



Certificate No.

IECRE.WE.TC.18.0018-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 V105-3.45 MW / V105-3.60 MW
Vestas V105-3.3 MW / V105-3.45 MW (BWC)
Vestas V105-3.3 MW / V105-3.45 MW

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. It is based on the following reference documents:

Design basis evaluation conformity statement
Dated

DB-DNVGL-SE-0074-01459-1
2017-02-10

Design evaluation conformity statement
Dated

DE-DNVGL-SE-0074-01460-1
2017-02-10

Type test conformity statement
Dated

TT-DNVGL-SE-0074-01461-1
2017-02-10

Manufacturing conformity statement
Dated

ME-DNVGL-SE-0074-01462-1
2017-02-10

Final evaluation report
Dated

FER-TC-DNVGL-SE-0074-01306-1
2017-02-10

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:
2021-03-28

Approved for issue on behalf of the IECRE
Certification Body:



Ramakrishna Parasarampuram / Christer Eriksson
Project Manager / Service Line Leader, Type
Certification
Hellerup 2018-12-17

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° |
| Cone angle: | 4° |
| Rated power: | See Annex 1 |
| Rated wind speed V_r : | See Annex 1 |
| Rotor diameter: | 105 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):

Normal and extreme temperature ranges:

Normal: -20°C to +45°C*
Extreme: -30°C to +50°C
Normal: -30°C to +45°C*
Extreme: -40°C to +50°C
See Annex 1

Relative humidity of the air:

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

Air density:

1.225 / 1.325ⁱ kg/m³
ⁱTo 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
1000 W/m²

Solar radiation:

Lightning protection system (standard and protection
class):

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



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Wind Turbine(s)

Major components*:

*Valid for V105-3.45 MW / V105-3.60 MW

*Valid for V105-3.3 MW / V105-3.45 MW
(BWC)

**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: 51.15 m
Number of blades: 3
Manufacturer: Vestas Wind Systems A/S
Drawing / Data sheet / Part No.: 0053-0523, Rev. 0 - V105 blade
Aero add-ons:
0055-9364, Rev. 0 - STE kit
0055-9655, Rev. 1 – Root Vortex
Generator
0056-7086, Rev. 1 – Gurney flap

Blade bearing:

Type: Double row four-point contact ball bearing
Manufacturer: Laulagun
Drawing / Data sheet / Part No.: 29049732, Rev. 3

Blade bearing:

Type: Double row four-point contact ball bearing
Manufacturer: Rollix
Drawing / Data sheet / Part No.: 29049732, Rev. 3

Blade bearing:

Type: Double row four-point contact ball bearing
Manufacturer: Liebherr
Drawing / Data sheet / Part No.: 29049732, Rev. 3



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TYPE CERTIFICATE
Wind Turbine(s)

Blade bearing:

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

Pitch System:

Motor / Actuator Type: One hydraulic cylinder (125/80x922) per
blade
Drawing / Data sheet / Part No.: 29084354, Rev. 1

Pitch Controller Type: Pitch Actuation Module
Drawing / Data sheet / Part No.: 29084357, Rev. 1

Main shaft:

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

Main shaft:

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
Drawing / Data sheet / Part No.: 240/950 CA/C3LW 33VQ113

Main bearing:

Type: Double-row spherical roller bearing
Manufacturer: FAG
Drawing / Data sheet / Part No.: F-582562.PRL-WPO



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TYPE CERTIFICATE
Wind Turbine(s)

Gearbox:

Type: 2 Planetary stages and one helical stage
Gear Ratio: 104.8
Manufacturer: ZF
Drawing / Data sheet / Part No.: EH921A

Gearbox:

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 tothing
Bearing Type: Friction bearing, permanently pre-tensioned
Gear Type: Multiple stage gearbox
Manufacturer: Comer
Drawing / Data sheet / Part No.: PG 1903
Brake Type: Electrical disc brake in yaw motors

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 voltage 750 V
Rated power factor (VFD) – Cos phi 0.87
Insulation class stator H
Protection class (acc. to IEC 529) IP54
Rated speed 1450 rpm / 1470 rpm



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TYPE CERTIFICATE

Wind Turbine(s)

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 |

Transformer:

| | |
|-----------------------|---|
| Type | Dry-type transformer 3-Phase GEA FOL – 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 |



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TYPE CERTIFICATE

Wind Turbine(s)

Fire class

F1

Tower:

Type:

Tubular Steel Tower

Hub height:

See Annex 1

Drawing / Data sheet / Part No.:

