



IECRE OPERATIONAL DOCUMENT

IEC System for Certification to Standards relating to Equipment for use in Renewable Energy applications (IECRE System)

Conformity assessment and certification of Blade by RECB





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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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1. Introduction and objectives

The objective is the definition of the evaluation method and procedure applied for Conformity assessment and certification of rotor blade by RECB's.

2. Norms and standards

The following referenced documents are indispensable for the application of this document.

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61400-1, Wind turbines – Part 1: Design requirements

IEC 61400-2, Wind turbines – Part 2: Design requirements for small wind turbines

IEC 61400-3: Wind turbines – Part 3: Design requirements for offshore wind turbines

IEC 61400-5 (under development): Wind turbines – Part 5: Wind turbine blades
Note: As long as IEC 61400-5 is under development, the assessment requirements shall be agreed within the design basis evaluation. Until 61400-5 is available, recognized technical standard for design requirements can be applied.

IEC 61400-23: Wind turbines – Part 23: Full-scale structural testing of rotor blades

IEC 61400-24: Wind turbines – Part 24: Lightning protection

3. Required documentation

The following documentation shall be provided for the design evaluation as applicable:

- Design basis
- Material properties (including material test reports)
- Blade specifications (including mass and stiffness distribution, natural frequencies, blade root geometry, blade mass and centre of gravity)
- Load report
- Verification reports
- Finite Element model
- Blade drawings
- Blade section geometry
- Aerodynamic data (calculated or measured lift, drag and moment characteristics)
- Lightning protection system according to IEC 61400-24
- Manufacturing description and specification (optional)
- Preliminary blade transportation, installation and O&M manuals
- QM certificates for the design process

The following documentation shall be provided for the blade test evaluation:

- Test specification including test loads

- Test reports
- Test assessment report
- Calibration sheets if not included in the test report
- Raw test data (on request)
- Manufacturing documentation for the test blade

4. Evaluation methods and procedures

4.1 Introduction

According to the IECRE certification scheme, a rotor blade can be the object of a part within a type certification or component certification. The purpose of blade certification is to confirm that the blade of a specific type is designed, documented, tested, manufactured and maintained in conformity with design assumptions, specific standards and other technical requirements.

The evaluation covers the complete rotor blade, including:

- The lightning protection system according to IEC 61400-24
- The blade-side of the blade root connection such as inserts and bolts
- Aerodynamic accessories e.g. vortex generators, dino-tails, serrations, winglets

The following points are not covered by this OD and shall be assessed within the Type Certification for the specific wind turbine:

- the load envelope
- the connection between the blade bearing and the wind turbine hub
- the tower clearance
- compatibility with the lightning protection system for the wind turbine
- verification of aerodynamic properties through load measurements

4.2 Design Basis Evaluation

The certification body shall assess the design basis which shall identify all requirements, assumptions and methodologies essential for the design and the design documentation, including:

- Codes and standards;
- Normal and extreme environmental conditions;
- Design parameters, assumptions, methodologies and principles, and
- Other requirements, e.g. for manufacture, transportation, installation and commissioning as well as for operation and maintenance.

4.3 Design Evaluation

The purpose of design evaluation is to examine whether the blade is designed and documented in conformity with the design assumptions, specific standards and other technical requirements. The evaluation of design shall be carried out by means of document review and independent analyses.

The certification body shall verify the following aspects:

- Material properties

The properties of the material used in the rotor blade design shall be proven by material testing to be consistent with the properties applied in the design calculations. All material tests shall be in general carried out by accredited test laboratories according to IEC/ISO 17025 and shall comply with the requirements of the relevant test standards. Deviating procedures shall be agreed with the RECB in advance.

- Blade structure

- Blade characteristics (aerodynamic and mechanical)

It shall be assessed that the characteristic data of the rotor blade given in the specification and related documents are consistent with the design documentation in order to ensure that the subsequent usage of these data is sufficiently verified.

- Mechanical data: It shall be assessed that the blade characteristic mechanical data (e.g. mass and stiffness distribution) given in the blade specification are consistent with the properties resulting from the drawings under consideration of the material properties and tolerances. A consistency check of the dominant natural frequencies may be carried out in the design evaluation, but shall be subject to recheck in the final evaluation stage.
- Aerodynamic data: It shall be assessed that the aerodynamic data of the rotor blade intended for use within the load calculation of a wind turbine are sufficiently demonstrated e.g. through data established for NACA profiles or wind tunnel test in case of non-standard profiles. The data should be adjusted for 3D effects and considering the blade surface roughness during normal operation (dirt, wear, etc.).

- Blade modelling

The structural calculation model used by the designer for the verification of the rotor blade strength shall be assessed by the RECB for suitability by reviewing the design calculation report. For e.g. the application of finite element method the mesh and the used FE technologies (e.g. element type, boundary conditions et cetera) shall be checked.

