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General Description

4MW Platform

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1 Introduction

The 4MW Platform wind turbine configurations covered by this General Description are listed below with designations according to IEC61400-22.

DIBt 2012 wind classes are also listed where applicable.

Please refer to the Performance Specification for the relevant turbine variant for full wind class definition.

This General Description contains data and descriptions common among the platform variants.

The variant specific performance can be found in the Performance Specifications for the turbine variant and operational mode required.

Turbine Type Class	Turbine Type | Operating Mode
V117-4.0/4.2 MW Strong Wind	V117-4.0 MW IEC IB / IEC IIA 50/60 Hz | Mode 0
	V117-4.0 MW IEC IB / IEC IIA 50/60 Hz | Reactive Power Optimized Mode (QO1)
	V117-4.2 MW IEC S / IEC IIA 50/60 Hz | Power Optimized Mode (PO1)
	V117-3.8 MW IEC IB / IEC IIA 50/60 Hz | Load Optimized Mode (LO1)
	V117-3.6 MW IEC IB / IEC IIA+ 50/60 Hz | Load Optimized Mode (LO2)
V117-4.0/4.2 MW Typhoon	V117-4.0 MW IEC IB-T / IEC IIA-T 50/60 Hz | Mode 0
	V117-4.0 MW IEC IB-T / IEC IIA-T 50/60 Hz | Reactive Power Optim. Mode (QO1)
	V117-4.2 MW IEC S-T / IEC IIA-T 50/60 Hz | Power Optimized Mode (PO1)
	V117-3.8 MW IEC IB-T / IEC IIA-T 50/60 Hz | Load Optimized Mode (LO1)
	V117-3.6 MW IEC IB-T / IEC IIA+-T 50/60 Hz | Load Optimized Mode (LO2)
V136-4.0/4.2 MW	V136-4.0 MW IEC IIB / IEC IIIB 50/60 Hz | Mode 0
	V136-4.0 MW IEC IIB / IEC IIIB 50/60 Hz | Reactive Power Optim. Mode (QO1)
	V136-4.2 MW IEC S / IEC IIIB 50/60 Hz | Power Optimized Mode (PO1)
	V136-3.8 MW IEC IIB / IEC IIIB 50/60 Hz | Load Optimized Mode (LO1)
	V136-3.6 MW IEC IIB / IEC IIIB 50/60 Hz | Load Optimized Mode (LO2)
	V136-4.0 MW DIBt S 50 Hz | Mode 0
	V136-4.0 MW DIBt S 50 Hz | Reactive Power Optimized Mode (QO1)
	V136-4.2 MW DIBt S 50 Hz | Power Optimized Mode (PO1)
	V136-3.8 MW DIBt S 50 Hz | Load Optimized Mode (LO1)
	V136-3.6 MW DIBt S 50 Hz | Load Optimized Mode (LO2)
V150-4.0/4.2 MW	V150-4.0 MW IEC IIIB 50/60 Hz | Mode 0
	V150-4.0 MW IEC IIIB 50/60 Hz | Reactive Power Optim. Mode (QO1)
	V150-4.2 MW IEC S 50/60 Hz | Power Optimized Mode (PO1)
	V150-3.8 MW IEC IIIB / IEC S 50/60 Hz | Load Optimized Mode (LO1)
	V150-3.6 MW IEC IIIB / S 50/60 Hz | Load Optimized Mode (LO2)
	V150-4.0 MW DIBt S 50 Hz | Mode 0

Turbine Type Class	Turbine Type | Operating Mode
V150-4.0/4.2 MW (cont'd)	V150-4.0 MW DIBt S 50 Hz | Reactive Power Optimized Mode (QO1)
	V150-4.2 MW DIBt S 50 Hz | Power Optimized Mode (PO1)
	V150-3.8 MW DIBt S 50 Hz | Load Optimized Mode (LO1)
	V150-3.6 MW DIBt S 50 Hz | Load Optimized Mode (LO2)

Table 1-1: 4MW Platform turbine configurations covered.

2 General Description

Vestas 4MW Platform comprises a family of wind turbines sharing a common design basis.

The 4MW Platform family of wind turbines includes V105-3.45/3.6 MW, V112-3.45/3.6 MW, V117-3.45/3.6 MW, V126-3.45 MW LTq, V126-3.45/3.6 MW HTq, V136-3.45/3.6 MW, V117-4.0/4.2 MW Strong Wind, V117-4.0/4.2 MW Typhoon, V136-4.0/4.2 MW and V150-4.0/4.2 MW.

For V105-3.45/3.6 MW, V112-3.45/3.6 MW, V117-3.45/3.6 MW, V126-3.45 MW LTq, V126-3.45/3.6 MW HTq and V136-3.45/3.6 MW, please refer to General Description 0053-3707.

This General Description only applies to V117-4.0/4.2 MW Strong Wind, V117-4.0/4.2 MW Typhoon, V136-4.0/4.2 MW and V150-4.0/4.2 MW.

These turbines are pitch regulated upwind turbines with active yaw and a three-blade rotor.

The turbines covered in this General Description are equipped with rotor with diameters residing in the range 117 m to 150 m and a rated output power of 4.0 MW.

A 4.0 MW Reactive Power Optimized Mode (QO1) is available for all variants.

A 4.2 MW Power Optimized Mode (PO1) is available for all variants.

Also, a 3.8 MW Load Optimized Mode (LO1) and a 3.6 MW Load Optimized Mode (LO2) is available for all variants.

The wind turbine family utilises the OptiTip® concept and a power system based on an induction generator and full-scale converter. With these features, the wind turbine is able to operate the rotor at variable speed and thereby maintain the power output at or near rated power even in high wind speed. At low wind speed, the OptiTip® concept and the power system work together to maximise the power output by operating at the optimal rotor speed and pitch angle.

Operating the wind turbine in 4.0 MW Reactive Power Optimized Mode (QO1) is achieved by applying an extended ambient temperature derate strategy compared with 4.0 MW Mode 0 operation.

Operating the wind turbine in 4.2 MW Power Optimized Mode (PO1) is achieved by applying an extended ambient temperature derate strategy and reduced reactive power capability compared with 4.0 MW Mode 0 operation.

3 Mechanical Design

3.1 Rotor

The wind turbine is equipped with a rotor consisting of three blades and a hub. The blades are controlled by the microprocessor pitch control system OptiTip®. Based on the prevailing wind conditions, the blades are continuously positioned to optimise the pitch angle.

Rotor	V117	V136	V150
Diameter	117 m	136 m	150 m
Swept Area	10751 m^2	14527 m^2	17671 m^2
Speed, Dynamic Operation Range	6.7-17.5	5.6-14.0	4.9-12.0
Rotational Direction	Clockwise (front view)		
Orientation	Upwind		
Tilt	6°		
Hub Coning	4°	4°	5.5°
No. of Blades	3		
Aerodynamic Brakes	Full feathering		

Table 3-1: Rotor data

3.2 Blades

The blades are made of carbon and fibreglass and consist of two airfoil shells bonded to a supporting beam or with embedded structure.

Blades	V117	V136	V150
Type Description	Airfoil shells bonded to supporting beam	Prepreg or infused structural airfoil shell	Prepreg or infused structural airfoil shell
Blade Length	57.15 m	66.66 m	73.66 m
Material	Fibreglass reinforced epoxy, carbon fibres and Solid Metal Tip (SMT)		
Blade Connection	Steel roots inserted		
Airfoils	High-lift profile		
Maximum Chord	4.0 m	4.1 m	4.2 m
Chord at 90% blade radius	1.1 m	1.2 m	1.4 m

Table 3-2: Blades data

3.3 Blade Bearing

The blade bearings allow the blades to operate at varying pitch angles.

Blade Bearing	
Blade bearing type (V117/V136)	Double-row four-point contact ball bearings
Blade bearing type (V150)	3-rows roller bearings
Lubrication	Manual grease lubrication

Table 3-3: Blade bearing data

3.4 Pitch System

The turbine is equipped with a pitch system for each blade and a distributor block, all located in the hub. Each pitch system is connected to the distributor block with flexible hoses. The distributor block is connected to the pipes of the hydraulic rotating transfer unit in the hub by means of three hoses (pressure line, return line and drain line).

Each pitch system consists of a hydraulic cylinder mounted to the hub and a piston rod mounted to the blade bearing via a torque arm shaft. Valves facilitating operation of the pitch cylinder are installed on a pitch block bolted directly onto the cylinder.

Pitch System	
Type	Hydraulic
Number	1 per blade
Range	-10° to 95°

Table 3-4: Pitch system data

Hydraulic System	
Main Pump	Two redundant internal-gear oil pumps
Pressure	260 bar
Filtration	3 µm (absolute)

Table 3-5: Hydraulic system data.

3.5 Hub

The hub supports the three blades and transfers the reaction loads to the main bearing and the torque to the gearbox. The hub structure also supports blade bearings and pitch cylinders.

Hub	
Type	Cast ball shell hub
Material	Cast iron

Table 3-6: Hub data

3.6 Main Shaft

The main shaft transfers the reaction forces to the main bearing and the torque to the gearbox.

Main Shaft	
Type Description	Hollow shaft
Material	Cast iron or forged steel

Table 3-7: Main shaft data

3.7 Main Bearing Housing

The main bearing housing covers the main bearing and is the first connection point for the drive train system to the bedplate.

Main Bearing Housing	
Material	Cast iron

Table 3-8: Main bearing housing data

3.8 Main Bearing

The main bearing carries all thrust loads.

Main Bearing	
Type	Double-row spherical roller bearing
Lubrication	Automatic grease lubrication

Table 3-9: Main bearing data

3.9 Gearbox

The main gear converts the low-speed rotation of the rotor to high-speed generator rotation.

The disc brake is mounted on the high-speed shaft. The gearbox lubrication system is a pressure-fed system.

Gearbox	
Type	Planetary stages + one helical stage
Gear House Material	Cast
Lubrication System	Pressure oil lubrication
Backup Lubrication System	Oil sump filled from external gravity tank
Total Gear Oil Volume	1000-1500
Oil Cleanliness Codes	ISO 4406-/15/12
Shaft Seals	Labyrinth

Table 3-10: Gearbox data

3.10 Generator Bearings

The bearings are grease lubricated and grease is supplied continuously from an automatic lubrication unit.

3.11 High-Speed Shaft Coupling

The coupling transmits the torque of the gearbox high-speed output shaft to the generator input shaft.

The coupling consists of two 4-link laminate packages and a fibreglass intermediate tube with two metal flanges.

The coupling is fitted to two-armed hubs on the brake disc and the generator hub.

3.12 Yaw System

The yaw system is an active system based on a robust pre-tensioned plain yaw-bearing concept with PETP as friction material.

Yaw System	
Type	Plain bearing system
Material	Forged yaw ring heat-treated. Plain bearings PETP
Yawing Speed (50 Hz)	0.45°/sec.
Yawing Speed (60 Hz)	0.55°/sec.

Table 3-11: Yaw system data

Yaw Gear	
Type	Multiple stages geared
Ratio Total	944:1
Rotational Speed at Full Load	1.4 rpm at output shaft

Table 3-12: Yaw gear data

3.13 Crane

The nacelle houses the internal safe working load (SWL) service crane. The crane is a single system hoist.

Crane	
Lifting Capacity	Maximum 800 kg

Table 3-13: Crane data

3.14 Towers

Tubular towers with flange connections, certified according to relevant type approvals, are available in different standard heights. The towers are designed with the majority of internal welded connections replaced by magnet supports to create a predominantly smooth-walled tower.

Magnets provide load support in a horizontal direction and internals, such as platforms, ladders, etc., are supported vertically (that is, in the gravitational direction) by a mechanical connection. The smooth tower design reduces the required steel thickness, rendering the tower lighter compared to one with all internals welded to the tower shells.

Available hub heights are listed in the Performance Specification for each turbine variant. Designated hub heights include a distance from the foundation section to the ground level of approximately 0.2 m depending on the thickness of the bottom flange and a distance from tower top flange to centre of the hub of 2.2 m.

Towers	
Type	Cylindrical/conical tubular

Table 3-14: Tower structure data

3.15 Nacelle Bedplate and Cover

The nacelle cover is made of fibreglass. Hatches are positioned in the floor for lowering or hoisting equipment to the nacelle and evacuation of personnel. The roof section is equipped with wind sensor system and skylights.

The skylights can be opened from inside the nacelle to access the roof and from outside to access the nacelle. Access from the tower to the nacelle is through the yaw system.

The nacelle bedplate is in two parts and consists of a cast iron front part and a girder structure rear part. The front of the nacelle bedplate is the foundation for the drive train and transmits forces from the rotor to the tower through the yaw system. The bottom surface is machined and connected to the yaw bearing and the yaw gears are bolted to the front nacelle bedplate.

The crane girders are attached to the top structure. The lower beams of the girder structure are connected at the rear end. The rear part of the bedplate serves as the foundation for controller panels, the cooling system and transformer. The nacelle cover is installed on the nacelle bedplate.

Type Description	**Material**
Nacelle Cover	GRP
Bedplate Front	Cast iron
Bedplate Rear	Girder structure

Table 3-15: Nacelle bedplate and cover data

3.16 Thermal Conditioning System

The thermal conditioning system consists of a few robust components:

- The Vestas CoolerTop® located on top of the rear end of the nacelle. The CoolerTop® is a free flow cooler, thus ensuring that there are no electrical components in the thermal conditioning system located outside the nacelle.

- The CoolerTop is available in a standard variant and an optional high temperature variant with improved cooler performance at high ambient temperatures (HT version is not available for all turbine variants. Please consult Vestas for more information).
- The CoolerTop® comes as standard in a “naked” form, with no side cover panels. Side cover panels are available as an option.
- The Liquid Cooling System, which serves the gearbox, hydraulic systems, generator and converter is driven by an electrical pumping system.
- The transformer forced air cooling comprised of an electrical fan.

3.16.1 Generator and Converter Cooling

The generator and converter cooling systems operate in parallel. A dynamic flow valve mounted in the generator cooling circuit divides the cooling liquid flow. The cooling liquid removes heat from the generator and converter unit using a free-air flow radiator placed on the top of the nacelle. In addition to the generator, converter unit and radiator, the circulation system includes an electrical pump and a three-way thermostatic valve.

3.16.2 Gearbox and Hydraulic Cooling

The gearbox and hydraulic cooling systems are coupled in parallel. A dynamic flow valve mounted in the gearbox cooling circuit divides the cooling flow. The cooling liquid removes heat from the gearbox and the hydraulic power unit through heat exchangers and a free-air flow radiator placed on the top of the nacelle.

In addition to the heat exchangers and the radiator, the circulation system includes an electrical pump and a three-way thermostatic valve.

3.16.3 Transformer Cooling

The transformer is equipped with forced-air cooling. The ventilator system consists of a central fan, located below the converter and an air duct leading the air to locations beneath and between the high voltage and low voltage windings of the transformer.

3.16.4 Nacelle Cooling

Hot air generated by mechanical and electrical equipment is dissipated from the nacelle by a fan system located in the nacelle.

3.16.5 Optional Air Intake Hatches

Specific air intakes in the nacelle can optionally be fitted with hatches which can be operated as a part of the thermal control strategy. In case of lost grid to the turbine, the hatches will automatically be closed.

4 Electrical Design

4.1 Generator

The generator is a three-phase asynchronous induction generator with cage rotor that is connected to the grid through a full-scale converter. The generator housing allows the circulation of cooling air within the stator and rotor.

The air-to-water heat exchange occurs in an external heat exchanger.

Generator	
Type	Asynchronous with cage rotor
Rated Power [P_N]	4250 / 4450 kW
Frequency [f_N]	0-100 Hz
Voltage, Stator [U_{NS}]	3 x 800 V (at rated speed)
Number of Poles	6
Winding Type	Form with VPI (Vacuum Pressurized Impregnation)
Winding Connection	Delta
Rated rpm	1450-1550 rpm
Overspeed Limit Acc. to IEC (2 minutes)	2400 rpm
Generator Bearing	Hybrid/ceramic
Temperature Sensors, Stator	3 PT100 sensors placed at hot spots and 3 as back-up
Temperature Sensors, Bearings	1 per bearing
Insulation Class	H
Enclosure	IP54

Table 4-1: Generator data

4.2 Converter

The converter is a full-scale converter system controlling both the generator and the power quality delivered to the grid. The converter consists of 3 machine-side converter units and 3 line-side converter units operating in parallel with a common controller.

The converter controls conversion of variable frequency AC power from the generator into fixed frequency AC power with desired active and reactive power levels (and other grid connection parameters) suitable for the grid.

The converter is located in the nacelle and has a grid side voltage rating of 720 V. The generator side voltage rating is up to 800 V dependent on generator speed.

Converter	
Rated Apparent Power [S_N]	5100 kVA
Rated Grid Voltage	3 x 720 V
Rated Generator Voltage	3 x 800 V
Rated Grid Current	4100 A (≤30°C ambient) / 4150 (≤20°C ambient)
Rated Generator Current	3600 A (≤30°C ambient) / 3650 (≤20°C ambient)
Enclosure	IP54

Table 4-2: Converter data

4.3 HV Transformer

The step-up HV transformer is located in a separate locked room in the back of the nacelle.

The transformer is a three-phase, three limb, two-winding, dry-type transformer that is self-extinguishing. The windings are delta-connected on the high-voltage side and star connected on the low voltage side.

The transformer is designed according to IEC standards, but also complying to European Eco-design regulation No 548/2014 and No 2019/1783 set by the European Commission.
The transformer supplied for countries under EU legislation will be:

- Eco-design based on Tier 1 requirements (effective in EU until 1 July 2021)[1].
- Eco-design based on Tier 2 requirements (effective in EU from 1 July 2021)[1].

For other countries Eco-design based on Tier 1 requirements will be supplied as default.

4.3.1 Eco-designs - IEC 50 Hz/60 Hz version

Transformer	
Type description	Eco-design dry-type cast resin transformer.
Basic layout	3 phase, 3 limb, 2 winding transformer.
Applied standards	IEC 60076-11, IEC 60076-16, IEC 61936-1, Commission Regulation No 548/2014 and Commission Regulation No 2019/1783.
Cooling method	AF
Rated power	5150 kVA
Rated voltage, turbine side	
U_m 1.1kV	0.720 kV
Rated voltage, grid side	
U_m 24.0kV	12.9-22.0 kV
U_m 36.0kV	22.1-33.0 kV
U_m 40.5kV	33.1-36.0 kV
Insulation level AC / LI / LIC	
U_m 1.1kV	3^2 / 3 / 3 kV
U_m 24.0kV	50^2 / 125 / 125 kV
U_m 36.0kV	70^2 / 170 / 170 kV
U_m 40.5kV	80^2 / 170 / 170 kV
Off-circuit tap changer	±2 x 2.5 %
Frequency	50 Hz / 60 Hz
Vector group	Dyn5
No-load current [3]	~0.5 %
Positive sequence short-circuit impedance @ rated power, reference temperature according to IEC 60076-11 [4]	9.9 %
Positive sequence short-circuit resistance@ rated power, reference temperature according to IEC 60076-11 [3]	~0.8 %

Transformer	
Zero sequence short-circuit impedance@ rated power, reference temperature according to IEC 60076-11 [3]	~8.3 %
Zero sequence short-circuit resistance@ rated power, reference temperature according to IEC 60076-11 [3]	~0.7 %
No-load reactive power [3]	~20 kVAr
Full load reactive power [3]	~550 kVAr
Inrush peak current [3]	5-8 x $\hat{I}_n$ A
Half crest time [3]	~ 0.6 s
Sound power level	≤ 80 dB(A)
Average temperature rise at max altitude	≤ 90 K
Max altitude [5]	2000 m
Insulation class	
LV coil	155 (F)
HV coil	155 (F) or 180 (H)
Environmental class	E2
Climatic class	C2
Fire behaviour class	F1
Corrosion class	C4
Weight	≤11000 kg
Temperature monitoring	PT100 sensors in LV windings and core
Overvoltage protection	Surge arresters on HV terminals
Temporary earthing	3 x Ø25 mm earthing ball points

Table 4-3: Transformer data for Eco-designs IEC 50 Hz/60 Hz version.

The transformer loss limits are given at rated power as combination of load loss and no-load loss which shall fulfil the Peak Efficiency Index (PEI) of the Eco-design requirements.

The maximum losses are described by the PEI limit section and stretches over a range between Loss variant 1 and Loss variant 2, see Figure 4-1 and Figure 4-2. The loss variant values are selected based on energy loss optimization with the turbine user profile hence the energy loss of transformers between Loss variant 1 and Loss variant 2 are comparable.

