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

STANDARD PREVIEW
*Adhésifs — Lignes directrices pour les procédures de fabrication et de
rapport pour l'évaluation des risques liés aux structures collées par
adhésifs*
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Contents

Page

| | |
|---|----|
| Foreword..... | iv |
| Introduction | v |
| 1 Scope | 1 |
| 2 Normative references | 2 |
| 3 Terms and definitions..... | 2 |
| 4 Contract, design review and quality plan..... | 3 |
| 5 Outsourcing..... | 4 |
| 6 Personnel..... | 4 |
| 7 Equipment | 4 |
| 8 Adhesive bonding activities | 5 |
| 9 Post-bonding operations | 8 |
| 10 Storage and handling of bonding materials | 9 |
| 11 Storage and handling of adherends | 9 |
| 12 Post-bonding finishing..... | 9 |
| 13 Inspection and testing..... | 9 |
| 14 Non-conformance and corrective action..... | 11 |
| 15 Identification and traceability..... | 11 |
| 16 Quality records..... | 11 |
| Annex A (informative) Example of a quality plan..... | 13 |
| Annex B (informative) Example of a job history sheet..... | 14 |
| Annex C (informative) Adhesives material log..... | 15 |
| Bibliography | 16 |

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 21368 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

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Introduction

Adhesive bonding technology is widely used to fabricate many of the structures in the manufacturing industry, and in some companies it is the key feature to production. Such structures may range from microelectronic encapsulation to the structure and reinforcement of aircraft wings and bridges. Adhesive bonding technology is attractive to industry because it allows flexibility in the selection of materials, product design and product manufacture through to 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.

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

Quality cannot be inspected into a product, it has to be built in. Even the most extensive and sophisticated non-destructive testing does not improve the quality of bonds.

For adhesively bonded structures to be effective and fit for purpose in service, it is necessary to provide controls, from the design phase, through material selection, into fabrication and subsequent inspection. Poor design for adhesive bonding will create serious risks and costly difficulties in the workshop, on site or in service. Inadequate consideration of the materials to be bonded and the choice of adhesive may result in bonding problems such as lack of adhesion or inadequate gap-filling of the structure. Adhesive bonding procedures have to be correctly formulated and approved to avoid imperfections. There must be supervision to ensure that the specified quality will be achieved.

To ensure the quality of adhesively bonded structures, management needs to appreciate potential sources of trouble and to introduce appropriate quality procedures.

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

1 Scope

This International Standard provides guidelines describing the adhesive bonding quality requirements suitable for use by manufacturers 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 manufacturers' 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 may be used as the basis for risk evaluation of adhesively bonded structures in service and in use;
- e) they may 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 International Standard may be adopted in full or selectively chosen by the manufacturer 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 which require the manufacturer to have a quality system other than ISO 9001.

Case 2

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

Case 3

The provision of specific requirements for references in application standards which 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 referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8502-4, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 4: Guidance on the estimation of the probability of condensation prior to paint application*

ISO 8504-1, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 1: General principles*

ISO 17212, *Structural adhesives — Guidelines for the surface preparation of metals and plastics prior to adhesive bonding*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1

contract

agreed requirements for structure(s) ordered by a specific purchaser

or

a fabricator's basic specification for structure(s) manufactured in series for purchasers unknown to the fabricator at the time of design and production

NOTE The contract is assumed to include reference to all regulatory requirements.

3.2

special processes

processes within ISO 9001 quality systems, the result of which cannot be fully verified by subsequent inspection and testing of the product and where, for example, processing deficiencies may become apparent only after the product is in use

NOTE Continuous monitoring and/or compliance with documented procedures is required to ensure that the specified requirements are met.

3.3

fabricator

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

3.4**qualified personnel**

personnel approved and qualified in accordance with EWF guidelines or guidelines that can be demonstrated as equivalent

NOTE See the Bibliography.

3.5**structure**

semi-finished or fully finished adhesively bonded component or assembly, or any other form of adhesively bonded item

3.6**quality plan**

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

4 Contract, design review and quality plan

The fabricator shall review the contractual requirements and the design data provided by the purchaser or in-house data for structures designed by the fabricator. All information necessary to carry out the fabrication operations shall be available prior to the commencement of work.

