ENERGY

Certification and Shop Approval for Repair Work on Rotor Blades

DNV GL Renewables Certification

Markus Selinka

10 November 2016

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SAFER, SMARTER, GREENER

AGENDA

01 New standard and new service specification

02 Certification of repairs during manufacturing

03 Shop approval for repair service provider

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DNV GL Renewables Certification – Rotor Blades

- 12 rotor blade experts in Hamburg, Copenhagen & Shanghai
- Intercultural & interdisciplinary
- Worked on standard since mid of 2014
- Broad experience in standardization work (e.g. from IEC committees)

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Our new standard DNVGL-ST-0376

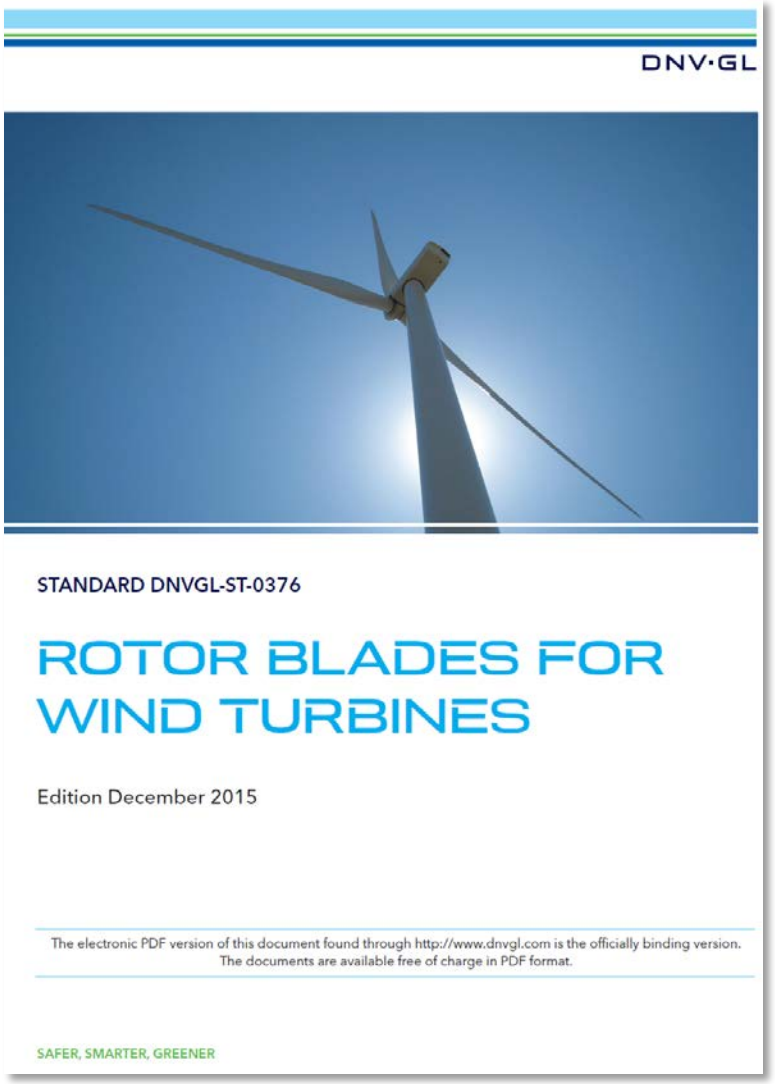
- Content:

  Preamble

  1 Introduction
  2 Design
  3 Materials
  4 Full scale blade testing
  5 Manufacturing
  6 Transport and installation **NEW**
  7 In-service inspections and maintenance **NEW**
  8 Repair of manufacturing non-conformities **NEW**
  9 Repair of in-service damages **NEW**

  Annexes

- Overall objective:
  - based on continuous feed-back from the industry
  - create a more comprehensive, yet **more flexible** standard
  - improve product **quality and reliability** in operation
  - reduce overall cost of energy



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Our new service specification DNVGL-SE-0436

DNV·GL

SERVICE SPECIFICATION

DNVGL-SE-0436

Edition March 2016

Shop approval in renewable energy

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The documents are available free of charge in PDF format.

