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DIN 2304 – Quality requirements for adhesive bonding processes

Abstract: Today's adhesives are high quality products. Their proper use normally leads to a zero--defect-production. If bonding failures nevertheless occur, more than 90% these failures result from failures in the adhesive bonding process and do not result from failures of the adhesive. Precisely in this contradiction (high quality adhesives for a zero-defect-production vs. adhesive bonding failures) DIN 2304 starts to take effect: DIN 2304 implements quality standards for the proper use of adhesives. The standard determines the current state of the art for the organization of a proper realization of adhesive bonding processes in the user-company. Therefore, the quality of the adhesive bonding process will be adapted to the quality of the adhesive production process. In this context. DIN 2304 concerns every adhesively bonded material compound with the main function of transferring mechanical loads, independent from the strength and deformability characteristics as well as the solidification mechanism of the used adhesive. Due to the fact that the OEM Working Group "Automotive" has decided to implement the standard into their productions, DIN 2304 may rapidly become global - for the automotive producers as well as for their suppliers.

Keywords: adhesive bonding, DIN 2304, quality requirements

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Adhesives used today in production are high-quality products. The correct use of these high quality products normally enables zero-defect production – from the planning up to the bonded product. Unfortunately – and too often - bonding errors still arise. These errors result in more than 90% of all cases from application errors. Exactly this contradiction, "*zero-defect-production vs. occurring bonding errors*", is the subject of DIN 2304 "*Adhesive Bonding – quality requirements for adhesive bonding processes*": If the main reason for a bonding error is not an adhesive error but an application error then the application must be optimized.

Hence, DIN 2304 is an application standard which is based on ISO 9001. The objective of DIN 2304 is to establish the best organizational design for the application processes in adhesive bonding. The adhesive user should become able to control his whole process from the idea, via the development, and up to the production of the bonded product. That will mean that the bonding processes will become robust and reproducible. DIN 2304 is valid for all classes of adhesives independent from their strength and deformation properties. The standard is also valid for all branches and every adhesively bonded joint which has the primary function in the transfer of mechanical loads.

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DIN 2304 – a standard for users

DIN 2304 is based on ISO 9001: If a production step or a finished product cannot be nondestructively tested concerning errors with a 100% – result („special process" according to ISO 9001) on the way to the completed product, definitively all error possibilities must be excluded. This is the key message from ISO 9001! In this way the adhesive bonding processes have to become "controlled".

In order to achieve this, DIN 2304 „Adhesive bonding – quality requirements for bonding processes" concretizes ISO 9001 for adhesive bonding applications. DIN 2304 determines the current state of the art for the organization of the professional implementation of bonding processes in the user company. This determination is valid across all industrial sectors and all products. DIN 2304 solely refers to adhesively bonded joints having the primary function of transferring mechanical loads.

The standard also determines

- he requirements for the right quality of the production of adhesively bonded joints along the whole adhesive bonding process chain

as well as

- the general organizational, contractual and production-technical basics for the production of adhesively bonded joints.

DIN 2304 includes the following three key elements:

- classification of the adhesively bonded joints due to their safety requirements
- appointment of supervisors-in-charge of adhesive bonding (SIC)
- verification management, that during the whole life cycle of an adhesively bonded joint, the load it bears is smaller the load limit of the joint.

Furthermore, the user-companies receive the possibility to verify and to document their standardized quality of their adhesive bonding applications with

- certification according to DIN 2304.

Key element 1: Classification of adhesively bonded joints

According to DIN 2304 all adhesively bonded joints will be classified into the safety classes