The fabricator shall demonstrate the capability to meet the contractual requirements for adhesively bonded structures by the preparation of a quality plan detailing materials, methods, work instructions, and inspection and quality assurance (QA) procedures. Where relevant, national and international standards shall be incorporated for definition, processing, inspection and testing procedures. Where standards are not available, the fabricator shall specify suitable procedures and methods allowing compliance with the contractual requirements.

It is necessary to provide a quality plan resulting from the contract and design reviews between fabricator and customer.

The quality plan shall define and document how customer requirements shall be met, and shall define all relevant aspects of

- materials;
- methods;
- production plans;
- work instructions;
- inspection and test;
- QA procedures;
- health and safety measures;
- disposal and environmental protection measures.

National statutory obligations as to health and safety requirements and environmental protection measures shall be incorporated.

The quality plan shall not be accepted for use until mutually agreed and confirmed in writing between customer and fabricator, where appropriate.

An example of a quality plan is given in Annex A.

Issues relating to good joint design shall be included in the procurement specification issued to the fabricator.

5 Outsourcing

When a fabricator intends to outsource (e.g. for adhesive bonding, inspection or non-destructive testing), all relevant specifications and requirements shall be supplied by the fabricator to the outsource supplier. The fabricator shall require outsource suppliers to provide a quality plan and such records and documentation of their work as may be specified by the fabricator.

The fabricator shall ensure that outsource suppliers can comply with the quality requirements of the contract.

The information to be provided by the fabricator to the outsource supplier shall include all relevant data from the contract and design review. Additional requirements may need to be specified if any design aspects of the structure are to be outsourced.

6 Personnel

6.1 Qualifications

The fabricator shall ensure that personnel involved in inspection and testing are qualified and are competent to perform their respective tasks.

NOTE EWF guidelines are considered adequate for such qualification and certification.

6.2 Process management and audit

The fabricator shall have appropriately qualified personnel such that all specified processing requirements can be fulfilled throughout the fabrication process.

The fabricator shall ensure that all necessary procedural and recording documentation and safety and personnel protection equipment is available during all phases of fabrication.

The fabricator shall ensure that procedures are in place for internal and external audits. Audits shall be carried out by relevantly qualified personnel within the fabricator's quality organization.

6.3 Inspection and testing

The fabricator shall ensure that the personnel involved in inspection and testing are suitably qualified and are competent to perform their respective tasks.

NOTE Personnel certificated to ISO 9712 or EN 473 would be considered adequate.

7 Equipment

7.1 Production equipment

The following equipment shall be available when necessary:

- appropriate storage facilities;
- relevant safety and personnel protection equipment;
- dispensing, mixing and application equipment for adhesives;

- jigs, fixtures, clamping and pressure application devices/systems;
- surface cleaning/degreasing agents;
- heating systems for elevated-temperature curing of adhesives;
- appropriate facilities for waste disposal.

7.2 Testing equipment

Access to the following shall be possible:

- destructive testing equipment;
- non-destructive testing equipment.

Where appropriate, equipment shall be calibrated or verified at specified intervals, or prior to use, against measurement standards traceable to international or national measurement standards; where no such standards exist, the basis used for calibration or verification shall be recorded.

8 Adhesive bonding activities

8.1 Production plan

The fabricator shall carry out adequate production planning, compatible with the facilities detailed in 7.1 and the quality plan in Annex A. This shall include

- specification of the sequence by which the structure shall be manufactured, e.g. single parts, sub-assemblies, and the order of subsequent final assembly;
- identification of the adhesive bonding and associated processes required to manufacture the structure, and reference to the appropriate bonding procedure specification;
- specification of inspection and testing procedures, including the involvement of any independent inspection body.

8.2 Bonding procedure

8.2.1 Health and safety and environmental protection

Procedures and operations shall comply with national statutory obligations at all times. The supplier instructions and safety data sheets for the correct use, and any subsequent disposal, of products shall be followed. If a deviation from the established procedures is found to be necessary, the fabricator shall consult with the adhesive supplier as to the suitability of the proposed changes to the procedures, prior to implementing such a deviation. Records of deviations shall be maintained.

8.2.2 Work instructions

Bonding procedures (including surface preparation, post-bonding finishing, etc.) shall comply with the quality plan.

The fabricator may use the bonding procedure specification directly in the workshop for the purposes of instructing the adhesive bonding personnel. Alternatively, the fabricator may use dedicated work instructions. Dedicated work instructions shall be prepared from an approved bonding procedure and do not require separate approval.