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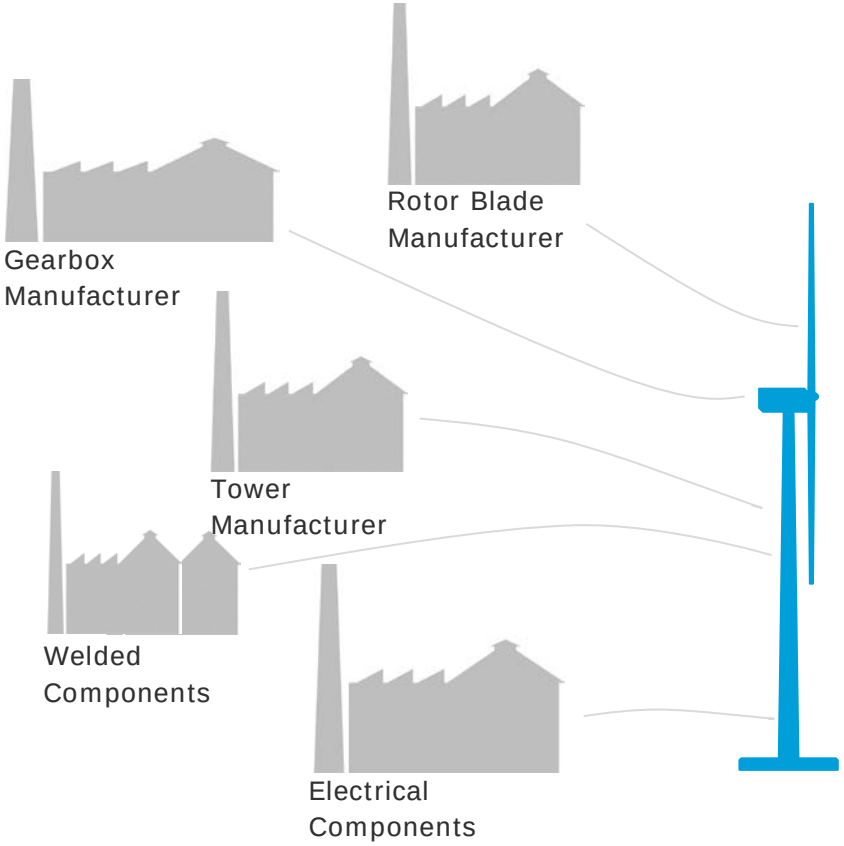

service specification: DNVGL-SE-0436

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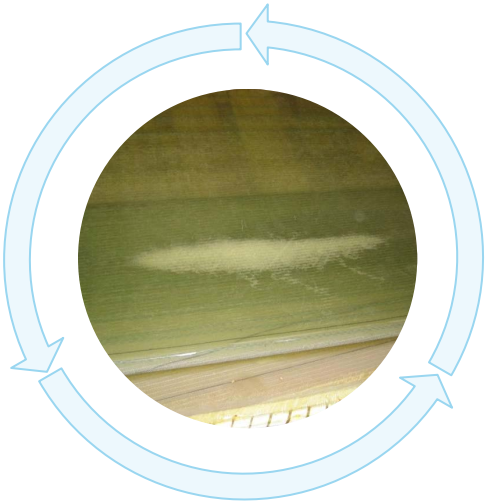
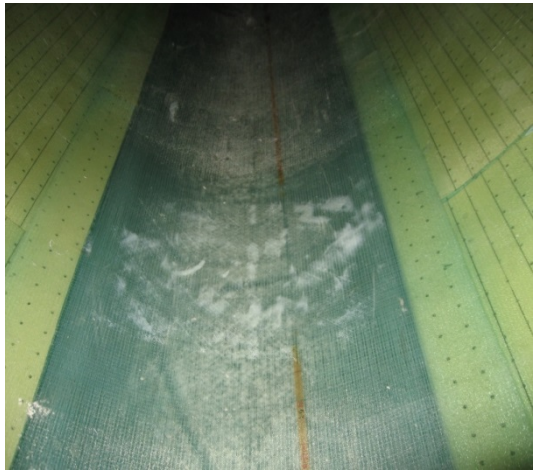
Certification of repairs during manufacturing





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8.2.2 Materials 80

8.2.3 Design 80

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8.2.5 Testing 81

8.3 Execution of the repair 82

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Certification of repairs during manufacturing

- → the approach of generic standard repairs can be embedded in various certification modules

(3) Depending on the context, the requirements stated in this section 8 may become applicable as basis for certification, e.g. in the following cases:

— if standard repairs are part of a design evaluation, as per section [2.4.4]
— if repairs are part of a blade test evaluation, as per section [4.2.3]
— if repairs are part of a manufacturing evaluation, as per Sec.5
— for project certification.

Guidance note:
Typically, these requirements may be applied as basis for certification of repairs of manufacturing non-conformities carried out by the OEM during or after manufacturing; or as a basis for certification of standard repair measures specified by the OEM.

