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Press Release

Focus on the Fatigue Endurance of Stainless-Steel Fasteners

New Findings from the FOSTA P 1797 Research Project

Stainless steel fasteners are used in many industrial sectors where high corrosion resistance is required in addition to mechanical performance. Applications in which bolted joints are exposed to permanent cyclic loading are particularly critical – for example in mechanical and plant engineering, energy technology, or marine environments.

In mechanical engineering, the design of such joints is typically based on VDI 2230 Part 1 (2015), which is internationally recognized as a key reference for the calculation of bolted joints.

The basis for designing bolted joints is their fatigue endurance. However, for nut-and-bolt assemblies made from stainless steel materials, this aspect has so far only been insufficiently investigated and documented.

This is where the research project FOSTA P 1797, “Assessment of the Fatigue Endurance of Highly Cyclically Loaded Nut-and-Bolt Assemblies Made from Stainless Steel for Mechanical Engineering,” comes in. The project is being carried out by Wismar University of Applied Sciences and the Fraunhofer Institute for Large Structures in Production Engineering IGP in Rostock, together with industrial partners including Sonderschrauben Güldner. It is funded as part of the German Industrial Collective Research program, with DLR as the project management agency, based on a resolution of the German Bundestag and with support from the Federal Ministry for Economic Affairs and Energy.

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Practical Background

The project is based on findings from preliminary investigations. Stainless steel fasteners, particularly those made from austenitic and austenitic-ferritic materials, can exhibit different behavior under high-cycle loading compared with fasteners made from carbon steels.

While carbon steel is often assumed to have a clearly defined fatigue limit, results indicate that this may be less evident in stainless steel fasteners. In some cases, fractures can still occur even at very high numbers of load cycles.

For practical applications, this means that existing assumptions may be too optimistic – with direct implications for component safety and joint design. Uncertainty in design, combined with a potential overestimation of fatigue strength in the high-cycle range, can lead to premature and unexpected damage or failure. This represents a product and safety risk, can result in costs for damage remediation, shorten product service life, and may ultimately affect a company's reputation.

Objective of the Research Project

The aim of the FOSTA P 1797 research project is to systematically investigate the fatigue endurance of stainless-steel bolted joints and to create a reliable basis for future design rules.

The key influencing factors being examined include:

- steel grade and property class
- manufacturing process
- manufacturer influence
- size effect
- lubrication
- mean stress

The investigations are carried out in the form of fatigue tests in which nut-and-bolt assemblies are subjected to cyclic loading under realistic conditions.

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Bridging Research and Practice: Güldner's Role

As an industrial partner, Sonderschrauben Güldner contributes its experience in the production and application of fasteners to the project.

One key contribution is the targeted provision of test parts under defined conditions. This includes, among other things, the production of selected fasteners and fastening components from a single material batch. This makes it possible to examine specific influencing factors that are often difficult to isolate in real-world applications.

The close link between research and industrial implementation ensures that the results are not only scientifically sound but also directly relevant to practical applications.

Comparison of Materials

The project investigates, among others, austenitic, martensitic, and austenitic-ferritic stainless steels.

Austenitic materials such as A4-80 are characterized by high corrosion resistance and good ductility. Their strength is primarily achieved through cold working.

Martensitic materials such as C1-70, on the other hand, offer higher strength and hardness but are more sensitive to notches and have lower corrosion resistance.

An austenitic-ferritic material with a duplex microstructure, such as D8-100, combines high mechanical strength achieved through cold working with good corrosion resistance.

The direct comparison of these material groups makes it possible to better understand the influence of microstructure and material behavior on fatigue strength.

Influence of Material and Manufacturing

In addition to the material itself, the material condition and manufacturing process also play a decisive role.

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In series production, fasteners are typically manufactured by cold forming. This process can create favorable properties such as continuous grain flow and compressive residual stresses, which may have a positive effect on fatigue endurance.

As part of the project, machined components produced from solid material are also being investigated. These components have different boundary conditions, such as interrupted grain flow or altered residual stress states.

The aim is to better understand the influence of these differences and to assess the extent to which laboratory investigations can be transferred to real series-production components.

Initial Findings and Expectations

The results and hypotheses available to date indicate that the fatigue behavior of stainless-steel fasteners needs to be considered in a more differentiated way than previously assumed.

In particular, the investigations indicate:

- a possible further decline of the S-N curve in the long-life fatigue range
- a significant influence on mean stress
- measurable differences between materials and manufacturing methods

In the long term, these findings could contribute to the adaptation of existing calculation approaches.

Benefits for Industrial Practice

The project provides important insights for industrial users.

In design engineering, the results enable more realistic dimensioning and a better balance between safety and weight.

In quality assurance, they help to better understand variations and to analyze the causes of fatigue failure more precisely.

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In purchasing, they support decisions on when standard parts are sufficient and when specific requirements may be appropriate.

Outlook

The findings gained from the project are intended to contribute to the further development of existing standards and guidelines, in particular VDI 2230 Part 1.

This will enable a more reliable and, at the same time, more cost-efficient design of stainless-steel bolted joints in the future.

For companies, this means greater long-term safety, less over dimensioning, and a better decision-making basis along the entire value chain.

About Güldner

Sonderschrauben Güldner GmbH & Co. KG, based in Niederstetten, Germany, is part of the Würth Group and has been manufacturing custom fasteners and fastening components for various industrial applications for more than 45 years. On May 4, 2026, the company celebrated its 45th anniversary. Today, more than 112 employees work at the Niederstetten site.

Güldner specializes in customer-specific fastening components and covers various manufacturing processes for demanding applications.

Web:

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Editorial Note

This technical article was prepared in cooperation with Wismar University of Applied Sciences and technically coordinated with the project partners. Internal approval for editorial distribution has been granted.

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