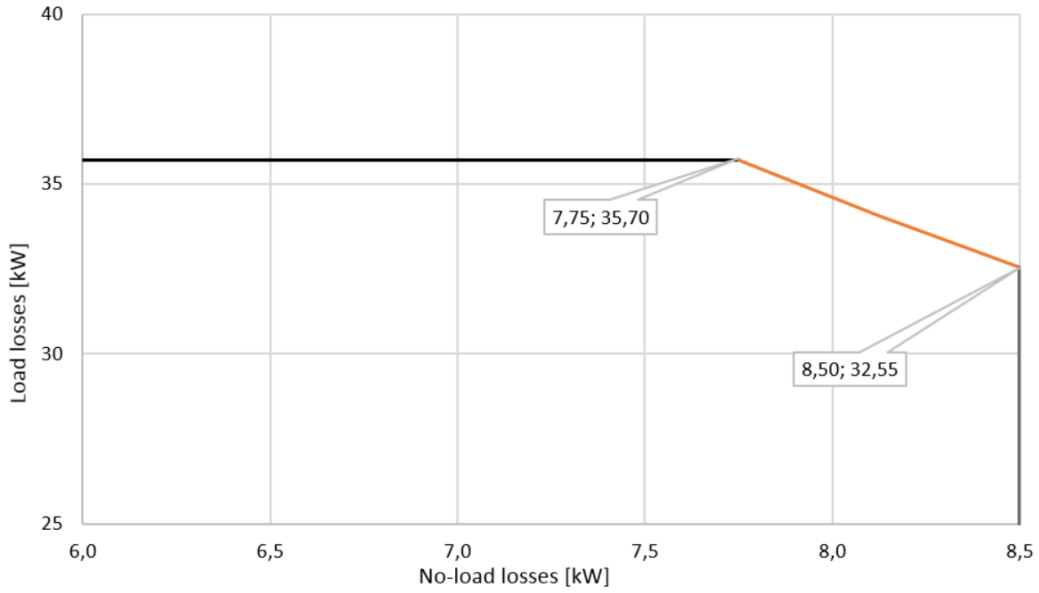


Figure 4-1 Transformer losses allowable area for Tier 1

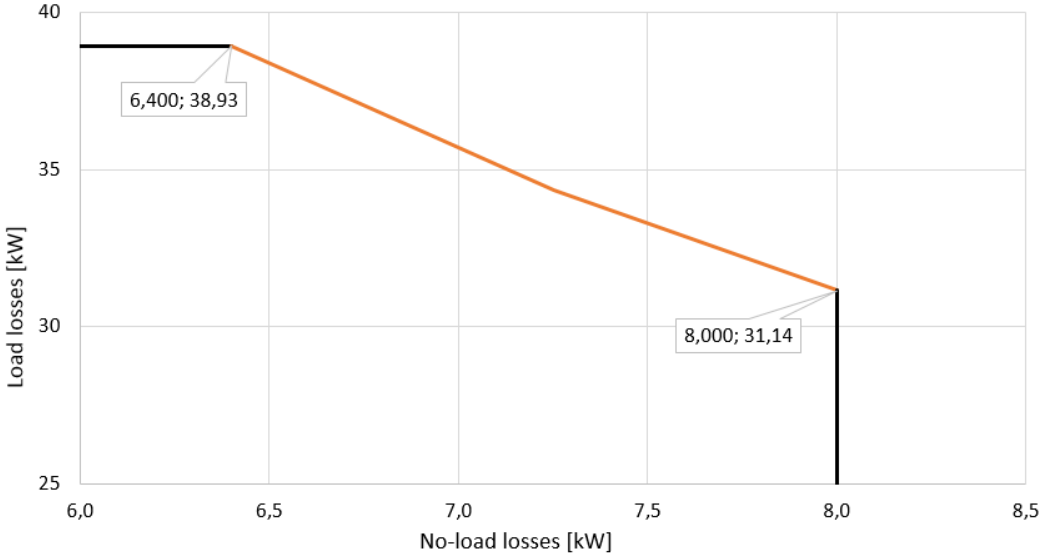


Figure 4-2 Transformer losses allowable area for Tier 2

The actual load losses vary depend on the operation mode of the turbine, hence in Table 4-4 the load losses are provided at different operation modes for the two loss variants. Table 4-4 covers both Tier 1 and Tier 2 transformer design. For further recalculation of load losses at different operation modes, refer to Figure 4-3.

Transformer losses Tier 1			
Peak Efficiency Index (PEI)	> 99.354		
Loss variant 1			
No-load loss	7.75 kW		
Load loss @ power, reference temperature according to IEC 60076-11	**@5150kVA**	**@4200kVA[6]**	**@4000kVA[6]**
	≤ 35.70 kW	≤ 23.75 kW	≤ 21.54 kW
Loss variant 2			
No-load loss	8.5 kW		
Load loss @ power, reference temperature according to IEC 60076-11	**@5150kVA**	**@4200kVA[6]**	**@4000kVA[6]**
	≤ 32.55 kW	≤ 21.65 kW	≤ 19.64 kW
Transformer losses Tier 2			
Peak Efficiency Index (PEI)	> 99.387		
Loss variant 1			
No-load loss	6.4 kW		
Load loss @ power, reference temperature according to IEC 60076-11	**@5150kVA**	**@4200kVA[6]**	**@4000kVA[6]**
	≤ 39.93 kW	≤ 25.89 kW	≤ 23.49 kW
Loss variant 2			
No-load loss	8.0 kW		
Load loss @ power, reference temperature according to IEC 60076-11	**@5150kVA**	**@4200kVA[6]**	**@4000kVA[6]**
	≤ 31.14 kW	≤ 20.71 kW	≤ 18.79 kW

Table 4-4: Transformer losses for Eco-designs IEC 50 Hz/60 Hz version.

NOTE

[1] The date reflects date for shipment of transformer from manufacturer.

[2] @1000m. According to IEC 60076-11, AC test voltage is altitude dependent.
[3] Based on an average of calculated values across voltages and manufacturers.
[4] Subjected to standard IEC tolerances.
[5] Transformer max altitude may be adjusted to match turbine location. For voltage class Um 40,5 kV altitude are limited to 1000m for Eco-design Tier 2.
[6] Information values based on operation mode, see Figure 4-3.

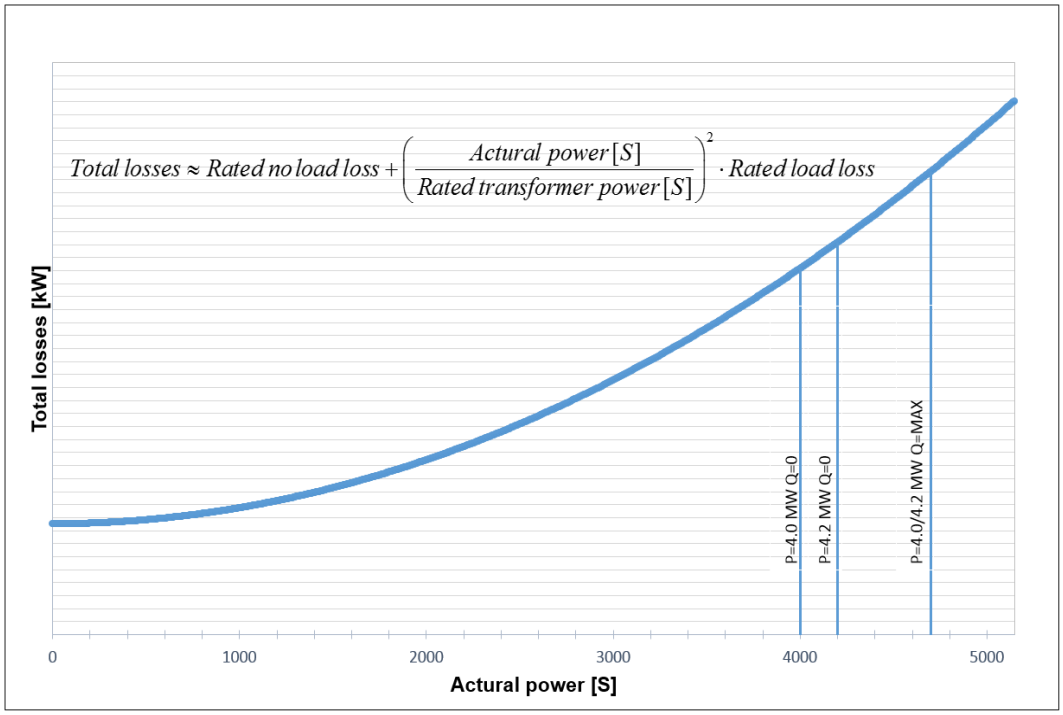


Figure 4-3: Total Losses vs. Actual Power.

4.4 HV Cables

The high-voltage cable runs from the transformer in the nacelle down the tower to the HV switchgear located at the bottom of the tower. The high-voltage cable can be of two different constructions:

- A three-core, rubber-insulated, halogen-free, high-voltage cable with a three-core split earth conductor.
- A four-core, rubber-insulated, halogen-free, high-voltage cable.

HV Cables	
High-Voltage Cable Insulation Compound	Improved ethylene-propylene (EP) based material-EPR or high modulus or hard grade ethylene-propylene rubber-HEPR
Pre-terminated	HV termination in transformer end. T-Connector Type-C in switchgear end.
Maximum Voltage	24 kV for 19.1-22.0 kV rated voltage 42 kV for 22.1-36.0 kV rated voltage
Conductor Cross Sections	3x70 / 70 mm^2 (Single PE core) 3x70 + 3x70/3 mm^2 (Split PE core)

Table 4-5: HV cables data

4.5 HV Switchgear

A gas insulated switchgear is installed in the bottom of the tower as an integrated part of the turbine. Its controls are integrated with the turbine safety system, which monitors the condition of the switchgear and high voltage safety related devices in the turbine. This system is named ‘Ready to Protect’ and ensures all protection devices are operational, whenever high voltage components in the turbine are energised. To ensure that the switchgear is always ready to trip, it is equipped with redundant trip circuits consisting of an active trip coil and an undervoltage trip coil.

In case of grid outage the circuit breaker will disconnect the turbine from the grid after an adjustable time.

When grid returns, all relevant protection devices will automatically be powered up via UPS.

When all the protection devices are operational, the circuit breaker will re-close after an adjustable time. The re-close functionality can furthermore be used to implement a sequential energization of a wind park, in order to avoid simultaneous inrush currents from all turbines once grid returns after an outage.

In case the circuit breaker has tripped due to a fault detection, the circuit breaker will be blocked for re-connection until a manual reset is performed.

In order to avoid unauthorized access to the transformer room during live condition, the earthing switch of the circuit breaker, contains a trapped-key interlock system with its counterpart installed on the access door to the transformer room.

The switchgear is available in three variants with increasing features, see Table 4-6. Beside the increase in features, the switchgear can be configured depending on the number of grid cables planned to enter the individual turbine. The design of the switchgear solution is optimized such grid cables can be connected to the switchgear even before the tower is installed and still maintain its protection toward weather conditions and internal condensation due to a gas tight packing.

The switchgear is available in an IEC version and in an IEEE version. The IEEE version is however only available in the highest voltage class. The electrical parameters of the switchgear are seen in Table 4-7 for the IEC version and in Table 4-8 for the IEEE version.

HV Switchgear			
Variant	**Basic**	**Streamline**	**Standard**
IEC standards	○	⊙	⊙
IEEE standards	⊙	○	⊙
Vacuum circuit breaker panel	⊙	⊙	⊙
Overcurrent, short-circuit and earth fault protection	⊙	⊙	⊙
Disconnector / earthing switch in circuit breaker panel	⊙	⊙	⊙
Voltage Presence Indicator System for circuit breaker	⊙	⊙	⊙
Voltage Presence Indicator System for grid cables	⊙	⊙	⊙
Double grid cable connection	⊙	⊙	⊙
Triple grid cable connection	⊙	○	○
Preconfigured relay settings	⊙	⊙	⊙
Turbine safety system integration	⊙	⊙	⊙
Redundant trip coil circuits	⊙	⊙	⊙
Trip coil supervision	⊙	⊙	⊙
Pendant remote control from outside of tower	⊙	⊙	⊙
Sequential energization	⊙	⊙	⊙
Reclose blocking function	⊙	⊙	⊙
Heating elements	⊙	⊙	⊙
Trapped-key interlock system for circuit breaker panel	⊙	⊙	⊙
Motor operation of circuit breaker	⊙	⊙	⊙
Cable panel for grid cables (configurable)	○	⊙	⊙
Switch disconnector panels for grid cables – max three panels (configurable)	○	⊙	⊙
Earthing switch for grid cables	○	⊙	⊙
Internal arc classification	○	⊙	⊙
Supervision on MCB’s	○	⊙	⊙
Motor operation of switch disconnector	○	○	⊙
SCADA operation and feedback of circuit breaker	○	○	⊙
SCADA operation and feedback of switch disconnector	○	○	⊙

Table 4-6: HV switchgear variants and features

4.5.1 IEC 50/60Hz version

HV Switchgear	
Type description	Gas Insulated Switchgear
Applied standards	IEC 62271-103 IEC 62271-1, 62271-100, 62271-102, 62271-200, IEC 60694
Insulation medium	SF_6
Rated voltage	
U_r 24.0kV	12.9-22.0 kV
U_r 36.0kV	22.1-33.0 kV
U_r 40.5kV	33.1-36.0 kV
Rated insulation level AC // LI Common value / across isolation distance	
U_r 24.0kV	50 / 60 // 125 / 145 kV
U_r 36.0kV	70 / 80 // 170 / 195 kV
U_r 40.5kV	85 / 90 // 185 / 215 kV
Rated frequency	50 Hz / 60 Hz
Rated normal current	630 A
Rated Short-time withstand current	
U_r 24.0kV	20 kA
U_r 36.0kV	25 kA
U_r 40.5kV	25 kA
Rated peak withstand current 50 / 60 Hz	
U_r 24.0kV	50 / 52 kA
U_r 36.0kV	62.5 / 65 kA
U_r 40.5kV	62.5 / 65 kA
Rated duration of short-circuit	1 s
Internal arc classification (option)	
U_r 24.0kV	IAC A FLR 20 kA, 1 s
U_r 36.0kV	IAC A FLR 25 kA, 1 s
U_r 40.5kV	IAC A FLR 25 kA, 1 s
Connection interface	Outside cone plug-in bushings, IEC interface C1.
Loss of service continuity category	LSC2
Ingress protection	
Gas tank	IP 65
Enclosure	IP 2X
LV cabinet	IP 3X
Corrosion class	C3

Table 4-7: HV switchgear data for IEC version

4.5.2 IEEE 60Hz version

HV Switchgear	
Type description	Gas Insulated Switchgear
Applied standards	IEEE 37.20.3, IEEE C37.20.4, IEC 62271-200, ISO 12944.
Insulation medium	SF_6
Rated voltage	
U_r 38.0kV	22.1-36.0 kV
Rated insulation level AC / LI	70 / 150 kV
Rated frequency	60 Hz
Rated normal current	600 A
Rated Short-time withstand current	25 kA
Rated peak withstand current	65 kA
Rated duration of short-circuit	1 s
Internal arc classification (option)	IAC A FLR 25 kA, 1 s
Connection interface grid cables	Outside cone plug-in bushings, IEEE 386 interface type deadbreak, 600A.
Ingress protection	
Gas tank	NEMA 4X / IP 65
Enclosure	NEMA 2 / IP 2X
LV cabinet	NEMA 2 / IP 3X
Corrosion class	C3

Table 4-8: HV switchgear data for IEEE version

4.6 AUX System

The AUX system is supplied from a separate 650/400/230 V transformer located in the nacelle inside the converter cabinet. All motors, pumps, fans and heaters are supplied from this system.

230 V consumers are generally supplied from a 400/230 V transformer located in the tower base. Internal heating and ventilation of cabinets as well as specific option 230 V consumers are supplied from the auxiliary transformer in the converter cabinet.

Power Sockets	
Single Phase (Nacelle)	230 V (16 A) (standard) 110 V (16 A) (option) 2 x 55 V (16 A) (option)
Single Phase (Tower Platforms)	230 V (10 A) (standard) 110 V (16 A) (option) 2 x 55 V (16 A) (option)
Three Phase (Nacelle and Tower Base)	3 x 400 V (16 A)

Table 4-9: AUX system data

4.7 Wind Sensing System

The turbine is equipped with a wind sensing system which can provide the wind speed and wind direction in all weather conditions. It consists of at least one wind sensor combined with different estimators which gives an estimate of the wind in the entire rotor area.

4.8 Vestas Multi Processor (VMP) Controller

The turbine is controlled and monitored by the VMP8000 control system.

VMP8000 is a multiprocessor control system comprised of main controller, distributed control nodes, distributed IO nodes and ethernet switches and other network equipment. The main controller is placed in the tower bottom of the turbine. It runs the control algorithms of the turbine, as well as all IO communication.

The communications network is a time triggered Ethernet network (TTEthernet).

The VMP8000 control system serves the following main functions:

- Monitoring and supervision of overall operation.
- Synchronizing of the generator to the grid during connection sequence.
- Operating the wind turbine during various fault situations.
- Automatic yawing of the nacelle.
- OptiTip® - blade pitch control.
- Reactive power control and variable speed operation.
- Noise emission control.
- Monitoring of ambient conditions.
- Monitoring of the grid.
- Monitoring of the smoke detection system.

4.9 Uninterruptible Power Supply (UPS)

During grid outage, an UPS system will ensure power supply for specific components.

1. 230V AC UPS for all power backup to nacelle and hub control systems
2. 24V DC UPS for power backup to tower base control systems and ready to protect.
3. 230V AC UPS for power backup to internal lights in tower, nacelle and hub.

Backup Time	**Standard**	**Optional**
Control System* **(230V AC and 24VDC UPS)**	30 min	Up to 19.5 hours **
Ready to protect **(24V DC UPS)**	7 days	80 days***

Table 4-10: UPS data

Light Box		
Backup Time	**Standard**	**Optional**
Internal Lights	30 min	60 min****

Table 4-11: UPS data

**The control system includes: the turbine controller (VMP8000), HV switchgear functions, and remote control system.*

***Requires upgrade of the 230V UPS for control system with extra batteries.*

****Requires upgrade of the 24V DC UPS with extra battery panel.*

*****Requires upgrade of the 230V UPS for internal light with extra batteries.*

NOTE For alternative backup times, consult Vestas.

5 Turbine Protection Systems

5.1 Braking Concept

The main brake on the turbine is aerodynamic. Stopping the turbine is done by full feathering the three blades (individually turning each blade). Each blade has a hydraulic accumulator to supply power for turning the blade.

In addition, there is a mechanical disc brake on the high-speed shaft of the gearbox with a dedicated hydraulic system. The mechanical brake is only used as a parking brake and when activating the emergency stop buttons.

5.2 Short Circuit Protections

Breakers	Breaker for Aux. Power. Back-up CB (T5V-HA 400A TMA 800V) and aux. power CB (T4V-HA 125A TMA 800V) tested in coordination	Breaker 1 for Converter Modules MTZ2 1600A 1000 V	Breaker 2 for Converter Modules MTZ2 3200A 1000 V
Breaking Capacity Icu, Ics	75 kA rms @ max 840 V Ics = 100%	66 kA rms @ max 1000 V Ics = 100%	66 kA rms @ max 1000 V Ics = 100%
Making Capacity Icm	166 kA peak @ max 840 V	145 kA peak @ max 1000 V	145 kA peak @ max 1000 V

Table 5-1: Short circuit protection data

5.3 Overspeed Protection

The generator rpm and the main shaft rpm are registered by inductive sensors and calculated by the wind turbine controller to protect against overspeed and rotating errors.

The safety-related partition of the VMP8000 control system monitors the rotor rpm. In case of an overspeed situation, the safety-related partition of the VMP8000 control system activates the emergency feathered position (full feathering) of the three blades independently of the non-safety related partition of VMP8000 control system.

Overspeed Protection	
Sensors Type	Inductive
Trip Level (variant dependent)	12.0-17.5 rpm / 2000 (generator rpm)

Table 5-2: Overspeed protection data

5.4 Arc Detection

The turbine is equipped with an Arc Detection system including multiple optical arc detection sensors placed in the HV transformer compartment and the converter cabinet. The Arc Detection system is connected to the turbine safety system ensuring immediate opening of the HV switchgear if an arc is detected.

5.5 Smoke Detection

The turbine is equipped with a Smoke Detection system including multiple smoke detection sensors placed in the nacelle (above the disc brake), in the transformer compartment, in main electrical cabinets in the nacelle and above the HV switchgear in the tower base. The Smoke Detection system is connected to the turbine safety system ensuring immediate opening of the HV switchgear if smoke is detected.

5.6 Lightning Protection of Blades, Nacelle, Hub and Tower

The Lightning Protection System (LPS) helps protect the wind turbine against the physical damage caused by lightning strikes. The LPS consists of five main parts:

- Lightning receptors. All lightning receptor surfaces on the blades are unpainted, excluding the Solid Metal Tips (SMT).
- Down conducting system (a system to conduct the lightning current down through the wind turbine to help avoid or minimise damage to the LPS itself or other parts of the wind turbine).
- Protection against overvoltage and overcurrent.
- Shielding against magnetic and electrical fields.
- Earthing system.

V136 blades and V150 blades:

Lightning Protection Design Parameters			Protection Level I
Current Peak Value	i_{max}	[kA]	200
Impulse Charge	$Q_{impulse}$	[C]	100
Long Duration Charge	Q_{long}	[C]	200
Total Charge	Q_{total}	[C]	300
Specific Energy	W/R	[MJ/Ω]	10
Average Steepness	di/dt	[kA/µs]	200

Table 5-3: Lightning protection design parameters (IEC)

Hub/Nacelle/Tower/Foundation and V117 blades:

Lightning Protection Design Parameters			Protection Level I
Current Peak Value	i_{max}	[kA]	200
Impulse Charge	$Q_{impulse}$	[C]	200
Long Duration Charge	Q_{long}	[C]	600
Total Charge	Q_{total}	[C]	800
Specific Energy	W/R	[MJ/Ω]	20
Average Steepness	di/dt	[kA/µs]	200

Table 5-4: Lightning protection design parameters (IEC & JIS)

NOTE The Lightning Protection System is designed according to IEC and JIS standards (see section 8 Design Codes, p. 28).