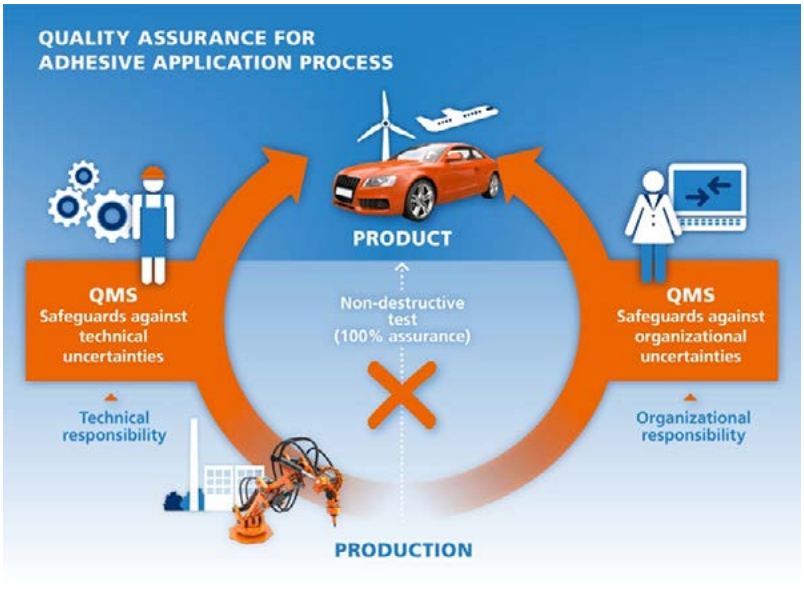
- S1 (direct or indirect endangerment of life and limb),
- S2 (possible endangerment of life and limb, large environmental damages, large financial losses),
- S3 (probably no endangerment of life and limb, environmental damages and financial losses, maximum losses of comfort or performance) and
- S4 (definitively no damages of life and limb or environment, no larger financial losses, maximum losses of comfort or performance).

The classification has to be carried out by the design engineer, respectively, the person responsible for the components. The classifications are solely based on potential effects coming from the failure of the main function of the adhesively bonded joint - the transfer of mechanical loads. This is independent from the strength and deformation behavior of the used adhesive.

Key element 2: Supervisors-in-charge (SIC)

The supervisors-in-charge (SIC) are employees who bear responsibility in the user-company

for adhesive bonding technology and all linked activities. The supervisors-in-charge (SIC) have to verify their suitability and technology-specific knowledge. They are the central contact persons for all quality-influencing factors along the "special process" adhesive bonding. Therefore, the user-company must provide sufficient and qualified staff. Their nomination must be documented.



Key element 3: Verification management

Over the whole life cycle, the load which an adhesively bonded joint bears must be smaller than the load limit. According to DIN 2304 this must be ensured in cooperation with the supervisors-in-charge. The verification management has to be documented replicable. The verification management can be carried out in the following ways: 1. design/calculation, 2. component testing, 3. documented experience respectively, 4. combination of points 1-3.

Perspective: Certification according to DIN 2304

The adhesive user-companies have the possibility to become certified according to DIN 2304. This certification will be carried by authorized certification bodies which are accredited according to DIN EN ISO 17065. In opposite to audits, reviews or evaluations without an official, acknowledged certificate, this official "third party"-certification according to DIN 2304 gives the user-companies a credit of trust to the clients. This accreditation shows that the user-company produces adhesively bonded joints exactly in that way which is determined in DIN 2304. In other words: The adhesively bonded joints are carried out according to the current state of the art.

DIN 6701 – a success story

With DIN 6701 „Adhesive bonding of rail vehicles and rail vehicle parts "and their crosslinking with ISO 9001, a success story already exists, which is accepted by adhesive user-companies and their customers, adhesive producers and the German Railway Authority equally. This success story shows, how organizational quality assurance can be established successfully in user-companies. This is underlined by the fact that meanwhile this national standard serves internationally as a foundation for adhesive bonding processes, not only for the rail vehicle industry. Currently DIN 6701 will be transferred into a European Standard (EN).

According to DIN 6701 and based on ISO 9001, the railway adhesive bonding user-companies have been restructured concerning their staff, their equipment and their production workshops. These restructuring measures also include process organization. By now, the long-term – and international – experience with DIN 6701 shows that the expenditures mentioned above will provide medium-term benefit in a technological as well as in an economic way.

Conclusion

Until we do not have a 100% non-destructive inspection technology for adhesive bonding processes, adhesive bonding remains as a "special process" according to ISO 9001. The error prevention which is determined in ISO 9001 and which is concretized in DIN 2304 does not have

an alternative. "Controlling of bonding processes" is the order of the day! This professional quality assurance in adhesive bonding technology minimizes errors, saves money, creates trust, increases the use of adhesives and adhesive bonding technology and simultaneously optimizes the long-lasting image of adhesive bonding. DIN 6701 is the evidence of that.

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