

Note on Engineering Details

No: DWM-MRis-extern-001

Title: **Fatigue assessment of welded machinery structures: Permissible Palmgren-Miner damage sum**

Ref.: GL's Wind "Guideline for the Certification of Wind Turbines", Edition 2003 with Supplement 2004.
Sections 5.3.3.2.3 and 5.3.3.4.1

GL's Wind "Guideline for the Certification of Offshore Wind Turbines", Edition 2005.
Sections 5.3.4.2.3 and 5.3.4.4.1

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Within the next revision of the "Guideline for the Certification of Wind Turbines", Edition 2003 with Supplement 2004, the below mentioned changes will be implemented. In the meantime we appeal to the voluntariness of the wind turbine manufacturers to implement these changes in their design calculations and documentation.

Welded machinery structures (e.g. main frame, generator frame) of wind turbines generally features complex design and are subject to complex loading.

Current design recommendations [1], research [2] and engineering literature [3] reach the conclusion that the permissible Palmgren-Miner damage sum $D \leq 1$ does not comply with the state of technology with regard to the above mentioned design and loading conditions.

The current edition of the "Recommendations for fatigue design of welded joints and components" [1] published by the International Institute of Welding proposes a

permissible damage sum $D \leq 0.5$.

The specified limit applies for the fatigue assessment using S/N curves and linear damage calculation by the Palmgren-Miner rule. Moreover the limit is applicable for variable amplitude loading. In case of constant amplitude loading the permissible damage sum remains $D \leq 1$.

Therefore the limitation of the damage sum for welded machinery structures will be implemented in the next regular revision of GL's Wind Guideline.
GL recommends as from now to design the relevant components under consideration of the updated damage sum limit as mentioned above.

- [1] International Institute of Welding: Recommendations for fatigue design of welded joints and components, IIW document IIW-1823-07, December 2008.
- [2] Assessment of multiaxial spectrum loading of welded steel and aluminium joints by modified equivalent stress and Gough-Pollard algorithms, IIW-Doc. No. XIII-2158r1-07/XV-1250r1-07, 2007.
- [3] Fatigue assessment of welded joints by local approaches (Radaj, Sonsino, Fricke), Woodhead Publishing, Edition 2006.

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