5.7 EMC

The turbine and related equipment fulfils the EU Electromagnetic Compatibility (EMC) legislation:

- DIRECTIVE 2014/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.

5.8 Earthing

The Vestas Earthing System consists of a number of individual earthing electrodes interconnected as one joint earthing system.

The Vestas Earthing System includes the TN-system and the Lightning Protection System for each wind turbine. It works as an earthing system for the medium voltage distribution system within the wind farm.

The Vestas Earthing System is adapted for the different types of turbine foundations. A separate set of documents describe the earthing system in detail, depending on the type of foundation.

In terms of lightning protection of the wind turbine, Vestas has no separate requirements for a certain minimum resistance to remote earth (measured in ohms) for this system. The earthing for the lightning protection system is based on the design and construction of the Vestas Earthing System.

A primary part of the Vestas Earthing System is the main earth bonding bar placed where all cables enter the wind turbine. All earthing electrodes are connected to this main earth bonding bar. Additionally, equipotential connections are made to all cables entering or leaving the wind turbine.

Requirements in the Vestas Earthing System specifications and work descriptions are minimum requirements from Vestas and IEC. Local and national requirements, as well as project requirements, may require additional measures.

5.9 Corrosion Protection

Classification of corrosion protection is according to ISO 12944-2.

Corrosion Protection	External Areas	Internal Areas
Nacelle	C5	C3
Hub	C5	C3
Tower	C5	C3

Table 5-5: Corrosion protection data for nacelle, hub, and tower

6 Safety

The safety specifications in this section provide limited general information about the safety features of the turbine and are not a substitute for Buyer and its agents taking all appropriate safety precautions, including but not limited to (a) complying with all applicable safety, operation, maintenance, and service agreements, instructions, and requirements, (b) complying with all safety-related laws, regulations, and ordinances, and (c) conducting all appropriate safety training and education.

6.1 Access

Access to the turbine from the outside is through a door located at the entrance platform approximately 3 meter above ground level. The door is equipped with a lock. Access to the top platform in the tower is by a ladder or service lift. Access to the nacelle from the top platform is by ladder. Access to the transformer room in the nacelle is controlled with a lock. Unauthorised access to electrical switchboards and power panels in the turbine is prohibited according to IEC 60204-1 2006.

6.2 Escape

In addition to the normal access routes, alternative escape routes from the nacelle are through the crane hatch, from the spinner by opening the nose cone, or from the roof of the nacelle. Rescue equipment is placed in the nacelle.

The hatch in the roof can be opened from both the inside and outside. Escape from the service lift is by ladder.

An emergency response plan, placed in the turbine, describes evacuation and escape routes.

6.3 Rooms/Working Areas

The tower and nacelle are equipped with power sockets for electrical tools for service and maintenance of the turbine.

6.4 Floors, Platforms, Standing, and Working Places

All floors have anti-slip surfaces.

There is one floor per tower section.

Rest platforms are provided at intervals of 9 metres along the tower ladder between platforms.

Foot supports are placed in the turbine for maintenance and service purposes.

6.5 Service Lift

The turbine is delivered with a service lift installed as an option.

6.6 Climbing Facilities

The tower ladder is equipped with a fall arrest system, either a rail system or a wire.

The service areas in the turbines are equipped with anchor points. The anchor point may be used for work positioning, fall restraint, fall arrest and to attach a descent device to perform rescue or escape from the turbine.

Anchor points are coloured yellow and are tested to 22.5 kN.

6.7 Moving Parts, Guards, and Blocking Devices

All moving parts in the nacelle are shielded.

The turbine is equipped with a rotor lock to block the rotor and drive train.

Blocking the pitch of the cylinder can be done with mechanical tools in the hub.

6.8 Lights

The turbine is equipped with lights in the tower, nacelle and hub.

There is emergency light in case of the loss of electrical power.

6.9 Emergency Stop

There are emergency stop buttons in the nacelle, hub and bottom of the tower.

6.10 Power Disconnection

The turbine is equipped with breakers to allow for disconnection from all power sources during inspection or maintenance. The switches are marked with signs and are located in the nacelle and bottom of the tower.

6.11 Fire Protection/First Aid

A handheld 5-6 kg CO_2 fire extinguisher, first aid kit and fire blanket are required to be located in the nacelle during service and maintenance.

- A handheld 5-6 kg CO_2 fire extinguisher is required only during service and maintenance activities, unless a permanently mounted fire extinguisher located in the nacelle is mandatorily required by authorities.
- First aid kits are required only during service and maintenance activities.
- Fire blankets are required only during non-electrical hot work activities.

6.12 Warning Signs

Warning signs placed inside or on the turbine must be reviewed before operating or servicing the turbine.

6.13 Manuals and Warnings

The Vestas Corporate OH&S Manual and manuals for operation, maintenance and service of the turbine provide additional safety rules and information for operating, servicing or maintaining the turbine.

7 Environment

7.1 Chemicals

Chemicals used in the turbine are evaluated according to the Vestas Wind Systems A/S Environmental System certified according to ISO 14001:2015. The following chemicals are used in the turbine:

- Anti-freeze to help prevent the cooling system from freezing.
- Gear oil for lubricating the gearbox.
- Hydraulic oil to pitch the blades and operate the brake.
- Grease to lubricate bearings.
- Various cleaning agents and chemicals for maintenance of the turbine.

8 Design Codes

8.1 Design Codes – Structural Design

The turbine design has been developed and tested with regard to, but not limited to, the following main standards:

Design Codes	
Nacelle and Hub	IEC 61400-1 Edition 3 EN 50308

Design Codes	
Tower	IEC 61400-1 Edition 3 Eurocode 3
Blades	DNV-OS-J102 IEC 1024-1 IEC 60721-2-4 IEC 61400 (Part 1, 12 and 23) IEC WT 01 IEC DEFU R25 ISO 2813 DS/EN ISO 12944-2
Gearbox	IEC 61400-4
Generator	IEC 60034
Transformer	IEC 60076-11, IEC 60076-16, CENELEC HD637 S1
Lightning Protection	IEC 62305-1: 2006 IEC 62305-3: 2006 IEC 62305-4: 2006 IEC 61400-24:2010 JIS C 1400-24 2014
Rotating Electrical Machines	IEC 34
Safety of Machinery, Safety-related Parts of Control Systems	IEC 13849-1
Safety of Machinery – Electrical Equipment of Machines	IEC 60204-1

Table 8-1: Design codes

9 Colours

9.1 Nacelle Colour

Colour of Vestas Nacelles	
Standard Nacelle Colour	RAL 7035 (light grey)
Standard Logo	Vestas

Table 9-1: Colour, nacelle

9.2 Tower Colour

Colour of Vestas Tower Section		
	External:	**Internal:**
Standard Tower Colour	RAL 7035 (light grey)	RAL 9001 (cream white)

Table 9-2: Colour, tower

9.3 Blade Colour

Blade Colour	
Standard Blade Colour	RAL 7035 (light grey). All lightning receptor surfaces on the blades are unpainted, excluding the Solid Metal Tips (SMT).
Tip-End Colour Variants	RAL 2009 (traffic orange), RAL 3020 (traffic red)
Gloss	< 30% DS/EN ISO 2813

Table 9-3: Colour, blades

10 Operational Envelope and Performance Guidelines

Actual climate and site conditions have many variables and should be considered in evaluating actual turbine performance. The design and operating parameters set forth in this section do not constitute warranties, guarantees, or representations as to turbine performance at actual sites.

10.1 Climate and Site Conditions

Values refer to hub height:

Extreme Design Parameters	
Wind Climate	**All**
Ambient Temperature Interval (Standard Temperature Turbine)	-40° to +50°C

Table 10-1: Extreme design parameters

10.2 Operational Envelope – Temperature and Altitude

Values below refer to hub height and are determined by the sensors and control system of the turbine.

Operational Envelope – Temperature	
Ambient Temperature Interval (V117 and V136 Standard Turbine)	-20° to +45°C
Ambient Temperature Interval (V117 and V136 Low Temperature Turbine)	-30° to +45°C

Operational Envelope – Temperature	
Ambient Temperature Interval (V150 Standard Turbine)	-30° to +45°C

Table 10-2: Operational envelope – temperature

NOTE The wind turbine will stop producing power at ambient temperatures above 45°C.

For the low temperature options of the wind turbine, consult Vestas.

The turbine is designed for use at altitudes up to 1000 m above sea level as standard and optional up to 2000 m above sea level.

10.3 Operational Envelope – Temperature and Altitude

The turbine comes in two cooler top configurations with different performance as function of temperature. Figure 10-1 illustrate performance for standard cooler top and Figure 10-2 illustrate performance for high temperature cooler top. (HT version is not available for all turbine variants. Please consult Vestas for more information).

The values in the graphs refer to hub height and are determined by the sensors and control system of the turbine. At ambient temperatures above the thresholds shown in the figures the turbine will maintain derated production. The derate values depend of the altitude of the turbine.

The graphs show the derate curve for PO1. Mode 0, LO1 and LO2 will follow the same derate curve, but with a nominal power at respectively 4.0MW, 3.8MW and 3.6MW.

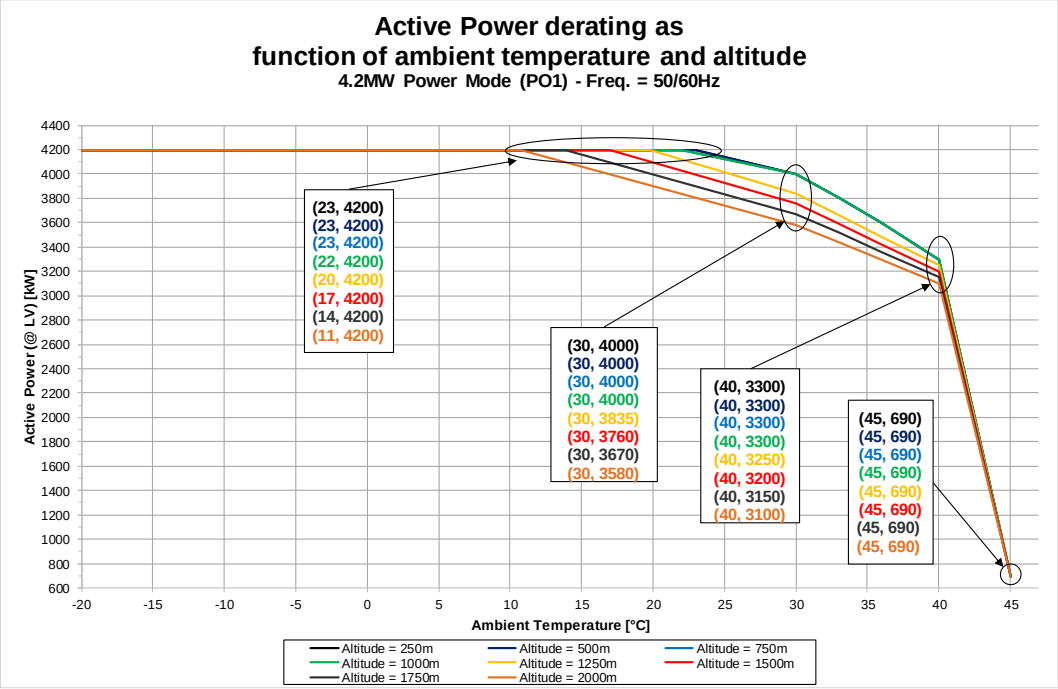


Figure 10-1: Temperature dependant derated operation – Standard Cooler Top.

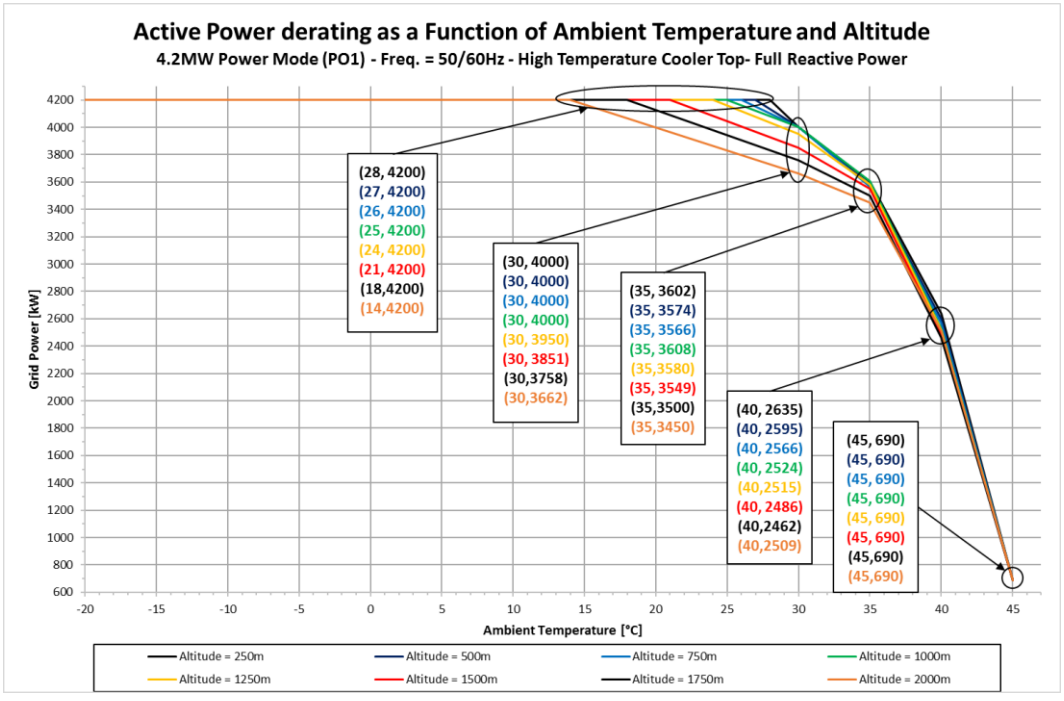


Figure 10-2: Temperature dependant derated operation – High Temperature Cooler Top.

10.4 Operational Envelope – Grid Connection

Operational Envelope – Grid Connection		
Nominal Phase Voltage	[U_{NP}]	720 V
Nominal Frequency	[f_N]	50/60 Hz
Maximum Frequency Gradient	±4 Hz/sec.	
Maximum Negative Sequence Voltage	3% (connection) 2% (operation)	
Minimum Required Short Circuit Ratio at Turbine HV Connection	5.0 (contact Vestas for lower SCR levels)	
Maximum Short Circuit Current Contribution	Contact Vestas for details	

Table 10-3: Operational envelope – grid connection

The generator and the converter will be disconnected if*:

Protection Settings	
Voltage Above 110% of Nominal for 1800 Seconds**	792 V
Voltage Above 116% of Nominal for 60 Seconds	835 V
Voltage Above 125% of Nominal for 2 Seconds	900 V
Voltage Above 136% of Nominal for 0.150 Seconds	979 V
Voltage Below 90% of Nominal for 180 Seconds (FRT)**	648 V
Voltage Below 85% of Nominal for 12 Seconds (FRT)	612 V
Voltage Below 80% of Nominal for 4.8 Seconds (FRT)	576 V
Frequency is Above 106% of Nominal for 0.2 Seconds	53/63.6 Hz
Frequency is Below 94% of Nominal for 0.2 Seconds	47/56.4 Hz

Table 10-4: Generator and converter disconnecting values

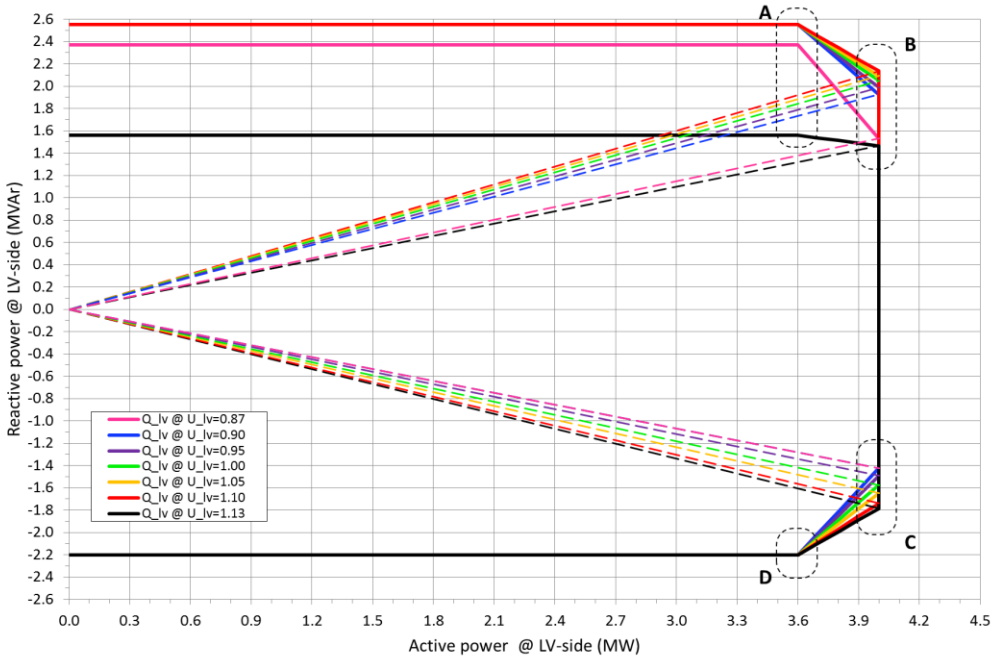
NOTE

* Over the turbine lifetime, grid drop-outs are to occur at an average of no more than 50 times a year.

** The turbine may be configured for continuous operation @ +/- 13 % voltage. Reactive power capability is limited for these widened settings to an extent that is yet to be determined.

10.5 Operational Envelope – Reactive Power Capability in 4.0 MW Mode 0

The turbine has a reactive power capability in 4.0 MW Mode 0 on the low voltage side of the HV transformer as illustrated in Figure 10-3:



		Coordinates								Power factor	
	Point:	A		B		C		D		B (Capacitive)	C (Inductive)
	Coordinate:	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)		
	Reactive power [kVAr] @ LV side @ U_lv = 0.87 p.u. voltage	3.600	2.370	4.000	1.530	4.000	-1.425	3.600	-2.200	0.934	0.942
	Reactive power [kVAr] @ LV side @ U_lv = 0.90 p.u. voltage	3.600	2.550	4.000	1.926	4.000	-1.425	3.600	-2.200	0.901	0.942
	Reactive power [kVAr] @ LV side @ U_lv = 0.95 p.u. voltage	3.600	2.550	4.000	1.988	4.000	-1.491	3.600	-2.200	0.895	0.937
	Reactive power [kVAr] @ LV side @ U_lv = 1.00 p.u. voltage	3.600	2.550	4.000	2.049	4.000	-1.575	3.600	-2.200	0.890	0.930
	Reactive power [kVAr] @ LV side @ U_lv = 1.05 p.u. voltage	3.600	2.550	4.000	2.093	4.000	-1.648	3.600	-2.200	0.886	0.925
	Reactive power [kVAr] @ LV side @ U_lv = 1.10 p.u. voltage	3.600	2.550	4.000	2.137	4.000	-1.740	3.600	-2.200	0.882	0.917
	Reactive power [kVAr] @ LV side @ U_lv = 1.13 p.u. voltage	3.600	1.560	4.000	1.465	4.000	-1.787	3.600	-2.200	0.939	0.913

Figure 10-3: Reactive power capability for 4.0 MW Mode 0.

When operating at 4.0 MW nominal power at LV side of the HV transformer, the reactive power capability on the high voltage side of the HV transformer is approximately:

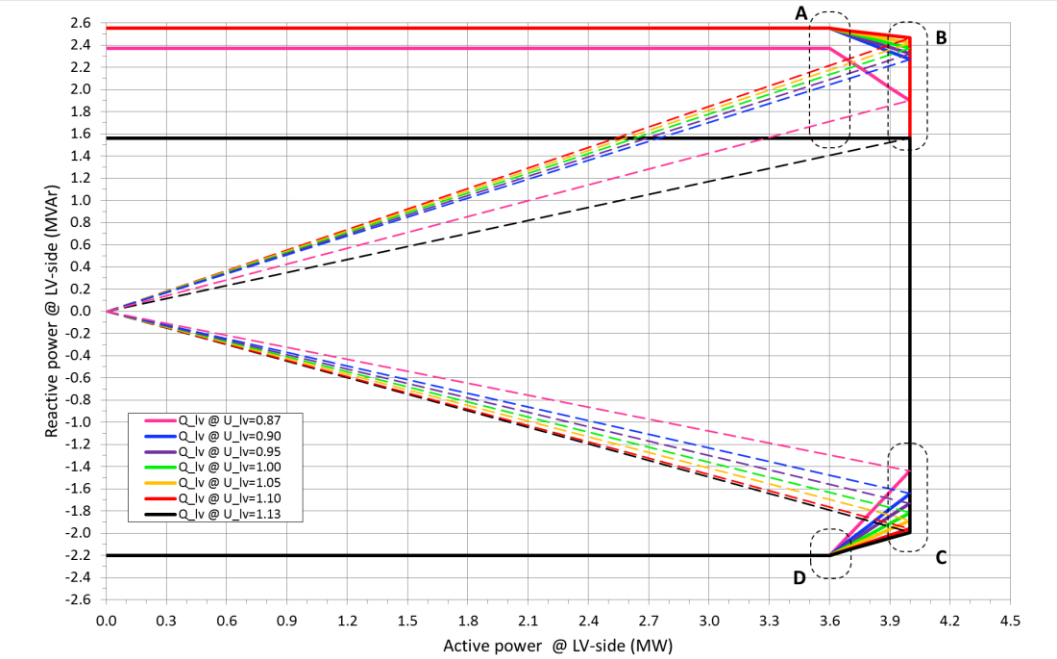
- cosφ(HV) = 0.95/0.90 capacitive/inductive @ U(HV) = 0.90 p.u. voltage
- cosφ(HV) = 0.93/0.87 capacitive/inductive @ U(HV) = 1.10 p.u. voltage

Reactive power is produced by the full-scale converter. Traditional capacitors are, therefore, not used in the turbine.

