



BSI Standards Publication

**Adhesives — Guidelines for the fabrication
of adhesively bonded structures and
reporting procedures suitable for the
risk evaluation of such structures**

National foreword

This British Standard is the UK implementation of EN ISO 21368:2023. It is identical to ISO 21368:2022. It supersedes BS ISO 21368:2022, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/52, Adhesives.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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30 September 2023	This corrigendum renumbers BS ISO 21368:2022 as BS EN ISO 21368:2023

English Version

Adhesives - Guidelines for the fabrication of adhesively bonded structures and reporting procedures suitable for the risk evaluation of such structures (ISO 21368:2022)

Adhésifs - Lignes directrices pour la fabrication des structures collées par adhésifs et procédures pour l'établissement de rapports pour l'évaluation des risques liés à ces structures (ISO 21368:2022)

Klebstoffe - Richtlinien für die Herstellung geklebter Strukturen und Berichtsverfahren, die für die Risikobewertung solcher Strukturen geeignet sind (ISO 21368:2022)

This European Standard was approved by CEN on 24 August 2023.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of ISO 21368:2022 has been prepared by Technical Committee ISO/TC 61 "Products" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 21368:2023 by Technical Committee CEN/TC 193 "Adhesives" the secretariat of which is held by UNE.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2024, and conflicting national standards shall be withdrawn at the latest by August 2026.

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

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 21368:2022 has been approved by CEN as EN ISO 21368:2023 without any modification.

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 21368:2005), which has been technically revised.

The main changes compared to the previous edition are as follows:

- broadening of the terms and definitions to include relevant processing and manufacturing terms;
- classification of adhesively bonded joints according to safety requirements;
- clarification of the competences, knowledge and experience of adhesive bonding personnel;
- comprehensive explanation the design of adhesively bonded joints;
- thorough description of surface treatment procedures;
- extensive account of how to assemble/manufacture of adhesively bonded joints.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Adhesive bonding technology is used widely internationally to fabricate many of the structures in the adhesive-using industry. In some companies, it is the key feature to production. Such structures range from microelectronic encapsulation to the structure and reinforcement of aircraft wings and bridges. Adhesive bonding technology appeals to industry across sectors and applications because it allows flexibility in the selection of materials, product design and product manufacture up to the final assembly. As such, adhesive bonding technology exerts a profound influence on the cost of fabrication and the quality of the product, thus allowing significant production savings and a competitive advantage in comparison with traditional methods of manufacture. It is important, therefore, to ensure that adhesive bonding technology is carried out in the most effective way and that appropriate control is exercised over all aspects of the operation. If used properly and professionally, the adhesive bonding technology is undoubtedly able to meet the requirements of circular economy and eco-design.

Within the ISO 9000 series of standards for quality systems, adhesive bonding technology is to be treated as a “special process” since adhesively bonded joints cannot be fully verified by subsequent inspection and testing of the product to ensure the required quality standards have been met.

As per today’s knowledge, adhesively bonded joints cannot be inspected into a product. The task is to install them faultlessly from the outset. Even the most extensive and sophisticated non-destructive testing does not improve the quality of adhesively bonded joints.

For adhesively bonded structures to be effective and fit for purpose in service, there is a need to provide controls from the design stage through material selection to manufacture and subsequent inspection. Poor design for adhesive bonding creates serious risks and costly difficulties in the workshop, on site or in service. Inadequate consideration of the materials to be adhesively bonded and the choice of adhesive may result in adhesive bonding problems such as lack of adhesion or inadequate gap-filling of the structure. It is therefore essential for adhesive bonding procedures to be correctly formulated and approved to avoid imperfections. Comprehensive and qualified supervision ensures that the specified quality is achieved.

To ensure the quality of adhesively bonded structures on an international level and to make the quality of adhesively bonded structures internationally comparable, the task of management is to:

- identify possible sources of error;
- create organizational structures that prevent these sources of error from the outset; and
- introduce suitable quality procedures.

For these reasons, this document represents the state of the art for the professional organization of adhesive bonding processes in all areas of industry and trade in a holistic and international view. It also applies analogously to sealing processes if the function of the seal is only to secure and support adhesively bonded joints. The consideration of adhesive bonding technology according to this document comprises, starting with the first idea, the development of adhesively bonded joints (pre-production), continues through production, i.e. the manufacture of adhesively bonded joints (in-production), to the finished adhesively bonded product including its maintenance, repair and disposal (post-production).

This holistic approach also includes the quality assurance of production, inspection and maintenance, including the repair and disposal of adhesively bonded joints. The approach according to this document is, without exception and in any case, independent of the lot size as well as the respective area of application.

This document establishes definitions and sets out organizational, management technical, contractual and technical principles to be followed when manufacturing adhesively bonded joints. This is achieved by defining three essential core elements:

- Core element 1: the classification of each adhesive bond according to safety requirements (see [Clause 4](#));

- Core element 2: the appointment of supervisory personnel [Adhesive Bonding Coordinators (ABCs)] and execution personnel (Adhesive Bonding Operators) who are both capable of objectively verifying the necessary and required adhesive bonding competence, knowledge and experience in each case (see [Clause 5](#));
- Core element 3: the verification that the real load of the respective adhesive bond in the use and application of the adhesively bonded product is in any case less than the maximum load bearing capacity (see [Clause 6](#)).

The above-mentioned, necessary worldwide comparability in quality and implementation is achieved through a uniform implementation of these three core elements at the international level.

Since the all numerical values described in this document are reference values, it is advisable for the practitioners to decide on their own when implementing them.

Adhesives — Guidelines for the fabrication of adhesively bonded structures and reporting procedures suitable for the risk evaluation of such structures

1 Scope

This document provides guidelines describing the adhesive bonding quality requirements suitable for use by adhesive user-companies utilizing adhesive bonding as a means of fabrication. In particular, the guidelines define various approaches to meeting quality requirements for fabrication and reporting procedures, both in workshops and on site. These guidelines aim to convey the importance of maintaining quality standards in fabrication and reporting procedures, keeping records and thus enabling documentation to provide the basis for risk evaluation of adhesively bonded structures in service and in use.

These guidelines have been prepared such that:

- a) they are independent of the type of adhesively bonded structure;
- b) they are independent of adhesive user-companies' and suppliers' product recommendations;
- c) they define the quality requirements for adhesive bonding in terms of fabrication and reporting procedures, both in workshops and on site;
- d) they can be used as the basis for risk evaluation of adhesively bonded structures in service and in use;
- e) they can be used as a basis for assessing a fabricator's capability to produce adhesively bonded structures fulfilling specified quality requirements when they are detailed in one or more of the following:
 - a contract between the parties involved;
 - an application standard;
 - a regulatory statement.

The guidelines contained within this document can be adopted in full or selectively chosen by the adhesive user to suit the structure concerned. The guidelines provide a flexible framework for the control of adhesive bonding activities in the following cases.

Case 1

The provision of specific requirements for adhesive bonding in contracts that require the adhesive user to have a quality system other than ISO 9001.

Case 2

The provision of specific requirements for adhesive bonding as guidance to an adhesive user developing a quality system.

