

Principles for the testing and certification of safety-related assistance systems on machinery and commercial vehicles

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GS-BAU-70

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We test for your safety.

GS-BAU-70

Test principles

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0 Preliminary remark

This test principle is a joint work by the following DGUV Test testing and certification bodies:

- DGUV Test Testing and Certification Body Foodstuffs Industry and Packaging Industry (NV)
- DGUV Test Testing and Certification Body Expert Committee for Traffic and Environment (VL)
- DGUV Test Testing and Certification Body for Printing and Paper Converting (DP)
- DGUV Test Testing and Certification Body Expert Committee for the Construction Industry (BAU)
- DGUV Test Testing and Certification Body Institute for Occupational Safety and Health (IFA)
- DGUV Test Testing and Certification Body Expert Committee for Woodworking and Metalworking (HM)

Changes to the content of the test principle shall be agreed between the DGUV Test testing and certification bodies involved. Current contact details of the testing and certification bodies can be found on the website www.dguv.de/dguv-test.

Assistance systems are not described in the Machinery Directive 2006/42/EC and do not constitute safety components within the meaning of Article 2, paragraph c of the Directive.

This test principle contains specifications for the testing of assistance systems of stationary and mobile machines, machine superstructures on vehicles and commercial vehicles. They are used for the assessment of safety-related requirements by the DGUV test and certification bodies.

In line with the latest findings in the field of occupational safety and technical progress, the principle is regularly reviewed and revised as necessary. The latest edition is binding for application.

The principle for testing is intended for use with a contractual agreement as part of a certification procedure of the DGUV Test testing and certification bodies. Any other use requires the general approval of the DGUV Test testing and certification bodies.

The test principle applies in conjunction with

- the DGUV Test Rules of Procedure for Testing and Certification - Part 1: Certification of Products, Processes and Quality Management Systems (DGUV Principle 300-003), as amended,
- the respective certification programme (if applicable),
- the other specifications of the respective certification body (if applicable).

Test principles

1 General

1.1 Scope

This principle applies to the testing of assistance systems of stationary and mobile machines as well as machine superstructures on vehicles and commercial vehicles,

- which are intended to prevent accidents and damage to health (e.g. by preventing handling errors or incorrect actions),
- which assist persons in safety-related tasks (in the area of application),
- which are only informing and warning systems as well as intervening systems or a combination of both,
- whose main task is to ensure the safe operation of the machine and not exclusively to make work easier for the operating personnel,
- which are actually installed in a representative machine (application).

This principle does not apply to the testing of assistance systems of stationary and mobile machinery and machine superstructures on vehicles and commercial vehicles,

- which serve purely to increase productivity,
- the machines or vehicles themselves, in which the assistance system is installed, are not part of this test principle.

If the assistance system implements the required risk reduction as defined by the Machinery Directive in accordance with DIN EN ISO 12100, the application of this test principle alone is not sufficient. In principle, assistance systems are not intended to replace e.g. protective devices required by a standard.

This test principle describes requirements for assistance systems of classes A, B, C and D (see clause 2, Terms and definitions).

Class A, B and C assistance systems are assumed to have only a supporting effect, but the full responsibility lies with the user.

Further requirements shall be observed for class D assistance systems (see clause 3.8).

Class E assistance systems are not part of this test principle.

1.2 Test principles

Compliance with national legal regulations, e.g. registration regulations for motor vehicles, is a prerequisite.

The safety testing is based in particular on directives, harmonised standards and other regulations as amended.

EC Directives

- 2006/42/EC (EC Machinery Directive)
- (EU) 2023/1230 (EU Machinery Regulation)

Standards

Type C standards relating to the basic machines are used by the relevant DGUV testing and certification body.

Product-specific technical and generally applicable rules (e.g. DIN EN ISO 16001, DIN 92419) can also be used for testing.

1.3 Validity

This test principle applies from **1st February 2026** and is valid until it is replaced by a revised version or withdrawn.

2 Terms and definitions

2.1 Machine

Machines are considered in this test principle in the sense of the Machinery Directive 2006/42/EC and the Regulation (EU) 2023/1230.

2.2 Assistance system

An assistance system is a support system for the users of stationary and mobile machines as well as machine superstructures on vehicles and commercial vehicles of mobile machines, which provides an assisting function for driving and other operating tasks or is intended to counteract errors and incorrect behaviour in the driving and operating task.