- Evaluation of blade strength calculations

The blade strength calculations provided by the designer shall be evaluated by the RECB through documentation review supported by the results from RECB's independent strength calculations in regard to:

- Ultimate strength analysis

In addition to operational loads also transport and installation loads shall be considered in the strength calculations.

- Fatigue failure analysis

The independent fatigue strength calculation shall among others properly consider the mean stress effects

- Inter-fibre failure analysis
- Stability analysis

At a certain load compressed structures will start to buckle. Buckling may occur on large scale where the complete shell panel buckles or on a small scale where only the surface shell of a sandwich panel buckles (wrinkling). The buckling of all blade panels including the trailing edge shall be avoided with the required safety or the buckled condition shall be considered in the strength analysis if allowed by the applied and agreed design standard.

Sometimes the buckling is verified by pure analytical procedures on the basis of diagrams or analytical formulas obtained for curved orthotropic structures. In this case and if allowed by the applied and agreed design standard, the certification body shall assess that the analytical procedures are based on representative experiments and that they result in a design with the required safety.

In addition to buckling of blade shell panels, the column buckling of the trailing edge shall be analysed.

- Bonding joint strength analysis

The bonding strength shall be assessed with regard to ultimate and fatigue loads considering manufacturing methods and resulting tolerances.

- Eigenfrequency analysis

The natural frequencies are often used as a simplified measure for the stiffness of the blade structure. It is used to compare the blade data during testing or load verification with the design documentation of the blade. The natural frequencies of the blade shall be assessed based on the model used for structural verification and checked for compliance with the blade specification

- Analysis of the blade root section

The blade root shall be assessed based on documentation review, normally supported by testing.

- Lightning protection

The lightning protection shall be assessed according to IEC 61400-24.

- Testing procedures

Full scale structural testing shall consider the design critical locations of a rotor blade. The test specification shall be assessed during the design evaluation to make sure that a sufficient load level is applied and design critical modes are sufficiently tested. The full-scale structural testing shall be performed according to IEC 61400-23 and, if required, for lightning protection according to IEC 61400-24.

- Manufacturing procedures

During the design evaluation the manufacturing procedures shall be assessed for suitability to reach the quality and material strength assumed during the design verification.

Repair procedures normally applied in the blade manufacturing shall be evaluated based on the applied and agreed design standard.

- Transportation, installation and maintenance procedures

The manuals shall be reviewed for compliance with the requirements in the design basis e.g. transport requirements and blade inspection and repair procedures.

4.4 Independent analyses

When necessary, blade design assessment may be realized through a finite element model including pre-processing and post-processing for composite. The extent of independent analyses is of the responsibility of the certification body.

4.5 Manufacturing evaluation

The blade manufacturing evaluation shall be carried out as specified in OD 501.

The manufacturing procedure shall be documented in suitable specifications and work instructions. The documentation shall be assessed for suitability for the production of the rotor blade under consideration.

4.6 Type test evaluation

The purpose of blade tests is to verify blade structural design and to verify the suitability of manufacturing processes. The evaluation of type testing will be carried out by means of document review, inspection and witnessing.

Fatigue tests as well as static tests are required and shall be done according to IEC 61400-23.

The certification body shall review the final type test plan based on the design evaluation documents.

The certification body may inspect the test blade before as well as after the tests in order to confirm the manufacturer's judgment in case of observed damage or other observations/deviations.

Test blades shall be representative for the blade design subject to design evaluation. Hence, the manufacturing documentation of the test blade shall be compared with the design documentation for the blade.

Deviations will be subject to approval of certification body. New tests shall be required for significant changes in blade design including modifications to the blade structure. Significant changes also include modifications to the structural system, including the internal stiffening arrangement.

The certification body shall ensure that the test laboratory is approved for IEC RE testing, RETL laboratory or OEM approved laboratory according to OD xxx.

This test report will be evaluated by the certification body to ensure that the tests have been carried out in accordance with the detailed test plan and that the test report properly documents the aspects required for evaluation.

5. Reporting

The evaluation report shall cover the following:

1. Introduction
2. Scope of evaluation
 - 2.1. Blade characteristics/description
 - 2.2. Purpose/scope of the evaluation
 - 2.3. Reference standards

3. Documentation
 - 3.1 Reports
 - 3.2 Specifications
 - 3.3 Drawings
 - 3.4 Documentation for information only
4. Evaluation
 - 4.1. Methodology
 - 4.2. Evaluation results
 - 4.3. Remarks
6. Conditions and Interfaces
7. Conclusion (including possible outstanding issues)

The reporting template in OD-550-x shall be used for the reporting from the blade evaluation. Any non-resolved deviations to the procedures and standards shall be highlighted in the conclusion of this report. For further requirements to reporting and handling of non-conformities, see the draft Rules of Procedures document WE-OMC/007/DC 2015-03-2.

**INTERNATIONAL
ELECTROTECHNICAL
COMMISSION**

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
info@iec.ch
www.iec.ch

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3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
secretariat@iecre.org
www.iecre.org