Case 3

The provision of specific requirements for references in application standards that uses adhesive bonding as part of its requirements or in a contract between relevant parties.

Case 4

The provision of a framework for fabrication and reporting procedures to a quality standard, suitable in particular as a basis for the risk evaluation of adhesively bonded structures.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 472, *Plastics — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 adherend substrate

object or semi-finished product (for example, sheet metal, wires, metal extruded, moulded plastic, fabrics, glass, etc.) on which an adhesive is applied

Note 1 to entry: In adhesive bonding processes, the term adherend is often used as a synonym for substrate.

3.2 adhesion

interaction between the adhesive and the *adherend/substrate* (3.1) surface

Note 1 to entry: The interactions that make up adhesion are based on forces between the surface of the adherend/substrate and the adhesive film and include physical interactions, chemical bonds and micromechanical interlocking.

Note 2 to entry: Adhesion occurs in nm-dimensions.

3.3 adhesion promotor primer

liquid used in surface treatment to improve the adhesion of the adhesive to the *substrate/adherend* (3.1)

Note 1 to entry: Adhesion promoters often are named as primers, accelerators or activators.

3.4 adhesive

non-metallic material, which joins two *adherends/substrates* (3.1) together via adhesion and cohesion

3.5 adhesive bonding

special process for joining of *adherends/substrates* (3.1) by using an adhesive

Note 1 to entry: The adherends/substrates can be made of the same as well as of different materials and can have different surface characteristics.

3.6**adhesive bonding area**

area used to join two *adherends/substrates* (3.1) using an adhesive

Note 1 to entry: Usually the product of the overlap length and overlap width of the adherends/substrates.

3.7**adhesive bonding coordinator****ABC****responsible adhesive bonding coordinator****rABC**

competent person with proven professional skills in adhesive bonding technology responsible for the supervision and release of the adhesive bonding processes and for all activities associated with it including the release

Note 1 to entry: The responsible adhesive coordinator (rABC) is the appointed head of all adhesive bonding processes including their release and with the appropriate decision-making managerial authority concerning the adhesive technology within the company.

3.8**adhesive bonding operator****ABO**

execution personnel with proven corresponding knowledge applying or executing independently the adhesive bonding process to manufacture, maintain or repair components according to approved work instructions

3.9**adhesive bonding personnel****ABP**

people involved in the design, planning, manufacturing, quality assurance and maintenance/repair related to the adhesive bonding process

Note 1 to entry: As a rule, this employee group consists of ABCs (3.7) and ABOs (3.8).

3.10**adhesive bonding procedure**

all processes concerned with adhesive bonding such as surface treatment, processing the adhesive, application of the adhesive, joining the *adherends/substrates* (3.1), and solidification (curing/hardening)

3.11**adhesive bonding surface**

area prepared for adhesive bonding, or on which the adhesive is applied, or the surface of the part to be adhesively bonded with adhesive between two parts to be adhesively bonded [length of overlap × width of overlap mm]

3.12**adhesively bonded joint**

connection of two or more substrates (adherends) from the same material or different materials with the use of an adhesive

Note 1 to entry: An adhesively bonded joint can be defined as rigid coupling, flexible coupling or joint sealing. All three types of junction are based on the same principles of operation.

3.13**adhesively bonded structure****structure**

structure used for a partially or fully finished constituent or any other form of adhesively bonded item and designed mainly to transmit mechanical loads

Note 1 to entry: The loadbearing function is the main role of the adhesively bonded item ensuring reliability and fitness-for-purpose throughout the life cycle of the finished product.

3.14

adhesive tape

flexible backing or carrier coated with a pressure-sensitive, moisture- or heat-activated adhesive

3.15

ageing

entirety of all irreversible chemical and physical processes occurring in a material in the course of time

Note 1 to entry: This can relate to:

- evolution of the properties of adhesively bonded joints with time;
- reproduction of the real operating life through accelerating (reduce time) test of ageing in appropriated environment (chemical and mechanical).

3.16

application

placement of the adhesive during the adhesive bonding procedure

3.17

assembly

group of parts that has been placed together for adhesive bonding or has been adhesively bonded

3.18

clamping

holding of an adhesively bonded joint under pressure with clamps during solidification of the adhesive between the adherends

3.19

cohesion

internal strength that, for example, keep the molecules of an adhesive together

Note 1 to entry: These forces are based on attractive physical forces between the polymer chains, entanglement of the polymer chains, and chemical bonds inside and between the adhesive polymer chains.

3.20

component

one part of an adhesive system

Note 1 to entry: In adhesive bonding technology, the parts of an adhesive system (resin and hardener) are called components (component A and component B).

3.21

conditioning

exposure of *components* (3.20) and joining parts required for the adhesive bonding process for a reasonable period in compliance with the specified requirements

3.22

curing

chemical solidification of the adhesive

Note 1 to entry: Chemical reactions leading to solidification of the adhesive in the form of thermoplastic, elastomeric or thermoset polymers.

Note 2 to entry: This refers to chemically curing adhesives.

3.23

curing time

period of time required to solidify an adhesive *curing* (3.22) by chemical reactions

3.24**destructive testing**

analyses, tests and surveys carried out for the definition of information of qualitative/quantitative about specific properties of the analysed system, obtained following the destruction of the system itself

Note 1 to entry: The test specimen will be destroyed during the test and cannot be used afterwards.

3.25**exposure time**

length of time for which adhesively bonded joints are exposed under specified conditions

3.26**fabricator**

adhesive bonding workshops and/or sites under the same technical and quality management

Note 1 to entry: See *user-company* (3.59).

3.27**flash off-time**

minimum waiting time when using cleaners, activators or primers until the solvent has completely evaporated

3.28**high-modulus adhesive****load-bearing adhesive****structural adhesive**

adhesive where strength and stiffness are the most important properties after solidification

Note 1 to entry: In contrast, there are low-modulus adhesives.

Note 2 to entry: After solidification, high-modulus adhesives concentrate on their strength and stiffness, and less on their formability.

Note 3 to entry: The property transitions between high and low-modulus adhesives are fluid and not precisely defined [see *low-modulus adhesive* (3.37)].

Note 4 to entry: The term "structural adhesives" is often used for high-modulus adhesives. For the purposes of this document, the term "structural adhesives" is replaced by "load-bearing adhesives" (analogous: "load-bearing adhesive bonds" instead of "structural bonds").

3.29**hot spot**

small region or area with a high value of a quantity

EXAMPLE Stress, strain, energy.

Note 1 to entry: A hot spot can be calculated with FEM.

3.30**joining**

assembling of *components* (3.20) to become a whole

EXAMPLE Adhesive bonding is just one joining method. Other examples are welding, screwing and riveting.

3.31**influence**

non-mechanical parameters that are applied to a material which changes its properties

Note 1 to entry: The nature of the non-mechanical parameters influences the material behaviour (loading) and the load capacity to be selected.

Note 2 to entry: Further influences can have an impact on the adhesive selection.

3.32

in-production

all adhesive bonding activities after preparation, which are connected with the execution of the respective adhesively bonded joint/component until its completion

Note 1 to entry: See *pre-production* ([3.42](#)).

