

# TYPE CERTIFICATE

Certificate No.:  
TC-DNVGL-SE-0074-02382-3

Issued:  
2017-11-24

Valid until:  
2020-01-16

Issued for:

## Vestas V110 2.0-2.2 MW 50 Hz VCS Mk 10

Specified in Annex 1 and Annex 2

Issued to:

## Vestas Wind Systems A/S

Hedeager 42  
8200 Aarhus N  
Denmark

According to:

## IEC 61400-22:2010-05 Wind turbines – Part 22: Conformity testing and certification

Based on the documents:

DB-DNVGL-SE-0074-02383-2

Design Basis Conformity Statement, dated 2017-11-24

DE-DNVGL-SE-0074-02384-2

Design Evaluation Conformity Statement, dated 2017-11-24

TT-DNVGL-SE-0074-02385-2

Type Test Conformity Statement, dated 2017-11-24

ME-DNVGL-SE-0074-02386-3

Manufacturing Evaluation Conformity Statement,  
dated 2017-11-24

TCM-DNVGL-SE-0074-02387-1

Type Characteristic Measurement Conformity Statement,  
dated 2017-11-24

FER-TC-DNVGL-SE-0074-02382-3

Final Evaluation Report, dated 2017-11-24

Changes of the system design, the production and erection or the manufacturer's quality system are to be approved by DNV GL.

Hellerup, 2017-11-24

For DNV GL Renewables Certification



**Christer Eriksson**  
Service Line Leader for Type Certification



By DAkkS according DIN EN IEC/ISO 17065 accredited Certification Body for products. The accreditation is valid for the fields of certification listed in the certificate.

Hellerup, 2017-11-24

For DNV GL Renewables Certification



**Mark Wollenberg**  
Project Manager

The accredited certification body is Germanischer Lloyd Industrial Services GmbH, Brooktorkai 18, 20457 Hamburg.

DNV GL Renewables Certification is the trading name of DNV GL's certification business in the renewable energy industry.

VESTAS PROPRIETARY NOTICE: This document contains valuable confidential information of Vestas Wind Systems A/S. It is protected by copyright law as an unpublished work. Vestas reserves all patent, copyright, trade secret, and other proprietary rights to it. The information in this document may not be used, reproduced, or disclosed except if and to the extent rights are expressly granted by Vestas in writing and subject to applicable conditions. Vestas disclaims all warranties except as expressly granted by written agreement and is not responsible for unauthorized uses, for which it may pursue legal remedies against responsible parties.

# TYPE CERTIFICATE - ANNEX 1

Certificate No.: TC-DNVGL-SE-0074-02382-3

Page 2 of 6

## Wind turbine type certification

Basic standard	IEC 61400-1 ed. 3 + A1
IEC WT class	S (specified below for each configuration ID numbers)

## General

Power regulation	pitch-controlled
Rotor orientation	upwind
Rotor tilt	6°
Cone angle	3°
Rated power	ID 1, 2 & 3: 2.0 MW* ID 4, 5 & 6: 2.2 MW**

\* derating strategy for cooler top 30 at ambient temperature above 35°C

\* derating strategy for cooler top 40 at ambient temperature above 40°C

\*\* derating strategies for ambient temperature above 30°C

Rated wind speed $V_r$	ID 1, 2 & 3: 9.6 m/s ID 4, 5 & 6: 10.0 m/s
Rotor diameter	110 m
Hub height(s)	75m, 80 m, 95 m, 110 m, 120 m and 125 m
Hub height operating wind speed range $V_{in} - V_{out}$	ID 1, 2 & 3: 3-22 m/s with high wind operation from 19 m/s ID 4, 5 & 6: 3-20 m/s
Design life time	20 years
Software version	VMP Global 17.06.44

## Wind conditions

Wind conditions ID1 to ID3: Wind turbine class S (IIIA/IIIB/IIIC except for temperature ranges)