This test principle defines five classes of assistance systems and gives examples of the individual classes as follows.

2.2.1 Class A assistance system

A class A assistance system is an information system with an indirect effect.

Examples:

Imaging system as a visual aid for environment perception, traffic sign assistant, night vision assistant

2.2.2 Class B assistance system

A class B assistance system is a warning system with an indirect effect that provides information with emphasis.

Examples:

Person recognition warning assistant, attention assistant, lane departure warning, reversing warning device, passive turning assistant, assistant for warning of critical conditions

2.2.3 Class C assistance system

A class C assistance system is an assistance system with a direct effect that can be overridden by the user if this is required in the application. Such a system actively intervenes in a minimising/limiting manner, makes a suggestion for action to the user if necessary and is not part of the risk reduction strategy.

Examples:

Person recognition system with brake intervention until complete standstill, such as start-up, reversing or turning assistants, cornering assistant, assistant for avoiding critical conditions (e.g. short distance, high speed), hand detection on saws.

2.2.4 Class D assistance system

A class D assistance system is a semi-automated system with a direct effect that can be overridden by the user if required in the application. Such a system actively intervenes in a minimising/limiting manner, is part of the risk reduction strategy and can, for example, take over part of the operating task.

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Examples:

Adaptive cruise control, lane keeping assist with steering control, assistance system for automated driving and loading functions and examples as listed under C, if they are part of the risk reduction strategy.

2.2.5 Class E assistance system

A class E assistance system is a fully automated system with a direct effect that cannot be overridden by the user.

Examples:

System for fully automated operation, including driverless driving and loading functions.

2.3 Test pieces

Test pieces are determined based on the use cases of the assistance system. The information provided by the manufacturer of the machine in the associated risk analysis, for example, can be used for this purpose.

Test pieces are aids that can be used, for example, to simulate potential collision obstacles such as the human body or body parts or other obstacles, depending on the environment in which the assistance system is used. Suitable dummies can be used as test objects.

3 Requirements and tests

3.1 Documentation

The documentation submitted to the testing body shall be complete and clearly labelled with details such as file name, date, etc.; it shall be compiled in a documentation list to provide an overview.

Changes to previously published document lists shall be labelled. The testing bodies provide data exchange platforms for the secure exchange of data. The technical documentation that shall be made available to the testing body includes the following documents (if applicable):

- a general description of the assistance system (including design and functionality, intended use and operating environment),
- accompanying information (see 3.16),
- block diagram and/or connection diagram,
- documentation on functional safety as specified by the testing body (e.g. FMEA, description of diagnostic measures),
- existing evidence for the product from other bodies and evidence from the manufacturer.

If necessary, the testing body may request further documentation and evidence.

All documents required for the testing shall be provided primarily in German and in digital form (e.g. PDF format). If required, the documentation and evidence may also be submitted in paper form.

3.2 Requirements for the function

Assistance systems shall always have a functionality and corresponding performance data that is adapted/suitable for the respective machine and its application. The included hazard and operating situations of the machine and performance/usage limits of the assistance systems shall be taken into account.

The human-machine interface shall be suitably adapted to the defined utilisation requirements. The design of the interfaces shall meet ergonomic requirements.

Test principles

The operation, functionality and, depending on the state of the art, the reaching of system limits of assistance systems shall be clearly signalled to users in a context-related manner.

For Class A, B and C assistance systems, the functionality and reliability of the system shall be within the limits reasonably expected by the user.

The trust of the user is decisive for the acceptance of the use of an assistance system. The use of an assistance system shall not impair the functionality of the machine to such an extent that this leads to a lack of consideration of ergonomic findings on safe and healthy design and to a lack of usability or loss of trust and acceptance, e.g. due to maloperation or incorrect warnings.

The reasonably foreseeable use of the machine shall be taken into account when designing the assistance system.

Where appropriate, decisions made by an assistance system should be presented transparently to the user and interventions by an assistance system should be announced, e.g. by means of visual and/or acoustic and/or haptic signals.

If the assistance system has a configuration option, e.g. for the parameterisation of product parameters by service personnel, a management system for the authorisation of persons or groups of persons shall be installed.

If the assistance system has facilities for making user-specific settings, these shall be stored on a personalised basis and be easily retrievable and resettable for each user.