3.33

load

mechanical parameters that are applied to a material and lead to stresses and strains (deformations) in the material

Note 1 to entry: The type of mechanical parameters influence the material behaviour (stress, strain and/or strain energy) and the *load capacity* ([3.34](#)) to be selected.

3.34

load capacity

limit of the adhesively bonded joint to withstand stress, strain and strain energy

Note 1 to entry: The load capacity can be a permissible value.

3.35

load case

combination of loads and influences applied to an adhesively bonded joint at the same time

Note 1 to entry: Usually there are several load cases which describe different states in vehicle operation as well as in the manufacturing/repair process. Manufacturing/repair load cases are always to be evaluated in combination with the solidification state of the adhesive in the adhesively bonded joint and are basis for the determination of handling strength and commissioning times.

3.36

loading

physical results in the adhesively bonded joint due to the load and influence combinations defined in the *load case* ([3.35](#))

Note 1 to entry: Physical results of the calculation can be e.g. stress, strain and/or strain energy.

3.37

low-modulus adhesive

adhesives that show an elongation at break of at least 100 % and a modulus of elasticity of at most 10 MPa after solidification

Note 1 to entry: This definition is adapted from ISO 21194. There is no scientifically exact definition. In these adhesives, the deformation properties are the dominant and less their strength and stiffness. Their opposites are the high-modulus adhesives. These adhesives concentrate on their strength and stiffness after solidification. The deformation properties take a back seat. The property transitions between high and low modulus adhesives are fluid.

3.38

mechanical properties

features relating to the behaviour of an adhesive or adhesively bonded joint when subjected to external physical forces (tensile forces, shear forces, abrasive forces, compressive forces, torsional forces, lap shear forces, etc.)

3.39

non-destructive testing

analyses, tests and measurements performed using methods that do not change the material and do not require the destruction or removal of samples of the test system, aimed at the investigation and identification of defects of the structure itself

Note 1 to entry: Each test specimen can be used afterwards without compromising the functioning of the product.

3.40**post-production**

all adhesive bonding activities after the execution of the adhesive bonding

Note 1 to entry: These activities include, among other things, the testing and evaluation of work samples during production, the adaptation of the adhesive bonding process, if necessary, the non-destructive testing (e.g. visual) of the manufactured adhesive bonds, the execution of repairs and repair work as well as disposal.

Note 2 to entry: See *in-production* (3.32).

3.41**pot life**

period of time during which a reactive adhesive shall be applied after mixing (the maximum processing time)

Note 1 to entry: This time depends on the speed of the chemical reactions responsible for polymer formation (curing speed) and also on the external boundary conditions (temperature, amount of mixture prepared). In order to create high-quality adhesive bonds, the pot life is strictly adhered to. Chemically curing adhesives that have exceeded their pot life are to be treated as waste and are unsuitable for application to joining surfaces. The pot life varies with the volume and temperature of the mixed adhesive and the environment.

3.42**pre-production**

all adhesive bonding activities prior to execution of the adhesive bonding

Note 1 to entry: These activities include the development and planning (including work preparation and workplace preparation) of the respective adhesive bonding and the respective adhesive bonding processes. In addition, verification that the real load of the adhesively bonded joint is always smaller than the maximum load capacity in the application (see [Clause 6](#)). After that, the adhesive bonding process can also be implemented in the respective production in the planned manner.

Note 2 to entry: See *in-production* (3.32).

3.43**pressure-sensitive adhesive**

adhesive that, in a dry state, is permanently tacky at room temperature and adheres readily to surfaces under light and brief pressure

Note 1 to entry: Pressure-sensitive adhesives are used, for instance, for the manufacture of pressure-sensitive tape.

3.44**qualification of the adhesive**

process for proving that the adhesive meets the requirements placed on it

3.45**competent personnel**

employees who have the required competences, knowledge and experience in adhesive bonding technology, who have acquired this through further training with a recognised credential, vocational training or comparable adhesive bonding technology activities and who can objectively verify this through recognised documents and unequivocally prove it

3.46**quality plan**

plan to define and document how customer requirements are to be met

3.47**reproducibility**

correspondence between the individual results obtained by the same procedure on identical tests

Note 1 to entry: This applies here to bonds produced under different conditions (different operators, different instruments, different laboratories, different laboratories) and/or at different times.

3.48

safety class

performance requirements of the adhesively bonded joint defined based on the potential of damage effect that the failure of the joint can cause

3.49

**safety data sheet
(SDS)**

product-specific data sheet containing important safety information about that product

3.50

special process

manufacturing process or process step that cannot be tested by non-destructive means with one hundred percent certainty for any faults

Note 1 to entry: The basic idea is to eliminate all possible errors already during the entire manufacturing process by monitoring the complete production process. This is achieved by the introduction and implementation of an adapted quality management system (e.g. ISO 9001), which is specifically designed for adhesive bonding with the help of this document.

Note 2 to entry: Continuous monitoring and/or compliance with documented procedures are basic requirements to ensure that the specified requirements are met.

3.51

stress cracking

crack development in plastics because of the simultaneous action of chemicals (e.g. solvents) and mechanical stress

Note 1 to entry: The intrinsic stress of a material often suffices for stress cracks to develop.

3.52

stress distribution

spreading of forces across an adhesively bonded surface

3.53

surface treatment

treatment of adherend surfaces in order to optimize the wettability, the adhesion, and give reproducible adhesively bonded joints having good long-term stability

3.54

tack

property of a material that enables it to form a bond immediately on contact with another surface, which can be an adherend or another layer of adhesive

Note 1 to entry: Stickiness describes the ability of the adhesive surface to deform and flow, wetting the second surface immediately on contact, thereby forming a bond. The stickiness test with the finger is a subjective assessment of stickiness.

3.55

**technical data sheet
TDS**

information sheet prepared by an adhesive manufacturer about the product

Note 1 to entry: It gives information about the properties of an adhesive, and how to process and apply the adhesive.

3.56

tensile test

determination of the strength of a solid, such as an adhesive or an adhesively bonded component

Note 1 to entry: A test bar is subjected to an increasing load in a testing machine.

3.57**thermoplastic**

class of plastics whose polymers are not chemically cross-linked with each other and which can therefore be deformed at will within a certain temperature range without undergoing a chemical change

3.58**thermoset**

type of plastic with polymer chains chemically crosslinked in a narrow-mesh that cannot be deformed in any desired way, without undergoing chemical change

3.59**user-company****adhesive user****adhesive using-company**

company using adhesives and adhesive bonding technology for their production, maintenance and repair

Note 1 to entry: See *fabricator* (3.26).

3.60**wetting**

ability of a liquid (for example an adhesive) to distribute itself on a solid surface and to cling to a solid surface

Note 1 to entry: Even though the adhesion is also dependent on other factors, the wetting of the surface is a necessary condition in order to obtain adhesion between adherend and adhesive, but not the only one.