See Annex 1

Control System:

Manufacturer

Vestas Wind System A/S

Type

Vestas Multi Processor VMP Global –
System 8000

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

Service lift

Manufacturer

Avanti

Type

Avanti Shark or Power Lift Sherpa-SD

Crane

Manufacturer

Star 071/95 Liftket

Type

max 800 kg



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Major components*:

*Valid for V105-3.3 MW / V105-3.45 MW

**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: 51.15 m
Number of blades: 3
Manufacturer: Vestas Wind Systems A/S
Drawing / Data sheet / Part No.: 0053-0523, V105 blade:
Aero add-ons :
0055-9364, Rev. 0 - STE kit

Hub

Type: Cast ball shell hub
Material: EN GJS-400-18U-LT
Drawing / Data sheet / Part No.: 085210

Blade bearing:

Type: Double row four-point contact ball bearing
Manufacturer: Laulagun bearings
Drawing / Data sheet / Part No.: F2840M00DST0125VW

Blade bearing:

Type: Double row four-point contact ball bearing
Manufacturer: Rollix
Drawing / Data sheet / Part No.: 13-2620-01

Pitch System:

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



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TYPE CERTIFICATE
Wind Turbine(s)

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

Motor / Actuator Type: One hydraulic cylinder per blade
Manufacturer: Parker

Pitch Controller Type: Pitch Actuation Module
Manufacturer: PMC Technology A/S

Main shaft:

Type: Cast hollow shaft
Material: EN GJS-400-18U-LT
Drawing / Data sheet / Part No.: 085196 / 29024367

Main bearing:

Type: Double-row spherical roller bearing
Manufacturer: SKF
Drawing / Data sheet / Part No.: 240/950 CA/C3LW 33VQ113

Main bearing:

Type: Double-row spherical roller bearing
Manufacturer: FAG
Drawing / Data sheet / Part No.: 240/950 F-582562.PRL.WPOS

Gearbox:

Type: 2 Planetary stages and one helical stage
Gear Ratio: 104.8
Manufacturer: ZF
Drawing / Data sheet / Part No.: EH921A

Gearbox:

Type: 2 Planetary stages and one helical stage



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TYPE CERTIFICATE
Wind Turbine(s)

Gear Ratio: 104.9
Manufacturer: Winergy
Drawing / Data sheet / Part No.: PZAB 3530.1

Couplings:

Main shaft-Main gear Shrink disc
Manufacturer Tollok
Type TLK622 990x1350

Main gear-Generator Flexible composite coupling
Manufacturer KTR Kupplungstechnik GmbH
Type RADEX-N 2200kpl.m.Lamellenp

Machine foundation:

Type Cast
Material EN GJS-400-18U-LT
Drawing / Data sheet / Part no. 29006988

Yaw System:

Drive Type: Nacelle mounted electrical driven plain
bearing with external toothing

Bearing Type: Friction bearing, permanently pre-
tensioned

Gear Type: Multiple stage gearbox
Manufacturer Comer
Drawing / Data sheet / Part No.: PG 1603

Gear Type: Multiple stage gearbox
Manufacturer Bonfiglioli
Drawing / Data sheet / Part No.: 709T4U

Gear Type: Multiple stage gearbox



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TYPE CERTIFICATE
Wind Turbine(s)

Manufacturer: Liebherr
Drawing / Data sheet / Part No.: DAT350/1492-4000

Brake Type: Electrical disc brake in yaw motors

Mechanical brakes:

Manufacturer Eurotubi / Vestas
Type Disc brake
Location High speed shaft of gearbox
Brake torque Min. 17.4 kNm (static)

Generator:

Manufacturer Siemens (not valid for V126-3.45MW)
Type Three phase induction generator with squirrel cage rotor - JGWA-560LM-06A
Rated power 3500kW
Voltage 750 V
Nominal Speed 1450 rpm
Insulation class F
Protection class (acc. to IEC 529) IP54

Generator:

Manufacturer Siemens
Type Three phase induction generator with squirrel cage rotor - JGWA-560LM-06A
Rated voltage 750 V
Rated power 3650 kW
Rated current 3440 A
Cos phi 0.82
Rated speed 1450 rpm
Protection class (acc. to IEC 529) IP54
Rated frequency 72.2 Hz
Insulation class F



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Wind Turbine(s)

