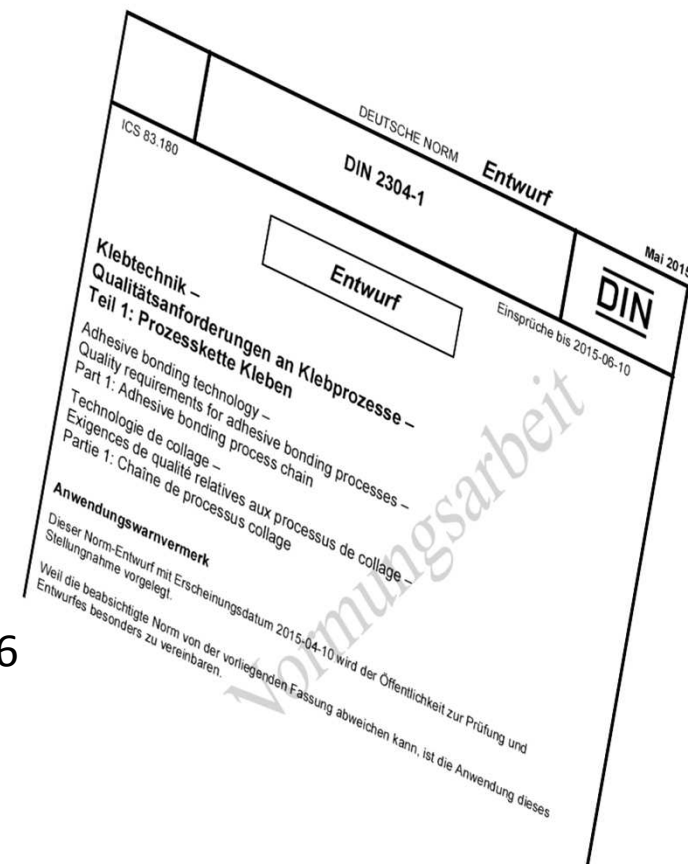




THE NEW DIN 2304-1 STANDARD - THE WAY TO A ZERO DEFECT BONDING PROCESS

Kick-off meeting:	12.03.2012
Basis:	ISO 9001 DVS-RL 3310 (2003/2012) DIN 6701
Release of draft :	10.05.2015
Period for objection:	10.05. – 10.06.2015
Comments-resolution meeting:	07./08.10.2015
Formal release:	expected for February 2016



THE NEW DIN 2304-1 STANDARD – THE WAY TO A ZERO DEFECT BONDING PROCESS



KLEBTECHNIK

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Solar panels bonded to a substructure became loose during a storm, not only damaging other panels but also becoming a risk for hurting passing by pedestrians.

Investigating the case led to the conclusion that, probably due to a lack of knowledge fatal mistakes have been made at several steps along the process chain

Introduction

Status Quo

DIN 2304-1

objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

Perspectives

Conclusion



Status Quo Adhesive Bonding

Multiple bonding applications both in industrial series production as well as in handicraft have proven that

- the adhesive available on the market are high-quality products which are manufactured in compliance with standards in „managed“ processes.
- a correct use of these adhesives – from the planning stage to the bonding process – generally leads to zero defect parts

Contradicting this statement is the fact that bonded joints unfortunately all too often do not meet the requirements placed on them, resulting in failure during the usage phase

Introduction

Status Quo

DIN 2304-1

objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

Perspectives

Conclusion



Status Quo Adhesive Bonding

NMI Study „Reliable Bonding“ Core Statements:

1. In general joining technologies do have a large potential for added value
2. Adhesive bonding is a well established joining technology
3. Adhesives bonding allows joining of a wide variety of different materials
4. Adhesive bonding offers competitive advantages
5. In many case the boning process is not planned end-to-end
6. The bonding process is not always fully controlled
7. Companies utilizing adhesive bonding are considered as innovative and are open for advise
8. Adhesive bonding is ecological friendly