4 Core element 1: Classification of adhesively bonded joints according to safety requirements

4.1 General

An adhesively bonded structure within the meaning of this document is a material compound produced using adhesive(s) and designed mainly to transmit mechanical loads, its loadbearing function ensuring its reliability and fitness for use throughout the life cycle of the product. As part of a technical unit, the adhesively bonded joint in this assembly contributes to the strength and stability of the unit as a whole, or of part of the unit, or of a component. It is intended, in accordance with its requirement profile, to resist all stresses involved, irrespective of whether these are static, dynamic or a combination of both, and whether or not environmental effects are to be considered.

Requirements for the high-quality workmanship of those adhesively bonded joints shall be established by classifying them into safety classes. This classification into safety classes is based solely on the answer to the question of what happens if the adhesively bonded joint fails: What consequences can be expected for people and the environment and whether the consequences may occur directly or indirectly or how the probability of their occurrence is to be assessed? This question and its answer apply to every adhesively bonded joint in all areas of application in industry and trade for every adhesive used, regardless of:

- the strength and deformation properties of the adhesive used (i.e. all types of adhesives are covered, from low-modulus, highly resilient to high-modulus, very stiff adhesives);
- the solidification mechanism of the adhesive used (e.g. chemically curing, physically hardening, combined solidification mechanisms or adhesive-covered material such as adhesive tape); and
- the sector or purpose in which or for which the adhesively bonded assembly is to be used.

The safety classification of adhesively bonded joints in this document does not allow for any aspects such as their suitability for use with food, their fire resistance, compliance with pollution control

regulations or any stipulations regarding occupational safety or environmental protection, since these are covered in other standards, codes of practice or technical rules.

4.2 Definition of safety classes

The designer or the person dealing with the component concerned shall classify [in cooperation with the adhesive bonding coordinator (ABC) see [Clause 5](#)] each adhesively bonded joint into one of the following safety classes, taking into consideration the potential effects of adhesively bonded joint failure (see [Table 1](#)). The safety class of the relevant safety requirements to be met by an adhesively bonded joint shall be specified prior to its execution at the latest, or specified and documented by the adhesive bonding user in consultation with the Adhesive Bonding Coordinator (ABC see [5.1](#) and [5.3](#)).

[Table 1](#) illustrates the classification of adhesively bonded joints as a function of the relevant level of safety requirements.

Table 1 — Classification of adhesively bonded joints as a function of the level of safety requirements

S1 High level	Failure of the adhesively bonded joint will
	— directly or indirectly lead to an inevitable hazard to life or limb; — result in a failure of the function, the effect of which will mostly lead to an evident hazard to life or limb.
S2 Medium level	Failure of the adhesively bonded joint
	— can lead to a hazard to life or limb; — will result in a failure of the functionality, the effect of which will probably involve personal injury or result major environmental damage; — will result in a failure of the functionality, the effect of which will most likely involve major damage to property.
S3 Low level	Failure of the adhesively bonded joint will result in a loss of functionality, the effect of which will probably:
	— not involve personal injury or result in major environmental damage; — affect comfort or performance at the most; — not involve major damage to property.
S4 No level	Failure of the adhesively bonded joint will result in a failure of functionality, the effect of which will:
	— not, under foreseeable circumstances, involve personal injury or result in environmental damage; — only affect comfort or performance; — not involve damage to property.

An adhesively bonded joint can be assigned a higher safety class for economic, ecological and/or functional reasons, for example.

In particular applications, safety classes may already be specified in other existing International Standards, approvals or elsewhere. In cases of doubt, the highest possible class shall be assumed.

A component may include different types of adhesively bonded joints, which can be assigned to different safety classes, depending on the requirements specified.

Where an adhesively bonded joint is not to meet at least a low-level safety requirement, this adhesively bonded joint can be assigned to class S4.

All requirements of this document are for adhesively bonded joints classified as S1, S2 or S3. If an adhesive bonded joint is classified S4, this should be reasoned and to be documented but no more requirements of this document have to be fulfilled.

4.3 Documentation of the classification according to safety classes

The classification of the respective adhesively bonded joint shall be documented in writing by the responsible persons (see [4.2](#)).

5 Core element 2: Adhesive bonding personnel (ABP)— Competences, knowledge and experiences

5.1 General

Depending on the classification of the safety requirements assigned to the respective adhesively bonded joint (see [Clause 4](#)), adhesive bonding work requires personnel with verifiable competence, knowledge and experience in adhesive bonding technology.

The user-company shall have sufficient competent personnel in accordance with the respective specified adhesive bonding requirements. This applies to all employees directly or indirectly involved in the adhesive bonding technology. The levels of competences, knowledge and experience required for the adhesive bonding personnel [(ABP) see [Figure 1](#) as well as [5.2](#) and [5.3](#)] are specified in [5.4](#).

In this context, adhesive bonding personnel (ABP) is the overarching term and includes all employees involved in the design, planning, manufacturing, quality assurance and maintenance/repair of adhesively bonded components and testing. This group consists of the following employees as shown in [Figure 1](#).

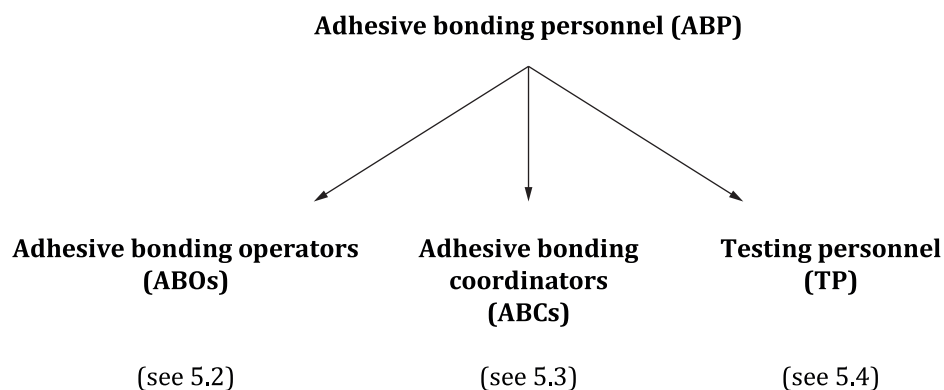


Figure 1 — Composition of the adhesive bonding personnel (ABP)

All adhesive bonding work carried out by subcontractors shall be carried out in the same manner in accordance with the requirements of this document. The subcontractor shall make the ABC available to supervise the adhesive bonding work.

For each adhesive bonding process, the necessary adhesive bonding competence of the personnel shall be determined. For all employees directly involved in adhesive bonding technology, it shall be ensured before the start of production that a competent personnel is available for all adhesive bonding work to be carried out.

For safety class S4 adhesively bonded joints (no safety requirements), this document does not impose any requirements on the adhesive bonding competence, knowledge and experience of the personnel. This can be defined in technical specifications or in the contract design outside this document (see [5.5](#), [Table 4](#)).