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Certification of repairs during manufacturing

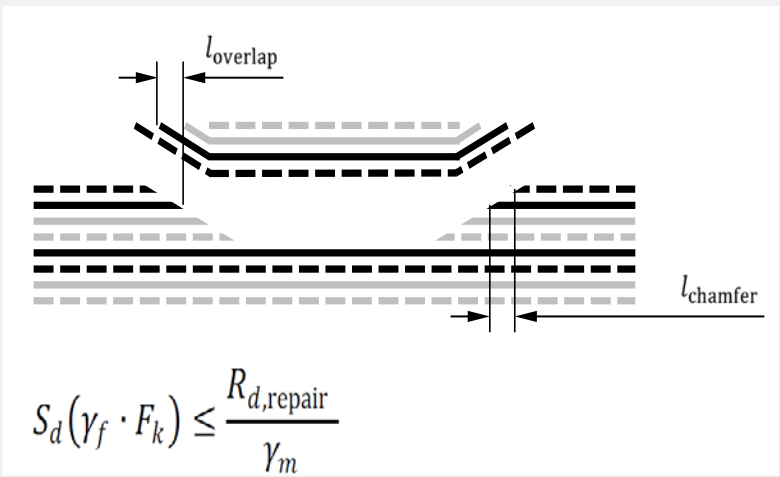
- DNVGL-ST-0376 contains requirements for:
  - repair specification (documentation)
  - repair materials
  - design of the repair
  - verification calculations
  - testing

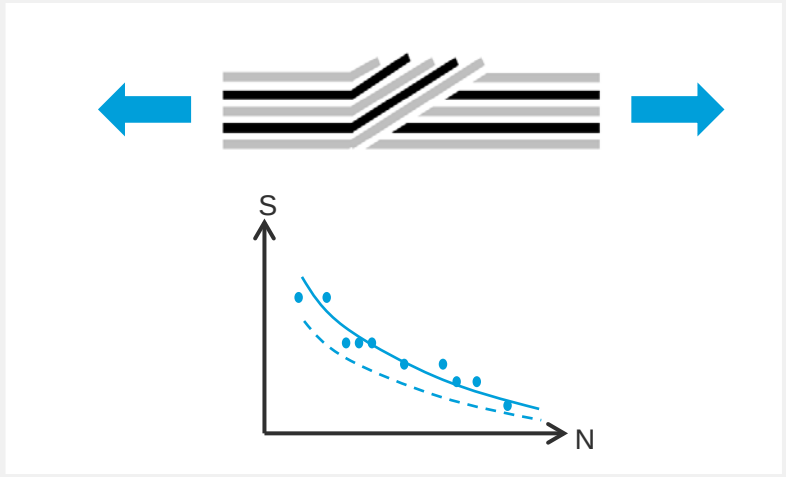
WORK INSTRUCTION

Repair Specification

MATERIALS

Repair Material Specification





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Certification of repairs during manufacturing

- Guidance for generic repair specification
  - Type of damage to be repaired
  - Repair process (incl. parameters)
  - Materials
- Verification of repair solutions
  - Based on test results
  - Application of partial reduction factors

AGENDA

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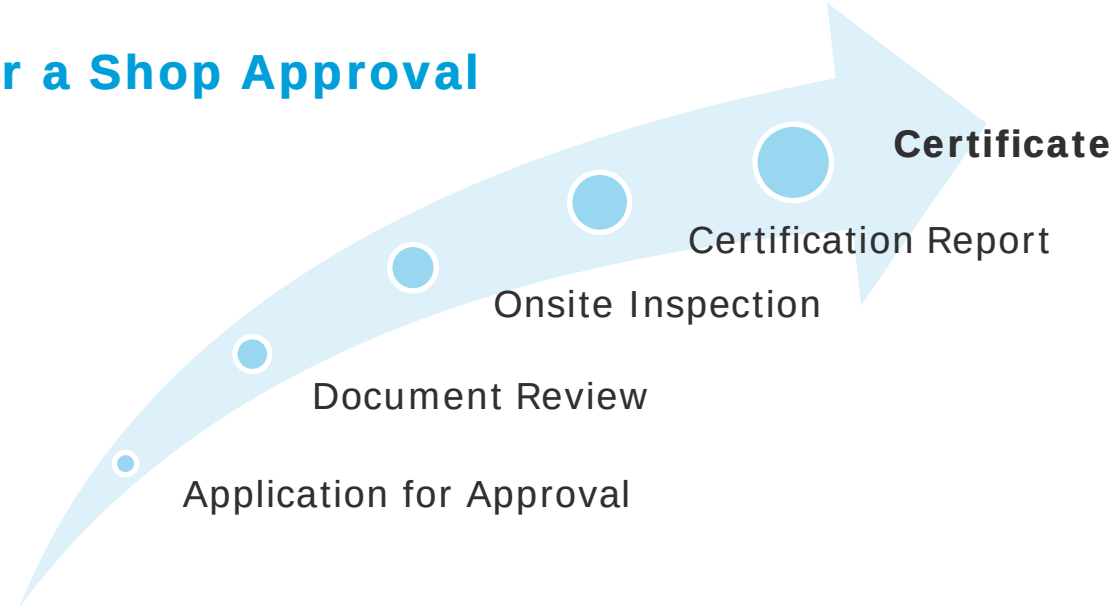
Shop approval for repair service provider