Introduction

Status Quo

DIN 2304-1

objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

Perspectives

Conclusion

*Source: University Tübingen: (Natural and Medical Sciences Institute at the University of Tübingen
<http://www.nmi.de/nc/aktuell/aktuell/detailseite-download/artikel/2015-nmi-studie-sicheres-kleben/>



Status Quo Adhesive Bonding

NMI Study „Reliable Bonding“ Core Statements:

1. In general joining technologies do have a large potential for added value
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- 6. The bonding process is not always fully controlled**
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Introduction

Status Quo

DIN 2304-1
objectives
ISO 9001 as base

Limits of ISO 9001

DIN 2304-1
• contents
• core elements

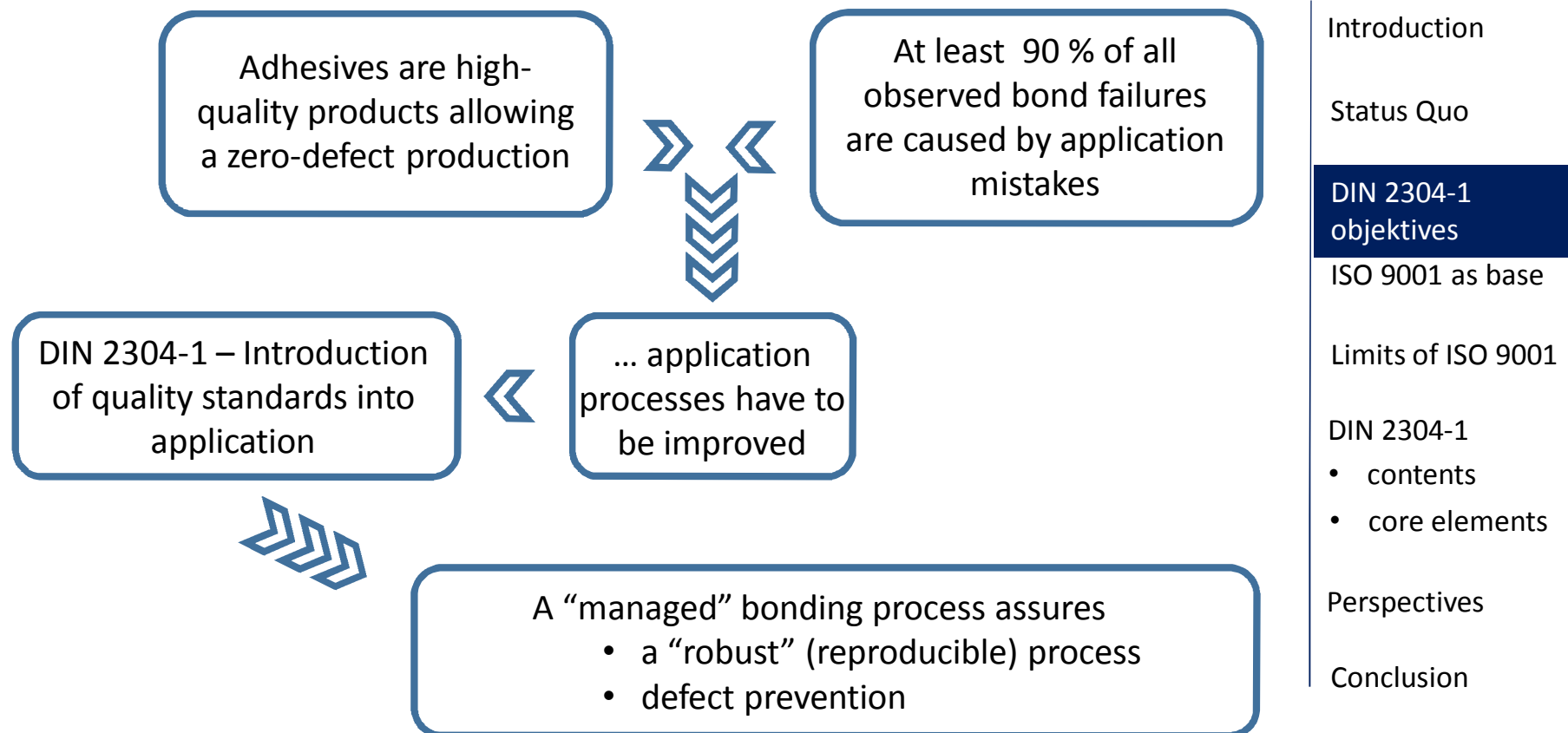
Perspectives

Conclusion

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DIN 2304-1 - Objectives



Introduction

Status Quo

**DIN 2304-1
objectives**

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

Perspectives

Conclusion



DIN EN ISO 9001 as base for DIN 2304-1

If a production step or a finished product cannot be tested by non-destructive means with 100 % certainty for potential faults, namely when it concerns a so-called

„special process“

all possible errors throughout the finished product must be ruled out “managing” the whole production process!

Based on the premises that the adhesive is a quality product which if correctly used allows zero defect production measures to rule out all errors all along the process chain are required.

Defect prevention is, in accordance to DIN EN ISO 9001 the magic formula for “special processes”

Note:

In welding technology this is already considered as state of the art

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

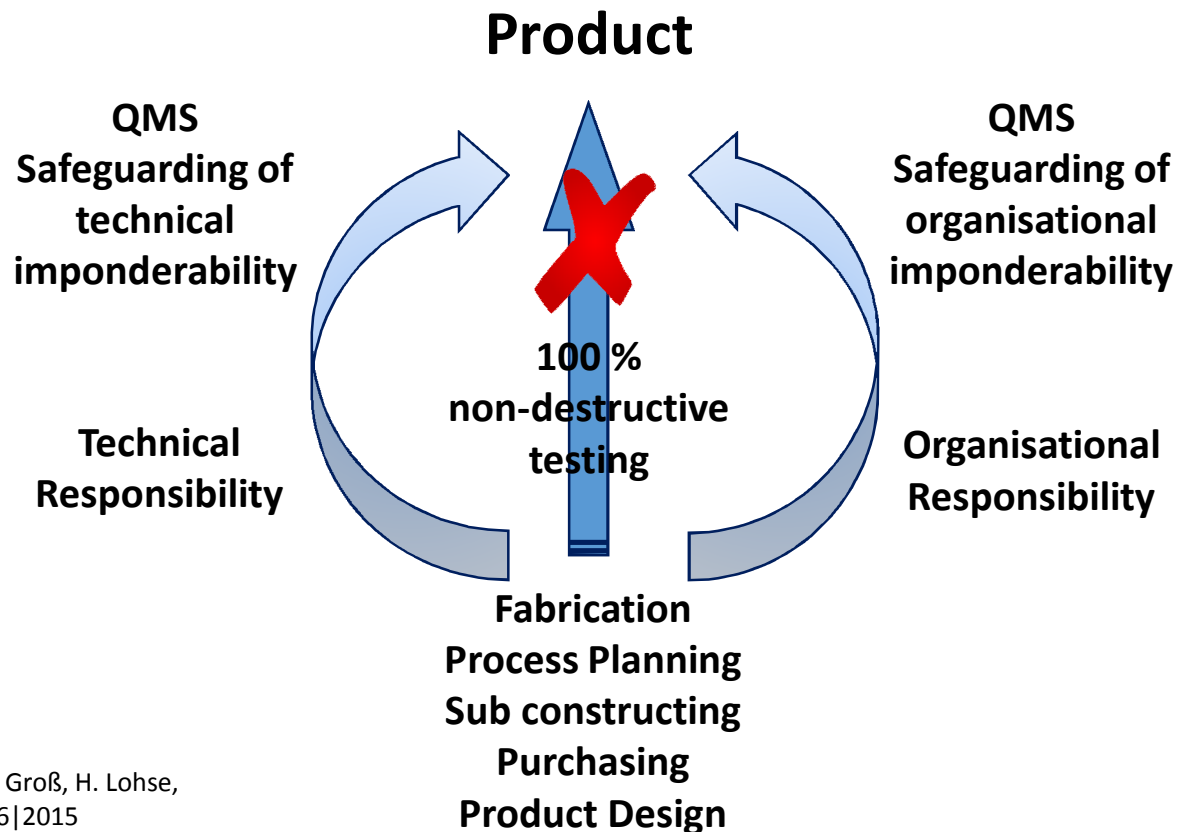
Perspectives

Conclusion



DIN EN ISO 9001 as base for DIN 2304-1

Technical and organisational quality assurance as a “detour” for assuring high quality products in a „special process”



Source: A. Groß, H. Lohse,
Adhäsion 6 | 2015

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

Perspectives

Conclusion



Limits of ISO 9001 and the need for DIN 2304-1

The ISO 9001 deals with

- the fundamentals of Quality Management Systems (QMS)
- and
- the requirements that organizations need to meet the customers' and other stakeholders' requirements related to the quality of products or services

Subject of a formal certification according to ISO 9001 is the QMS but not the relevant (application) process.

ISO 9001 provides the basis for quality assurance but is too general to be the sole instrument for quality assurance. There is a need for specifics, namely technology-specific regulations such as standards which lay down the structures of an "organization" - namely a company using adhesives - required for correct application of the technology.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- contents
- core elements

Perspectives

Conclusion



DIN 2304-1 – Adhesive bonding technology – Quality requirements for adhesive bonding processes

DIN 2304-1 is defining the generally binding state of the art for adhesive bonding processes,

- non regardless of the type of finished product
- for all areas of application (industrial production as well as handicraft manufacturing)
- for all adhesive joints whose primary function is to transfer mechanical loads.

by stipulating the requirements for manufacturing quality bonded joints along the whole process chain from development through to production and repairs/maintenance and by laying down the general organizational, contractual and technical-production basis for the manufacturing of bonded joints.

The DIN 2304-1 is a standard for users!

