

## Note on Engineering Details

**No:** DWM-Poll-extern-001, Rev. 1

**Title:** Gearbox structures

**Ref.:** [1] GL Wind "Guideline for the Certification of Wind Turbines",  
Edition 2003 with Supplement 2004  
[2] GL Wind "Guideline for the Certification of Offshore Wind Turbines",  
Edition 2005  
[3] GL "Guideline for the Certification of Wind Turbines", Edition 2010

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This revision of the Note on Engineering Details DWM-Poll-extern-001 clarifies certain requirements in reference to the usage of high strength cast irons with spheroidal graphite for gearbox structures.

In case non-ductile cast irons with spheroidal graphite ( $A_5 < 12.5\%$ ,  $KV_{\text{mean}} < 10\text{J}$ ) will be used for gearbox structures, the applicability has to be evaluated as follows.

Load carrying structures for gearboxes, which are made of high strength cast irons with spheroidal graphite (higher strength than EN-GJS-400 according to EN 1563) demand an extension of the common requirements by an adequate qualification of the respective structure (see Section 3.3.1.1 of [1] - [3] and 3.3.2.5 of [1], [3], 3.3.2.8 of [2] and 6.3.1 of [3]). The details of the qualification procedure need to be agreed. Further information is available upon request from GL.

The qualification procedure is necessary for gearbox structures made of non-ductile cast irons with spheroidal graphite in the following cases:

- new gearbox design,
- new load assumptions (in case of load increases),
- modified gearbox (e.g. different gear ratio),
- cold climate application.

The qualification procedure can be omitted (short term solution), if the strength analyses of the relevant structure shows stress reserve factors (SRF) of  $\text{SRF} \geq 1.5$ . This stress reserve shall be achieved for extreme and fatigue analyses according to Section 5 of the above mentioned references [1] - [3], under consideration of the common safety concept.

In component areas where the stress reserve factor is between  $1.0 \leq \text{SRF} < 1.5$  the qualification procedure (e.g. by fracture mechanics and testing) can be omitted, if the below listed items 1 through 6 will be realised to increase the component's quality. In this case the critical areas of the component regarding stress are defined by  $\text{SRF} < 1.5$  for the ultimate and fatigue design calculations.

The following figure 1 gives an overview of the different options.

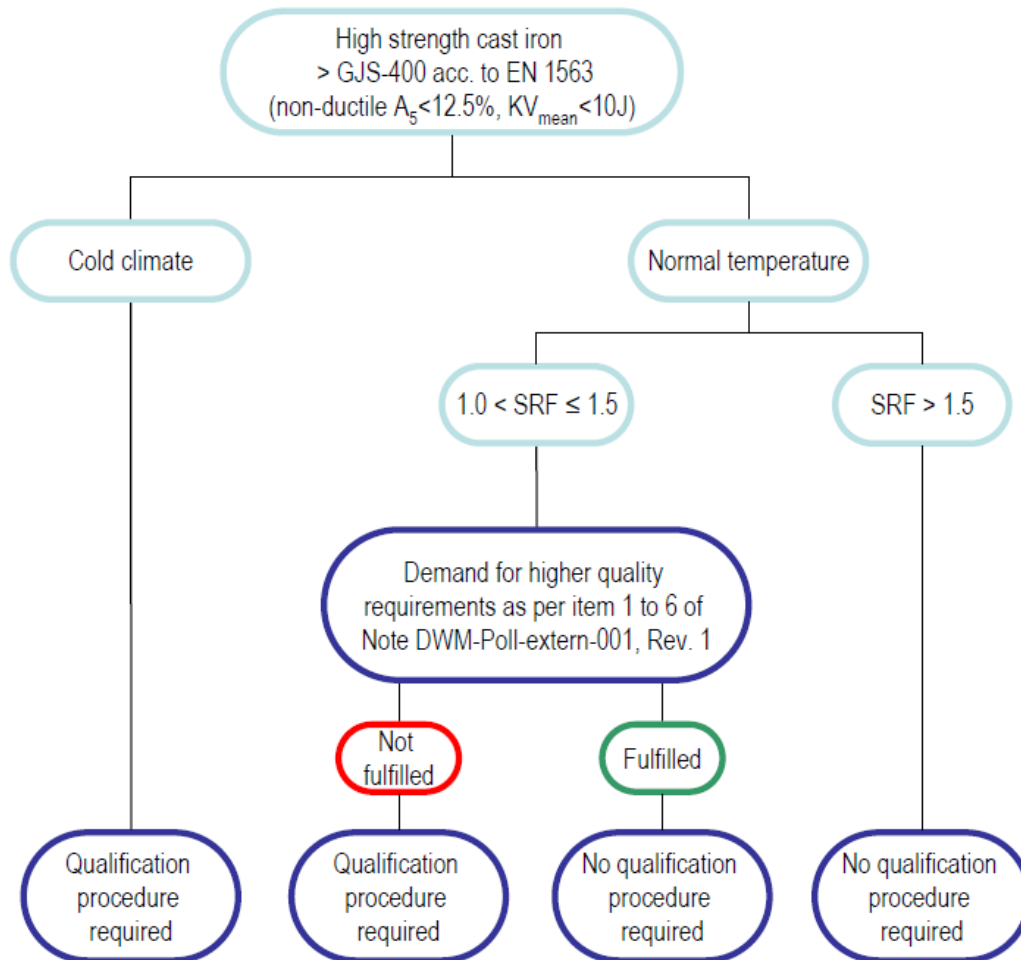


Figure 1: Requirements for high strength cast iron for gearbox structures

1. The critical areas of the component shall fulfil the cast quality level 1 in reference to volume and surface testing.
2. A 100% quality testing shall be performed in the critical areas.
3. The critical areas of the component regarding stress and casting process shall not overlap. This condition shall be requested by the component designer from the component manufacturer. The casting critical component areas can be obtained by cast simulations (see item 6).
4. The above listed requirements (items 1-3) shall be specified by the component designer during the Design Assessment already (e.g. by component specifications and/or component drawings).

5. During manufacturing of the component an inspection of the respective component is required. The inspection is requested within the Design Assessment already and can be valid for later Implementation of the design-related requirements in Production and Erection (IPE), too. During inspection of the component manufacturing the practical realisation of the specified requirements shall be approved. Part of the inspection will be the non destructive testing.
6. For evidence of the above mentioned item 3 it is necessary to check the casting simulation by plausibility. Alternatively it is possible to perform e.g. tests or radiographic testing.

The risk for brittle fracture of the high strength cast iron component in gearbox will be reduced by the higher quality requirements and its assurance of realisation.

This possibility is given for gearboxes structures applicable in normal ambient temperatures (between -20°C and +50°C) only. For cold climate applications a detailed qualification procedure is indispensable.

If the items 1 through 6 will not be considered the qualification procedure has still to be applied, e.g. by fracture mechanics calculations and material testing of the respective structure to verify the material assumptions. The details of the qualification procedure need to be agreed in advance. Further information is available upon request from GL.

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