Assistance systems with a direct effect on the behaviour of a machine (class C and D) may be overridden by the user. Deactivation by the user should not be possible as a rule, unless certain impairments caused by the assistance system can be avoided by deactivation. The deactivation of an assistance system function shall be permanently indicated by a signalling device. The possibility of deactivation shall be realised appropriately for the context of use.

3.3 Scope of testing

The test focusses on the aspect of targeted functionality of the assistance system and its reliability.

An testing of individual details, e.g. of programme codes, circuit boards or environmental aspects, only takes place in justified cases.

If necessary for the product, further test requirements can be defined. The interpretation of a technical specification can be concretised from a standard, for example.

The testing body draws up a test plan on the basis of the technical documents submitted by the applicant. The manufacturer will be informed of the scope of testing or test plan specified therein.

The test depth at which the following test elements are tested is determined by the testing body. The test depth depends on the design of the assistance system.

3.4 Equipment

The assistance systems shall be designed in accordance with the standard DIN EN 60204-1 with regard to electrical equipment. The standards DIN EN ISO 4413 and DIN EN ISO 4414 apply to fluid technology equipment. Where vehicle equipment is concerned, the comparable vehicle authorisation regulations (e.g. UN ECE Regulations) apply.

For assistance systems that are installed in machines, vehicles and devices for commercial use comparable standards are used.

If it becomes apparent during a test that individual requirements from the above-mentioned documents have not been fulfilled, the manufacturer may be required to provide technical test evidence.

Test principles

The mechanical design of all individual components shall be evaluated by visual inspection with regard to their suitability for the operating environment and their installation location.

3.5 Operating environment

The application as well as the associated operating and environmental conditions are determined by the operating environment.

The purpose of the test is to determine the suitability and targeted functionality of the assistance system in the operating environment for a specific type of machine. The operating environment defined by the manufacturer is to be checked and the assistance system evaluated accordingly. The effectiveness is tested using key parameters (e.g. response times, etc.).

If an assistance system is intended by the manufacturer not only for use with a specific type of machine, but, for example, for a category of machine, the testing body decides to what extent the results of the test are transferable for use with other types of machine and documents this in the test report.

Partial tests (optional, e.g. EMC, electrical safety, equipment, ergonomic design, etc.) are carried out under environmental conditions specified by the testing body. The exact data is determined and recorded. Other than the specified environmental conditions are then not part of the test.

3.6 Test pieces

If test pieces have to be defined, they shall be customised for the assistance system to be tested and described in the test report.

The following exemplary references can be mentioned:

- DIN EN ISO 3691-4
- DIN EN ISO 16001
- GS-VL 40
- DIN 33402-2
- DIN EN IEC 61496-3
- DIN IEC/TS 61496-4-3
- DIN IEC/TS 62998-3 (under development)
- specifications for dummies in the automotive sector

3.7 Experimental setup

Since this test principle can be used to test a wide variety of assistance systems, no specific test setup can be defined or specified.

The test setup is determined by the respective testing body. The manufacturer's risk evaluation serves as the basis. Part of the risk evaluation can be, for example, the risk assessment, the system FMEA or system specification.

3.8 Reliability

The assistance system is tested for reliability.

A reliability test should primarily relate to the effectiveness of the intended function and the failure of the assistance system.

To evaluate the reliability of the intended function, individual test criteria and test procedures shall be established, e.g. endurance test, determination of the detection rates of the sensor system, number of repetitions and environmental conditions to be tested.

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For the detection and signalling of failures that are not automatically apparent to the user, assistance systems of classes A, B and C shall be equipped with automatically performed diagnostic measures for the detection and signalling of failures that are appropriate to the function of the assistance system. Further requirements for safety integrity (e.g. PL or SIL) do not have to be fulfilled. In the case of Class C assistance systems, however, this shall take into account the requirements for functional safety, e.g. based on DIN EN ISO 13849-1.

Possible sufficient tests for functional safety are, for example:

- function test,
- analysing the technical documentation,
- evaluation of the evidence of tests or records already carried out,
- evidence from another testing body.

If the assistance system requires the evaluation of artificial intelligence, DGUV Test Information 05 " General principles for assessing the safety of artificial intelligence (AI)" is a possible basis for this partial test.

Fault resistance, if applicable, and fault detection shall be tested.