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

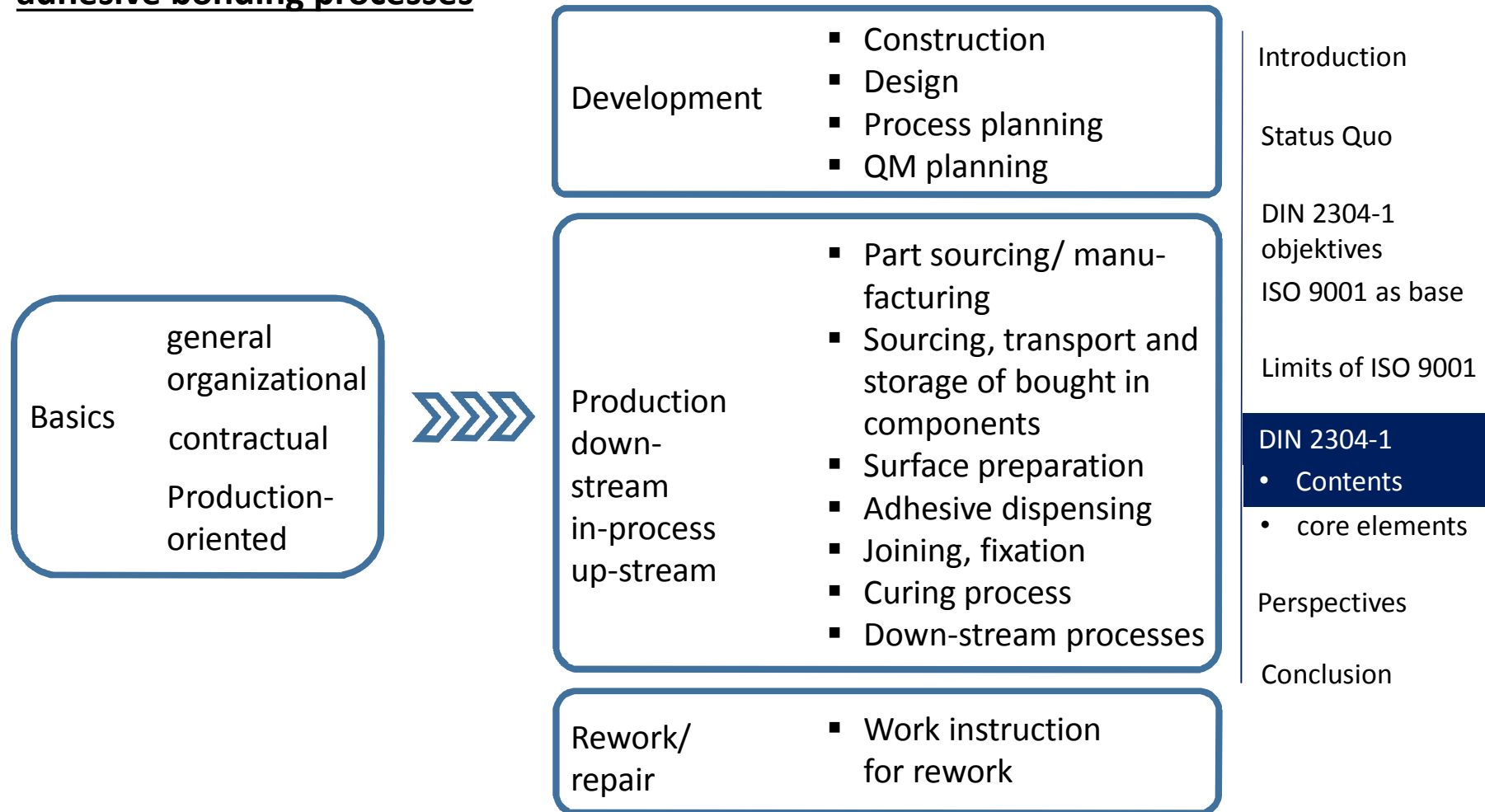
- Contents
- core elements

Perspectives

Conclusion

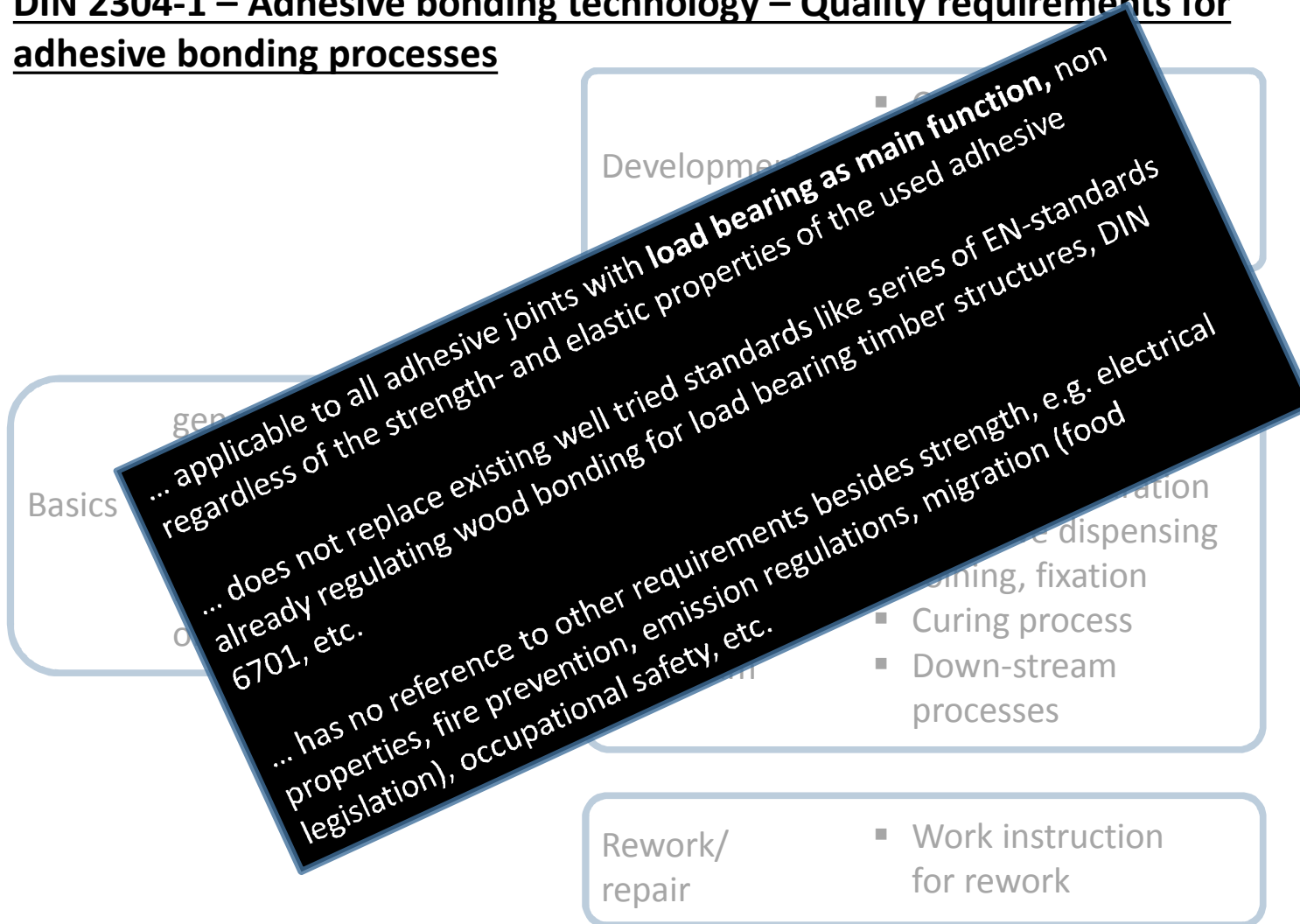


DIN 2304-1 – Adhesive bonding technology – Quality requirements for adhesive bonding processes





DIN 2304-1 – Adhesive bonding technology – Quality requirements for adhesive bonding processes



Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Contents
- core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements

- 1. Classification** of bonded joints in accordance with safety requirements
What are the consequences of a potential failure in load bearing capability of the bond?
- 2. Work force qualification** with the assignment of supervisors in charge (SIC) of adhesive bonding work
Providing qualified personnel (e.g. trained in accordance to EWF requirements, EAB, EAS, EAE)
- 3. Verification** that during the whole life cycle of a bonded joint the loads/stresses to which a bonded joint is exposed are always smaller than the load/stress limit of that bonded joint

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 1. Safety requirements

Safety category	Definition of safety requirements
S1	High safety requirements The failure of the bonded joint leads <ul style="list-style-type: none">• indirectly or directly to an inevitable danger to life and limb• to a loss of the functionality, whose effects will very probably be an inevitable danger to life and limb

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 1. Safety requirements

Safety category	Definition of safety requirements
S1	High safety requirements
S2	Moderate safety requirements The failure of the bonded joint <ul style="list-style-type: none">• may be a danger to life and limb• leads to a loss of the functionality, whose effects will probably be harmful to people or the environment• leads to a loss of the functionality, whose effects will very probably cause far-reaching damage to property

Introduction

Status Quo

DIN 2304-1

objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content

- **Core elements**

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 1. Safety requirements

Safety category	Definition of safety requirements
S1	High safety requirements
S2	Moderate safety requirements
S3	Low safety requirements The failure of the bonded joint leads to a loss of the functionality, <ul style="list-style-type: none">• whose effects will probably not be harmful to people or the environment• whose effects will at most detriment comfort and performance• whose effects will probably not cause major damage to property