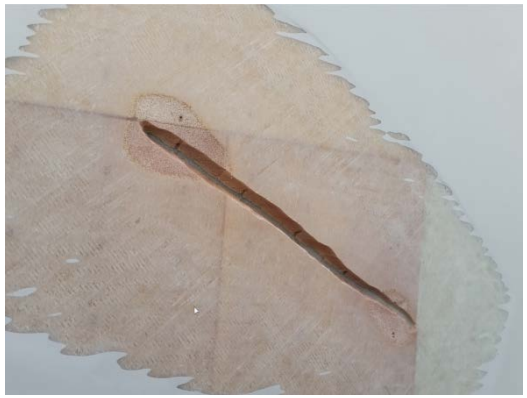
Process for a Shop Approval



[Detailed certification process]

- Shop Approval - Tower and Monopile
- Shop Approval - Gearbox
- Shop Approval - Welded Components
- Shop Approval – Electrical Components
- **Shop Approval – Rotor Blades**
- Shop Approval – Cast Components
- Shop Approval – Main Bearings
- Shop Approval – Main Shaft

Shop approval for repair service provider



Example of a repair

Shop approval for repair service provider

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9.3.5 Documentation 88

Shop Approval

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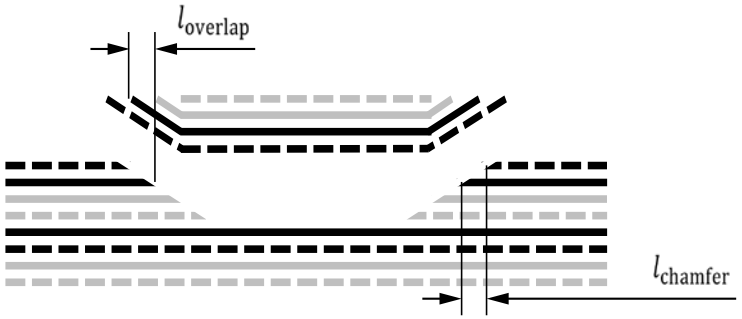
Shop approval for repair service provider

9.2.3 Simplified design verification

(1) If no standard repair is specified (e.g. by the OEM) according to section [8.2], the approach described in this section [9.2.3] may be applied for laminates and sandwich constructions. In this case, no further verification or testing is required.

(2) The minimum chamfer length in the longitudinal direction shall be determined according to the following equation:

$$l_{\text{chamfer}} = \frac{\sigma_{11,\text{t,repair}}}{\tau_{\text{inferface}}} \cdot t_{\text{ply,repair}} \cdot \gamma_{\text{process}} \cdot \gamma_{\text{env}}$$



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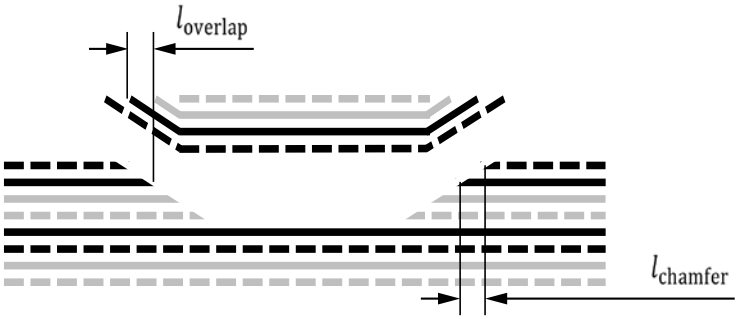
9.2.4 Repair design by minimum chamfer ratios

As an alternative to section [9.2.3], the following chamfering slopes may be applied for glass fibre laminates, provided that the repair material has a fibre area weight not exceeding 1000g/m²:

- 1:100 for UD materials
- 1:50 for biaxial materials



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Shop approval for repair service provider

Evaluation of repair service providers:

- staff qualification
- repair materials
- processing capabilities
- equipment
- repair execution
- quality management
- reporting
- Safe execution of repair

→ **Shop Approval**

- Higher durability of repaired structure

→ improved quality and reliability of the rotor blade in operation

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Shop approval for repair service provider

Minimizing…

-Delays
-Costs
-Efforts
-Risks

Maximizing…

-Marketing potential
-Improving processes and products

Increased confidence of the wind turbine manufacturer, investors, insurers, banks, operators and authorities **in your product and service**

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Thank you for your attention!

Markus Selinka
markus.selinka@dnvgl.com
+49 40 36149 7920

www.dnvgl.com

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