The turbine is able to maintain the reactive power capability at low wind with no active power production.

10.6 Operational Envelope – Reactive Power Capability in 4.0 MW Reactive Power Optimized Mode (QO1)

An optional, extended reactive power capability is available with 4.0 MW Reactive Power Optimized Mode (QO1) when ambient temperature is below +20°C for ≤1000 m.a.s.l. The reactive power capability is as seen in Figure 10-4:



	Point:	Coordinates A		B		C		D		Power factor B (Capacitive)	Power factor C (Inductive)
	Coordinate:	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)		
	Reactive power [kVAr] @ LV side @ U_lv = 0.87 p.u. voltage	3.600	2.370	4.000	1.900	4.000	-1.438	3.600	-2.200	0.903	0.941
	Reactive power [kVAr] @ LV side @ U_lv = 0.90 p.u. voltage	3.600	2.550	4.000	2.272	4.000	-1.643	3.600	-2.200	0.870	0.925
	Reactive power [kVAr] @ LV side @ U_lv = 0.95 p.u. voltage	3.600	2.550	4.000	2.323	4.000	-1.733	3.600	-2.200	0.865	0.918
	Reactive power [kVAr] @ LV side @ U_lv = 1.00 p.u. voltage	3.600	2.550	4.000	2.373	4.000	-1.815	3.600	-2.200	0.860	0.911
	Reactive power [kVAr] @ LV side @ U_lv = 1.05 p.u. voltage	3.600	2.550	4.000	2.419	4.000	-1.888	3.600	-2.200	0.856	0.904
	Reactive power [kVAr] @ LV side @ U_lv = 1.10 p.u. voltage	3.600	2.550	4.000	2.464	4.000	-1.960	3.600	-2.200	0.851	0.898
	Reactive power [kVAr] @ LV side @ U_lv = 1.13 p.u. voltage	3.600	1.560	4.000	1.560	4.000	-1.994	3.600	-2.200	0.932	0.895

Figure 10-4: Reactive power capability for 4.0 MW Reactive Power Optimized Mode (QO1).

When operating at 4.0 MW in Reactive Power Optimized Mode (QO1) at LV side of the HV transformer, the reactive power capability on the high voltage side of the HV transformer is approximately:

- cosφ(HV) = 0.92/0.88 capacitive/inductive @ U(HV) = 0.90 p.u. voltage
- cosφ(HV) = 0.90/0.85 capacitive/inductive @ U(HV) = 1.10 p.u. voltage

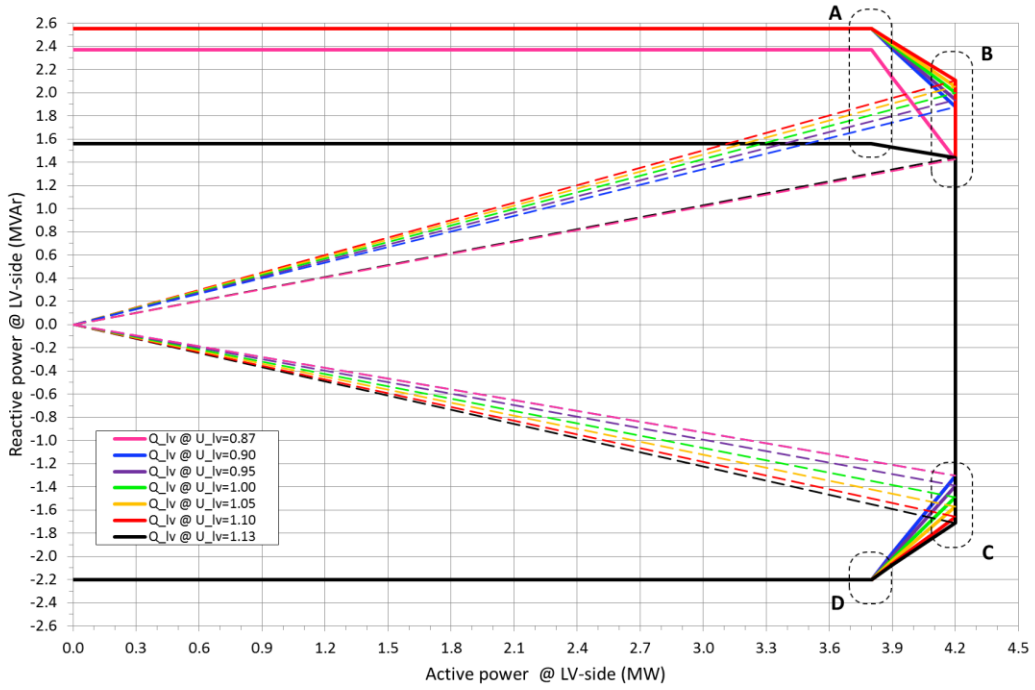
The turbine is able to maintain the reactive power capability at low wind with no active power production.

NOTE

4.0 MW Reactive Power Optimized Mode (QO1) derates reactive power linearly above +20°C ambient temperature to converge with the reactive power capability of 4.0 MW Mode 0 in Figure 10-3 at +30°C.

10.7 Operational Envelope – Reactive Power Capability in 4.2 MW Power Optimized Mode (PO1)

The reactive power capability for the 4.2 MW Power Optimized Mode (PO1) is as illustrated in Figure 10-5:



		Coordinates								Power factor	
	Point:	A		B		C		D		B (Capacitive)	C (Inductive)
	Coordinate:	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)		
	Reactive power [kVAr] @ LV side @ U_lv = 0.87 p.u. voltage	3.800	2.370	4.200	1.425	4.200	-1.304	3.800	-2.200	0.947	0.955
	Reactive power [kVAr] @ LV side @ U_lv = 0.90 p.u. voltage	3.800	2.550	4.200	1.877	4.200	-1.304	3.800	-2.200	0.913	0.955
	Reactive power [kVAr] @ LV side @ U_lv = 0.95 p.u. voltage	3.800	2.550	4.200	1.938	4.200	-1.392	3.800	-2.200	0.908	0.949
	Reactive power [kVAr] @ LV side @ U_lv = 1.00 p.u. voltage	3.800	2.550	4.200	1.998	4.200	-1.490	3.800	-2.200	0.903	0.942
	Reactive power [kVAr] @ LV side @ U_lv = 1.05 p.u. voltage	3.800	2.550	4.200	2.052	4.200	-1.570	3.800	-2.200	0.898	0.937
	Reactive power [kVAr] @ LV side @ U_lv = 1.10 p.u. voltage	3.800	2.550	4.200	2.105	4.200	-1.660	3.800	-2.200	0.894	0.930
	Reactive power [kVAr] @ LV side @ U_lv = 1.13 p.u. voltage	3.800	1.560	4.200	1.439	4.200	-1.712	3.800	-2.200	0.946	0.926

Figure 10-5: Reactive power capability for 4.2 MW Power Optimized Mode (PO1).

When operating at 4.2 MW in Power Optimized Mode (PO1) at LV side of the HV transformer, the reactive power capability on the high voltage side of the HV transformer is approximately:

- cosφ(HV) = 0.95/0.91 capacitive/inductive @ U(HV) = 0.90 p.u. voltage
- cosφ(HV) = 0.94/0.88 capacitive/inductive @ U(HV) = 1.10 p.u. voltage

The turbine is able to maintain the reactive power capability at low wind with no active power production.

NOTE

4.2 MW Power Optimized Mode (PO1) is mutually exclusive with 4.0 MW Reactive Power Optimized Mode (QO1) (since Q is traded for P).

10.8 Operational Envelope – Temperature dependent Reactive Power Capability

The reactive power capabilities shown in Figure 10-3, Figure 10-4 and Figure 10-5 are valid for ambient temperatures at which no active power derate is needed according to **Error! Reference source not found.** and **Error! Reference source t found.**.

For ambient temperatures up to 40°C, where active power is derated as a consequence of ambient temperature, the shape of the PQ chart (E.g. Figure 10-3: A, B, C and D points) is maintained. The active power for the A, B, C and D points is however adjusted according to the overall WTG active power derate according to Figure 10-1 and Figure 10-2.

For ambient temperatures between 40°C and 45°C, reactive power is derated proportional to the active power derate.

Figure 10-6 shows an illustrative example of the reactive power derate.

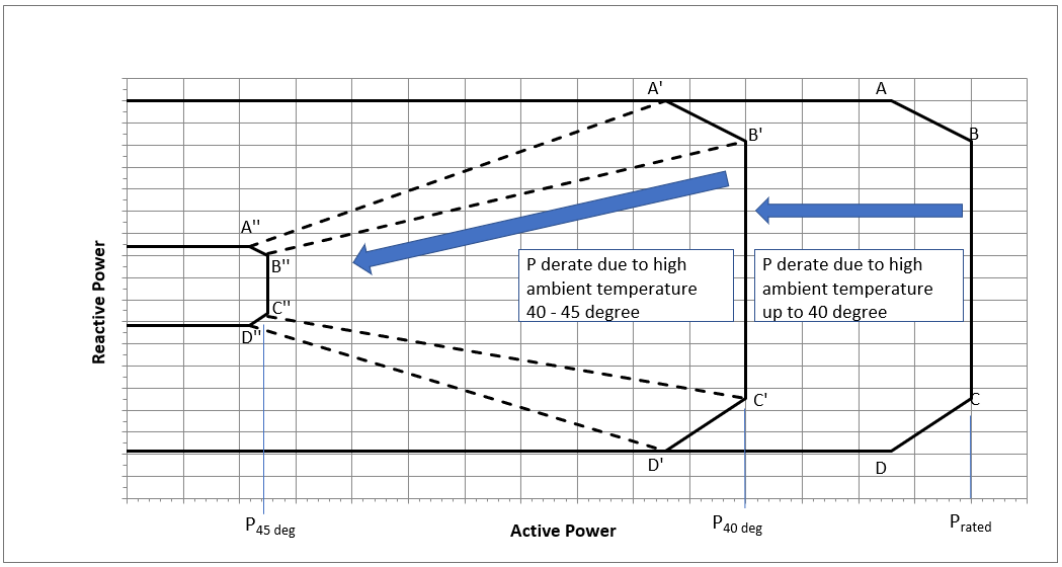


Figure 10-6: Reactive power capability temperature dependency. Illustrative example.

10.9 Performance – Fault Ride Through

The turbine is equipped with a full-scale converter to gain better control of the wind turbine during grid faults. The turbine control system continues to run during grid faults.

The turbine is designed to stay connected during grid disturbances within the voltage tolerance curve as illustrated below:

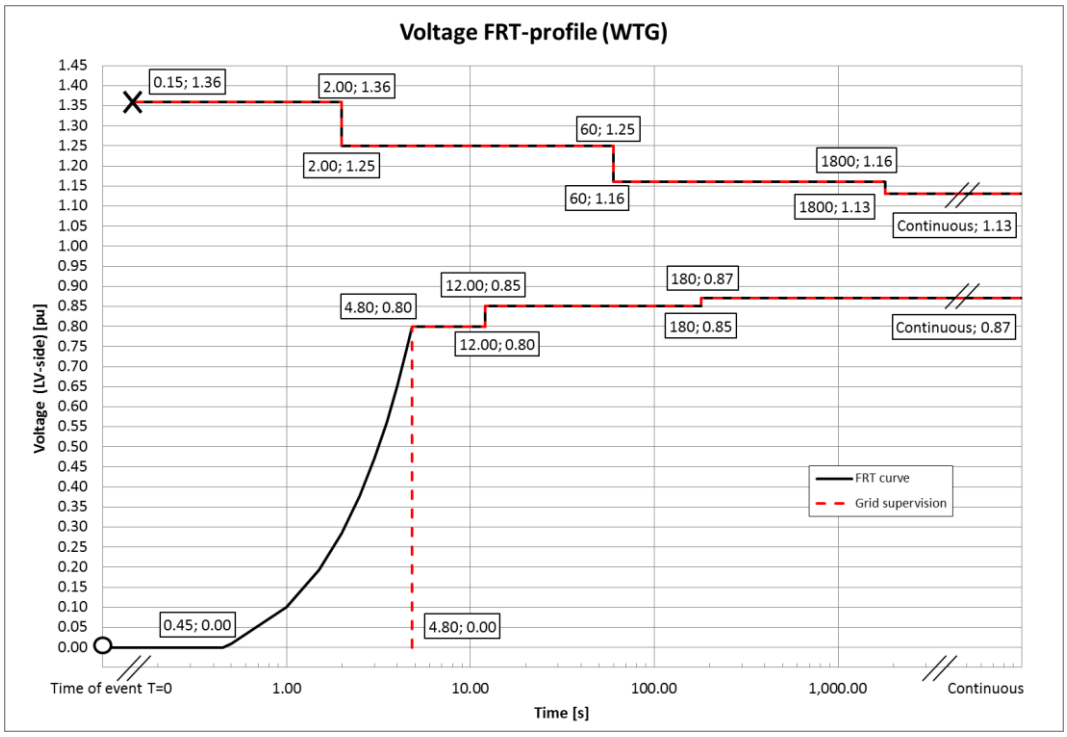


Figure 10-7: Voltage tolerance curve for symmetrical and asymmetrical faults, where U represents voltage as measured on the grid.

For grid disturbances outside the tolerance curve in Figure 10-7, the turbine will be disconnected from the grid.

Power Recovery Time	
Power Recovery to 90% of Pre-Fault Level	Maximum 0.1 seconds

Table 10-5: Power recovery time

10.10 Performance – Reactive Current Contribution

The reactive current contribution depends on whether the fault applied to the turbine is symmetrical or asymmetrical.Symmetrical Reactive Current Contribution

During symmetrical voltage dips, the wind farm will inject reactive current to support the grid voltage. The reactive current injected is a function of the measured grid voltage.

The default value gives a reactive current part of 1 p.u. of the rated active current at the high voltage side of the HV transformer. Figure 10-8, indicates the reactive current contribution as a function of the voltage. The reactive current contribution is independent from the actual wind conditions and pre-fault power level. As seen in Figure 10-8, the default current injection slope is 2% reactive current increase per 1% voltage decrease. The slope can be parameterized between 0 and 10 to adapt to site specific requirements.

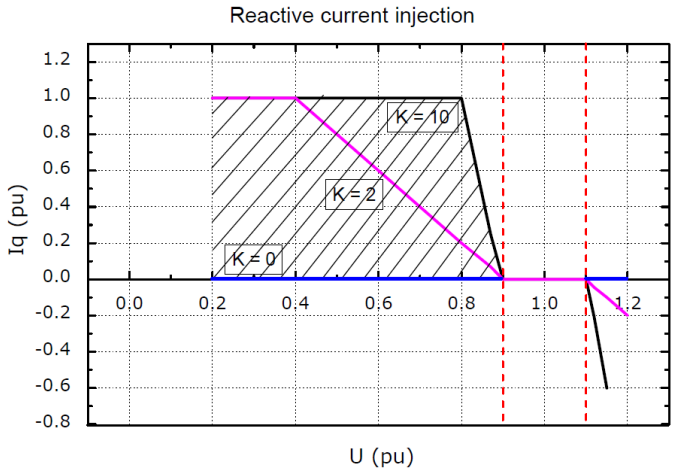


Figure 10-8: Reactive current injection

10.10.1 Asymmetrical Reactive Current Contribution

The injected current is based on the measured positive sequence voltage and the used K-factor. During asymmetrical voltage dips, the reactive current injection is limited to approximate 0.4 p.u. to limit the potential voltage increase on the healthy phases.

10.11 Performance – Multiple Voltage Dips

The turbine is designed to handle re-closure events and multiple voltage dips within a short period of time due to the fact that voltage dips are not evenly distributed during the year. For example, the turbine is designed to handle 10 voltage dips of duration of 200 ms, down to 20% voltage, within 30 minutes.

10.12 Performance – Active and Reactive Power Control

The turbine is designed for control of active and reactive power via the VestasOnline® SCADA system.

Maximum Ramp Rates for External Control	
Active Power	0.1 p.u./sec for max. power level change of 0.3 p.u. 0.3 p.u./sec for max. power level change of 0.1 p.u.
Reactive Power	20 p.u./sec

Table 10-6: Active/reactive power ramp rates.

To support grid stability the turbine is capable to stay connected to the grid at active power references down to 10 % of nominal power for the turbine. For active power references below 10 % the turbine may disconnect from the grid.

10.13 Performance – Voltage Control

The turbine is designed for integration with VestasOnline® voltage control by utilising the turbine reactive power capability.

10.14 Performance – Frequency Control

The turbine can be configured to perform frequency control by decreasing the output power as a linear function of the grid frequency (over frequency). Dead band and slope for the frequency control function are configurable.

10.15 Distortion – Immunity

The turbine is able to connect with a pre-connection (background) voltage distortion level at the grid interface of 8% and operate with a post-connection voltage distortion level of 8%.

10.16 Main Contributors to Own Consumption

The consumption of electrical power by the wind turbine is defined as the power used by the wind turbine when it is not providing energy to the grid. This is defined in the control system as Production Generator 0 (zero).

The components in Table 10-7 have the largest influence on the own consumption of the wind turbine (the average own consumption depends on the actual conditions, the climate, the wind turbine output, the cut-off hours, etc.).

The VMP8000 control system has a hibernate mode that reduces own consumption when possible. Similarly, cooling pumps may be turned off when the turbine idles.

Main contributors to Own Consumption	
Hydraulic Motor	2 x 15 (V117) / 18.5 kW (V136 + V150) (master-slave)
Yaw Motors	Maximum 21 kW in total
Water Heating	10 kW
Water Pumps	2.2 + 5.5 kW
Oil Heating	7.9 kW
Oil Pump for Gearbox Lubrication	12.5 kW
Controller Including Heating Elements for the Hydraulics and all Controllers	Approximately 3 kW
HV Transformer No-load Loss	See section 4.3 HV Transformer, p. 14

Table 10-7: Main contributors to own consumption data.

11 Drawings

11.1 Structural Design – Illustration of Outer Dimensions

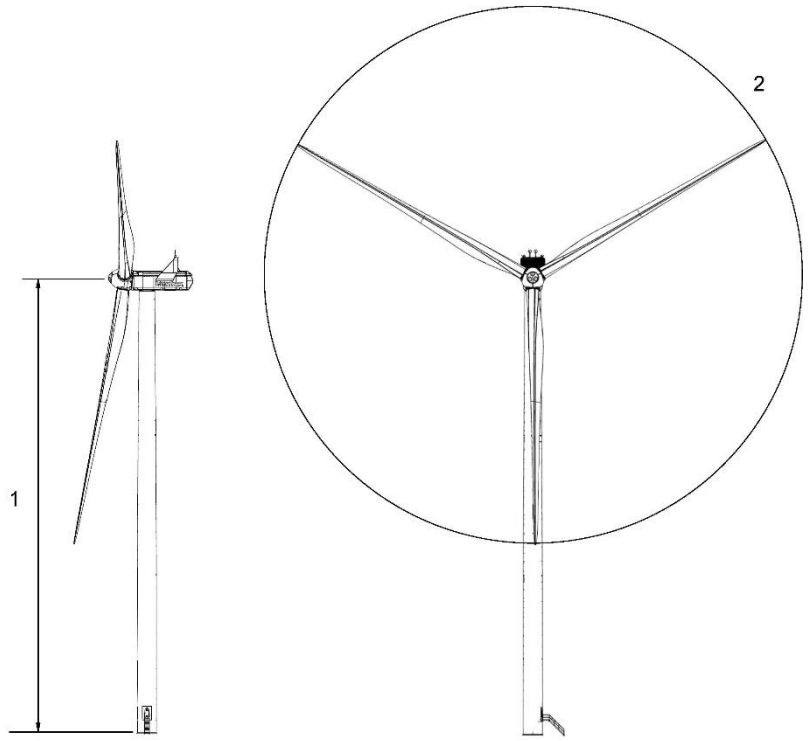


Figure 11-1: Illustration of outer dimensions – structure

1 Hub heights: See Performance Specification

2 Rotor diameter: 117-150 m

11.2 Structural Design – Side View Drawing

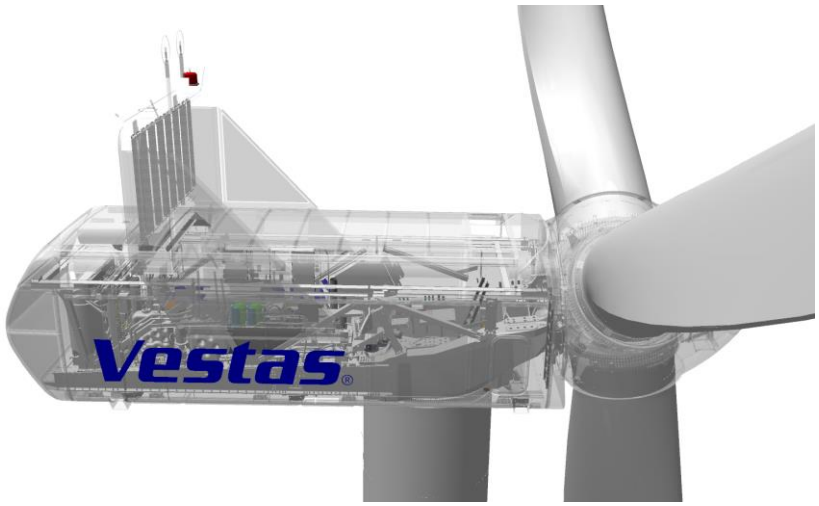


Figure 11-2: Side-view drawing

12 General Reservations, Notes and Disclaimers

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- The general descriptions in this document apply to the current version of the 4MW Platform wind turbines. Updated versions of the 4MW Platform wind turbines, which may be manufactured in the future, may differ from this general description. In the event that Vestas supplies an updated version of a specific 4MW Platform wind turbine, Vestas will provide an updated general description applicable to the updated version.
- Vestas recommends that the grid be as close to nominal as possible with limited variation in frequency and voltage.
- A certain time allowance for turbine warm-up must be expected following grid dropout and/or periods of very low ambient temperature.
- All listed start/stop parameters (e. g. wind speeds and temperatures) are equipped with hysteresis control. This can, in certain borderline situations, result in turbine stops even though the ambient conditions are within the listed operation parameters.
- The earthing system must comply with the minimum requirements from Vestas, and be in accordance with local and national requirements and codes of standards.
- This document, General Description, is not an offer for sale, and does not contain any guarantee, warranty and/or verification of the power curve and noise (including, without limitation, the power curve and noise verification method). Any guarantee, warranty and/or verification of the power curve and noise (including, without limitation, the power curve and noise verification method) must be agreed to separately in writing.