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- **Core elements**

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 1. Safety requirements

Safety category	Definition of safety requirements
S1	High safety requirements
S2	Moderate safety requirements
S3	Low safety requirements
S4	No safety requirements The failure of the bonded joint leads to a loss of the functionality, <ul style="list-style-type: none">• whose effects under predictable conditions will not be harmful to people or the environment• whose effects will solely detriment comfort and performance• whose effects will not cause major damage to property

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- **Core elements**

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 1. Safety requirements

Safety category	Safety requirements	Organisational requirements
S1	High Safety requirements	high
S2	Moderate safety requirements	
S3	Low safety requirements	
S4	No safety requirements	Low



The classification of bonded joints needs to be done carefully considering

- the severity of the resulting effect
- the probability of its occurrence
- the possibility for in time recognizing of the failure and by a fair degree of sure instinct.

It defines the degree of to be implemented organisational measures in accordance to DIN 2304-1

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 2. Work force qualification

„The organisation (user company doing adhesives bonding) must provide a sufficient number of trained personnel for all relevant tasks along the adhesive bonding process chain and has to document their appointment”

„A *supervisor in charge* (SIC) has to be assigned.“
(DIN 2304-1 Abs. 5.)

Supervisor in charge (SIC):

The supervisor in charge (SIC) is the main contact person for all quality matters relating to the so-called "special process" of adhesive bonding - from the planning stage through to production and maintenance/repair.

Depending on the safety class of the bonded joint (first core element), the verification of qualifications for appointment as a supervisor in charge of adhesive bonding work may include professional training / apprenticeships (joinery, flooring fitter, decorator, etc.) and in-job further training. For S4 no SIC is required.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 3. Verification

Load/stress limit
of the bond

>

Load/stresses the
bond is exposed to

The verification of this can be carried out in four ways and needs to be documented:

- 1. Measurements:** Based on the specifications, the load/stress is determined from experiments, calculations, standards, real data or a combination of these and documented. The load/stress limit must be determined by experiment, with accompanying statistics, taking into account ageing, test media, combinations of effects, etc..

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 3. Verification

Load/stress limit
of the bond

>

Load/stresses the
bond is exposed to

The verification of this can be carried out in four ways and needs to be documented:

1. Measurements:

2. Component testing: by testing a whole system or part of a system under real conditions or under conditions which mimic reality. When testing a part of a system, the mutual interaction between the part-system and whole-system must also be taken into account and it must be verified that this does not falsify the results in an impermissible way. A failure criterion for test evaluation, including an integrated safety factor, must be defined.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 3. Verification

Load/stress limit
of the bond

>

Load/stresses the
bond is exposed to

The verification of this can be carried out in four ways and needs to be documented:

1. **Measurements:**
2. **Component testing:**
3. **Documented experience:** The verification based on experience requires that the design of the bonded joint is already proven.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Core Elements - 3. Verification

Load/stress limit
of the bond

>

Load/stresses the
bond is exposed to

The verification of this can be carried out in four ways and needs to be documented:

1. **Measurements:**
2. **Component testing:**
3. **Documented experience:**
4. **Combination of 1. to 3.:** The verification of combinations of the aforementioned routes must ensure that all requirements are suitably evaluated and that the individual components are compatible with each other.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



Perspectives

After having discussed various objections and suggestions for improvement during the comments-resolution-meeting early October 2015 the official release of DIN 2304-1 final version is expected to take place in February 2016.

Further concretion:

It is planned to further concretise the contents of DIN 2304-1 e.g. in regard to certain applications like

- bonding of fibre reinforced plastics (DINSpec 2305-1)
- bonding by the use of adhesive tapes (DVS-Guideline)
- providing further clarification and definitions (F&Q-list)
- ...