In addition, for safety class S1 and class S2 adhesive bonds, the following requirements shall be met (see [5.5](#), [Table 4](#)):

- the whole adhesive bonding process (from the start of surface treatment to the completion of the respective adhesively bonded joint) shall only be carried out by competent ABP as defined in [5.2](#) and [5.3](#);
- during adhesive bonding work, an ABC shall be accessible who is qualified and authorized to take any necessary action(s) in the case of any process deviations or a process released by the ABC exists that regulates the necessary action(s) to be taken if the ABC is not present on site;
- adhesive bonding process deviations and any action taken shall be documented.

5.2 Adhesive bonding operators (ABO)

5.2.1 General

The user-company shall have verifiable competent and trained personnel as adhesive bonding operators (ABOs), who are able to carry out adhesive bonding work processes independently and properly.

5.2.2 Functions

The ABOs in the company are the persons who independently and professionally carry out the adhesive bonding processes for the manufacture, maintenance or repair of components according to recognized work instructions.

5.2.3 Duties

The ABOs in the company have proven competence, knowledge and experience in adhesive bonding technology. This basis of understanding enables them to:

- understand the contents of approved work instructions in a technically competent way;
- classify their activities independently and professionally in the respective daily work context; and
- adapt their working methods accordingly.

5.2.4 Competences, knowledge and experiences

In the case of class S1 and S2 adhesive bonds, all employees involved in adhesive bonding work shall have verifiable level 3 competences (see [Tables 3](#) and [4/5.4](#) and [5.5](#) as well as [Annex A](#) for assistance).

Vocational training in adhesive bonding or sealing (e.g. carpenter, floor layer, and upholsterer) can be accepted and documented by the ABC (see [5.3](#)) as evidence of sufficient knowledge if adhesive bonding work is carried out in these areas. Participation in product training courses does not constitute sufficient proof.

The ABC is responsible for confirming the competence of the ABP for Class S3 adhesive bonds. The prerequisite is that ABC can prove that they have at least level 2 competence (see [Tables 3](#) and [4](#) as well as for assistance [A.1](#)). The ABC shall justify the qualification of the adhesive bonding operators (ABOs).

The ABOs shall participate in verifiable regular (internal or external) training courses at intervals not exceeding two years, whereby it is the task of the ABC to decide on the scope and content of these training courses (see [5.4.2.5](#)).

The competences, knowledge and experiences for ABO level 3 are defined in [5.4.2.4](#), and - both for assistance - [Table A.1](#) as well as in [A.3](#).

5.3 Adhesive bonding coordinator (ABC)

5.3.1 General

The adhesive bonding supervision is the responsibility of the user-company. In the user-company, one or more persons, depending on the extent of the adhesive bonding and the size of the user-company shall perform the adhesive bonding supervision.

However, the user-company shall instruct at least one ABC if at least class S3 adhesively bonded joints are dimensioned, planned, manufactured, commissioned, maintained or repaired.

The designation shall be carried out and documented by a leading or legitimate person.

If several persons have been designated as ABCs, the user-company can designate one ABC as the responsible adhesive bonding coordinator (rABC) who is authorized to coordinate all operations associated with adhesive bonding work in the various manufacturing areas.

Where a number of persons have been charged as ABCs, the tasks, scope of responsibility and interfaces shall be specified for each ABC separately.

In any case, the user-company shall organize a deputy regulation for each individual ABC or the rABC. If no equal deputy is appointed for the individual ABC or the rABC, it shall be ensured that no adhesive bonding-related decisions are made in the absence of the corresponding ABC.

The ABC shall not also be charged with adhesive bonding work as an ABO.

5.3.2 Functions

The ABC has the function of responsible adhesive bonding development, planning and process organization and execution. In addition, the person is responsible for supervising the adhesive bonding processes and all associated activities. This person is the appointed leader of all adhesive bonding processes (pre-, in-, post-production) including their release. The ABC thus has the appropriate decision-making authority with regard to the adhesive bonding technology in the company and is independent of operational, economic and time restrictions. For this reason, only those employees are appointed as ABCs who are in a position to:

- take a holistic and technically correct view of the adhesive bonding processes, i.e. from the idea to planning and execution to maintenance/repair and disposal; and
- perform the respective tasks and duties in accordance with this document without restriction.

5.3.3 Duties

During the adhesive bonding process, all special requirements for the adhesively bonded joint shall be taken into account. This shall be ensured for all relevant areas of the user-company's works. This includes, among other things:

- the development of the adhesively bonded joint including the design and constructional layout of the adhesively bonded joint as well as the design of the adhesive bonding process;
- the implementation of the adhesive bonding process in production;
- the consideration of reparability;
- purchasing as well as sales;
- assembly and
- subcontracting.

The main duties of the ABC are summarized in [Table 2](#).

Table 2 — Duties of adhesive bonding coordinators (ABCs/examples)

Item no.	Description of duty
1	Checking the contractual provisions — Checking the suitability of the company which accepts the order for adhesive bonding and associated work.
2	Checking the construction — Conformance with relevant adhesive bonding standards, codes of practice and instruction sheets; — Analysis of stresses; — Design of adhesive bonds considering the construction requirements; — Specifying the adhesive bonding system; — Specifying adherends in cooperation with the responsible design engineer; — Accessibility for adhesive bonding; — Analysis of stress resistance of adhesive bonds. — Design of gap between adherends
3	Checking the verification of adhesive bonds as specified in Clause 6
4	Checking storage and transport of adherends and other adhesive bonding system components — Delivery and transport conditions; — Marking, storage, in-house transport und handling; — Traceability.
5	Checking production planning — Drawings and part lists, specifications for adhesive bonding and other materials, auxiliary materials and equipment used; — Drawings and part lists, specifications for adhesive bonding system and other materials, auxiliary materials and equipment used; — Work and repair instructions, their adequacy and validation; — Any necessary adhesive bonding and clamping equipment required verifiable qualifications of ABO; — Work and assembly sequences for components required ambient conditions.
6	Assessment of any imperfections, damage or faults
7	Checking the equipment — Suitability of adhesive bonding equipment; — Compliance with required manufacturing conditions; — Provision, identification and handling of any auxiliary materials and equipment.
8	Supervision of adhesive bonding work — Preparatory work; — Adhesive bonding; — Curing/hardening (solidification); — Checking the ambient conditions, including upstream and downstream process parameters.

Table 2 (continued)

Item no.	Description of duty
9	Checking the adhesive bonding process — Verifying maintenance of manufacturing quality.
10	Testing the adhesive bonds — Visual examination; — Destructive and non-destructive testing; — Assessing adhesively bonded and sealed joints.
11	Checking any sub-contractors — Suitability in terms of staff qualification, availability of staff, equipment, manufacturing facilities and the adhesive bonding process.
12	Documentation — Preparing, drafting and retaining any necessary reports, including those of sub-contractors.

5.3.4 Competences

The minimum requirements for the technological competences, knowledge and experience in the adhesive bonding technology of the ABC(s) are laid down as mandatory in 5.5, Table 4. These are supplemented by Table 3 (see 5.4.1). Annex A describes the contents in detail for assistance.

ABCs shall regularly prove that they have maintained or expanded their competence, see 5.4.2.5.

If an ABC does not perform certain tasks, these tasks may be assigned to employees with the same or lower adhesive bonding competence. It is the task of the ABC to select those deputy employees, to check their competences and instruct them as to the work to be performed. All details of such an assignment shall be documented in detail (see Table 4).