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2025-02-26

Performance Specification

V136-4.0/4.2 MW 50/60 Hz

Table of contents

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See general reservations, notes and disclaimers (including, Section 5, p. 13) to this Performance Specification.

1 General Description

The Vestas V136-4.0/4.2 MW wind turbine is a pitch regulated upwind turbine with active yaw and a three-blade rotor. The Vestas V136-4.0/4.2 MW turbine has a rotor diameter of 136 m and a rated power of 4.0 MW.

Vestas offers an optional Power Optimized (PO) mode at 4.2 MW for the V136-4.0 MW variant.

2 Type Approvals and Available Hub Heights

The standard turbine is type certified according to the certification standards and available hub heights listed below:

Certification	Wind Class	Hub Height	
Tower type		**Standard**	**Large diameter (split)**
IEC61400-22	IEC IIB	105 m(1) / 112 m / 117 m(1)	
	IEC IIIB		
DIBt 2012	WZ4(S), GK2	112 m	
	WZ2(S), GK2		149 m / 166 m

Table 2-1: Type approval data and available hub heights

(1): Special transport optimized tower for US/Canada.

The hub height can be increased by up to 3 m by use of raised foundation. Use of raised foundation is subject to site-specific evaluation and is not available for all soil conditions.

3 Operational Envelope and Performance Guidelines

Actual climate and site conditions have many variables and should be considered in evaluating actual turbine performance. The design and operating parameters set forth in this section does not constitute warranties, guarantees, or representations as to turbine performance at actual sites.

3.1 Climate and Site Conditions

The standard turbine is designed for the wind climate conditions listed below. Values refer to hub height.

Wind Climate	IEC IIB	IEC IIB S
Hub Height	**105/112/117 m**	**105/112/117 m**
Power Rating	**4.0MW**	**4.2MW**
Extr Wind Speed (10 min average), V_{50}	42.5 m/s	42.5 m/s
Survival Wind Speed (3 s gust), V_{e50}	59.5 m/s	59.5 m/s
Turbulence Intensity, I_{V50}	11%	11%

Table 3-1: Extreme design parameters – IEC

Wind Climate	IEC IIB	IEC IIB S
Hub Height	**105/112/117 m**	**105/112/117 m**
Power Rating	**4.0MW**	**4.2MW**
Wind Speed (10 min average), V_{ave}	8.5 m/s	8.0 m/s
Weibull Scale Factor, C	9.6 m/s	8.9 m/s
Weibull Shape Factor, k	2.0	2.0
I_{ref} acc. to IEC 61400-1	0.14	0.14
Turbulence Intensity acc. to IEC 61400-1, Including Wind Farm Turbulence (@15 m/s) I_{90} (90% quantile)	15.7%	15.7%
Wind Shear, α	0.20	0.20
Inflow Angle (vertical)	8°	8°

Table 3-2: Average design parameters – IEC

Wind Climate / Terrain Category	WZ4(S), GK2	WZ2(S), GK2	WZ2(S), GK2
Hub Height	**112 m**	**149 m**	**166 m**
Power Rating	**4.0/4.2MW**	**4.0/4.2MW**	**4.0/4.2MW**
Extr Wind Speed (10 min average), V_{50}	42.5 m/s	38.5 m/s	39.2 m/s
Survival Wind Speed (3 s gust), V_{e50}	59.5 m/s	53.9 m/s	54.9 m/s
Turbulence intensity, $I_{v(z)}$	12.9%	12.3%	12.1%

Table 3-3: Extreme design parameters – DIBt

Wind Climate / Terrain Category	WZ4(S), GK2	WZ2(S), GK2	WZ2(S), GK2
Hub Height	**112 m**	**149 m**	**166 m**
Power Rating	**4.0/4.2MW**	**4.0/4.2MW**	**4.0/4.2MW**
Wind Speed (10 min average), V_{ave}	7.95 m/s	7.63 m/s	7.05 m/s
I_{ref} acc. to IEC 61400-1	0.14	0.14	0.14
Turbulence Intensity acc. to IEC 61400-1, Including Wind Farm Turbulence (@15 m/s) I_{90} (90% quantile)	15.7%	15.7%	15.7%

Table 3-4: Average design parameters – DIBt

3.1.1 Complex Terrain

Classification of complex terrain according to IEC 61400-1:2005 Chapter 11.2. For sites classified as complex, appropriate measures are to be included in site assessment. Positioning of each turbine must be verified via Vestas Site Check.

3.1.2 Altitude

The turbine is designed for use at altitudes up to 1000 m above sea level as standard and optional up to 2000 m above sea level.

3.1.3 Wind Power Plant Layout

Turbine spacing is to be evaluated site-specifically. Spacing below two rotor diameters (2D) may require sector-wise curtailment.

NOTE As evaluation of climate and site conditions is complex, consult Vestas for every project. If conditions exceed the above parameters, Vestas must be consulted.

3.2 Operational Envelope – Wind

Values refer to hub height and are determined by the sensors and control system of the turbine.

Wind climate	**IEC IIB / IEC IIB S**
Hub height	**105 / 112 / 117 m**
Cut-In, V_{in}	3 m/s
Cut-Out (10 min exponential avg.), V_{out}	27.0 m/s
Re-Cut In (10 min exponential avg.)	25.0 m/s

Table 3-5: Operational envelope – wind – IEC

Wind climate	**WZ4(S)**	**WZ2(S)**
Hub height	**112 m**	**149 / 166 m**
Cut-In, V_{in}	3 m/s	3 m/s
Cut-Out (10 min exponential avg.), V_{out}	27.0 m/s	27.0 m/s
Re-Cut In (10 min exponential avg.)	25.0 m/s	25.0 m/s

Table 3-6: Operational envelope – wind – DIBt

3.3 Operational Envelope – Wind (HWO)

Optionally, the turbine can be offered with the High Wind Operation (HWO) control feature. The HWO control feature allows the turbine to operate up to the extended cut-out wind speeds listed in Table 3-7, p. 9 and Table 3-8, p. 9, with a controlled derating of power and speed. The power curves associated with optional HWO control are found in Sections 7, 9, 11, 13, 15, 17 and 19. Values refer to hub height and are determined by the sensors and control system of the turbine.

Wind climate	IEC IIB / IEC IIB S
Hub height	**105 / 112 / 117 m**
Cut-In, V_{in}	3 m/s
Cut-Out (10 min exponential avg.), V_{out}	32.0 m/s
Re-Cut In (10 min exponential avg.)	30.0 m/s

Table 3-7: Operational envelope – wind – IEC (High Wind Operation)

Wind climate	WZ4(S)	WZ2(S)
Hub height	**112 m**	**149 / 166 m**
Cut-In, V_{in}	3 m/s	3 m/s
Cut-Out (10 min exponential avg.), V_{out}	32.0 m/s	32.0 m/s
Re-Cut In (10 min exponential avg.)	30.0 m/s	30.0 m/s

Table 3-8: Operational envelope – wind – DIBt (High Wind Operation)

3.4 Operational Envelope – Conditions for Power Curve and Ct Values (at Hub Height)

Consult Section 6 and following sections for power curves and C_t values.

Conditions for Power Curve and C_t Values (at Hub Height)	
Wind Shear, α	0.00-0.30 (10 minute average)
Turbulence Intensity, I	6-12% (10 minute average)
Blades	Clean
Rain	No
Ice/Snow on Blades	No
Leading Edge	No damage
Terrain	IEC 61400-12-1
Inflow Angle (Vertical)	0 ±2°
Grid Voltage	Nominal Voltage ±2.5%
Grid Frequency	Nominal Frequency ±0.5 Hz
Grid Active Power (at LV-side of turbine transformer)	As per tabulated values from Section 6 and onwards
Grid Reactive Power (at LV-side of turbine transformer)	Power Factor 1.0

Table 3-9: Conditions for power curve and Ct values

3.5 Sound Modes

The sound modes listed below are available for the turbine.

Sound modes			
Mode No.	**Maximum Sound Level**	**Serrated trailing edges**	**Available hub heights**
0	103.9 dBA	Yes (standard)	105 / 112 / 117 / 149 / 166 m
0-0S	106.9 dBA	No (option)	105 / 112 / 117 / 149 / 166 m
PO1	103.9 dBA	Yes (standard)	105 / 112 / 117 / 149 / 166 m
PO1-0S	106.9 dBA	No (option)	105 / 112 / 117 / 149 / 166 m

Table 3-10: Available sound performance

NOTE The turbine is as standard equipped with serrated trailing edges on the blades. Optionally, Mode 0-0S can be offered without serrated trailing edges mounted on the blades.

In addition, Sound Optimized (SO) modes as listed below are available as options for the turbine.

Sound Optimized (SO) modes			
Mode No.	**Maximum Sound Level**	**Serrated trailing edges**	**Available hub heights**
SO1	102.0 dBA	Yes	105 / 112 / 117 / 149 / 166 m
SO2	99.5 dBA	Yes	105 / 112 / 117 / 149 / 166 m
SO6	99.5 dBA	Yes	105 / 112 m(1)
SO11	99.2 dBA	Yes	112 m(1)
SO12	99.9 dBA	Yes	112 m(1)
SO13	97.0 dBA	Yes	112 m(1)
SO7	99.2 dBA	Yes	105 / 112 m(1)
SO8	99.9 dBA	Yes	105 / 112 m(1)

Table 3-11: Available Sound Optimized modes

(1): SO6, SO11, SO12, SO13, SO7, SO8 is not applicable for DIBt towers

NOTE Sound Optimized (SO) modes are only available with serrated trailing edges on the blades. For further details on sound performance and in case of specific requests for sound modes per tower, please contact Vestas Wind Systems A/S.

3.6 Load Modes

The Load Optimized (LO) modes listed below are available for the turbine.

Load Optimized (LO) modes				
Mode No.	**Power**	**Maximum Sound Level**	**Serrated trailing edges**	**Available hub heights**
LO1	3.8 MW	103.9 dBA	Yes	105 / 112 / 117 / 149 / 166 m
LO2	3.6 MW	102.5 dBA	Yes	105 / 112 / 117 m

Table 3-12: Available Load Optimized modes

NOTE

Load Optimized (LO) modes are only available with serrated trailing edges mounted on the blades.

4 Drawings

4.1 Structural Design – Illustration of Outer Dimensions

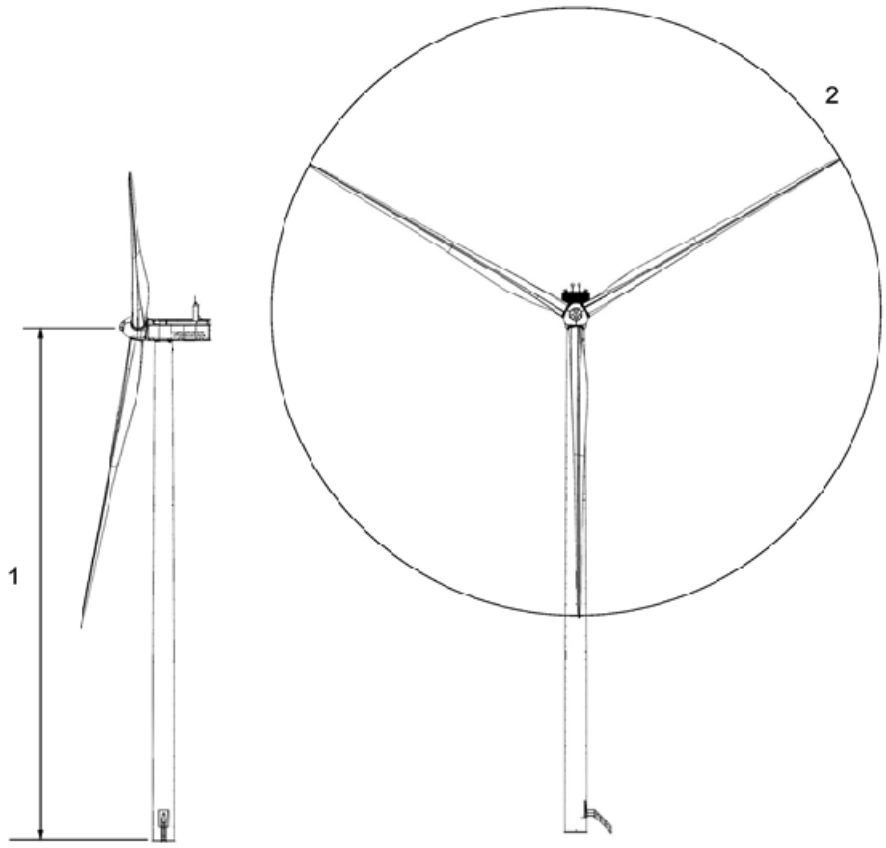


Figure 4-1: Illustration of outer dimensions – structure

1 Hub height:
105/112/117/149/166 m

2 Diameter:
136 m

5 General Reservations, Notes and Disclaimers

-
- The performance specifications described in this document apply to the current version of the V136-4.0/4.2 MW wind turbine. Updated versions of the V136-4.0/4.2 MW wind turbine, which may be manufactured in the future, may differ from these performance specifications. In the event that Vestas supplies an updated version of the V136-4.0/4.2 MW wind, Vestas will provide an updated performance specification applicable to the updated version.
- All listed start/stop parameters (e.g. wind speeds) are equipped with hysteresis control. This can, in certain borderline situations, result in turbine stops even though the ambient conditions are within the listed operation parameters.
- This document, Performance Specification, is not an offer for sale, and does not contain any guarantee, warranty and/or verification of the power curve and sound (including, without limitation, the power curve and sound verification method). Any guarantee, warranty and/or verification of the power curve and sound (including, without limitation, the power curve and sound verification method) must be agreed to separately in writing.

6 Power Curves, Ct Values and Sound Curves, Mode 0/0-0S

NOTE The power curves and Ct values presented in Section 6 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

6.1 Power Curves, Mode 0/0-0S

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	344	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	633	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1072	1119	1142
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1704**	1312	1347	1383	1419	1455	1491	1526	1562	1598	1633	1668	1739	1774
8.0	**2070**	1600	1643	1686	1730	1773	1816	1858	1901	1944	1986	2028	2112	2153
8.5	**2472**	1924	1975	2026	2077	2128	2178	2228	2278	2327	2376	2424	2520	2567
9.0	**2874**	2273	2330	2388	2446	2504	2558	2612	2667	2721	2772	2823	2923	2972
9.5	**3238**	2621	2681	2742	2803	2864	2919	2975	3030	3085	3136	3187	3286	3334
10.0	**3566**	2950	3011	3073	3135	3196	3251	3307	3362	3418	3467	3517	3610	3655
10.5	**3821**	3252	3314	3376	3438	3500	3552	3604	3656	3708	3746	3784	3849	3876
11.0	**3954**	3526	3582	3638	3694	3750	3787	3824	3861	3898	3916	3935	3964	3975
11.5	**3992**	3757	3797	3837	3877	3917	3932	3948	3963	3978	3983	3988	3994	3996
12.0	**3999**	3912	3929	3946	3964	3981	3985	3989	3993	3997	3998	3998	3999	4000
12.5	**4000**	3974	3979	3985	3991	3996	3997	3998	3999	4000	4000	4000	4000	4000
13.0	**4000**	3993	3994	3996	3998	3999	4000	4000	4000	4000	4000	4000	4000	4000
13.5	**4000**	3995	3996	3997	3998	3999	4000	4000	4000	4000	4000	4000	4000	4000
14.0	**4000**	3998	3999	3999	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
14.5	**4000**	3999	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
15.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
15.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
16.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
16.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
17.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
17.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
18.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
18.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
19.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
19.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
26.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
26.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
27.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

Table 6-1: Power curve, Mode 0/0-0S

6.2 Ct Values, Mode 0/0-0S

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.856	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.846**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.844	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.832	0.831	0.830	0.829	0.827	0.826
7.5	**0.821**	0.832	0.831	0.830	0.829	0.828	0.827	0.826	0.825	0.824	0.823	0.822	0.820	0.818
8.0	**0.822**	0.837	0.836	0.835	0.834	0.833	0.831	0.830	0.829	0.827	0.826	0.824	0.821	0.819
8.5	**0.802**	0.838	0.836	0.833	0.831	0.828	0.825	0.821	0.818	0.814	0.810	0.806	0.798	0.793
9.0	**0.745**	0.810	0.805	0.800	0.795	0.790	0.784	0.777	0.771	0.765	0.759	0.752	0.739	0.732
9.5	**0.673**	0.753	0.746	0.738	0.731	0.724	0.717	0.709	0.702	0.694	0.687	0.680	0.666	0.659
10.0	**0.606**	0.687	0.679	0.671	0.663	0.656	0.648	0.641	0.634	0.627	0.620	0.613	0.599	0.591
10.5	**0.541**	0.625	0.618	0.610	0.603	0.595	0.588	0.581	0.573	0.566	0.557	0.549	0.532	0.523
11.0	**0.471**	0.570	0.561	0.553	0.545	0.537	0.528	0.519	0.510	0.501	0.491	0.481	0.461	0.451
11.5	**0.404**	0.517	0.507	0.498	0.488	0.478	0.467	0.456	0.446	0.435	0.425	0.414	0.395	0.386
12.0	**0.348**	0.463	0.451	0.439	0.428	0.416	0.406	0.395	0.385	0.374	0.365	0.357	0.340	0.332
12.5	**0.302**	0.406	0.395	0.383	0.372	0.361	0.352	0.343	0.333	0.324	0.317	0.309	0.296	0.289
13.0	**0.265**	0.354	0.344	0.334	0.324	0.315	0.307	0.299	0.292	0.284	0.278	0.271	0.260	0.254
13.5	**0.236**	0.312	0.304	0.295	0.287	0.279	0.272	0.265	0.259	0.252	0.247	0.241	0.231	0.226
14.0	**0.210**	0.276	0.269	0.261	0.254	0.247	0.241	0.236	0.230	0.224	0.220	0.215	0.206	0.202
14.5	**0.188**	0.246	0.239	0.233	0.227	0.221	0.216	0.211	0.206	0.201	0.197	0.192	0.185	0.181
15.0	**0.169**	0.219	0.214	0.208	0.203	0.197	0.193	0.189	0.184	0.180	0.176	0.173	0.166	0.162
15.5	**0.153**	0.198	0.193	0.188	0.183	0.178	0.174	0.170	0.167	0.163	0.159	0.156	0.150	0.147
16.0	**0.139**	0.179	0.175	0.170	0.166	0.162	0.158	0.155	0.151	0.148	0.145	0.142	0.136	0.134
16.5	**0.127**	0.163	0.159	0.155	0.151	0.147	0.144	0.141	0.138	0.135	0.132	0.129	0.125	0.122
17.0	**0.116**	0.149	0.145	0.142	0.138	0.135	0.132	0.129	0.126	0.123	0.121	0.119	0.114	0.112
17.5	**0.107**	0.136	0.133	0.130	0.127	0.123	0.121	0.118	0.116	0.113	0.111	0.109	0.105	0.103
18.0	**0.098**	0.125	0.122	0.119	0.116	0.114	0.111	0.109	0.107	0.104	0.102	0.100	0.097	0.095
18.5	**0.091**	0.115	0.113	0.110	0.107	0.105	0.103	0.101	0.098	0.096	0.095	0.093	0.089	0.088
19.0	**0.084**	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.082	0.081
19.5	**0.078**	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.083	0.081	0.080	0.077	0.075
20.0	**0.073**	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.078	0.077	0.075	0.074	0.071	0.070
20.5	**0.068**	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.066
21.0	**0.064**	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.066	0.065	0.063	0.061
21.5	**0.060**	0.075	0.073	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.061	0.059	0.058
22.0	**0.057**	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055
22.5	**0.053**	0.066	0.065	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.052	0.052
23.0	**0.050**	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
23.5	**0.047**	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046
24.0	**0.045**	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.044	0.043
24.5	**0.042**	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041
25.0	**0.040**	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039
25.5	**0.039**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
26.0	**0.037**	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036
26.5	**0.035**	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.036	0.034	0.034
27.0	**0.033**	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033