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

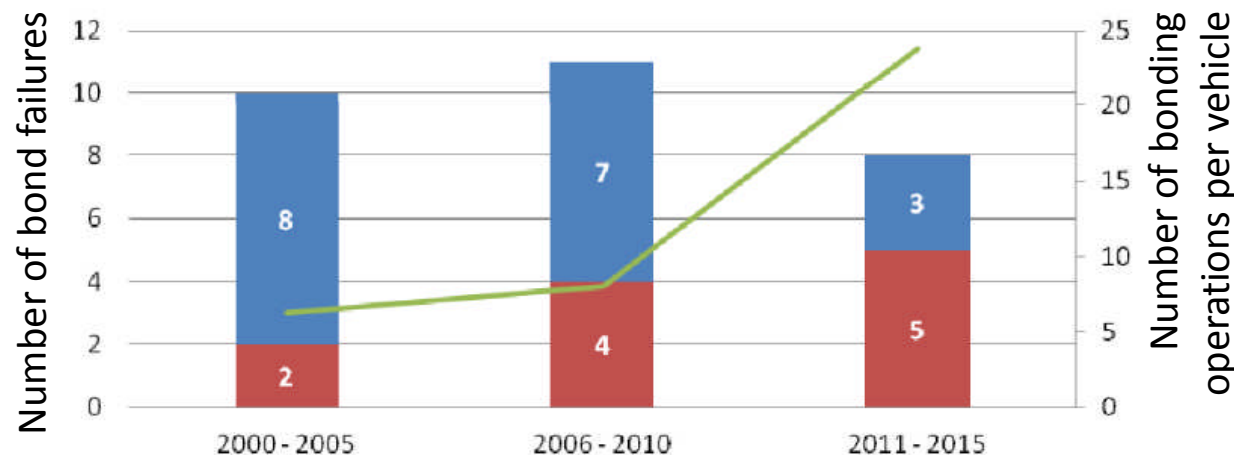
Conclusion



Perspectives

Experience on about 10 years with DIN 6701 (regulates, on the initiative of the “German Federal Railway Authority” adhesive bonding applications on parts intended for the use on the German railway system) shows that

- the number of adhesive related failures have been significantly reduced
- failures are noticed predominantly while the part still not delivered to the customer
- and the number of bonding application has been increased



Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion

Source: Peter Hellwig,
DIN 2304 Workshop,
Bremen 27.10.2015

■ Bond failures noticed during use
■ Bond failures noticed in production

— Number of bonding
operations per vehicle



Perspectives

DIN 2304-1 allows user-companies the option of being certified in accordance with this standard.

In contrast to

- a company audit,
- a process review,
- or
- an expert report

the certification of a company according to DIN 2304-1 gives customers the confidence that bonded joints are correctly manufactured in accordance with the state-of-the-art and can be considered as an advantage in competition.

Currently there is in contrast to DIN 6701 no legal obligation for a certification.

A certification of adhesives according to DIN 2304-1 is not planned and also not suitable, as the adhesive is only one part of multiple influencing the bond quality.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion



DIN 2304-1 – Conclusion

- Adhesive bonding becomes more and more an established joining technology
- The quality of modern adhesives allows zero defect production
- In part adhesive users suffer from a uncertainty about a sufficient process reliability, bonded parts fail.
- The quality of the adhesive application process must match the quality of the adhesive manufacturing process
- Adhesive bonding is a "special process"– not allowing a 100 % non-destructive testing
- There is no alternative but to use a comprehensive QMS to eradicate errors, as described in ISO 9001 and more specifically in DIN 2304
- Quality assurance for bonding processes - for correct adhesive application and documented via certification - minimizes faults, saves money, generates trust, promotes the wider use of adhesives, and sustainably improves the image of adhesive bonding.
- DIN 6701 has already demonstrated that.

Introduction

Status Quo

DIN 2304-1
objectives

ISO 9001 as base

Limits of ISO 9001

DIN 2304-1

- Content
- Core elements

Perspectives

Conclusion

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Adopting the principles and demands outlines in DIN 2304-1 will help that something like this will not happen again.

**Many Thanks for your
attention**

Questions?



in-adhesives

17./18. February 2016 - Munich

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28/28