5.3.5 Organizational integration of adhesive bonding coordination

Only those persons from either the user-company's staff or an external consultant shall be appointed as ABCs who are capable of performing their respective duties and responsibilities in accordance with this document without any restrictions. To this effect, they shall be conferred the necessary managerial authority and entrusted with the decision-making powers permitting them to act free of operational and temporal constraints.

Only persons that have the same (or higher) competences, and who have been appointed officially are entitled to act as deputies of ABC without any restriction.

The company owner, managing director, operations manager or production manager may be appointed as ABCs where small-scale adhesive bonding work and class S1, S2 and S3 adhesively bonded joints are involved. They may also be appointed as deputy coordinators.

Small-scale adhesive bonding work is understood to cover cases where not more than 50 adhesively bonded assemblies are manufactured within 12 months. This shall be done on the same site, for the same assembly and using the same adhesive bonding technique. If at least two assemblies differ in type, the scope of manufacture shall no longer be deemed small-scale.

The organizational chart of the user-company shall specify in writing the work areas and responsibilities of, and the relationship between all persons having a managerial, executive or supervisory function affecting the quality of adhesive bonding work. This applies in particular to:

- the duties of the ABC (the work areas and responsibilities shall be delineated where a number of coordinators are involved);
- work requiring the presence of the ABC;

- measures to be taken in the absence of the ABC (e.g. appointing deputies; specifying the adhesive bonding work that is permitted or prohibited; specifying the time when adhesive bonding work shall be stopped).

5.4 Levels of competences, knowledge and experiences for adhesive bonding personnel (ABP)

5.4.1 General

For the adhesive bonding personnel (ABP) consisting of ABCs and ABOs, this document defines three levels of competences, knowledge and experience across hierarchies (see [Table 3](#)):

Level 1: comprehensive (decision-making level);

Level 2: specific (supervision level);

Level 3: basic (execution level).

Table 3 — Levels of competences, knowledge and experience for adhesive bonding personnel

Level	Scope of competences, knowledge and experiences
1	Comprehensive technological competences, knowledge and experiences in adhesive bonding technology are fulfilled by the state of the art skills (see for assistance A.3.1 : Explanation of comprehensive competences) and advanced skills (minimum one-year suitable experience in adhesive bonding technology).
2	Specific technological competences, knowledge and experiences in adhesive bonding technology are fulfilled by the state of the art skills (see for assistance A.3.2 : Explanation of specific competences) and advanced skills (minimum one-year suitable experience in adhesive bonding technology).
3	Basic technological competences, knowledge and experiences in adhesive bonding technology are fulfilled by the state of the art skills (see for assistance A.3.3 : Explanation of basic competences). The training and qualification of this level can be approved by ABC. In this case, the ABC has to define the qualification range.

5.4.2 Requirements for each level of competences, knowledge and experiences

5.4.2.1 General

The focus for the verification of competences, knowledge and experience is the same for all three levels of competence (see [Table 3](#)). The subject contents summarized in the main categories (see list below), which together represent the entire field of modern adhesive bonding technology according to the current state of knowledge, are included:

- adhesion and adhesive;
- materials as substrates/adherends;
- design (including durability, ageing, fatigue, and its evaluation);
- adhesive bonding process – pre-production;
- adhesive bonding process – in-production;
- adhesive bonding process – post-production;
- maintenance;

- testing and analysis;
- health and safety;
- quality management.

The three levels mentioned in [Table 3](#) correspond in principle to the hierarchy levels/fields of activity of the adhesive activities in the user-company (level 1: decision-maker level/level 2: supervision level/level 3 execution level). These three competence levels determine which technical contents (see [5.4.2.2](#) to [5.4.2.4](#) and, for assistance, [Annex A](#)) shall be demonstrably mastered and to what extent a certain competence is required for a certain scope of work depending on the safety class according to this document (see [5.5](#)).

The individual contents for the verification of competences, knowledge and experience of each level according to the main subject content (see [5.4.2.2](#) to [5.4.2.4](#)) is specified in detail in [Annex A](#) for assistance.

The assignment of each level to the respective scope of work is specified in [5.5](#).

The minimum requirements for the technological competences, knowledge and experiences in adhesive bonding technology for the ABC and their deputies are shown in [5.5/ Table 4](#).

For processes that can be assigned to in-production or post-production (see Introduction), the minimum number of employees with appropriate and verifiable competence shall be two, for example, an ABO and an ABC (see [5.5/ Table 4](#) for the description of the competence level).

If necessary, a deputy ABC delegation shall be done in a suitable and traceable manner.

5.4.2.2 Level 1: Comprehensive

Comprehensive technological competences, knowledge application, practical application and experiences in adhesive bonding technology include the ability to supervise the whole spectrum of adhesive bonding work in the pre-production, in-production and post-production (see Introduction and Scope), that means from product development to production and on maintenance and repair activities. For correct technical application of adhesive bonding technology, these comprehensive competences require interdisciplinary thought, responsible decision-making and actions, as well as being able to oversee and take account of the entire product life cycle in a responsible way. These competences make persons comprehensively able to take on the tasks and responsibilities of the ABC in a company.

Comprehensive technological competences, knowledge application, practical application and experiences in adhesive bonding technology are defined in [A.3.1](#) for assistance.

5.4.2.3 Level 2: Specific

Specific technological competences, knowledge application, practical application and experiences in adhesive bonding technology include the ability to prepare work instructions and supervise ABO and other adhesive bonding employees on theoretical and practical matters relating to adhesive bonding. These competences include also the ability to plan, organize, and monitor adhesive bonding processes, monitor process parameters, and if necessary adjust them. Also included is the competence to identify irregularities in production processes, maintenance processes and repair processes, and respond accordingly. Specific technological competences, knowledge and experiences enable the persons in their certain area of responsibility in the pre-production, in-production and post-production to take on the tasks and responsibilities of the ABC in a company.

Specific technological competences, knowledge application, practical application and experiences in adhesive bonding technology are defined in [A.3.2](#) for assistance.

5.4.2.4 Level 3: Basic

Basic technological competences, knowledge application, practical application and experiences in adhesive bonding technology include fundamental understanding of adhesive bonding, enabling the special aspects of adhesive bonding processes to be understood and taken account of in production, maintenance and repair. The relevant context and importance of work instructions hence are clear. Basic technological competences enable the staff to independently undertake adhesive bonding work in a technically competent way in the in-production and post-production according to the given work instructions and to give feedback if irregularities occur.

Basic technological competences, knowledge application, practical application and experiences in adhesive bonding technology are defined in [A.3.3](#) for assistance [A.3](#).

5.4.2.5 Further training

The ABCs shall undergo further training at least every two years through measures (e.g. participation in adhesive bonding conferences, seminars or something like that) taken by providers who are legally and economically independent of the user-company. In-house training provided by the company's own personnel and product training shall not be considered training for ABCs for the purposes of this document.

At least every two years, ABOs shall also participate in further training measures. These measures can be held internally or externally. The content and duration of these courses shall be determined in consultation with the ABC.