Annual average wind speed at hub height $V_{ave}$	7.5 m/s
Reference wind speed $V_{ref}$	37.5 m/s
Mean flow inclination	8°
Hub height extreme wind speed $V_{e50}$	52.5 m/s
Mean turbulence intensity $I_{ref}$ at $V_{hub} = 15$ m/s	ID1: 0.16 (IEC turbulence class A) ID2: 0.14 (IEC turbulence class B) ID3: 0.12 (IEC turbulence class C)

Wind conditions ID4 to ID6: Wind turbine class S

Annual average wind speed at hub height $V_{ave}$	6.5 m/s
Reference wind speed $V_{ref}$	37.5 m/s
Mean flow inclination	8°
Hub height extreme wind speed $V_{e50}$	52.5 m/s
Mean turbulence intensity $I_{ref}$ at $V_{hub} = 15$ m/s	ID4: 0.16 (IEC turbulence class A) ID5: 0.14 (IEC turbulence class B) ID6: 0.12 (IEC turbulence class C)

## Electrical network conditions

Normal supply voltage and range	10.5 kV-35 kV
Normal supply frequency and range	50 Hz
Voltage imbalance	<3 %
Maximum duration of electrical power network outages	Not dimensioning
Number of electrical network outages	50

# TYPE CERTIFICATE - ANNEX 1

Certificate No.: TC-DNVGL-SE-0074-02382-3

Page 3 of 6

## Other environmental conditions

Standard temperature turbine (IEC standard temperature range)

Operating temperature	-20°C to +45°C
Extreme temperature, stand still	-30°C to +50°C

Low Temperature turbine

(LT, turbine components and operating strategy are identical to the standard temperature turbine but additional heating elements are installed for low temperature usage)

Operating temperature	-30°C to +45°C
Extreme temperature, stand still	-40°C to +50°C

Relative humidity of the air

100 % (max 10 % of lifetime)

Air density

1.225 kg/m<sup>3</sup> \*\* LT: The -30°C minimum operating temperature has been verified for loads and structural integrity by considering an air density of 1.325 kg/m<sup>3</sup>

Solar radiation

The turbine shall resist solar radiation (including UV) with 1000 W/m<sup>2</sup> and 8000 MJ/m<sup>2</sup> per year throughout the design lifetime

Description of lightning protection system

IEC 61400-24:2010, Protection Level 1

## Major components

<b>Blade</b>	Type	54m Structural shell
	Manufacturer	Vestas, TPI China
	Material	Glass fibre and carbon fibre reinforced epoxy
	Blade length	54 m
<b>Blade bearing</b>	Number of blades	3
	Drawing / Data sheet / Part no.	ID1 to ID3: 29061061 or 29083499 ID4 to ID6: 29061061
	Type	2 row 4-point contact ball bearing
	Manufacturer	Rollix
<b>Pitch system</b>	Drawing / Data sheet / Part no.	13-1920-02-DD0-5
	Type	2 row 4-point contact ball bearing
	Manufacturer	Liebherr
	Drawing / Data sheet / Part no.	648 VO 802-000
<b>Main shaft</b>	Type	2 row 4-point contact ball bearing
	Manufacturer	TMB
	Drawing / Data sheet / Part no.	B030.65.1920K
	Type	One cylinder per blade
<b>Pitch system</b>	Manufacturer	LJM, Glual and Hine
	Controller type	Hydraulic
	Motor / actuator	Hydraulic
	<b>Main shaft</b>	Type
Material		42CrMo4
Drawing / Data sheet / Part no.		29085836