Table 6-2: C_t values, Mode 0/0-0S

6.3 Sound Curves, Mode 0/0-0S

Sound Power Level at Hub Height		
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at hub height: 30% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m^3**	
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA] Mode 0 (Blades with serrated trailing edge)**	**Sound Power Level at Hub Height [dBA] Mode 0-0S (Blades without serrated trailing edge)**
3	90.9	93.2
4	91.1	93.6
5	92.9	96.5
6	96.0	100.0
7	99.6	103.2
8	102.9	106.0
9	103.9	106.9
10	103.9	106.9
11	103.9	106.9
12	103.9	106.9
13	103.9	106.9
14	103.9	106.9
15	103.9	106.9
16	103.9	106.9
17	103.9	106.9
18	103.9	106.9
19	103.9	106.9
20	103.9	106.9

Table 6-3: Sound curves, Mode 0/0-0S

7 Power Curves, Ct Values and Sound Curves, Mode 0/0-0S (HWO)

NOTE The power curves and Ct values presented in Section 7 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

7.1 Power Curves, Mode 0/0-0S (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	344	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	633	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1072	1119	1142
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1704**	1312	1347	1383	1419	1455	1491	1526	1562	1598	1633	1668	1739	1774
8.0	**2070**	1600	1643	1686	1730	1773	1816	1858	1901	1944	1986	2028	2112	2153
8.5	**2472**	1924	1975	2026	2077	2128	2178	2228	2278	2327	2376	2424	2520	2567
9.0	**2874**	2273	2330	2388	2446	2504	2558	2612	2667	2721	2772	2823	2923	2972
9.5	**3238**	2621	2681	2742	2803	2864	2919	2975	3030	3085	3136	3187	3286	3334
10.0	**3566**	2950	3011	3073	3135	3196	3251	3307	3362	3418	3467	3517	3610	3655
10.5	**3821**	3252	3314	3376	3438	3500	3552	3604	3656	3708	3746	3784	3849	3876
11.0	**3954**	3526	3582	3638	3694	3750	3787	3824	3861	3898	3916	3935	3964	3975
11.5	**3992**	3757	3797	3837	3877	3917	3932	3948	3963	3978	3983	3988	3994	3996
12.0	**3999**	3912	3929	3946	3964	3981	3985	3989	3993	3997	3998	3998	3999	4000
12.5	**4000**	3974	3979	3985	3991	3996	3997	3998	3999	4000	4000	4000	4000	4000
13.0	**4000**	3993	3994	3996	3998	3999	4000	4000	4000	4000	4000	4000	4000	4000
13.5	**4000**	3995	3996	3997	3998	3999	4000	4000	4000	4000	4000	4000	4000	4000
14.0	**4000**	3998	3999	3999	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
14.5	**4000**	3999	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
15.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
15.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
16.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
16.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
17.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
17.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
18.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
18.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
19.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
19.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.0	**3998**	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998
25.5	**3976**	3975	3975	3975	3975	3975	3975	3975	3975	3975	3975	3975	3976	3976
26.0	**3928**	3928	3928	3928	3928	3928	3928	3928	3928	3928	3928	3928	3928	3928
26.5	**3857**	3857	3857	3857	3857	3857	3857	3857	3857	3857	3857	3857	3857	3857
27.0	**3764**	3763	3763	3763	3763	3764	3764	3764	3764	3764	3764	3764	3764	3764
27.5	**3630**	3630	3630	3630	3630	3630	3630	3630	3630	3630	3630	3630	3630	3630

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**3468**	3468	3468	3468	3468	3468	3468	3468	3468	3468	3468	3468	3468	3468
28.5	**3275**	3275	3275	3275	3275	3275	3275	3275	3275	3275	3275	3275	3275	3274
29.0	**3049**	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049
29.5	**2805**	2806	2806	2806	2806	2806	2806	2806	2806	2806	2805	2805	2805	2805
30.0	**2565**	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565
30.5	**2324**	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324
31.0	**2090**	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090
31.5	**1884**	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884
32.0	**1732**	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732

Table 7-1: Power curve, Mode 0/0-0S (HWO)

7.2 Ct Values, Mode 0/0-0S (HWO)

Air density kg/m³														
Wind speed [m/s]	1.225	0.950	0.975	1.000	1.025	1.050	1.075	1.100	1.125	1.150	1.175	1.200	1.250	1.275
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.856	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.846**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.844	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.832	0.831	0.830	0.829	0.827	0.826
7.5	**0.821**	0.832	0.831	0.830	0.829	0.828	0.827	0.826	0.825	0.824	0.823	0.822	0.820	0.818
8.0	**0.822**	0.837	0.836	0.835	0.834	0.833	0.831	0.830	0.829	0.827	0.826	0.824	0.821	0.819
8.5	**0.802**	0.838	0.836	0.833	0.831	0.828	0.825	0.821	0.818	0.814	0.810	0.806	0.798	0.793
9.0	**0.745**	0.810	0.805	0.800	0.795	0.790	0.784	0.777	0.771	0.765	0.759	0.752	0.739	0.732
9.5	**0.673**	0.753	0.746	0.738	0.731	0.724	0.717	0.709	0.702	0.694	0.687	0.680	0.666	0.659
10.0	**0.606**	0.687	0.679	0.671	0.663	0.656	0.648	0.641	0.634	0.627	0.620	0.613	0.599	0.591
10.5	**0.541**	0.625	0.618	0.610	0.603	0.595	0.588	0.581	0.573	0.566	0.557	0.549	0.532	0.523
11.0	**0.471**	0.570	0.561	0.553	0.545	0.537	0.528	0.519	0.510	0.501	0.491	0.481	0.461	0.451
11.5	**0.404**	0.517	0.507	0.498	0.488	0.478	0.467	0.456	0.446	0.435	0.425	0.414	0.395	0.386
12.0	**0.348**	0.463	0.451	0.439	0.428	0.416	0.406	0.395	0.385	0.374	0.365	0.357	0.340	0.332
12.5	**0.302**	0.406	0.395	0.383	0.372	0.361	0.352	0.343	0.333	0.324	0.317	0.309	0.296	0.289
13.0	**0.265**	0.354	0.344	0.334	0.324	0.315	0.307	0.299	0.292	0.284	0.278	0.271	0.260	0.254
13.5	**0.236**	0.312	0.304	0.295	0.287	0.279	0.272	0.265	0.259	0.252	0.247	0.241	0.231	0.226
14.0	**0.210**	0.276	0.269	0.261	0.254	0.247	0.241	0.236	0.230	0.224	0.220	0.215	0.206	0.202
14.5	**0.188**	0.246	0.239	0.233	0.227	0.221	0.216	0.211	0.206	0.201	0.197	0.192	0.185	0.181
15.0	**0.169**	0.219	0.214	0.208	0.203	0.197	0.193	0.189	0.184	0.180	0.176	0.173	0.166	0.162
15.5	**0.153**	0.198	0.193	0.188	0.183	0.178	0.174	0.170	0.167	0.163	0.159	0.156	0.150	0.147
16.0	**0.139**	0.179	0.175	0.170	0.166	0.162	0.158	0.155	0.151	0.148	0.145	0.142	0.136	0.134
16.5	**0.127**	0.163	0.159	0.155	0.151	0.147	0.144	0.141	0.138	0.135	0.132	0.129	0.125	0.122
17.0	**0.116**	0.149	0.145	0.142	0.138	0.135	0.132	0.129	0.126	0.123	0.121	0.119	0.114	0.112
17.5	**0.107**	0.136	0.133	0.130	0.127	0.123	0.121	0.118	0.116	0.113	0.111	0.109	0.105	0.103
18.0	**0.098**	0.125	0.122	0.119	0.116	0.114	0.111	0.109	0.107	0.104	0.102	0.100	0.097	0.095
18.5	**0.091**	0.115	0.113	0.110	0.107	0.105	0.103	0.101	0.098	0.096	0.095	0.093	0.089	0.088
19.0	**0.084**	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.082	0.081
19.5	**0.078**	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.083	0.081	0.080	0.077	0.075
20.0	**0.073**	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.078	0.077	0.075	0.074	0.071	0.070
20.5	**0.068**	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.066
21.0	**0.064**	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.066	0.065	0.063	0.061
21.5	**0.060**	0.075	0.073	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.061	0.059	0.058
22.0	**0.057**	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055
22.5	**0.053**	0.066	0.065	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.052	0.052
23.0	**0.050**	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
23.5	**0.047**	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046
24.0	**0.045**	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.044	0.043
24.5	**0.042**	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041
25.0	**0.040**	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039
25.5	**0.038**	0.047	0.046	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.040	0.039	0.038	0.037
26.0	**0.036**	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.037	0.035	0.035
26.5	**0.034**	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033	0.033
27.0	**0.031**	0.038	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.030
27.5	**0.029**	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028
28.0	**0.026**	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
28.5	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023
29.0	**0.021**	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021
29.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019
30.0	**0.017**	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014
31.0	**0.013**	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010

Table 7-2: C_t values, Mode 0/0-0S (HWO)

7.3 Sound Curves, Mode 0/0-0S (HWO)

Sound Power Level at Hub Height		
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**	
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Mode 0 (HWO) (Blades with serrated trailing edge)**	**Sound Power Level at Hub Height [dBA]** **Mode 0-0S (HWO) (Blades without serrated trailing edge)**
3	90.9	93.2
4	91.1	93.6
5	92.9	96.5
6	96.0	100.0
7	99.6	103.2
8	102.8	105.9
9	103.9	106.9
10	103.9	106.9
11	103.9	106.9
12	103.9	106.9
13	103.9	106.9
14	103.9	106.9
15	103.9	106.9
16	103.9	106.9
17	103.9	106.9
18	103.9	106.9
19	103.9	106.9
20	103.9	106.9

Table 7-3: Sound curves, Mode 0/0-0S (HWO)

8 Power Curves, Ct Values and Sound Curves, Power Optimized Mode PO1/PO1-0S

NOTE The power curves and Ct values presented in Section 8 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

8.1 Power Curves, Power Optimized Mode PO1/PO1-0S

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	174	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	345	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	634	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1072	1119	1143
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1704**	1311	1347	1383	1419	1455	1491	1526	1562	1598	1633	1668	1739	1774
8.0	**2070**	1600	1643	1686	1730	1773	1816	1858	1901	1944	1986	2028	2112	2154
8.5	**2472**	1924	1975	2026	2077	2128	2178	2228	2278	2328	2376	2424	2520	2566
9.0	**2874**	2273	2330	2388	2446	2504	2558	2612	2667	2721	2772	2823	2923	2971
9.5	**3238**	2621	2681	2742	2803	2864	2919	2975	3030	3085	3136	3187	3286	3334
10.0	**3567**	2950	3012	3073	3135	3196	3252	3307	3362	3418	3468	3517	3612	3658
10.5	**3847**	3252	3314	3376	3438	3500	3554	3607	3661	3714	3758	3803	3884	3920
11.0	**4035**	3526	3584	3643	3701	3759	3803	3848	3892	3937	3970	4002	4059	4084
11.5	**4146**	3767	3817	3866	3916	3966	3998	4030	4062	4094	4112	4129	4157	4167
12.0	**4188**	3957	3993	4030	4066	4103	4119	4136	4152	4168	4175	4182	4191	4194
12.5	**4198**	4084	4104	4125	4146	4167	4173	4180	4187	4194	4195	4197	4199	4199
13.0	**4200**	4148	4159	4169	4180	4190	4192	4194	4196	4199	4199	4199	4200	4200
13.5	**4200**	4167	4174	4180	4187	4194	4195	4196	4198	4199	4199	4200	4200	4200
14.0	**4200**	4184	4187	4191	4194	4198	4198	4199	4199	4200	4200	4200	4200	4200
14.5	**4200**	4193	4194	4196	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200
15.0	**4200**	4194	4196	4196	4198	4198	4199	4199	4200	4200	4200	4200	4200	4200
15.5	**4200**	4196	4197	4198	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200
16.0	**4200**	4198	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200	4200	4200
16.5	**4200**	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
17.0	**4200**	4199	4199	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
17.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
18.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
18.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
19.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
19.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
20.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
20.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
21.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
21.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
22.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
22.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
23.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
23.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
24.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
24.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
25.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
25.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
26.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
26.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
27.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200

Table 8-1: Power curve, Power Optimized Mode PO1/PO1-0S

8.2 Ct Values, Power Optimized Mode PO1/PO1-0S

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.879**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.858	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.855	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.847**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.843	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.831	0.831	0.830	0.829	0.827	0.826
7.5	**0.821**	0.832	0.831	0.830	0.829	0.828	0.827	0.826	0.825	0.824	0.823	0.822	0.820	0.818
8.0	**0.822**	0.838	0.836	0.835	0.834	0.833	0.831	0.830	0.829	0.827	0.826	0.824	0.821	0.819
8.5	**0.802**	0.838	0.835	0.833	0.831	0.828	0.825	0.821	0.818	0.814	0.810	0.806	0.798	0.793
9.0	**0.745**	0.810	0.805	0.800	0.795	0.790	0.783	0.777	0.771	0.765	0.758	0.752	0.739	0.732
9.5	**0.673**	0.753	0.746	0.739	0.731	0.724	0.717	0.709	0.702	0.694	0.687	0.680	0.666	0.659
10.0	**0.606**	0.687	0.679	0.671	0.664	0.656	0.649	0.641	0.634	0.627	0.620	0.613	0.599	0.592
10.5	**0.545**	0.625	0.618	0.610	0.603	0.596	0.588	0.581	0.574	0.567	0.560	0.552	0.537	0.530
11.0	**0.483**	0.570	0.562	0.554	0.546	0.539	0.531	0.523	0.515	0.507	0.499	0.491	0.474	0.466
11.5	**0.423**	0.519	0.510	0.502	0.494	0.485	0.476	0.468	0.459	0.450	0.441	0.432	0.414	0.406
12.0	**0.367**	0.469	0.460	0.451	0.441	0.432	0.422	0.413	0.403	0.394	0.385	0.376	0.359	0.351
12.5	**0.319**	0.420	0.410	0.400	0.390	0.380	0.370	0.361	0.352	0.343	0.335	0.327	0.312	0.305
13.0	**0.280**	0.371	0.362	0.352	0.342	0.333	0.324	0.316	0.308	0.300	0.293	0.287	0.274	0.268
13.5	**0.249**	0.328	0.320	0.311	0.303	0.294	0.287	0.280	0.273	0.266	0.260	0.254	0.243	0.238
14.0	**0.221**	0.291	0.283	0.276	0.268	0.261	0.255	0.248	0.242	0.236	0.231	0.226	0.217	0.212
14.5	**0.198**	0.259	0.253	0.246	0.239	0.232	0.227	0.222	0.217	0.211	0.207	0.202	0.194	0.190
15.0	**0.177**	0.231	0.225	0.219	0.214	0.208	0.203	0.198	0.194	0.189	0.185	0.181	0.174	0.171
15.5	**0.161**	0.208	0.203	0.198	0.193	0.187	0.183	0.179	0.175	0.171	0.167	0.164	0.157	0.154
16.0	**0.146**	0.188	0.184	0.179	0.174	0.170	0.166	0.162	0.159	0.155	0.152	0.149	0.143	0.140
16.5	**0.133**	0.171	0.167	0.163	0.159	0.155	0.151	0.148	0.145	0.141	0.139	0.136	0.131	0.128
17.0	**0.122**	0.156	0.152	0.149	0.145	0.141	0.138	0.135	0.132	0.129	0.127	0.124	0.120	0.117
17.5	**0.112**	0.143	0.140	0.136	0.133	0.129	0.127	0.124	0.121	0.119	0.116	0.114	0.110	0.108
18.0	**0.103**	0.131	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.109	0.107	0.105	0.101	0.099
18.5	**0.095**	0.121	0.118	0.115	0.113	0.110	0.108	0.105	0.103	0.101	0.099	0.097	0.094	0.092
19.0	**0.088**	0.111	0.109	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.090	0.086	0.085
19.5	**0.082**	0.103	0.101	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.085	0.083	0.080	0.079
20.0	**0.076**	0.096	0.094	0.092	0.089	0.087	0.086	0.084	0.082	0.080	0.079	0.077	0.075	0.073
20.5	**0.071**	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.077	0.075	0.074	0.072	0.070	0.069
21.0	**0.066**	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.068	0.065	0.064
21.5	**0.063**	0.079	0.077	0.075	0.074	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.062	0.061
22.0	**0.059**	0.074	0.072	0.071	0.069	0.067	0.066	0.065	0.064	0.062	0.061	0.060	0.058	0.057
22.5	**0.056**	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.059	0.058	0.057	0.055	0.054
23.0	**0.052**	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.051	0.050
23.5	**0.049**	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.048
24.0	**0.047**	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045
24.5	**0.044**	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.045	0.043	0.043
25.0	**0.042**	0.052	0.051	0.049	0.048	0.047	0.047	0.046	0.045	0.044	0.043	0.043	0.041	0.041
25.5	**0.040**	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.041	0.039	0.039
26.0	**0.038**	0.047	0.046	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037
26.5	**0.036**	0.044	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.035
27.0	**0.035**	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.034

Table 8-2: C_t values, Power Optimized Mode PO1/PO1-0S

8.3 Sound Curves, Power Optimized Mode PO1/PO1-0S

Sound Power Level at Hub Height		
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**	
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Power Optimized Mode PO1 (Blades with serrated trailing edge)**	**Sound Power Level at Hub Height [dBA]** **Power Optimized Mode PO1-0S (Blades without serrated trailing edge)**
3	90.9	93.2
4	91.1	93.6
5	92.9	96.5
6	96.0	100.0
7	99.6	103.2
8	102.9	106.0
9	103.9	106.9
10	103.9	106.9
11	103.9	106.9
12	103.9	106.9
13	103.9	106.9
14	103.9	106.9
15	103.9	106.9
16	103.9	106.9
17	103.9	106.9
18	103.9	106.9
19	103.9	106.9
20	103.9	106.9

Table 8-3: Sound curves, Power Optimized Mode PO1/PO1-0S

9 Power Curves, Ct Values and Sound Curves, Power Optimized Mode PO1/PO1-0S (HWO)

NOTE The power curves and Ct values presented in Section 9 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

9.1 Power Curves, Power Optimized Mode PO1/PO1-0S (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	174	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	345	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	634	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1072	1119	1143
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1704**	1311	1347	1383	1419	1455	1491	1526	1562	1598	1633	1668	1739	1774
8.0	**2070**	1600	1643	1686	1730	1773	1816	1858	1901	1944	1986	2028	2112	2154
8.5	**2472**	1924	1975	2026	2077	2128	2178	2228	2278	2328	2376	2424	2520	2566
9.0	**2874**	2273	2330	2388	2446	2504	2558	2612	2667	2721	2772	2823	2923	2971
9.5	**3238**	2621	2681	2742	2803	2864	2919	2975	3030	3085	3136	3187	3286	3334
10.0	**3567**	2950	3012	3073	3135	3196	3252	3307	3362	3418	3468	3517	3612	3658
10.5	**3847**	3252	3314	3376	3438	3500	3554	3607	3661	3714	3758	3803	3884	3920
11.0	**4035**	3526	3584	3643	3701	3759	3803	3848	3892	3937	3970	4002	4059	4084
11.5	**4146**	3767	3817	3866	3916	3966	3998	4030	4062	4094	4112	4129	4157	4167
12.0	**4188**	3957	3993	4030	4066	4103	4119	4136	4152	4168	4175	4182	4191	4194
12.5	**4198**	4084	4104	4125	4146	4167	4173	4180	4187	4194	4195	4197	4199	4199
13.0	**4200**	4148	4159	4169	4180	4190	4192	4194	4196	4199	4199	4199	4200	4200
13.5	**4200**	4167	4174	4180	4187	4194	4195	4196	4198	4199	4199	4200	4200	4200
14.0	**4200**	4184	4187	4191	4194	4198	4198	4199	4199	4200	4200	4200	4200	4200
14.5	**4200**	4193	4194	4196	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200
15.0	**4200**	4194	4196	4196	4198	4198	4199	4199	4200	4200	4200	4200	4200	4200
15.5	**4200**	4196	4197	4198	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200
16.0	**4200**	4198	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200	4200	4200
16.5	**4200**	4198	4199	4199	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
17.0	**4200**	4199	4199	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
17.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
18.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
18.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
19.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
19.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
20.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
20.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
21.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
21.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
22.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
22.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
23.0	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
23.5	**4200**	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
24.0	**4199**	4199	4199	4199	4199	4199	4199	4199	4199	4199	4199	4199	4199	4199
24.5	**4189**	4189	4189	4189	4189	4189	4189	4189	4189	4189	4189	4189	4189	4189
25.0	**4146**	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146
25.5	**4079**	4079	4079	4079	4079	4079	4079	4079	4079	4079	4079	4079	4079	4079
26.0	**3984**	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984
26.5	**3873**	3873	3873	3873	3873	3873	3873	3873	3873	3873	3873	3873	3873	3873