Each further training measure shall be documented (such as date, duration, content, training documents, participants).

5.5 Assignment of the three competence levels to the safety classes depending on the respective scope of work — Correlation of the core elements

The level of technological competences, knowledge and experiences in adhesive bonding technology (see [Table 3](#)) is related to the safety class (see [Table 1](#)) of the adhesively bonded joints as well as to the scope of work outlined in [Table 4](#).

Table 4 — Minimum requirements regarding the technological competences, knowledge and experiences in adhesive bonding technology for the adhesive bonding coordinators (ABCs) and deputies

Scope of work	Comments	Class S1	Class S2		Class S3	Class S4
Release of development-phase (pre-production) product and process designing		Level 1	Level 1 for product design <i>with</i> calculation/validation	Level 2 for products <i>without</i> calculation/validation	Level 2	to be defined by the user-company
Supervision of production/manufacturing (in-production and maintenance/repair (post-production) without any process changes outside the defined process definition	In case of new or redesign and/or new processes or process changes go back to first line of this table	Level 2	Level 2		Level 3	to be defined by the user-company

Table 4 (continued)

Scope of work	Comments	Class S1	Class S2	Class S3	Class S4
Involvement of ABC in purchase, sales, assembly and sub-contracting of adhesively bonded components and adhesive bonding work	The supply chain shall be a closed loop in a traceable way to ensure that every contract partner has the necessary competences	Level 2	Level 2	to be defined in the technical specifications	to be defined by the user-company

5.6 Comparability of competences, knowledge and experience

Within the three core elements of this document (see [Clauses 4, 5 and 6](#)), the competence, knowledge and experience of the personnel for adhesive bonding (core element 2) play the key role. The professional planning and execution of the adhesive bonding technology and the testing of adhesively bonded joints (see [Clause 6](#)) are based on this core element 2.

In order to do justice to this special significance, the requirements of this document regarding the competences, knowledge and experience of the personnel involved in adhesive bonding are defined by describing the required adhesive bonding competences, differentiating between comprehensive competences (see [5.4.2.2](#)), specific competences (see [5.4.2.3](#)) and basic competences (see [5.4.2.4](#)).

In order to make the quality of adhesive bonded joints comparable at international level with the claim defined in the introduction, this document requires reliable comparability of the competences, knowledge and experience of the personnel involved in adhesive bonding and its processes at all levels.

NOTE In order to document expert competences to customers, clients, authorities, approval bodies and other interested parties with a maximum of security, ISO/IEC 17024 opens up a possibility of comparability of the proof of competence on national and international level.

5.7 Monitoring, inspection and testing personnel

The user-company shall have sufficient competent staff for the planning and execution of monitoring, quality control, testing and inspection of adhesive bonding work, in accordance with the requirements specified. As a rule, the evaluation of test results shall be the ABC's responsibility.

NOTE Personnel certificated to ISO 9712 is considered adequate.

6 Core element 3: Design and verification of adhesively bonded joints

6.1 General

The functional capability of an adhesively bonded joint is achieved if all requirements specified are satisfied. This will be ensured only if all of the following aspects are coordinated and are adequately dealt with giving due considerations to the requirements.

NOTE A detailed description is given in [Annexes B to F](#).

6.2 Assignment to safety classes

Each adhesively bonded joint shall be assigned to a safety class in accordance with any potential consequences of failure in terms of safety, which in this document are fixed in [4.1/Table 1](#). The safety class shall be specified and documented in consultation with the ABC.

6.3 Requirements to be met by the adhesively bonded joints

The requirements to be met by the adhesively bonded joints shall be established and, in consultation with the ABC, documented in all organizational departments.

In addition, for safety class S1 and class S2 adhesively bonded joints, the following requirements shall be met:

- a procedure shall be developed and documented which ensures that requirements from all departments concerned are established;
- the requirements established shall be documented (e.g. in a list of specifications);
- proof shall be provided that the ABC has checked the requirements relating to the adhesively bonded joint.

NOTE The subjects, which are to be considered for the creation of a list of requirements, are listed in [Annexes B](#) and [D](#).

6.4 Design of adhesively bonded joints

The size of adhesive bonding surfaces, their location, the distribution and the dimensions of the adhesive between adherends after solidification of the adhesive shall be specified and documented.

In addition, for safety class S1 and class S2 adhesively bonded joints, the following requirements shall be met:

- the joint tolerances shall be specified;
- conformance with the minimum or maximum adhesive bond line thickness shall be ensured;
- the relative position of adherends shall be clearly specified and shall be tolerances specified;
- tolerances shall be specified as a function of the requirements to be met by the adhesive system and the component or overall structure.

NOTE 1 Examples of design principles are described in in ISO 15785.

NOTE 2 A comprehensive adhesive bonding design guideline is included in [Annex C](#).

6.5 Adherends

The properties of adherends and their as-delivered condition shall be specified.

In addition, for safety class S1 and class S2 adhesively bonded joints, the following requirement shall be met:

- the design of adherends, in particular their behaviour under the expected stresses, shall be specified and documented so as to permit them to be reproducibly manufactured.

6.6 Adhesive

The type of adhesive, together with its components, its field of application and place of use shall be specified and recorded.

NOTE The criteria for choosing an adhesive bonding system are described in [Annex D](#). The requirements to be defined and specified (see [Annex B](#)) form the basis of the adhesive selection.

6.7 Surface treatment

The surface treatment, with all its stages, the materials used, place of use and working sequence shall be specified and recorded.

6.8 Factors affecting the adhesive bonding process

All factors affecting the adhesive bonding process (e.g. ambient conditions, processing times, stresses involved in the manufacturing process,) shall be established in cooperation with the ABC and the process design department and recorded.

6.9 Verification

6.9.1 General

Verification is a procedure intended to provide evidence that an assembly or a component complies with the requirements.

For safety class S1 and class S2 adhesively bonded joints, at least one of the following methods of verification shall be applied:

- 1) providing proof that stresses are lower than the stress resistance;
- 2) assembly/component testing;
- 3) documented experience;
- 4) combination of methods 1 to 3.

Verification shall cover not only the strength or stability under service conditions. It shall also include aspects such as adhesion, chemical resistance and stresses during manufacture.

6.9.2 Method 1 — Load in use < maximum load capacity

6.9.2.1 General

A safety factor shall be specified based on the quality of information obtained regarding load and load capacity; this shall be documented in a transparent way. Where laboratory values are used for assessing the adhesively bonded joint, proof shall specify that these results were obtained under real manufacturing conditions (process validation).

In addition, for safety class S1 adhesively bonded joints, the following requirement shall be met.

Process validation shall be repeated throughout the period of manufacture at reasonable, specified intervals, using suitable methods. These measures and their scope shall be specified and documented by the ABC.

6.9.2.2 Load

Loads can be derived from the list of specifications. They shall be determined by testing or calculation, or taken from standards or empirical data, or using a combination of these. Loads shall always take into consideration maximum values, exposure times, ambient conditions and any possible combined effects. Statistically substantiated information on the quality, intensity, duration and frequency of stresses throughout the lifecycle shall be obtained. The method by which such information was obtained shall be transparent and shall be documented.

