



Certificate No.

IECRE.WE.TC.19.0020-R0

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

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 V117-3.45 MW / V117-3.60 MW
Vestas V117-3.3 MW / V117-3.45 MW (BWC)

wind turbine class (class, standard, year)

IEC S (specified in Annex 1), IEC 61400-1 incl. Amd.1, 2010

This certificate is transferred from IEC 61400-22 to IECRE and 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-0074-00821-3
2018-12-19

Design evaluation conformity statement
Dated

DE-DNVGL-SE-0074-00822-3
2018-12-19

Type test conformity statement
Dated

TT-DNVGL-SE-0074-00823-3
2018-12-19

Manufacturing conformity statement
Dated

ME-DNVGL-SE-0074-00824-3
2018-12-19

Type characteristics conformity statement
Dated

TCM-DNVGL-SE-0074-00826-3
2018-12-19

Final evaluation report
Dated

FER-TC-DNVGL-SE-0074-00820-4
2018-12-19

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.

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

This certificate is valid until:
2022-02-27

Approved for issue on behalf of the IECRE
Certification Body:



Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany

Ramakrishna Parasarampuram /
Christer Eriksson
Project Manager / Service Line Leader,
Type Certification
Hamburg 2019-01-31



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Machine parameters:

| | |
|--|------------------|
| Power regulation: | pitch-controlled |
| Rotor orientation: | upwind |
| Number of rotor blades: | 3 |
| Rotor tilt: | 6° |
| Cone angle: | 4° |
| Rated power: | See Annex 1 |
| Rated wind speed V_r : | See Annex 1 |
| Rotor diameter: | 117 m |
| Hub height(s): | See Annex 1 |
| Hub height operating wind speed range $V_{in} - V_{out}$: | See Annex 1 |
| Design life time: | 20 years |
| Software version: | See Annex 1 |

Wind conditions:

| | |
|--|-------------|
| Characteristic turbulence intensity I_{ref} at $V_{hub} = 15$ m/s: | See Annex 1 |
| Annual average wind speed at hub height V_{ave} : | See Annex.1 |
| Reference wind speed V_{ref} : | See Annex 1 |
| Mean flow inclination: | 8° |

Electrical network conditions:

| | |
|---|------------------------------------|
| Normal supply voltage and range: | 3 x 650 V 10.5-36 kV \pm 10 % |
| Normal supply frequency and range: | 50 or 60 Hz \pm 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 |



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Other environmental conditions (where taken into account):

Standard temperature ranges

Normal: -20 °C to +45 °C*

Extreme: -30 °C to +50 °C

Low temperature range

Normal: -30 °C to +45 °C*

Extreme: -40 °C to +50 °C

*de-rating strategy

See Annex 1

Relative humidity of the air:

100% (max 40% of time) and
90% (rest of life time)

Air density:

To account for low temperature
operation, Vestas has applied
higher air density for the following
load cases: 1.2, 2.1, 3.1, 4.1 and
5.1

Solar radiation:

1000 W/m²

Lightning protection system (standard and protection
class):

Designed acc. to IEC 61400-24,
Protection Level 1 and IEC
61312-1



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Major components:

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

Blade:

| | |
|----------------------------------|---|
| Type: | Airfoil shells bonded to supporting beam |
| Material: | Fibreglass reinforced epoxy, carbon fibres and Solid Metal Tip (SMT) |
| Blade length: | 57.15 m |
| Number of blades: | 3 |
| Manufacturer: | Vestas |
| Drawing / Data sheet / Part No.: | 0037-6856, Rev.0 – V117 Blade 0054-9342, Rev.1 – V117 STE kit 0043-3896, Rev.2 – V117 Root Vortex Generator 0056-7084, Rev.1 – V117 Gurney Flap Assembly |

Blade bearing:

| | |
|----------------------------------|--|
| Type: | Double row four-point contact ball bearing |
| Manufacturer: | LGN/RLX/LBC/TMB |
| Drawing / Data sheet / Part No.: | 29049732, Rev. 3 |

Pitch System:

| | |
|---------------------------------|----------------------|
| Type | Hydraulic power unit |
| Pitch Actuation Module | 29080632, Rev. 0 |
| Hydraulic Cylinder (140/90X922) | 29080628, Rev. 0 |

Main shaft:

| | |
|----------------------------------|-------------------|
| Type: | Cast hollow shaft |
| Material: | EN GJS-500-14 |
| Drawing / Data sheet / Part No.: | 29085300, Rev. 1 |



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| | |
|----------------------------------|--|
| Type: | Cast hollow shaft |
| Material: | EN GJS-400-18U-LT |
| Drawing / Data sheet / Part No.: | 29024367, Rev. 2 |
| Main bearing: | |
| Type: | Double-row 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 Planetary stages and one helical stage |
| Gear Ratio: | 104.9 |
| Manufacturer: | ZF |
| Drawing / Data sheet / Part No.: | EH921A |
| Type: | 2 Planetary stages and one helical stage |
| Gear Ratio: | 104.9 |
| Manufacturer: | Winergy |
| Drawing / Data sheet / Part No.: | PZAB 3530.1 |
| Yaw System: | |
| Drive Type: | Nacelle mounted electrical driven plain bearing with external toothing |
| Yaw bearing type | Friction bearing, permanently pre-tensioned |
| Yaw drive type | Comer PG1903 / Bonfiglioli 709T4R / Liebherr DAT350 |
| Yaw brake type | Electrical disc brake in yaw motors |
| Yaw speed | 0.45 °/s for 50 Hz 0.55 °/s for 60 Hz |



