2 Guideline for the Certification of Offshore Wind Turbines

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3.4.5 Adhesive bonding

3.4.5.1 Adhesive joints

(1) Adhesive joints for load-bearing parts shall generally be verified by tests to be agreed on for each individual case, unless comparable experience is available.

Note:

Particularly in the case of highly thixotropic adhesives, prior proof of their suitability shall be given with due consideration of the production process.

(2) A specification for production and testing shall be compiled for the adhesive joints of load-bearing structures. In particular, the nominal values and tolerances of adhesive-layer thicknesses as well as the maximum size and extent of permissible flaws shall be defined. The adhesive layer thicknesses, tolerances and the maximum size and extent of permissible flaws shall be considered during the computational verification of the adhesive joint (see Section 5.5.6).

(3) Only adhesives with confirmed properties may be used for bonding. If adhesives are used for structural bonding and these components are part of a project certification, the adhesive shall have GL approval in addition. The adhesives may not have any negative effects on the materials to be joined.

(4) The possibility of contact corrosion (bond-line corrosion) shall be countered by suitable means.

(5) If FRP components are to be bonded and a resin system differing from the laminating system is used, the components shall be totally cured before bonding.

3.4.5.2 Assembly process

(1) The various surface pretreatments for synthetic materials and metals are for example compiled in VDI 2229 and VDI 3821.

(2) The surfaces of the materials to be bonded together shall be dry and free of release agents (wax, grease, oil etc.), impurities (dust, rust etc.) and solvents. Especially when using solvents for cleaning purposes, compatibility with the material and sufficient ventilation time shall be ensured.

(3) Smooth surfaces shall be roughened either mechanically (rough-grinding, sand-blasting etc.) or chemically by etching. It is absolutely necessary that layers on the surface of the materials to be bonded that exert a negative effect on the bonding process (e.g. skin-forming additives in polyester resins or residues of peel ply in the case of FRP, or oxide layers in the case of aluminium) be removed.

(4) In many cases, an increase in the strength of the bonded connection can be achieved by the use of specially matched primers. The use of primers is particularly recommended for bonded joints which later in service are relatively heavily stressed by environmental influences.

(5) The adhesive shall be processed in accordance with the manufacturer's instructions; the proportion of fillers may not exceed the permitted limit. When mixing the adhesive, its constituents shall be mixed in such a way that they are evenly distributed, care being taken to beat in as little air as possible.

(6) The adhesive shall be applied evenly and as bubble-free as possible to the materials to be joined. If highly thixotropic adhesives are used, it is advisable to apply a thin undercoat of the corresponding pure resin to the surfaces to be joined.

(7) Following application of the adhesive, the materials to be joined shall be brought together without delay and fixed in place.

(8) A loading of the adhesive joint before the adhesive has cured sufficiently is inadmissible (see Section 3.4.4.6, para 1). For all adhesive joints with thermosetting adhesives, subsequent tempering of the joint is recommended; in the case of cold-curing adhesives, tempering is necessary as a rule.

(9) After curing, the adhesive joint shall be protected by suitable means against penetration by extraneous media (e.g. moisture).

3.4.6 Manufacturing surveillance for FRP

3.4.6.1 General

(1) The following sections apply for the production surveillance of FRP components by GL Wind, as is the case in project certification for example.

(2) Manufacturing surveillance of FRP components comprises quality control of the raw material, surveillance during production, and checking the quality of the completed components.

(3) A distinction is made in manufacturing surveillance between internal and external surveillance. External surveillance in the sense of this Guideline means regular random-sampling checks of the internal sur-

veillance and of the component quality by GL Wind or a body recognized by GL Wind.

(4) GL Wind reserves the right to make unannounced inspections of the works. The manufacturer shall allow the representative of GL Wind access to all spaces serving the purposes of manufacture, storage and testing and shall permit him to examine the available production and testing documentation.

(5) In the case of companies manufacturing components in series with a certified quality management system, external surveillance is usually limited to routine checks at set intervals to be prescribed (audits).

(6) For companies which have production and witnessing documentation assessed by GL Wind that exceeds the requirements as per Section 3.4.6.1, para 5, and have concluded an agreement with GL Wind on the reporting of production changes, production deviations and claims, a works expert can be appointed and notified by GL Wind to be responsible towards GL Wind for the surveillance during production.

3.4.6.2 Incoming inspection

(1) The characteristic values and properties of the materials shall be verified by the manufacturer by means of inspection documents. The following inspection documents according to EN 10204 (ISO 10474) are required as a minimum:

EN 10204-2.2 Fibre products, gelcoat resins, paints

EN 10204-3.1 Laminating resins, prepregs, core materials, adhesives

(2) During the incoming inspection, the goods shall at least be checked for any damage and for compliance of the details in the certificates with the requirements. Material values should be checked by random sampling.

(3) The goods shall be stored in accordance with the requirements of the manufacturer and this Guideline.

3.4.6.3 Production surveillance

(1) Details of the production process shall be laid down by specifications which also contain specimen documents for production and testing of the components. The tasks and responsibility of the production and quality control departments shall be defined clearly.

(2) As the work progresses, the individual production steps shall be signed by the employees responsible for each stage on the basis of the prescribed documentation.

(3) The individuals entrusted with production shall be trained in accordance with their task, and shall work under professionally qualified supervision. In the case of adhesive joints, the responsible supervisors shall have an appropriate qualification in adhesives, and the individuals performing the work shall have undergone suitable training.

Note:

Training as adhesive bonding worker / adhesive bonding specialist according to DVS / EWF 3305 is desirable

(4) The batch numbers of the materials used in the component shall be given in the production documentation, in order that they can be traced back to the manufacturer if need be. Reinforcing layers introduced into the laminate shall be checked off immediately during the production process, with indication of the fibre direction.

(5) From every batch of reaction resin compound, a sample shall be taken and tested. If mixing is performed continuously, one sample per batch and production step is sufficient. These samples shall be randomly checked for their degree of curing. The results shall be recorded.

(6) On request by GL Wind, reference laminates of about 50 x 50 cm shall be produced in parallel. This shall result in confirmation of the material values used as a basis for the strength calculations.