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
27.0	**3763**	3763	3763	3763	3763	3763	3763	3763	3763	3763	3763	3763	3763	3763
27.5	**3629**	3629	3629	3629	3629	3629	3629	3629	3629	3629	3629	3629	3629	3629
28.0	**3467**	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467
28.5	**3274**	3274	3274	3274	3274	3274	3274	3274	3274	3274	3274	3274	3274	3274
29.0	**3048**	3048	3048	3048	3048	3048	3048	3048	3048	3048	3048	3048	3048	3048
29.5	**2805**	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805
30.0	**2564**	2564	2564	2564	2564	2564	2564	2564	2564	2564	2564	2564	2564	2564
30.5	**2324**	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324
31.0	**2089**	2089	2089	2089	2089	2089	2089	2089	2089	2089	2089	2089	2089	2089
31.5	**1883**	1883	1883	1883	1883	1883	1883	1883	1883	1883	1883	1883	1883	1883
32.0	**1731**	1732	1732	1732	1732	1732	1731	1731	1731	1731	1731	1731	1731	1731

Table 9-1: Power curve, Power Optimized Mode PO1/PO1-0S (HWO)

9.2 Ct Values, Power Optimized Mode PO1/PO1-0S (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.879**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.858	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.855	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.847**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.843	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.831	0.831	0.830	0.829	0.827	0.826
7.5	**0.821**	0.832	0.831	0.830	0.829	0.828	0.827	0.826	0.825	0.824	0.823	0.822	0.820	0.818
8.0	**0.822**	0.838	0.836	0.835	0.834	0.833	0.831	0.830	0.829	0.827	0.826	0.824	0.821	0.819
8.5	**0.802**	0.838	0.835	0.833	0.831	0.828	0.825	0.821	0.818	0.814	0.810	0.806	0.798	0.793
9.0	**0.745**	0.810	0.805	0.800	0.795	0.790	0.783	0.777	0.771	0.765	0.758	0.752	0.739	0.732
9.5	**0.673**	0.753	0.746	0.739	0.731	0.724	0.717	0.709	0.702	0.694	0.687	0.680	0.666	0.659
10.0	**0.606**	0.687	0.679	0.671	0.664	0.656	0.649	0.641	0.634	0.627	0.620	0.613	0.599	0.592
10.5	**0.545**	0.625	0.618	0.610	0.603	0.596	0.588	0.581	0.574	0.567	0.560	0.552	0.537	0.530
11.0	**0.483**	0.570	0.562	0.554	0.546	0.539	0.531	0.523	0.515	0.507	0.499	0.491	0.474	0.466
11.5	**0.423**	0.519	0.510	0.502	0.494	0.485	0.476	0.468	0.459	0.450	0.441	0.432	0.414	0.406
12.0	**0.367**	0.469	0.460	0.451	0.441	0.432	0.422	0.413	0.403	0.394	0.385	0.376	0.359	0.351
12.5	**0.319**	0.420	0.410	0.400	0.390	0.380	0.370	0.361	0.352	0.343	0.335	0.327	0.312	0.305
13.0	**0.280**	0.371	0.362	0.352	0.342	0.333	0.324	0.316	0.308	0.300	0.293	0.287	0.274	0.268
13.5	**0.249**	0.328	0.320	0.311	0.303	0.294	0.287	0.280	0.273	0.266	0.260	0.254	0.243	0.238
14.0	**0.221**	0.291	0.283	0.276	0.268	0.261	0.255	0.248	0.242	0.236	0.231	0.226	0.217	0.212
14.5	**0.198**	0.259	0.253	0.246	0.239	0.232	0.227	0.222	0.217	0.211	0.207	0.202	0.194	0.190
15.0	**0.177**	0.231	0.225	0.219	0.214	0.208	0.203	0.198	0.194	0.189	0.185	0.181	0.174	0.171
15.5	**0.161**	0.208	0.203	0.198	0.193	0.187	0.183	0.179	0.175	0.171	0.167	0.164	0.157	0.154
16.0	**0.146**	0.188	0.184	0.179	0.174	0.170	0.166	0.162	0.159	0.155	0.152	0.149	0.143	0.140
16.5	**0.133**	0.171	0.167	0.163	0.159	0.155	0.151	0.148	0.145	0.141	0.139	0.136	0.131	0.128
17.0	**0.122**	0.156	0.152	0.149	0.145	0.141	0.138	0.135	0.132	0.129	0.127	0.124	0.120	0.117
17.5	**0.112**	0.143	0.140	0.136	0.133	0.129	0.127	0.124	0.121	0.119	0.116	0.114	0.110	0.108
18.0	**0.103**	0.131	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.109	0.107	0.105	0.101	0.099
18.5	**0.095**	0.121	0.118	0.115	0.113	0.110	0.108	0.105	0.103	0.101	0.099	0.097	0.094	0.092
19.0	**0.088**	0.111	0.109	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.090	0.086	0.085
19.5	**0.082**	0.103	0.101	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.085	0.083	0.080	0.079
20.0	**0.076**	0.096	0.094	0.092	0.089	0.087	0.086	0.084	0.082	0.080	0.079	0.077	0.075	0.073
20.5	**0.071**	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.077	0.075	0.074	0.072	0.070	0.069
21.0	**0.066**	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.068	0.065	0.064
21.5	**0.063**	0.079	0.077	0.075	0.074	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.062	0.061
22.0	**0.059**	0.074	0.072	0.071	0.069	0.067	0.066	0.065	0.064	0.062	0.061	0.060	0.058	0.057
22.5	**0.056**	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.059	0.058	0.057	0.055	0.054
23.0	**0.052**	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.051	0.050
23.5	**0.049**	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.048
24.0	**0.047**	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045
24.5	**0.044**	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.045	0.043	0.043
25.0	**0.041**	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040
25.5	**0.039**	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.040	0.038	0.038
26.0	**0.036**	0.044	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.035
26.5	**0.034**	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033
27.0	**0.031**	0.038	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.030
27.5	**0.029**	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028
28.0	**0.026**	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
28.5	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023
29.0	**0.021**	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021
29.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019
30.0	**0.017**	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014
31.0	**0.013**	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010

Table 9-2: C_t values, Power Optimized Mode PO1/PO1-0S (HWO)

9.3 Sound Curves, Power Optimized Mode PO1/PO1-0S (HWO)

Sound Power Level at Hub Height		
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m³**	
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Power Optimized Mode PO1 (HWO) (Blades with serrated trailing edge)**	**Sound Power Level at Hub Height [dBA]** **Power Optimized Mode PO1-0S (HWO) (Blades without serrated trailing edge)**
3	90.9	93.2
4	91.1	93.6
5	92.9	96.5
6	96.0	100.0
7	99.6	103.2
8	102.8	105.9
9	103.9	106.9
10	103.9	106.9
11	103.9	106.9
12	103.9	106.9
13	103.9	106.9
14	103.9	106.9
15	103.9	106.9
16	103.9	106.9
17	103.9	106.9
18	103.9	106.9
19	103.9	106.9
20	103.9	106.9

Table 9-3: Sound curves, Power Optimized Mode PO1/PO1-0S (HWO)

10 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO1

NOTE The power curves and Ct values presented in Section 10 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

10.1 Power Curves, Sound Optimized Mode SO1

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	402	412	423	434	445	456	466	488	499
5.5	**648**	490	504	519	533	547	562	576	590	605	619	633	662	676
6.0	**853**	649	668	686	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	837	861	884	908	932	955	978	1002	1025	1049	1072	1119	1142
7.0	**1381**	1059	1088	1118	1147	1176	1206	1235	1265	1294	1323	1352	1411	1440
7.5	**1707**	1312	1348	1384	1421	1457	1493	1529	1565	1600	1636	1672	1742	1778
8.0	**2070**	1598	1641	1684	1728	1771	1814	1857	1900	1943	1985	2027	2112	2154
8.5	**2455**	1904	1955	2006	2056	2107	2157	2207	2257	2307	2356	2406	2503	2551
9.0	**2827**	2206	2264	2321	2379	2436	2493	2550	2606	2663	2718	2773	2880	2932
9.5	**3149**	2485	2549	2612	2676	2740	2801	2862	2923	2984	3039	3094	3198	3248
10.0	**3410**	2759	2827	2895	2963	3030	3090	3150	3210	3270	3317	3363	3447	3484
10.5	**3604**	3051	3118	3185	3252	3319	3367	3416	3464	3513	3543	3574	3625	3646
11.0	**3727**	3313	3371	3428	3486	3544	3577	3610	3644	3677	3694	3711	3737	3746
11.5	**3792**	3524	3567	3611	3655	3698	3716	3734	3752	3769	3777	3784	3795	3799
12.0	**3823**	3676	3703	3729	3756	3782	3791	3799	3807	3816	3818	3820	3824	3825
12.5	**3842**	3772	3785	3799	3812	3826	3829	3832	3836	3840	3840	3841	3843	3844
13.0	**3861**	3827	3834	3840	3847	3853	3855	3856	3858	3860	3860	3861	3862	3862
13.5	**3883**	3859	3864	3869	3874	3879	3880	3881	3882	3883	3883	3883	3883	3883
14.0	**3902**	3891	3893	3896	3898	3900	3901	3902	3902	3903	3902	3902	3902	3902
14.5	**3919**	3914	3915	3916	3918	3919	3919	3919	3919	3920	3920	3919	3919	3919
15.0	**3934**	3930	3931	3932	3933	3934	3934	3934	3934	3934	3934	3934	3934	3934
15.5	**3946**	3945	3945	3946	3946	3946	3947	3947	3947	3947	3947	3946	3946	3946
16.0	**3958**	3958	3958	3959	3959	3959	3959	3959	3959	3959	3959	3958	3958	3958
16.5	**3970**	3971	3972	3972	3972	3972	3972	3972	3971	3971	3971	3971	3970	3970
17.0	**3983**	3984	3984	3984	3984	3984	3984	3984	3983	3983	3983	3983	3982	3982
17.5	**3992**	3994	3994	3994	3993	3993	3993	3993	3993	3993	3993	3992	3992	3992
18.0	**3998**	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3997
18.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	3999	3999
19.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
19.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
26.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
26.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
27.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

Table 10-1: Power curve, Sound Optimized Mode SO1

10.2 Ct Values, Sound Optimized Mode SO1

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.851**	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850	0.850
5.5	**0.846**	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.847	0.846	0.845
6.0	**0.841**	0.847	0.847	0.846	0.845	0.845	0.844	0.844	0.843	0.843	0.842	0.842	0.840	0.840
6.5	**0.837**	0.845	0.844	0.844	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.836	0.835
7.0	**0.840**	0.850	0.849	0.848	0.847	0.846	0.845	0.844	0.843	0.843	0.842	0.841	0.839	0.838
7.5	**0.843**	0.854	0.853	0.852	0.852	0.851	0.850	0.849	0.848	0.847	0.846	0.844	0.842	0.841
8.0	**0.833**	0.845	0.844	0.843	0.842	0.841	0.840	0.839	0.838	0.837	0.835	0.834	0.831	0.830
8.5	**0.790**	0.805	0.804	0.803	0.802	0.801	0.799	0.798	0.797	0.796	0.794	0.792	0.787	0.785
9.0	**0.721**	0.737	0.736	0.735	0.734	0.734	0.732	0.731	0.729	0.728	0.726	0.723	0.717	0.714
9.5	**0.643**	0.662	0.662	0.661	0.660	0.660	0.658	0.657	0.655	0.654	0.650	0.647	0.638	0.634
10.0	**0.570**	0.607	0.605	0.604	0.603	0.602	0.598	0.595	0.592	0.588	0.582	0.576	0.563	0.556
10.5	**0.503**	0.573	0.569	0.565	0.561	0.557	0.550	0.543	0.536	0.529	0.521	0.512	0.493	0.484
11.0	**0.439**	0.536	0.529	0.522	0.514	0.507	0.498	0.488	0.479	0.470	0.460	0.449	0.430	0.420
11.5	**0.380**	0.489	0.480	0.470	0.460	0.451	0.440	0.430	0.419	0.409	0.399	0.390	0.372	0.363
12.0	**0.330**	0.436	0.426	0.415	0.404	0.394	0.384	0.374	0.364	0.355	0.346	0.338	0.322	0.315
12.5	**0.289**	0.384	0.374	0.364	0.354	0.343	0.335	0.326	0.318	0.310	0.303	0.296	0.282	0.276
13.0	**0.255**	0.338	0.329	0.320	0.311	0.302	0.294	0.287	0.280	0.273	0.267	0.261	0.250	0.244
13.5	**0.228**	0.300	0.292	0.285	0.277	0.269	0.263	0.257	0.250	0.244	0.239	0.233	0.224	0.219
14.0	**0.204**	0.268	0.261	0.254	0.247	0.240	0.235	0.229	0.224	0.218	0.214	0.209	0.200	0.196
14.5	**0.184**	0.240	0.234	0.228	0.222	0.216	0.211	0.206	0.201	0.196	0.192	0.188	0.181	0.177
15.0	**0.166**	0.215	0.210	0.204	0.199	0.194	0.189	0.185	0.181	0.177	0.173	0.169	0.163	0.159
15.5	**0.151**	0.195	0.190	0.185	0.180	0.176	0.172	0.168	0.164	0.160	0.157	0.154	0.148	0.145
16.0	**0.137**	0.177	0.173	0.168	0.164	0.160	0.156	0.153	0.150	0.146	0.143	0.140	0.135	0.132
16.5	**0.126**	0.161	0.158	0.154	0.150	0.146	0.143	0.140	0.137	0.134	0.131	0.128	0.123	0.121
17.0	**0.116**	0.148	0.144	0.141	0.138	0.134	0.131	0.128	0.126	0.123	0.120	0.118	0.114	0.111
17.5	**0.106**	0.136	0.133	0.129	0.126	0.123	0.121	0.118	0.115	0.113	0.111	0.109	0.105	0.103
18.0	**0.098**	0.125	0.122	0.119	0.116	0.113	0.111	0.109	0.107	0.104	0.102	0.100	0.097	0.095
18.5	**0.091**	0.115	0.113	0.110	0.107	0.105	0.103	0.101	0.098	0.096	0.095	0.093	0.089	0.088
19.0	**0.084**	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.082	0.081
19.5	**0.078**	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.083	0.081	0.080	0.077	0.075
20.0	**0.073**	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.078	0.077	0.075	0.074	0.071	0.070
20.5	**0.068**	0.085	0.083	0.082	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.066
21.0	**0.064**	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.066	0.065	0.063	0.061
21.5	**0.060**	0.075	0.073	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.061	0.059	0.058
22.0	**0.057**	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055
22.5	**0.053**	0.066	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.052
23.0	**0.050**	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
23.5	**0.047**	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.046	0.046
24.0	**0.045**	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043
24.5	**0.042**	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041
25.0	**0.040**	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039
25.5	**0.038**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
26.0	**0.037**	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036
26.5	**0.035**	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035	0.034	0.034
27.0	**0.033**	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032

Table 10-2: C_t values, Sound Optimized Mode SO1

10.3 Sound Curves, Sound Optimized Mode SO1

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO1** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.5
8	101.6
9	101.9
10	101.8
11	102.0
12	102.0
13	102.0
14	102.0
15	102.0
16	102.0
17	102.0
18	102.0
19	102.0
20	102.0

Table 10-3: Sound curves, Sound Optimized Mode SO1

11 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO1 (HWO)

NOTE The power curves and Ct values presented in Section 11 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

11.1 Power Curves, Sound Optimized Mode SO1 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	402	412	423	434	445	456	466	488	499
5.5	**648**	490	504	519	533	547	562	576	590	605	619	633	662	676
6.0	**853**	649	668	686	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	837	861	884	908	932	955	978	1002	1025	1049	1072	1119	1142
7.0	**1381**	1059	1088	1118	1147	1176	1206	1235	1265	1294	1323	1352	1411	1440
7.5	**1707**	1312	1348	1384	1421	1457	1493	1529	1565	1600	1636	1672	1742	1778
8.0	**2070**	1598	1641	1684	1728	1771	1814	1857	1900	1943	1985	2027	2112	2154
8.5	**2455**	1904	1955	2006	2056	2107	2157	2207	2257	2307	2356	2406	2503	2551
9.0	**2827**	2206	2264	2321	2379	2436	2493	2550	2606	2663	2718	2773	2880	2932
9.5	**3149**	2485	2549	2612	2676	2740	2801	2862	2923	2984	3039	3094	3198	3248
10.0	**3410**	2759	2827	2895	2963	3030	3090	3150	3210	3270	3317	3363	3447	3484
10.5	**3604**	3051	3118	3185	3252	3319	3367	3416	3464	3513	3543	3574	3625	3646
11.0	**3727**	3313	3371	3428	3486	3544	3577	3610	3644	3677	3694	3711	3737	3746
11.5	**3791**	3524	3567	3611	3655	3698	3716	3734	3752	3769	3777	3784	3795	3799
12.0	**3823**	3676	3703	3729	3756	3782	3791	3799	3807	3816	3818	3820	3824	3825
12.5	**3842**	3772	3785	3799	3812	3826	3829	3832	3836	3840	3840	3841	3843	3844
13.0	**3861**	3827	3834	3840	3847	3853	3855	3856	3858	3860	3860	3861	3862	3862
13.5	**3883**	3859	3864	3869	3874	3879	3880	3881	3882	3883	3883	3883	3883	3883
14.0	**3902**	3891	3893	3896	3898	3900	3901	3902	3902	3903	3902	3902	3902	3902
14.5	**3919**	3914	3915	3916	3918	3919	3919	3919	3919	3920	3920	3919	3919	3919
15.0	**3934**	3930	3931	3932	3933	3934	3934	3934	3934	3934	3934	3934	3934	3934
15.5	**3946**	3945	3945	3946	3946	3946	3947	3947	3947	3947	3947	3946	3946	3946
16.0	**3958**	3958	3958	3959	3959	3959	3959	3959	3959	3959	3959	3958	3958	3958
16.5	**3970**	3971	3972	3972	3972	3972	3972	3972	3971	3971	3971	3971	3970	3970
17.0	**3983**	3984	3984	3984	3984	3984	3984	3984	3983	3983	3983	3983	3982	3982
17.5	**3992**	3994	3994	3994	3993	3993	3993	3993	3993	3993	3993	3992	3992	3992
18.0	**3998**	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3998	3997
18.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	3999	3999
19.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
19.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
20.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
21.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
22.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
23.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
24.5	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.0	**4000**	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
25.5	**3999**	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999
26.0	**3987**	3987	3987	3987	3987	3987	3987	3987	3987	3987	3987	3987	3987	3987
26.5	**3946**	3946	3946	3946	3946	3946	3946	3946	3946	3946	3946	3946	3946	3946
27.0	**3882**	3882	3882	3882	3882	3882	3882	3882	3882	3882	3882	3882	3882	3882
27.5	**3731**	3731	3731	3731	3731	3731	3731	3731	3731	3731	3731	3731	3731	3731

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**3516**	3516	3516	3516	3516	3516	3516	3516	3516	3516	3516	3516	3516	3516
28.5	**3279**	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279
29.0	**3037**	3037	3037	3037	3037	3037	3037	3037	3037	3037	3037	3037	3037	3037
29.5	**2791**	2791	2791	2791	2791	2791	2791	2791	2791	2791	2791	2791	2791	2791
30.0	**2549**	2549	2549	2549	2549	2549	2549	2549	2549	2549	2549	2549	2549	2549
30.5	**2309**	2309	2309	2309	2309	2309	2309	2309	2309	2309	2309	2309	2309	2309
31.0	**2074**	2074	2074	2074	2074	2074	2074	2074	2074	2074	2074	2074	2074	2074
31.5	**1870**	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
32.0	**1722**	1722	1722	1722	1722	1722	1722	1722	1722	1722	1722	1722	1722	1723

Table 11-1: Power curve, Sound Optimized Mode SO1 (HWO)