In particular, the following shall be tested:

- fault tolerance in the user interface in the operating environment,
- reasonably foreseeable types of failure,
- behaviour in fault conditions,
- behaviour in the event of misuse,
- indicators that the system is ready for operation.

Class D assistance systems serve to risk reduction within the meaning of DIN EN ISO 12100 and shall fulfil all requirements and test specifications for functional safety, e.g. DIN EN ISO 13849-1 and applicable product-specific standards. If product-specific standards are not available, the testing body shall define product-specific requirements and tests.

3.9 Newly emerging direct hazards

Evident adverse effects/influences, i.e. newly arising direct hazards that emanate directly from the assistance system, shall be described by the manufacturer.

Tests that are not described in this test principle may be necessary for an evaluation.

3.10 Environmental conditions

The technical specifications of the manufacturer and the system limits specified in the operating instructions are checked for plausibility with regard to the application requirements. In justified cases, the manufacturer may be requested to provide technical evidence.

The manufacturer's information not relevant to the test as analysed by the testing body, e.g. technical information on environmental conditions, other technical specifications of the manufacturer on environmental conditions (see also information in the operating instructions), are not part of the test of the assistance system.

The manufacturer shall also supply the relevant evidence for electromagnetic compatibility (EMC); these are checked for relevance and completeness by the testing body.

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3.11 Human-machine interface, ergonomic requirements

Assistance systems shall provide users with relevant information in a timely and ergonomic manner so that they can reliably perceive and process it and react to all information in a timely and anticipatory manner.

The operating concept of the assistance system shall be integrated into the operating concept of the machine.

Principles of occupational science and ergonomics shall be applied both with regard to the design of assistance systems, including their user interfaces, and their use with a system or machine (e.g. in particular in accordance with the EC Machinery Directive and harmonised standards of the DIN EN 614 and DIN EN 894 series).

This means, for example, that:

- the design requirements of occupational science and ergonomics with regard to the arrangement of displays are met, even when several assistance systems are used,
- unrestricted functioning and use of the assistance system is guaranteed at the workplace where the task is being performed,
- primary information for task processing is recognisably displayed in the user's central field of view,
- the control elements for task processing can be arranged in the user's gripping area,
- an assistance system for viewing danger zones shall represent the danger zone plus an increment for the speed of movement of mobile machinery and persons outside the machine with the assistance system and the machine's own movement.

If the task processing with an assistance system requires a comparison of information or the simultaneous observation of several pieces of information by the user, this information shall be displayed in parallel and not serially.

If the task is to obtain an overview or an orientation for a status, the parallel information display is preferable to the serial information display.

The ergonomic design of an assistance system shall prevent negative risk behaviour.

Current information on the operating status and functionality shall be displayed in such a way that it can be reliably recognised by the user at all times.

The use of assistance systems shall not result in any impairments or hazards for users or indirectly affected persons.

The assistance system shall be ergonomically designed in such a way that the user's concentration and attention are ensured during use.

All displays shall take into account ergonomic design requirements in terms of character height, colour spectrum, sound spectrum and perception thresholds for the human sensory systems.

The design of warning signals shall also vary in warning intensity depending on the intensity of the hazard. The signal design should take into account, for example, proximity to the hazard, localisation in the case of warning signals for blind spots and collisions as well as variations in the intensity of the warning.

The ergonomic design of assistance systems shall take into account different operating conditions (e.g. inside a temperature-controlled warehouse or on an outdoor construction site, varying lighting conditions and ambient noise levels).

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The user concept of the assistance system shall not cause any unnecessary additional impairment of the user's information processing or tie up the user's attention for other tasks.

Operating the assistance system shall follow simple and logical procedures.

The visible and/or acoustic and/or haptic signals of the assistance system shall be designed to suit the environmental conditions (e.g. noise, lighting conditions) and be clearly perceptible to the user.

Note 1: If the assistance system concerns requirements for age/gender equality and accessibility, these requirements are not part of this test principle.

Note 2: DIN EN 614-1, DIN EN 894-1 or ISO 9355-1 and, where applicable, DIN EN ISO 9241-11 and DIN EN ISO 9241-210 can be used for the design process for the design of user interfaces of technical machinery and equipment in accordance with ergonomic principles.

3.12 Assistance system machine interface

Only interfaces that have been approved by both the manufacturer of the machine and the manufacturer of the assistance system may be used. If these interfaces comply with an international standard, they shall be suitable for connection by an assistance system.