6.9.2.3 Load capacity

The load capacity of adhesively bonded joints shall only be determined by testing. Tests shall be performed using samples, test components or an actual component as in service. Unless otherwise explicitly specified, adhesively bonded joints shall show cohesive failure in the case of destructive testing. Substrate failure shall be considered separately. If testing is not carried out on an actual assembly as in service, and if testing is not carried out under actual conditions, evidence shall be provided in a transparent way that deviations from the service conditions (e.g. accelerated ageing, testing agents used, and combinations of agents) are suitable for qualifying the adhesively bonded joint for the intended usage. Test results shall always be adequately evaluated statistically. The parameters determined shall be characteristic values with a specified survival probability. Data (e.g. test methods, results) shall be obtained in a transparent way, and shall be recorded.

6.9.3 Method 2 — Component testing

Component testing is understood to be testing the system as a whole or part of it under actual conditions or conditions reproducing the service conditions. Test conditions shall be comparable in terms of their effect on the adhesively bonded joint, proof of which shall be provided. When testing partial systems, the interaction between these and the system as a whole shall be considered and verified to make sure that the interaction does not unduly affect the results. For evaluation purposes, a failure criterion shall be specified. Test results shall be adequately evaluated statistically. Depending on the knowledge regarding the adhesively bonded joint, how far the test conditions are realistic, and the statistical evaluation applied, a safety factor shall be integrated into the failure criterion or test conditions. The overall process shall be documented. Any decisions made and justifications for them shall be documented.

6.9.4 Method 3 — Documented experience

If verification is based on experience, proof shall be provided that the system has proven itself adequate. To this effect, it shall be demonstrated that the behaviour of the adhesively bonded joint under service conditions can be applied to the adhesively bonded joint under consideration in terms of service life, loading conditions and adhesively bonded joint properties. The procedure shall be documented in a transparent way.

6.9.5 Method 4 — Combination of methods 1 to 3

If the verification is affected by combining the above methods, it shall be ensured that all requirements are adequately considered. Care shall also be taken to ensure that all parts of the verification process are mutually compatible (e.g. when comparing test results with pass/fail criteria). The procedure shall be documented in a transparent way.

NOTE A verification guideline is included in [Annex C](#).

7 Drafting contracts and subcontracting (outsourcing)

7.1 General

It is the responsibility of the company awarding the contract to check compliance with the terms of the contract with the provisions laid down by the customer and the internal guidelines of the user-company itself. It shall be ensured that all information required for the execution of the work is available before the start of the work.

The company accepting the contract shall demonstrate the ability to meet the contractual requirements for adhesively bonded constructions by establishing a quality plan including materials, methods, work instructions, inspection and quality assurance procedures (QA).

The company shall be aware of applicable national and international standards for definition, processing, inspection and testing procedures. Where standards are not available, the company

that accepts the order shall specify suitable procedures and methods allowing compliance with the contractual requirements. The company shall also be aware of national statutory obligations to health and safety requirements and environmental protection measures.

The company that accepts the order confirms to the company that places the order that all adhesive bonding work will be done in conformance with the contractual provisions. The company that accepts the order, in his/her own interest, shall identify any differences between the contractual provisions and any prior documentation, and inform the client about any modifications to the program, costs and workmanship that may result. The client shall ensure that all relevant information is made available.

The contractual provisions can refer to:

- required application standards, and any supplementary specifications;
- specifications for the adhesive bonding work to be done;
- details regarding the material and surface characteristics of the adherends;
- specifications regarding any surface treatment;
- quality documentation agreed with the client;
- specifications for the adhesive bonding technique to be used;
- specifications for testing, test methods;
- specifications for equipment to be used;
- approach regarding approval of the adhesive bonding technique to be used;
- recognition of verifiable staff qualifications;
- types, marking and/or traceability of adhesives and auxiliary materials, for example, and details of adhesive bonding work;
- provisions for quality control, any additional commissioning of an impartial test house;
- any other adhesive bonding requirements, e.g. purity of abrasives, temperature and/or humidity;
- ambient conditions on site affecting adhesive bonding work, e.g. a very low ambient temperature or any restrictions regarding surface treatment;
- any subcontracting permitted;
- measures to be taken in cases of non-conformity.

Where, in the course of adhesive bonding operations, there are organizational changes, for example, with respect to staff or equipment, it shall be checked whether such changes will affect quality. If so, any necessary measures are to be taken and are to be set down in the contract.

In addition, for safety class S1 and class S2 adhesively bonded joints, the following requirement shall be met.

- Any contractual check by which the order is accepted with regard to process steps that require special knowledge shall be documented.

7.2 Subcontracting (Outsourcing)

7.2.1 General

If an adhesive user intends to outsource or transfer the work to an external company (e.g. for adhesive bonding, destructive or non-destructive testing), the external company carries out the adhesive

bonding work in accordance with this document as an external service provider (subcontractor). As a rule, all requirements for the product shall be met, regardless of who performs which services.

It shall be ensured that the external service provider (subcontractor), who shall be able to fulfil these requirements, has been provided with all necessary documents and requirements, regardless of whether it is a service or an adhesively bonded product. They shall contain all relevant data from the contract and design review. Additional requirements shall be specified if design aspects of the structure are to be outsourced.

In most cases, the result of adhesive work cannot be verified non-destructively, it is the responsibility of the client to ensure that the processes at the external service provider's (subcontractor's) plant comply with the requirements effectively. This makes it necessary for external service providers (subcontractors) to conform with the relevant requirements of this document.

The client obliges the external service providers (subcontractors) to submit a quality plan as well as the records and documentation of their work specified by the client.

The client shall ensure that the external service providers (subcontractors) commissioned can fulfil the quality requirements of the contract.

In the case of subcontracting, the deputy ABC shall have at least level 3 qualification for class S1 and S2.

In case of subcontracting, an external ABC of the contracting company may not work for or be employed by subcontracting party.

7.2.2 Deciding on subcontracting

The decision as to whether any work is to be subcontracted, and the extent of any subcontracting shall be made in a transparent way.

In addition, for safety class S1 and class S2 adhesive bonds, the following requirements shall be met:

- the decision-making process shall involve the ABC;
- the decision shall be approved following a specified procedure;
- the approval shall be documented.

7.2.3 Details and documentation of procurement

The scope of the provided service shall be described correctly, completely, clearly and to be easy to understand.

All requirements to be fulfilled within the scope of work or services shall be established. The above description and the requirements shall be documented.

7.2.4 Selection of external service provider (subcontractor/supplier) and contracting

A suitable external service provider (subcontractor/supplier) shall be selected in accordance with the scope of work or service to be provided and the requirements to be satisfied.

Supplier and customer shall have reached agreement on a contract.

In addition, for safety class S1 and class S2 adhesive bonds, the following requirements shall be met:

- Changes to the documentation shall be subject to agreement between both parties and be clearly identified;
- External service provider (subcontractors/suppliers) shall be selected with the involvement of the ABC.