16750-2 Section 4.10).

6.4.1.1 Systems with 12 V Nominal Operating Voltage

U_{Smax} = 16 V.

6.4.1.2 Systems with 24 V Nominal Operating Voltage

U_{Smax} = 32 V.

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

NOTE: Communication lines (such as RS-232, USB, or ethernet) are not considered signal circuits and are not to be included in this test.

6.4.2 The system shall be tested for the short circuit protection of load circuits (refer to ISO 16750-2 Section 4.10.3).

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.5 Engine Starting

The system shall be tested for the influence of discontinuity in supply voltage under the following test conditions (refer to ISO 16750-2 Section 4.6.3).

6.5.1 Test Level: IV for 12 V Systems

6.5.2 Test Level: III for 24 V Systems

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.6 Reversed Polarity

6.6.1 Systems with a power supply from the vehicle battery shall be tested (refer to ISO 16750-2 Section 4.7).

6.6.2 If the system has exchangeable batteries integrated within the system, the batteries shall be inserted with reversed polarity for a duration of 60 seconds if it is possible to do so without mechanical modification.

After the test condition and after replacing all blown fuse links (if needed), the system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5).

6.7 Low Power Consumption State

The time-weighted average current draw over a 24 hour period for the system in low power-consumption state shall not exceed 3 mA at 12 V or at 24 V. For short periods of time, the current may be higher.

The overall current in low power mode shall be measured using an appropriate current or power-measuring device capable of recording the total power draw from the vehicle's battery to the system for a period of 24 hours at a sampling frequency of one sample every minute.

NOTE: The measurement should not be taken at the vehicle battery since other systems, such as the clock, might be drawing from the battery. The measurement should be taken as close to the system as possible.

6.8 Electrical Disturbances

This section is not applicable to parts of the system integrated into other vehicle systems.

6.8.1 Supply Lines

The system shall be tested for the influence of electrical disturbances (refer to ISO 7637-2) under the following test conditions:

- Test pulses 2a, 2b, 3a, 3b
- U_s: -100 V for nominal 12 V systems or -450 V for nominal 24 V systems

The system shall fulfill functional status A (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.8.2 Lines other than supply lines

The system shall be tested for the influence of electrical disturbances (refer to ISO 7637-3) under the following test conditions:

- Test pulses: 3a, 3b
- Test level: IV

The system shall fulfill functional status A (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.9 Electrostatic Discharge

The system shall be tested for the influence of electrostatic discharge (refer to ISO 10605) under the following test conditions:

- Direct contact discharge direct air discharge
- Test severity level: L_{1i}
- Function performance status: III

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

6.10 Electromagnetic Compatibility

6.10.1 Emissions

The tests shall be performed with the system ready to accept a breath sample. The system shall meet and satisfy EMC Class 5 (at a minimum) emissions (refer to CISPR 25).

6.10.2 Susceptibility

The tests shall be performed with the system ready to accept a breath sample and shall operate normally with EMC noise, floating earth, ignition pulse, over voltage, reverse connection, and EMI examinations (refer to ISO 11451-2).

- Test severity level: L_{2i}
- Function Category 1

The tests shall be performed with the system ready to accept a breath sample.

The system shall fulfill functional status C (refer to ISO 16750-1) when fulfilling the requirements of the functional test (see 5.5) at the end of the test condition.

7. CALIBRATION CURVE

For this test, the system shall be configured to report the measured alcohol concentration in units of mg/L with a minimum resolution of three decimal places.

The system shall be tested with calibration gases having alcohol concentrations of 0.000 mg/L, 0.095 mg/L, 0.238 mg/L, 0.476 mg/L, and 0.714 mg/L. At each concentration, 30 measurements shall be performed in intervals a minimum of 1 minute between breath samples.

The mean of the measurements, as reported by the system, shall not differ from the actual target concentration by more than ±7.5% of the respective experimental target concentration or ±0.015 mg/L, whichever is larger. The system shall meet the following experimental standard deviation (see Equation 2) for each alcohol concentration less than or equal to 5.0% of the respective target concentration or 0.015 mg/L, whichever is larger.

8. DURABILITY TESTS

8.1 Temperature Cycles

While in the low power-consumption state for a minimum of 1 hour after reaching “nominal” temperature conditions, the system shall be tested for temperature cycling durability (refer to ISO 16750-4 Section 5.3.1.2 Table 2).

The two classes of ambient temperatures are defined as (refer to ISO 16750-4 Section 4 Table 1):

- Code G (-40 to +85 °C) for parts to be fitted permanently in the passenger or luggage compartment
- Code O (-40 to +125 °C) for parts to be fitted in the engine compartment unless otherwise specified

After completion of the test, the basic functionality of the system and the user interface shall not be compromised and upon external inspection shall not show damage impairing its functionality as well as fulfill under normal conditions the requirements of the functional test (see 5.5) after a minimum of 1 hour after the case has achieved normal temperature condition (see 5.4.2).

8.2 Condensed water

While in the low power-consumption state, the system shall be tested for humidity resistance (refer to ISO 16750-4 Section 5.6.2.2).

8.3 Vibration

The system shall be mounted on a vibration table with its cabling representing the fixing points of the installation in the vehicle according to the manufacturer's instructions and shall be tested for vibration durability (refer to ISO 16750-3 Section 4.1.2.8).

After completion of the test, the basic functionality of the system and the user interface shall not be compromised and upon external inspection shall not show damage impairing its functionality as well as fulfill under normal conditions the requirements of the functional test (see 5.5).

8.4 Mechanical Shock

At normal temperature condition (see 5.4.2), the system shall be tested for driver’s door, shock profile 2 (refer to ISO 16750-3 Section 4.2).

After completion of the test, the basic functionality of the system and the user interface shall not be compromised and upon external inspection shall not show damage impairing its functionality as well as fulfill under normal conditions the requirements of the functional test (see 5.5).

8.5 Free Fall

At normal temperature condition (see 5.4.2), the system shall be tested for free fall durability (refer to ISO 16750-3 Section 4.3).

After completion of the test, the basic functionality of the system and the user interface shall not be compromised and upon external inspection shall not show damage impairing its functionality, as well as fulfill under normal conditions the requirements of the functional test (see 5.5).

8.6 Damp Heat, Steady-State

While in the low power-consumption state, the system shall be tested for damp head, steady-state durability (refer to ISO 16750-4 Section 5.7).

After completion of the test, the basic functionality of the system and the user interface shall not be compromised and upon external inspection shall not show damage impairing its functionality as well as fulfill under normal conditions the requirements of the functional test (see 5.5).