Certificate No.

IECRE.WE.TC.19.0057-R0

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

This certificate is issued to	Vestas Wind Systems A/S Hedeager 42 8200 Aarhus N Denmark
for the wind turbine	Vestas V136-4.0 MW / V136-4.2 MW
wind turbine class (class, standard, year)	WT class IIB, IEC 61400-1: 2005+Amd1: 2010 (V136-4.0 MW) WT class S, IEC 61400-1: 2005+Amd1: 2010 (V136-4.2 MW)

This certificate attests compliance with IEC 61400 Series as specified in subsequent pages . It is based on the following reference documents:

Design basis evaluation conformity statement Dated	DB-DNVGL-SE-0074-04978-0 2019-11-08
Design evaluation conformity statement Dated	DE-DNVGL-SE-0074-04979-1 2019-11-08
Type test conformity statement Dated	TT-B-DNVGL-SE-0074-04980-0 2019-11-08
Manufacturing conformity statement Dated	ME-B-DNVGL-SE-0074-05446-0 2019-11-08
Final evaluation report Dated	FER-TC-B-DNVGL-SE-0074-04977-0 2019-11-08

The conformity evaluation was carried out in accordance with the rules and procedures of the IECRE System www.iecre.org

The wind turbine type specification begins on page 2 of this certificate.

The outstanding issues are listed in Annex 2 of this certificate.

Changes in the system design or the manufacturer's quality system are to be approved by DNV GL. Without approval, the certificate loses its validity.

This certificate is valid until:
2020-11-07

Approved for issue on behalf of the IECRE Certification Body:

Nils Kreidelmeyer / Bente Vestergaard
Senior Project Manager / Service Line Leader, Type Certification
Hamburg 2019-11-08

DNV·GL

Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany

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Machine parameters:

Power regulation:	pitch-controlled
Rotor orientation:	Upwind
Number of rotor blades:	3
Rotor tilt:	6.0°
Cone angle:	4.0°
Rated power:	4000 kW / 4200 kW
Rated wind speed Vr:	10.7 m/s (V136-4.0 MW)
	11.0 m/s (V136-4.2 MW)
Rotor diameter:	136 m
Hub height(s):	112 m
Hub height operating wind speed range V_{in} – V_{out}:	3.0 – 27.0 m/s (HWO disabled)
	3.0 – 32.0 m/s (HWO enabled)
Design life time:	20 years
Software version:	2017.09.126

Wind conditions:

Characteristic turbulence intensity I_{ref} at V_{hub} = 15 m/s:	0.14
Annual average wind speed at hub height V_{ave} :	8.5 m/s (V136-4.0 MW)
	8.0 m/s (V136-4.2 MW)
Reference wind speed V_{ref} :	42.5 m/s
Mean flow inclination:	8°

Electrical network conditions:

Normal supply voltage and range:	720 V
	19.1-36 kV ± 10 %
Normal supply frequency and range:	50 or 60 Hz ± 6 % Hz
Voltage imbalance:	IEC 61000-3-6 TR max 2 %
Maximum duration of electrical power network outages:	Two 3 months periods
Number of electrical network outages	Max 52 per year

Other environmental conditions (where taken into account):

Normal and extreme temperature ranges: *de-rating strategy above +30°C for V136-4.0 MW *de-rating strategy above +20°C for V136-4.2 MW	Normal: -20°C to +40°C* Extreme: -20°C to +50°C
Relative humidity of the air:	100% (max 40% of time) and 90% (rest of life time)
Air density:	1.225 kg/m^3 (for normal operation) 1.273 kg/m^3 (for low temperature operation)
Solar radiation:	1000 W/m^2
Lightning protection system (standard and protection class):	Designed acc. to IEC 61400-24, Protection Level 1 and IEC 61312-1

Major components:

**If not otherwise stated, the certificate holder is the manufacturer.

Blade:

Type:	Hybrid/Infused
Material:	Hybrid: Glass fibre pre-preg / dry glass "hybrid" and pvc core with Carbon and T pultrusions Infused: dry glass together with Carbon and T pultrusions
Blade length:	66.65 m
Number of blades:	3
Manufacturer:	Vestas
Drawing / Data sheet / Part No.:	V136 blade: 0055-0068, Rev. 6 Aero add-ons: 0059-6671, Rev. 0 - V136 STE kit 0056-5767, Rev. 1 - V136 Vortex Generator Assembly

Blade bearing:

Type:	Double row four-point contact ball bearing
Manufacturer:	Laulagun/Rollix/Liebherr/TMB
Drawing / Data sheet / Part No.:	29058368, Rev.1

Pitch System:

Type:	Hydraulic power unit
Manufacturer:	LJM/Glual/Hine/Liebherr
Hydraulic Cylinder (140/90x922):	29060554, Rev. 2

Type	Pitch Actuation Module
Manufacturer	Vestas Wind Systems A/S
Drawing / Data sheet / Part no.	29113714, Rev.1

Main shaft:

Type:	Cast iron
Material:	EN-GJS-500-14
Drawing / Data sheet / Part no.:	29085300, Rev. 4

Main bearing:

Type:	Spherical Roller Bearing
Manufacturer:	SKF/FAG
Drawing / Data sheet / Part no.:	SKF - 240/950 CA/C3LW 33VQ113 FAG - F-582562.PRL-WPO

Gearbox:

Type:	2 stage planetary and helical stage gearbox
Manufacturer:	ZF (EH1052A)
Gear ratio:	1:137
Drawing / Data sheet / Part no.:	096-EH1052A001, Rev. A

Type:	2 stage planetary and helical stage gearbox
Manufacturer:	Winergy (PZAB 3580)
Gear ratio:	1:142.76
Drawing / Data sheet / Part no.:	A5E45622888A, rev.2

Yaw System:

Drive type:	8 x 2.7 kW, 400 V, 50 Hz asynchronous motors
Drive manufacturer:	Lafert
Drawing / Data sheet / Part no.:	MZ10/A4A-55337

Drive type:	8 x 3.2 kW, 400 V, 60 Hz asynchronous motors
Drive manufacturer:	Lafert
Drawing / Data sheet / Part no.:	MZ10/A4A-55338

Drive type:	8 x 2.7 kW, 400 V, 50 Hz asynchronous motors

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Drive manufacturer:	ABB
Drawing / Data sheet / Part no.:	3GZF500810-23 A 14 AA 100 A
Drive type:	8 x 3.2 kW, 400 V, 60 Hz asynchronous motors
Drive manufacturer:	ABB
Drawing / Data sheet / Part no.:	3GZF500810-23 A 14 AA 100 A
Drive type:	8 x 2.7 kW, 400 V, 50 Hz asynchronous motors
Drive manufacturer:	Bonfiglioli
Drawing / Data sheet / Part no.:	CD00006614-02
Drive type:	8 x 3.2 kW, 400 V, 60 Hz asynchronous motors
Drive manufacturer:	Bonfiglioli
Drawing / Data sheet / Part no.:	CD00007013-01
Gear type:	Bevel stage and three planetary stages, i = 952.3
Gear manufacturer:	Bonfiglioli
Drawing / Data sheet / Part no.:	I7090T010300
Gear type:	Bevel stage and three planetary stages, i = 935
Gear manufacturer:	Comer
Drawing / Data sheet / Part no.:	N07297_01
Bearing type:	Preloaded sliding bearing, PETP pads
Bearing manufacturer:	Vestas Wind Systems A/S
Drawing / Data sheet / Part no.:	29104726, Rev. 0

Generator:

Type:	DASG 560/6M, Induction generator
Manufacturer:	Vestas Nacelles Deutschland (VND)
Rated power:	4450 kW

Rated frequency:	74 Hz
Rated speed:	1485 rpm
Rated voltage:	800 V
Rated current:	3650 A
Insulation class:	H
Degree of protection:	IP54

Converter:

Type:	Full quadrant IGBT
Manufacturer:	Vestas Wind Systems A/S
Rated voltage machine/grid:	720 Vrms / 800 Vrms
Rated current:	3200 A
Degree of protection:	IP54
Drawing / Data sheet / Part no.:	0069-2805, Rev. 0

Transformer:

Type:	Cast-Resin transformer 4GY6781-1EY
Manufacturer:	Siemens
Rated voltage:	33 / 0.72 V
Degree of protection:	IP00
Drawing / Data sheet / Part no.:	0073-7914, Rev. 0

Type:	Cast-Resin transformer DTTH1N 4000/30
Manufacturer:	SGB
Rated voltage:	33 / 0.72 V
Degree of protection:	IP00
Drawing / Data sheet / Part no.:	0073-7915, Rev. 0

Tower:

Type:	Conical steel
Number of sections:	5
Length:	109.60 m (HH 112 m)

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Drawing / Data sheet / Part no.:	0072-0565 Rev. 0

Manuals:

O&M manual:	0040-6996, Rev. 14
Transport manual:	0040-6996, Rev. 14
Installation / Commissioning manual:	0040-6996, Rev. 14

Annex 2

Outstanding issues:

The following outstanding issues should be resolved for Type Certification:

- Full scale fatigue test for the V136 blade (hybrid/infused) shall be completed to achieve the final Type Certificate
- The robustness test, disassembly of the gearbox after robustness test and gear box field test for PZAB 3580 gear box are pending for the Type Certification.
- Potential issues from specific resonances found during calculation of the drive train dynamics analysis needs to be confirmed during type testing to not being critical to the turbine.
- The Manufacturing Evaluation for the components listed in section 7.5.3 of IECRE OD-501, ed. 2 is pending for Type Certification except for the following components:
    - V136 blade (Hybrid)
    - V136 blade (Infused)
    - Tower
    - ZF Gearbox
    - Hub & Nacelle Assembly
- Final set of manuals for Vestas V136-4.0 MW / V136-4.2 MW wind turbine shall be submitted by Vestas and approved by DNV GL for Type Certification.