



Certificate No.

IECRE.WE.TC.18.0013-R1

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 V110-2 MW 50 Hz VCS Mk 10

wind turbine class (class, standard, year)

WT class S, IEC 61400-1: 2005+Amd1: 2010

This certificate is transferred from IEC 61400-22 to IECRE and attests compliance with IEC 61400 Series as specified in subsequent pages and later renewed according to IECRE OD-501 Ed.2. It is based on the following reference documents:

Design basis evaluation conformity statement
Dated

DB-DNVGL-SE-0074-01323-5
2018-01-26

Design evaluation conformity statement
Dated

DE-B-DNVGL-SE-0074-01324-6
2020-01-16

Type test conformity statement
Dated

TT-B-DNVGL-SE-0074-01325-6
2020-01-16

Manufacturing conformity statement
Dated

ME-B-DNVGL-SE-0074-01326-6
2020-01-16

Type characteristics conformity statement
Dated

TCM-DNVGL-SE-0074-01328-3
2018-01-26

Final evaluation report
Dated

FER-TC-B-DNVGL-SE-0074-01322-6
2020-01-16

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. Outstanding issues are listed in the last page 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:
2021-01-15

Approved for issue on behalf of the IECRE
Certification Body:



Florian Willers Bente Vestergaard

Florian Willers / Bente Vestergaard
Senior Project Manager / Service Line
Leader, Type Certification
Hellerup 2020-01-16

Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Machine parameters:

| | |
|--|---|
| Power regulation: | pitch-controlled |
| Rotor orientation: | upwind |
| Number of rotor blades: | 3 |
| Rotor tilt: | 6° |
| Cone angle: | 3° |
| Rated power: | 2000 / 2100 / 2200 kW (refer to annex 1 for details) |
| 2000 kW: | derating strategy for cooler top 30 at ambient temperature above 35°C |
| 2000 kW: | derating strategy for cooler top 40 at ambient temperature above 40°C |
| 2100 kW, 2200 kW: | derating strategies for ambient temperature above 30°C |
| Rated wind speed V_r : | 9.6m/s (2000 kW) 10 m/s (2100 kW) 10 m/s (2200 kW) |
| Rotor diameter: | 110 m |
| Hub height(s): | 95 m, T2X420 110 m, T2X430, TS192 125 m, T2X431 (refer to annex 1 for details) |
| Hub height operating wind speed range $V_{in} - V_{out}$: | 3 - 20 m/s (2100 and 2200 kW) 3 - 22 m/s (2000 kW) |
| Design life time: | 20 years |
| Software version: | VMP Global 17.06 |

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 |
| Weibul shape factor (k) | See annex 1 |
| Mean flow inclination: | 8° |
| Hub height 50-year extreme wind speed V_{e50} : | See annex 1 |

Electrical network conditions:

| | |
|---|-------------------|
| Normal supply voltage and range: | 10500 V - 35000 V |
| Normal supply frequency and range: | 50 Hz |
| Voltage imbalance: | <3 % |
| Maximum duration of electrical power network outages: | Not dimensioning |



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Number of electrical network outages 50 / year

Other environmental conditions (where taken into account):

Normal and extreme temperature ranges: See annex 1

Relative humidity of the air: 100 % (max 10 % of lifetime)

Air density: See annex 1

Solar radiation: The turbine shall resist solar radiation (including UV) with 1000 W/m² and 8000 MJ/m² per year throughout the design lifetime

Lightning protection system (standard and protection class): IEC 61400-24:2010, Protection Level 1



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Major components:

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

Blade:

Type: 54m Structural shell
Manufacturer: Vestas Wind Systems A/S, TPI China
Material: Glass fibre and carbon fibre reinforced epoxy
Blade length: 54m
Number of blades: 3
Drawing / Data sheet / Part No.: 29061061 or 29083499 (2000 kW)
29061061 (2100 and 2200 kW)

Blade bearing:

Type: 2 row 4-point contact ball bearing
Manufacturer: Rollix
Drawing / Data sheet / Part No.: 13-1920-02-DD0-5

Blade bearing:

Type: 2 row 4-point contact ball bearing
Manufacturer: Liebherr
Drawing / Data sheet / Part No.: 648 VO 802-000

Blade bearing:

Type: 2 row 4-point contact ball bearing
Manufacturer: TMB
Drawing / Data sheet / Part No.: B030.65.1920K

Pitch System:

Motor / Actuator Type: One hydraulic cylinder per blade
Pitch Controller Type: Hydraulic
Manufacturer: LJM



