# Document Control Sheet

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Entwicklung eines Anrisskonzepts zur Schwingfestigkeitsbewertung von Schweißverbindungen unter mehrachsigen Belastungszeitverläufen

| 4. author(s) (family name, first name(s)) | 5. end of project<br>30.09.2025 |
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18. abstract
Currently, there are no practical methods in the literature or guidelines for reliably predicting the fatigue life of welded joints under multiaxial, non-proportional cyclic loads. In the field of maritime load-bearing structures, damage-relevant multiaxial load scenarios occur at the failure-critical weld notch due to a variety of environmental influences. As part of this project, a comprehensive database was created based on all studies of welded joints under multiaxial stress available in the literature, and an extensive test program was carried out with multiaxial, practice-relevant and unexplored stress scenarios. On this basis, a new evaluation methodology was developed which achieved a reliable and precise fatigue life prediction based on both the literature data and the new test program. At the same time, the developed methodology was validated for practical application using the effective stress concept, taking into account the local weld geometry, by using a uniform fatigue strength for each welded joint. This eliminates the need to carry out reference experiments to determine the fatigue strength under uniaxial stress. Based on the test program, a wide range of findings regarding the influence of various multiaxial, non-proportional stress scenarios on the fatigue life could be derived and directly integrated into the evaluation methodology. The evaluation concept developed allows for a significant improvement in prediction quality of 24% to 77% compared to established standards and guidelines, simplifies the evaluation through a consistent evaluation methodology and, at the same time, extends the evaluation method to include various stress scenarios with a stress component parallel to the weld seam. As a result, the assessment methodology leads to significantly reduced sheet thicknesses and weld volumes while maintaining the same level of safety due to its higher reliability. The assessment method is expected to be integrated into standards and guidelines for broad application in industry in the near future and has already been partially integrated.

19. keywords
fatigue, welded joints, fatigue life prediction, multiaxial loading, variable amplitude loading, welded maritime structures, local stress analysis, machine learning, explainable artificial intelligence

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