# TYPE CERTIFICATE - ANNEX 1

Certificate No.: TC-DNVGL-SE-0074-02382-3

Page 4 of 6

<b>Main bearing</b>	Type	Two double row spherical roller bearing
	Manufacturer	SKF
	Drawing / Data sheet / Part no.	230/630 CA/HM2 W33 24188 ECA/HM2 W33
	Manufacturer	KOYO
	Drawing / Data sheet / Part no.	230/630 RHAW33T 24188 RHAW33
	Manufacturer	FAG
	Drawing / Data sheet / Part no.	F-582558.PRL-WPO F-582559.PRL-WPO
<b>Gearbox</b>	Type	3 stage gearbox (1 planetary stage)
	Manufacturer	Winergy
	Gear Ratio	1:112.2
	Drawing / Data sheet / Part no.	PEAB 4440
	Type	3 stage gearbox (1 planetary stage)
	Manufacturer	ZF
	Gear Ratio	1:112.36
	Drawing / Data sheet / Part no.	Atlas 1.2, 1.21
<b>Yaw system</b>	Drive type	Electrical motor
	Manufacturer	ABB or Lafert
	Drawing / Data sheet / Part no.	29005012
	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
<b>Generator</b>	Manufacturer	Vestas
	Type	DVSG 500/4M SP. (Asynchronous generator with wound rotor)
	Rated power	2060 kW or 2260 kW
	Rated frequency	50 Hz
	Rated speed	1680 rpm
	Rated voltage	690 VAC
	Rated stator 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)

# TYPE CERTIFICATE - ANNEX 1

Certificate No.: TC-DNVGL-SE-0074-02382-3

Page 5 of 6

<b>Converter</b>	Manufacturer Type Rated voltage Nominal current (at 2.0 MW) Grid Rotor Nominal current (at 2.2 MW) Grid Rotor Degree of protection	Vestas Wind System A/S Full quadrant IGBT 480 V  240 A 592 A  256 A 655 A IP 54
<b>Transformer</b>	Manufacturer Type Rated voltage	Siemens, SGB, JST Dry type HV side: 10.5-35.0 [kV] LV side: 690 [V] +/-2% & 480 [V] +/-2%
<b>Tower</b>	Type Manufacturer  Number of sections Length Drawing / Data sheet / Part no.	Tubular steel Several, see manufacturing evaluation conformity statement Please refer to annex 2 Please refer to annex 2 Please refer to annex 2
<b>Foundation load(s)</b>		Please refer to annex 2
<b>Manuals</b>	O&M manual  Transport manual  Installation / Commissioning manual	See list of manuals 0068-9605.V01 See list of manuals 0068-9605.V01 See list of manuals 0068-9605.V01
<b>Service lift (optional)</b>	Not included	
<b>Crane (optional)</b>	Not included	

# TYPE CERTIFICATE - ANNEX 2

Certificate No.: TC-DNVGL-SE-0074-02382-3

Page 6 of 6

## Tower list

HH	Tower No.	Sections	Drawing	Foundation loads	ID
75	T2X302	3	0059-1124.V00	0065-7541.V01 0065-7546.V01*	ID2, ID5
80	T2X103	4	0043-5737.V00	0063-5617.V01 0063-5639.V01*	ID1, ID4
80	T2X203	3	0044-7632.V01	0063-5618.V02 0063-5640.V02*	ID3, ID6
80	T2X300	3	0056-9134.V00	0063-5619.V01 0063-5642.V01*	ID1, ID4
95	T2X122	4	0039-6458.V00	0063-5621.V01 0063-5643.V01*	ID1, ID4
95	T2X222	4	0044-7654.V01	0063-5628.V01 0063-5646.V01*	ID2, ID5
95	T2X320	4	0056-8544.V01	0063-5630.V01 0063-5648.V01*	ID1, ID4
95	T2X321	4	0056-9137.V01	0063-5631.V01 0063-5649.V01*	ID2, ID5
110	T2X330	4	0056-9139.V02	0063-5632.V01 0063-5650.V01*	ID2, ID5
120	T2X331	5	0056-9140.V02	0063-5633.V01 0063-5651.V01*	ID2, ID5
125	T2X133	5	0048-4332.V00	0063-5634.V01 0063-5652.V01*	ID2, ID5

\* Up to 3m above ground due to raised foundations