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Pitch System:

Motor / Actuator Type: One hydraulic cylinder per blade
Pitch Controller Type: Hydraulic
Manufacturer: Glual

Pitch System:

Motor / Actuator Type: One hydraulic cylinder per blade
Pitch Controller Type: Hydraulic
Manufacturer: Hine

Main shaft:

Type: Forged hollow trumpet shaft
Material: 42CrMo4
Drawing / Data sheet / Part No.: 29085836

Main bearing:

Type: Two double row spherical roller bearing
Manufacturer: SKF
Drawing / Data sheet / Part No.: 230/630 CA/HM2 W33
24188 ECA/HM2 W33

Main bearing:

Type: Two double row spherical roller bearing
Manufacturer: KOYO
Drawing / Data sheet / Part No.: 230/630 RHAW33T
24188 RHAW33

Main bearing:

Type: Two double row spherical roller bearing
Manufacturer: FAG
Drawing / Data sheet / Part No.: F-582558.PRL-WPO
F-582559.PRL-WPO

Gearbox:

Type: 3 stage planetary gearbox



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Manufacturer: Winergy
Gear Ratio: 1:112.2
Drawing / Data sheet / Part No.: PEAB 4440

Gearbox:

Type: 3 stage planetary gearbox
Manufacturer: ZF
Gear Ratio: 1:112.36
Drawing / Data sheet / Part No.: Atlas 1.2, 1.21

Yaw System:

Drive Type: Electrical motor
Manufacturer: ABB or Lafert
Drawing / Data sheet / Part No.: 29005012*

* Note, verified for use of either 5 or 6 yaw drives

Bearing Type: Friction Bearing (PETP slide plate)
Manufacturer: Vestas Wind System A/S
Drawing / Data sheet / Part No.: 29011239.V01

Gear Type: Planetary-/worm gear combination
Manufacturer: Bonfiglioli, Comer
Drawing / Data sheet / Part No.: 29014048 (left) /29014049 (right)

Brake Type: Friction brake, motor brake included in
the drive unit
Manufacturer: ABB or Lafert
Drawing / Data sheet / Part No.: 29005012

Generator:

Type: DVSG 500/4M SP.
(Asynchronous generator with wound
rotor)
Manufacturer: Vestas Wind System A/S



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

| | |
|----------------------------------|---|
| Rated Power: | 2060 kW or 2260 kW |
| Rated Frequency: | 50 Hz |
| Rated Speed: | 1680 rpm |
| Rated Voltage: | 690 VAC |
| Rated Current: | 1573 A or 1713 A |
| Insulation Class: | H/H |
| Degree of Protection: | IP54 |
| Drawing / Data sheet / Part No.: | 0007-0081.V09 (2060 kW) 0057-1280.V02 (2260kW) |

Converter:

| | |
|-----------------------------|------------------------|
| Type: | Full quadrant IGBT |
| Manufacturer: | Vestas Wind System A/S |
| Rated Voltage (grid side): | 480 V |
| Nominal current (at 2.0 MW) | |
| Grid | 240 A |
| Rotor | 592 A |
| Nominal current (at 2.2 MW) | |
| Grid | 256 A |
| Rotor | 655 A |
| Degree of Protection: | IP 54 |

Transformer:

| | |
|----------------|--|
| Type: | Dry type |
| Manufacturer: | Siemens |
| Rated Voltage: | HV side: 10500-35000 V LV side: 690 V +/-2% & 480 V +/-2% |

Transformer:

| | |
|----------------|--|
| Type: | Dry type |
| Manufacturer: | SGB |
| Rated Voltage: | HV side: 10500-35000 V LV side: 690 V +/-2% & 480 V +/-2% |



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Transformer:

Type: Dry type
Manufacturer: JST
Rated Voltage: HV side: 10500-35000 V
LV side: 690 V +/-2% & 480 V +/-2%

Tower:

Type: Tubular steel
Sections: 4
Hub height: 95 m
Drawing / Data sheet / Part No.: 0063-1772.V0 (T2X420)
(please refer to annex 1 for details)

Tower:

Type: Tubular steel
Sections: 4
Hub height: 110 m
Drawing / Data sheet / Part No.: 0063-1776.V0 (T2X430)
(please refer to annex 1 for details)

Tower:

Type: Tubular steel
Sections: 4
Hub height: 110 m
Drawing / Data sheet / Part No.: 0046-8897.V0 (TS192)
(please refer to annex 1 for details)

Tower:

Type: Tubular steel
Sections: 5
Hub height: 125 m
Drawing / Data sheet / Part No.: 0063-1777.V0 (T2X431)
(please refer to annex 1 for details)

Manuals:

Operation & maintenance manual: See list of manuals
0068-9605.V01



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Transport manual:

See list of manuals
0068-9605.V01

Installation & commissioning manual:

See list of manuals
0068-9605.V01



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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Annex 1 – Configuration matrix

| ID ¹ | Tower | Rated power (kW) | I _{ref} | V _{ave} (m/s) | Weibull (k) | V _{ref} (m/s) | V _{e50} (m/s) | Operating temp. range (°C) | Extreme temp. range (°C) | Air density (kg/m ²) |
|-----------------|--------|------------------|------------------|------------------------|-------------|------------------------|------------------------|----------------------------|--------------------------|----------------------------------|
| 1.1 | T2X420 | 2100 | 0.14 | 7.10 | 2.5 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.18 |
| 1.2 | T2X420 | 2000 | 0.14 | 7.50 | 2.5 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.12 |
| 1.3 | T2X420 | 2200 | 0.14 | 6.50 | 2.5 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.12 |
| 2.1 | T2X430 | 2100 | 0.13 | 7.14 | 2.78 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.092 |
| 2.2 | T2X430 | 2000 | 0.12 | 7.50 | 2.78 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.06 |
| 2.3 | T2X430 | 2100 | 0.12 | 7.00 | 2.78 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.06 |
| 2.4 | T2X430 | 2200 | 0.12 | 6.50 | 2.78 | 37.5 | 52.5 | -10 to +40 | -20 to +50 | 1.06 |
| 3.1 | T2X431 | 2100 | 0.14 | 7.10 | 2.5 | 35.0 | 49.0 | -10 to +40 | -20 to +50 | 1.18 |
| 3.2 | T2X431 | 2000 | 0.11 | 7.50 | 2.5 | 35.0 | 49.0 | -10 to +40 | -20 to +50 | 1.12 |
| 3.3 | T2X431 | 2100 | 0.11 | 7.00 | 2.5 | 35.0 | 49.0 | -10 to +40 | -20 to +50 | 1.12 |
| 3.4 | T2X431 | 2200 | 0.11 | 6.50 | 2.5 | 35.0 | 49.0 | -10 to +40 | -20 to +50 | 1.12 |
| 4.1 | TS192 | 2100 | 0.13 | 7.00 | 2.78 | 35.0 | 49.0 | 5 to +40* | -20 to +50 | 1.092 |
| 4.2 | TS192 | 2000 | 0.13 | 7.14 | 2.78 | 35.0 | 49.0 | 5 to +40* | -20 to +50 | 1.092 |
| 4.3 | TS192 | 2200 | 0.13 | 6.5 | 2.78 | 35.0 | 49.0 | 5 to +40* | -20 to +50 | 1.092 |

* Special temperature Turbine (SpT) intended for climate conditions with temperatures above 5°C. In these conditions the heating fans are found to be redundant and can therefore be removed.

¹ The ID follows the tower with its first digit, the second digit is only consecutive to identify the different configurations within one tower.



Certificate. No.

IECRE.WE.TC.18.0013-R1

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

PROVISIONAL TYPE CERTIFICATE

Wind Turbine

Outstanding issues:

The following are the outstanding issues in order to achieve the full Type Certificate:

- Gap analysis between the IEC 61400-22:2010 and IECRE OD-501, Ed.2 shall be submitted for review and needs to be accepted by DNV GL.
- The manufacturing evaluation for the following components shall be re-performed by DNV GL.

| Component | Manufacturer / Workshop | DNV GL Inspection date |
|---------------------------------|--|-------------------------------|
| Gearbox (Winergy PEAB 4440) | Winergy facilities in Voerde, Germany | 2015-01-09 |
| Gearbox (ZF Atlas 1.0/1.2/1.21) | ZF facilities in Gainesville, GA USA | 2012-11-28 |
| Nacelle and hub assembly | Vestas, Colorado | 2014-11-10 |
| V110 Blade | Vestas, Smed Hansenevej 23 Lem, Denmark | 2014-03-19 |
| V110 Blade | Vestas, Smed Hansenevej 23 Lem, Denmark | 2015-02-25 |
| V110 Blade | Vestas, Smed Hansenevej 23 Lem, Denmark | 2015-06-03 |
| V110 Blade | TPI, Dafeng, China | 2015-05-07 |
| Tower | GWS Galicia, O Carballiño Ourense, Spain | 2015-07-22 |