Generator:

| | |
|------------------------------------|--|
| Manufacturer | VND SFIG |
| Type | Three phase induction generator with squirrel cage rotor - DASG 560/6M |
| Nominal power | 3650 kW |
| Voltage | 750 V |
| Nominal Speed | 1450 rpm |
| Insulation class | H |
| Protection class (acc. to IEC 529) | IP54 |

Generator:

| | |
|------------------------------------|--|
| Manufacturer | VND SFIG_V2 |
| Type | Three phase induction generator with squirrel cage rotor - DASG 560/6M |
| Rated power | 3650 kW |
| Rated voltage | 750 V |
| Rated frequency | 72.5 Hz |
| Rated power factor (VFD) – Cos phi | 0.87 |
| Insulation class stator | H |
| Protection class (acc. to IEC 529) | IP54 |
| Rated speed | 1450 rpm |
| Rated stator current | 3230 A |

Converter:

| | |
|------------------------------------|-----------------------------|
| Type | Full-scale Converter System |
| Rated apparent power | 4000 kVA |
| Rated Grid Voltage | 650 V |
| Rated Generator Voltage | 750 V |
| Rated Generator Current | 3286 A |
| Protection class (acc. to IEC 529) | IP54 |

Transformer:

| | |
|--------------|----------------------|
| Manufacturer | SGB / Siemens |
| Type | Dry-type transformer |



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| | |
|---------------------|------------------------------|
| Nominal power | 3750 kVA |
| Environmental Tests | E2 according to IEC 60076-11 |
| Climatic Tests | C2 according to IEC 60076-11 |

Tower:

| | |
|----------------------------------|---------------------|
| Type: | Tubular Steel Tower |
| Hub height: | See Annex 1 |
| Drawing / Data sheet / Part No.: | See Annex 1 |

Control System:

| | |
|--------------|-----------------------------------|
| Manufacturer | Vestas Wind Systems A/S |
| Type | Vestas Multi Processor VMP Global |

Manuals:

| | |
|---------------------------------------|---|
| Operation & maintenance manual: | See list of manuals 0006-6955, Rev. 24 |
| Transport manual: | See list of manuals 0040-6996, Rev. 9 |
| Installation & commissioning. manual: | See list of manuals 0040-6996, Rev. 9 |

Service lift:

| | |
|--------------|-----------------------------|
| Manufacturer | Avanti |
| Type | Avanti Dolphin service lift |

Crane:

| | |
|--------------|---------------------|
| Manufacturer | Star 071/95 Liftket |
| Type | max 800 kg |



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Annex 1 – Configurations covered by this Type Certificate

| Variants | IEC WT class | Power* (MW) | V _r (m/s) | V _{in} - V _{out} incl. HWO (m/s) | V _{ave} (m/s) | V _{ref} (m/s) |
|---------------------------------|-----------------|-------------|----------------------|--|------------------------|------------------------|
| V105-3.3 MW/ V105-3.45 MW | S (IA)** / S*** | 3.3 /3.45 | 11.60 / 12 | 3 - 25 | 10 / 9.8 | 50 |
| V105-3.3 MW/ V105-3.45 MW (BwC) | S (IA)** / S*** | 3.3 /3.45 | 11.60 / 12 | 3 - 25 | 10 / 9.8 | 50 |
| V105-3.45 MW/ V105-3.60 MW | S (IA)** | 3.45 /3.60 | 11.7 / 11.9 | 3 - 30 | 10 | 50 |

Notes:

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

S (IA)** - IEC Wind turbine class IA except for the temperature range.

S*** - The mean wind speed (V_{ave}) is lowered to 9.8 m/s for V105-3.45 MW power mode.

| Variants | Hub Height (m) | Tower (drawing no) | I _{ref} | De-rating temperature | Software version |
|---------------------------------|----------------|--------------------|------------------|--|----------------------------------|
| V105-3.3 MW/ V105-3.45 MW | 72.5 | 0041-8294.V00 | 0.16 | *de-rating strategy above +30 °C for V105-3.3MW *de-rating strategy above +25 °C for V105-3.45MW | 13.08.56 |
| V105-3.3 MW/ V105-3.45 MW (BwC) | 72.5 | 0041-8294.V00 | 0.16 | *de-rating strategy above +30 °C for V105-3.3MW *de-rating strategy above +25 °C for V105-3.45MW | VMP Global, Build: 2016.07 (BwC) |
| V105-3.45 MW/ V105-3.60 MW | 72.5 | 0060-4286.V00 | 0.16 | *de-rating strategy above +30 °C for V105-3.45 MW *de-rating strategy above +20 °C for V105-3.60 MW | VMP Global, Build: 2016.07 |