Appropriate diagnostic measures shall be taken at the assistance system machine interface in accordance with the class of the assistance system (see clause 3.2).

The design properties of the interface shall be realised in accordance with the relevant regulations and the respective installation situation.

3.13 Evidence from other bodies

Evidence/test reports from manufacturers or other testing bodies can be recognised if they have been checked and checked for plausibility by the testing body.

3.14 Manipulations

Assistance systems shall be designed, integrated and usable in such a way that there are no incentives for operators to carry out foreseeable manipulations.

Manipulations should be detected by the assistant as far as technically feasible and this should be displayed.

3.15 Labelling/type plate

Assistance systems placed on the market individually shall be provided with legible and permanent labelling (type plate).

The following minimum information shall be stated on the labelling/type plate: Manufacturer (name and full address), type designation, serial number, year of manufacture.

Assistance systems that are an integral part of the basic machine shall be clearly labelled, e.g. the part number with serial assignment.

3.16 Requirements and testing of the accompanying information

The user information on the intended use of the respective assistance system includes the specified operating and hazardous situations.

Performance/usage limits and the handling of the assistance system shall be made clearly transparent, e.g. via the human-machine interface or by means of suitable accompanying information.

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The operating instructions of assistance systems shall contain sufficient and appropriate information and instructions for the use of the assistance systems, focusing on the instruction of contents specific to the assistance system. This includes addressing any necessary health requirements.

The content of the accompanying information shall be evaluated by the testing body.

General scope of the accompanying information for assistance systems:

- a) intended use with area of application and specification of the machine type or machine category with which the assistance system is to be used,
- b) assembly instructions including fully dimensioned assembly drawing(s), installation steps and intended installation materials,
- c) connection diagram with supply data and interface data with their requirements/connection data,
- d) operating instructions,
- e) instructions/information for the operator station (e.g. as a quick guide, alternatively: slide-log-supported via the monitor) and for the human-machine interface,
- f) listing of conformity references and test evidences,
- g) protocol or sample protocol for testing commissioning and for maintenance (e.g. visual inspections and functional tests).

4 Type, scope and procedure of testing

4.1 General

Testing is preferably carried out on the installed assistance system under defined environmental conditions. Alternatively, individual tests can be carried out in a laboratory setup. The selection is made in accordance with the specifications of the DGUV testing and certification body.

The test usually takes place at the manufacturer's premises. Alternative locations for testing can also be arranged.

The working language for a testing is German. Other languages are possible by prior agreement and require the involvement of translation personnel if necessary.

4.2 Procedure of the test procedure

The test procedure is described in the current edition of the Rules of Procedure for Testing and Certification (PZO). If necessary, further documents of the respective DGUV Test testing and certification body apply.

4.3 Scope of testing

The scope of testing depends on the test basis, the specific test order and the respective specifications of the responsible DGUV Test testing and certification body.

The fulfilment of the test requirements for the respective type shall be verifiable by the submitted order-specific documents.

Visual and functional tests, measurements, analyses, etc. are carried out on the type to be tested.

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4.4 Test procedure

The scope of the test and the test procedure are determined in accordance with the specifications of the respective DGUV Test testing and certification body and are generally based on the following steps in order processing:

- submission of the application documents to the responsible DGUV Test testing and certification body,
- selection of the type (basic device, variants, manufacturer configuration, etc.),
- organisational preparation and coordination of the testing date,
- evaluation of the existing technical documentation,
- evaluation of any further evidence required from the manufacturer or third parties,
- testing of the assistance system in a selected operating environment and/or in the test laboratory,
- experimental report, test report with test result and noted findings,
- obtaining and evaluating any necessary subsequent submissions,
- if necessary, repeat testing or partial testing of the assistance system.

In addition, further activities may be carried out or agreed between the contracting parties in relation to the process.

5 Documentation

5.1 Test report

Once the test has been carried out, the test personnel prepare a test report which is based on the specifications of DIN EN ISO/IEC 17025.

The test report is sent to the client.

5.2 Test certificate

The test certificate contains information on the partial aspects tested. Furthermore, the limits of use, intended use and, if applicable, a defined reference to the machine types are specified.

The following test certificates can be issued as a result of a successful test:

- test certificate, without DGUV test mark - PZB21
- DGUV test certificate (product corresponds to specified test basis), with DGUV test mark with additional text - PZB08