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Generator:

| | |
|------------------------------------|--|
| Type | VND SFIG V2 - DASG 560/6M (Three phase induction generator with squirrel cage rotor) |
| Rated Power: | 3450 kW, 3650 kW, 3800 kW |
| Rated Speed: | 1520 rpm |
| Rated Voltage: | 750 V |
| Rated power factor (VFD) – Cos phi | 0.87 |
| Insulation Class: | H |
| Degree of Protection: | IP54 |

Converter:

| | |
|----------------------------|-----------------------------------|
| Type: | Full-scale converter - cube power |
| Manufacturer: | Vestas |
| Line side voltage level | 650 Vac |
| Machine side voltage level | 750 Vac |
| Nominal apparent power | 4.4 MVA |
| Line side AC Frequency | 50 / 60 Hz |
| DC-Link voltage | 1150 Vdc |

Transformer:

| | |
|-----------------------|----------------------------|
| Type: | Dry-type transformer (ECO) |
| Manufacturer: | SGB |
| Nominal power | 4000 kVA |
| Nominal voltages (HV) | 33 kV |
| Nominal voltage (LV) | 650 V |
| Frequency | 50 Hz |
| Vector group | Dyn5 |
| Environmental Tests | E2 |
| Climatic Tests | C2 |
| Fire class | F1 |



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| | |
|---------------------------------------|--|
| Type | Dry-type transformer 3-Phase GEAFOL – Transformer (ECO) |
| Manufacturer | Siemens |
| Nominal power | 4000 kVA |
| Nominal voltages (HV) | 33 kV / 34.5 kV |
| Nominal voltage (LV) | 650 V |
| Frequency | 50 Hz / 60 Hz |
| Vector group | Dyn5 |
| Environmental Tests | E2 |
| Climatic Tests | C2 |
| Fire class | F1 |
| Tower: | |
| Type: | Tubular steel tower |
| Hub height | See Annex 1 |
| Drawing / Data sheet / Part No.: | See Annex 1 |
| Manuals: | |
| Operation & maintenance manual: | See list of manuals 0006-6955, Rev. 25 |
| Transport manual: | See list of manuals 0040-6996, Rev. 10 |
| Installation & commissioning. manual: | See list of manuals 0040-6996, Rev. 10 |
| Control System | |
| Manufacturer | Vestas |
| Type | Vestas Multi Processor VMP Global – System 8000 |
| Service lift (optional) | |
| Manufacturer | Avanti |
| Type | Avanti Shark or Power Lift Sherpa- SD |



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Crane (optional)

Manufacturer

Star 071/95 Liftket

Maximum lifting capacity

max 800 kg



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Annex 1 - Configurations covered by this Type Certificate

| Variants | IEC WT class** | Power* | Rated wind speed V_r | Operating Wind Speed (vin - vout) including HWO | Mean wind speed V_{ave} | Reference wind speed V_{ref} |
|---------------------------------|----------------------------------|-------------------|------------------------|---|---------------------------|--------------------------------|
| V117-3.3 MW/ V117-3.45 MW (BWC) | S (IEC IIA) / IEC S ¹ | 3.3 MW / 3.45 MW | 11.20 m/s | 3 m/s-25 m/s | 8.5 m/s / 8.2 m/s | 42.5 m/s / 37.5 m/s |
| V117-3.45 MW/ V117-3.60 MW | S (IEC IB) / IEC S ² | 3.45 MW / 3.60 MW | 10.9 m/s / 11.2 m/s | 3 m/s-30 m/s | 10 m/s / 9.5 m/s | 50 m/s |
| | S (IEC IIA) | | 10.9 m/s / 11.2 m/s | | 10 m/s | 42.5 m/s |

Notes:

Power* - see De-rating temperature defined in the table below.

IEC WT class** -

S (IEC IIA) – IEC wind turbine class IIA except for the temperature range.

S (IEC IB) – IEC wind turbine class IB except for the temperature range.

IEC S¹ – The mean wind speed (V_{ave}) is lowered to 8.2 m/s for V117-3.45 MW power mode.

IEC S² – The mean wind speed (V_{ave}) is lowered to 9.5 m/s for V117-3.60 MW power mode.

| Variants | Tower (drawing no.) | Turbulence Intensity I_{ref} | De-rating temperature | Software version |
|---------------------------------|--|--------------------------------|--|----------------------------------|
| V117-3.3 MW/ V117-3.45 MW (BWC) | HH 91.5 m - 0037-6190.R00 HH 91.5 m US - 0038-6862.R00 (Valid for 25 years also) HH 91.5m US - 0041-3059.R00 HH 116.5 m - 0040-6557.R01 (Valid for 25 years also) | 0.16 | *de-rating strategy above +30 °C for V117-3.3MW *de-rating strategy above +25 °C for V117-3.45MW | VMP Global, Build: 2016.07 (BWC) |
| V117-3.45 MW/ V117-3.60 MW | HH 80.0 m - 0055-9824.R00 HH 91.5 m - 0057-6835.R00 HH 116.5 m - 0060-1658.R00 | 0.14 | *de-rating strategy above +30 °C for V117-3.45 MW *de-rating strategy above +20 °C for V117-3.60 MW | VMP Global, Build: 2016.07 |
| | HH 116.5 m - 0058-6486.R00 | 0.16 | | |