11.2 Ct Values, Sound Optimized Mode SO1 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.851**	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850	0.850
5.5	**0.846**	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.847	0.846	0.845
6.0	**0.841**	0.847	0.847	0.846	0.845	0.845	0.844	0.844	0.843	0.843	0.842	0.842	0.840	0.840
6.5	**0.837**	0.845	0.844	0.844	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.836	0.835
7.0	**0.840**	0.850	0.849	0.848	0.847	0.846	0.845	0.844	0.843	0.843	0.842	0.841	0.839	0.838
7.5	**0.843**	0.854	0.853	0.852	0.852	0.851	0.850	0.849	0.848	0.847	0.846	0.844	0.842	0.841
8.0	**0.833**	0.845	0.844	0.843	0.842	0.841	0.840	0.839	0.838	0.837	0.835	0.834	0.831	0.830
8.5	**0.790**	0.805	0.804	0.803	0.802	0.801	0.799	0.798	0.797	0.796	0.794	0.792	0.787	0.785
9.0	**0.721**	0.737	0.736	0.735	0.734	0.734	0.732	0.731	0.729	0.728	0.726	0.723	0.717	0.714
9.5	**0.643**	0.662	0.662	0.661	0.660	0.660	0.658	0.657	0.655	0.654	0.650	0.647	0.638	0.634
10.0	**0.570**	0.607	0.605	0.604	0.603	0.602	0.598	0.595	0.592	0.588	0.582	0.576	0.563	0.556
10.5	**0.503**	0.573	0.569	0.565	0.561	0.557	0.550	0.543	0.536	0.529	0.521	0.512	0.493	0.484
11.0	**0.439**	0.536	0.529	0.522	0.514	0.507	0.498	0.488	0.479	0.470	0.460	0.449	0.430	0.420
11.5	**0.380**	0.489	0.480	0.470	0.460	0.451	0.440	0.430	0.419	0.409	0.399	0.390	0.372	0.363
12.0	**0.330**	0.436	0.426	0.415	0.404	0.394	0.384	0.374	0.364	0.355	0.346	0.338	0.322	0.315
12.5	**0.289**	0.384	0.374	0.364	0.354	0.343	0.335	0.326	0.318	0.310	0.303	0.296	0.282	0.276
13.0	**0.255**	0.338	0.329	0.320	0.311	0.302	0.294	0.287	0.280	0.273	0.267	0.261	0.250	0.244
13.5	**0.228**	0.300	0.292	0.285	0.277	0.269	0.263	0.257	0.250	0.244	0.239	0.233	0.224	0.219
14.0	**0.204**	0.268	0.261	0.254	0.247	0.240	0.235	0.229	0.224	0.218	0.214	0.209	0.200	0.196
14.5	**0.184**	0.240	0.234	0.228	0.222	0.216	0.211	0.206	0.201	0.196	0.192	0.188	0.181	0.177
15.0	**0.166**	0.215	0.210	0.204	0.199	0.194	0.189	0.185	0.181	0.177	0.173	0.169	0.163	0.159
15.5	**0.151**	0.195	0.190	0.185	0.180	0.176	0.172	0.168	0.164	0.160	0.157	0.154	0.148	0.145
16.0	**0.137**	0.177	0.173	0.168	0.164	0.160	0.156	0.153	0.150	0.146	0.143	0.140	0.135	0.132
16.5	**0.126**	0.161	0.158	0.154	0.150	0.146	0.143	0.140	0.137	0.134	0.131	0.128	0.123	0.121
17.0	**0.116**	0.148	0.144	0.141	0.138	0.134	0.131	0.128	0.126	0.123	0.120	0.118	0.114	0.111
17.5	**0.106**	0.136	0.133	0.129	0.126	0.123	0.121	0.118	0.115	0.113	0.111	0.109	0.105	0.103
18.0	**0.098**	0.125	0.122	0.119	0.116	0.113	0.111	0.109	0.107	0.104	0.102	0.100	0.097	0.095
18.5	**0.091**	0.115	0.113	0.110	0.107	0.105	0.103	0.101	0.098	0.096	0.095	0.093	0.089	0.088
19.0	**0.084**	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.082	0.081
19.5	**0.078**	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.083	0.081	0.080	0.077	0.075
20.0	**0.073**	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.078	0.077	0.075	0.074	0.071	0.070
20.5	**0.068**	0.085	0.083	0.082	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.066
21.0	**0.064**	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.066	0.065	0.063	0.061
21.5	**0.060**	0.075	0.073	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.061	0.059	0.058
22.0	**0.057**	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055
22.5	**0.053**	0.066	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.052
23.0	**0.050**	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
23.5	**0.047**	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.046	0.046
24.0	**0.045**	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043
24.5	**0.042**	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041
25.0	**0.040**	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039
25.5	**0.038**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
26.0	**0.037**	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.035
26.5	**0.035**	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.036	0.035	0.034	0.034
27.0	**0.032**	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032
27.5	**0.030**	0.036	0.036	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.029
28.0	**0.027**	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026
28.5	**0.024**	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024
29.0	**0.022**	0.026	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.021	0.021
29.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019
30.0	**0.017**	0.020	0.020	0.020	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014
31.0	**0.013**	0.015	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013
31.5	**0.011**	0.013	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010

Table 11-2: C_t values, Sound Optimized Mode SO1 (HWO)

11.3 Sound Curves, Sound Optimized Mode SO1 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO1 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.5
8	101.6
9	101.9
10	101.8
11	102.0
12	102.0
13	102.0
14	102.0
15	102.0
16	102.0
17	102.0
18	102.0
19	102.0
20	102.0

Table 11-3: Sound curves, Sound Optimized Mode SO1 (HWO)

12 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO2

NOTE The power curves and Ct values presented in Section 12 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

12.1 Power Curves, Sound Optimized Mode SO2

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	402	412	423	434	445	456	466	488	499
5.5	**648**	490	504	519	533	547	562	576	590	605	619	633	662	676
6.0	**853**	649	668	686	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	837	861	885	908	932	955	979	1002	1026	1049	1072	1120	1143
7.0	**1381**	1058	1088	1117	1147	1176	1206	1235	1264	1294	1323	1352	1410	1438
7.5	**1675**	1304	1340	1376	1412	1448	1483	1518	1552	1587	1616	1646	1700	1724
8.0	**1870**	1560	1599	1637	1675	1714	1740	1767	1794	1820	1837	1853	1880	1890
8.5	**1967**	1790	1818	1845	1873	1901	1914	1926	1939	1952	1957	1962	1970	1974
9.0	**2030**	1955	1968	1981	1994	2007	2011	2015	2020	2024	2026	2028	2031	2031
9.5	**2075**	2049	2054	2059	2064	2069	2070	2071	2072	2073	2074	2074	2075	2076
10.0	**2114**	2108	2108	2109	2110	2111	2111	2112	2113	2113	2114	2114	2114	2114
10.5	**2148**	2159	2157	2155	2153	2151	2151	2150	2149	2149	2148	2148	2147	2147
11.0	**2195**	2230	2226	2221	2216	2212	2209	2206	2203	2200	2199	2197	2194	2192
11.5	**2238**	2284	2279	2274	2268	2263	2259	2255	2251	2247	2244	2241	2236	2233
12.0	**2295**	2344	2338	2333	2328	2322	2318	2314	2310	2306	2302	2299	2292	2288
12.5	**2361**	2414	2409	2403	2397	2391	2386	2382	2377	2372	2368	2365	2357	2354
13.0	**2420**	2475	2469	2462	2456	2450	2446	2441	2436	2432	2428	2424	2417	2414
13.5	**2473**	2523	2517	2511	2505	2498	2494	2490	2486	2482	2479	2476	2470	2467
14.0	**2516**	2565	2559	2553	2547	2542	2537	2533	2529	2525	2522	2519	2513	2510
14.5	**2566**	2618	2612	2606	2600	2594	2590	2586	2581	2577	2573	2570	2563	2560
15.0	**2673**	2716	2711	2707	2702	2698	2694	2691	2687	2684	2680	2677	2670	2666
15.5	**2760**	2795	2791	2788	2785	2781	2778	2775	2772	2769	2766	2763	2757	2754
16.0	**2852**	2880	2877	2874	2872	2869	2867	2864	2862	2860	2857	2854	2849	2847
16.5	**2927**	2943	2942	2940	2939	2937	2936	2934	2933	2932	2930	2929	2925	2923
17.0	**2976**	2979	2979	2979	2979	2979	2979	2978	2978	2978	2977	2976	2975	2974
17.5	**2997**	2996	2996	2997	2997	2998	2998	2998	2998	2998	2997	2997	2997	2996
18.0	**3006**	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006
18.5	**3020**	3020	3020	3020	3021	3021	3021	3020	3020	3020	3020	3020	3019	3019
19.0	**3046**	3058	3057	3056	3055	3054	3053	3052	3050	3049	3048	3047	3045	3044
19.5	**3091**	3104	3103	3102	3101	3100	3099	3098	3096	3095	3094	3093	3090	3089
20.0	**3154**	3162	3162	3161	3161	3161	3160	3159	3158	3157	3156	3155	3153	3152
20.5	**3222**	3217	3218	3219	3220	3220	3221	3221	3222	3222	3222	3222	3222	3222
21.0	**3276**	3260	3262	3264	3266	3267	3269	3270	3272	3273	3274	3275	3277	3277
21.5	**3314**	3299	3301	3302	3304	3306	3307	3309	3310	3312	3312	3313	3315	3316
22.0	**3341**	3324	3327	3329	3331	3333	3334	3336	3337	3339	3339	3340	3341	3342
22.5	**3368**	3352	3354	3356	3358	3360	3361	3363	3364	3365	3366	3367	3368	3369
23.0	**3393**	3373	3375	3377	3380	3382	3384	3386	3387	3389	3390	3392	3394	3395
23.5	**3407**	3389	3391	3393	3395	3398	3399	3401	3402	3404	3405	3406	3408	3410
24.0	**3415**	3397	3399	3401	3403	3406	3407	3409	3410	3412	3413	3414	3416	3417
24.5	**3419**	3401	3403	3405	3407	3409	3410	3412	3413	3415	3416	3417	3420	3421
25.0	**3418**	3401	3403	3405	3407	3410	3411	3412	3413	3415	3416	3417	3420	3421
25.5	**3405**	3381	3383	3386	3389	3392	3394	3396	3398	3400	3402	3404	3407	3408
26.0	**3402**	3380	3383	3385	3387	3389	3391	3393	3395	3397	3399	3401	3404	3405
26.5	**3400**	3380	3382	3384	3386	3388	3390	3391	3393	3395	3397	3399	3401	3403
27.0	**3384**	3367	3368	3370	3372	3374	3375	3377	3378	3380	3381	3382	3385	3386

Table 12-1: Power curve, Sound Optimized Mode SO2

12.2 Ct Values, Sound Optimized Mode SO2

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.851**	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850	0.850
5.5	**0.846**	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.847	0.846	0.845
6.0	**0.847**	0.853	0.853	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.848	0.848	0.846	0.846
6.5	**0.844**	0.852	0.852	0.851	0.850	0.850	0.849	0.848	0.848	0.847	0.846	0.845	0.843	0.842
7.0	**0.844**	0.855	0.855	0.854	0.853	0.852	0.851	0.850	0.849	0.849	0.847	0.845	0.840	0.837
7.5	**0.790**	0.843	0.842	0.841	0.840	0.839	0.834	0.830	0.826	0.821	0.811	0.801	0.779	0.768
8.0	**0.655**	0.800	0.791	0.781	0.772	0.763	0.749	0.735	0.721	0.706	0.689	0.672	0.638	0.621
8.5	**0.526**	0.709	0.693	0.677	0.661	0.645	0.627	0.608	0.590	0.572	0.557	0.541	0.513	0.499
9.0	**0.433**	0.601	0.583	0.564	0.545	0.527	0.512	0.498	0.483	0.469	0.457	0.445	0.423	0.412
9.5	**0.365**	0.498	0.483	0.468	0.453	0.438	0.427	0.415	0.404	0.392	0.383	0.374	0.357	0.349
10.0	**0.313**	0.419	0.407	0.395	0.383	0.371	0.362	0.353	0.344	0.335	0.327	0.320	0.306	0.299
10.5	**0.271**	0.361	0.350	0.340	0.330	0.320	0.313	0.305	0.297	0.290	0.283	0.277	0.265	0.260
11.0	**0.238**	0.318	0.309	0.300	0.291	0.282	0.276	0.269	0.262	0.255	0.250	0.244	0.234	0.229
11.5	**0.211**	0.281	0.274	0.266	0.258	0.250	0.244	0.238	0.232	0.226	0.221	0.216	0.207	0.203
12.0	**0.190**	0.252	0.245	0.238	0.231	0.224	0.219	0.214	0.208	0.203	0.199	0.194	0.186	0.182
12.5	**0.172**	0.228	0.222	0.216	0.209	0.203	0.199	0.194	0.189	0.184	0.180	0.176	0.169	0.165
13.0	**0.157**	0.206	0.201	0.196	0.190	0.185	0.180	0.176	0.172	0.167	0.164	0.160	0.154	0.150
13.5	**0.144**	0.188	0.183	0.178	0.173	0.169	0.165	0.161	0.157	0.153	0.150	0.147	0.141	0.138
14.0	**0.131**	0.171	0.167	0.162	0.158	0.153	0.150	0.147	0.143	0.140	0.137	0.134	0.128	0.126
14.5	**0.120**	0.157	0.153	0.149	0.145	0.141	0.138	0.135	0.131	0.128	0.126	0.123	0.118	0.116
15.0	**0.113**	0.146	0.143	0.139	0.135	0.132	0.129	0.126	0.123	0.120	0.118	0.115	0.111	0.108
15.5	**0.106**	0.136	0.133	0.130	0.126	0.123	0.120	0.118	0.115	0.112	0.110	0.108	0.104	0.102
16.0	**0.099**	0.128	0.125	0.122	0.119	0.116	0.113	0.111	0.108	0.106	0.104	0.102	0.098	0.096
16.5	**0.093**	0.119	0.116	0.114	0.111	0.108	0.106	0.104	0.101	0.099	0.097	0.095	0.092	0.090
17.0	**0.087**	0.110	0.108	0.105	0.103	0.100	0.098	0.096	0.094	0.092	0.090	0.089	0.085	0.084
17.5	**0.081**	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.079	0.078
18.0	**0.075**	0.094	0.092	0.090	0.088	0.086	0.084	0.082	0.081	0.079	0.078	0.076	0.073	0.072
18.5	**0.069**	0.087	0.086	0.084	0.082	0.080	0.078	0.077	0.075	0.073	0.072	0.071	0.068	0.067
19.0	**0.065**	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063
19.5	**0.061**	0.077	0.075	0.074	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.060	0.059
20.0	**0.058**	0.073	0.071	0.070	0.068	0.067	0.065	0.064	0.063	0.061	0.060	0.059	0.057	0.056
20.5	**0.055**	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054
21.0	**0.053**	0.065	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.051
21.5	**0.050**	0.063	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049
22.0	**0.048**	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.049	0.047	0.046
22.5	**0.045**	0.056	0.055	0.054	0.053	0.051	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044
23.0	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
23.5	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040	0.039
24.0	**0.039**	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038
24.5	**0.037**	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036
25.0	**0.035**	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035	0.034	0.034
25.5	**0.033**	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.032
26.0	**0.032**	0.038	0.038	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031
26.5	**0.030**	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.029
27.0	**0.029**	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028

Table 12-2: C_t values, Sound Optimized Mode SO2

12.3 Sound Curves, Sound Optimized Mode SO2

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO2** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.0
8	99.4
9	99.4
10	99.5
11	99.5
12	99.5
13	99.5
14	99.5
15	99.5
16	99.5
17	99.5
18	99.5
19	99.5
20	99.5

Table 12-3: Sound curves, Sound Optimized Mode SO2

13 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO2 (HWO)

NOTE The power curves and Ct values presented in Section 13 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

13.1 Power Curves, Sound Optimized Mode SO2 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	402	412	423	434	445	456	466	488	499
5.5	**648**	490	504	519	533	547	562	576	590	605	619	633	662	676
6.0	**853**	649	668	686	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	837	861	885	908	932	955	979	1002	1026	1049	1072	1120	1143
7.0	**1381**	1058	1088	1117	1147	1176	1206	1235	1264	1294	1323	1352	1410	1438
7.5	**1675**	1304	1340	1376	1412	1448	1483	1518	1552	1587	1616	1646	1700	1724
8.0	**1870**	1560	1599	1637	1675	1714	1740	1767	1794	1820	1837	1853	1880	1890
8.5	**1967**	1790	1818	1845	1873	1901	1914	1926	1939	1952	1957	1962	1970	1974
9.0	**2030**	1955	1968	1981	1994	2007	2011	2015	2020	2024	2026	2028	2031	2031
9.5	**2075**	2049	2054	2059	2064	2069	2070	2071	2072	2073	2074	2074	2075	2076
10.0	**2114**	2108	2108	2109	2110	2111	2111	2112	2113	2113	2114	2114	2114	2114
10.5	**2148**	2159	2157	2155	2153	2151	2151	2150	2149	2149	2148	2148	2147	2147
11.0	**2195**	2230	2226	2221	2216	2212	2209	2206	2203	2200	2199	2197	2194	2192
11.5	**2238**	2284	2279	2274	2268	2263	2259	2255	2251	2247	2244	2241	2236	2233
12.0	**2295**	2344	2338	2333	2328	2322	2318	2314	2310	2306	2302	2299	2292	2288
12.5	**2361**	2414	2409	2403	2397	2391	2386	2382	2377	2372	2368	2365	2357	2354
13.0	**2420**	2475	2469	2462	2456	2450	2446	2441	2436	2432	2428	2424	2417	2414
13.5	**2473**	2523	2517	2511	2505	2498	2494	2490	2486	2482	2479	2476	2470	2467
14.0	**2516**	2565	2559	2553	2547	2542	2537	2533	2529	2525	2522	2519	2513	2510
14.5	**2566**	2618	2612	2606	2600	2594	2590	2586	2581	2577	2573	2570	2563	2560
15.0	**2673**	2716	2711	2707	2702	2698	2694	2691	2687	2684	2680	2677	2670	2666
15.5	**2760**	2795	2791	2788	2785	2781	2778	2775	2772	2769	2766	2763	2757	2754
16.0	**2852**	2880	2877	2874	2872	2869	2867	2864	2862	2860	2857	2854	2849	2847
16.5	**2927**	2943	2942	2940	2939	2937	2936	2934	2933	2932	2930	2929	2925	2923
17.0	**2976**	2979	2979	2979	2979	2979	2979	2978	2978	2978	2977	2976	2975	2974
17.5	**2997**	2996	2996	2997	2997	2998	2998	2998	2998	2998	2997	2997	2997	2996
18.0	**3006**	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006	3006
18.5	**3020**	3020	3020	3020	3021	3021	3021	3020	3020	3020	3020	3020	3019	3019
19.0	**3046**	3058	3057	3056	3055	3054	3053	3052	3050	3049	3048	3047	3045	3044
19.5	**3091**	3104	3103	3102	3101	3100	3099	3098	3096	3095	3094	3093	3090	3089
20.0	**3154**	3162	3162	3161	3161	3161	3160	3159	3158	3157	3156	3155	3153	3152
20.5	**3222**	3217	3218	3219	3220	3220	3221	3221	3222	3222	3222	3222	3222	3222
21.0	**3276**	3260	3262	3264	3266	3267	3269	3270	3272	3273	3274	3275	3277	3277
21.5	**3314**	3299	3301	3302	3304	3306	3307	3309	3310	3312	3312	3313	3315	3316
22.0	**3341**	3324	3327	3329	3331	3333	3334	3336	3337	3339	3339	3340	3341	3342
22.5	**3368**	3352	3354	3356	3358	3360	3361	3363	3364	3365	3366	3367	3368	3369
23.0	**3393**	3373	3375	3377	3380	3382	3384	3386	3387	3389	3390	3392	3394	3395
23.5	**3407**	3389	3391	3393	3395	3398	3399	3401	3402	3404	3405	3406	3408	3410
24.0	**3415**	3397	3399	3401	3403	3406	3407	3409	3410	3412	3413	3414	3416	3417
24.5	**3419**	3401	3403	3405	3407	3409	3410	3412	3413	3415	3416	3417	3420	3421
25.0	**3418**	3401	3403	3405	3407	3410	3411	3412	3413	3415	3416	3417	3420	3421
25.5	**3405**	3381	3383	3386	3389	3392	3394	3396	3398	3400	3402	3404	3407	3408
26.0	**3402**	3380	3382	3384	3386	3389	3391	3393	3395	3397	3398	3400	3403	3405
26.5	**3388**	3369	3371	3373	3375	3377	3379	3380	3382	3384	3385	3387	3389	3391
27.0	**3337**	3322	3323	3325	3327	3328	3330	3331	3333	3334	3335	3336	3338	3339
27.5	**3142**	3137	3137	3138	3138	3139	3140	3140	3141	3141	3141	3142	3143	3143

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**2825**	2822	2822	2823	2823	2823	2824	2824	2824	2824	2824	2824	2825	2825
28.5	**2364**	2366	2366	2366	2365	2365	2365	2365	2365	2364	2364	2364	2364	2364
29.0	**1893**	1895	1895	1895	1894	1894	1894	1894	1893	1893	1893	1893	1893	1892
29.5	**1570**	1571	1571	1571	1571	1571	1571	1571	1570	1570	1570	1570	1570	1570
30.0	**1364**	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1363	1363
30.5	**1225**	1226	1225	1225	1225	1225	1225	1225	1225	1225	1225	1225	1225	1225
31.0	**1150**	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
31.5	**1098**	1098	1098	1098	1098	1098	1098	1098	1098	1098	1098	1098	1098	1098
32.0	**1074**	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1075

Table 13-1: Power curve, Sound Optimized Mode SO2 (HWO)

13.2 Ct Values, Sound Optimized Mode SO2 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.851**	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850	0.850
5.5	**0.846**	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.847	0.846	0.845
6.0	**0.847**	0.853	0.853	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.848	0.848	0.846	0.846
6.5	**0.844**	0.852	0.852	0.851	0.850	0.850	0.849	0.848	0.848	0.847	0.846	0.845	0.843	0.842
7.0	**0.844**	0.855	0.855	0.854	0.853	0.852	0.851	0.850	0.849	0.849	0.847	0.845	0.840	0.837
7.5	**0.790**	0.843	0.842	0.841	0.840	0.839	0.834	0.830	0.826	0.821	0.811	0.801	0.779	0.768
8.0	**0.655**	0.800	0.791	0.781	0.772	0.763	0.749	0.735	0.721	0.706	0.689	0.672	0.638	0.621
8.5	**0.526**	0.709	0.693	0.677	0.661	0.645	0.627	0.608	0.590	0.572	0.557	0.541	0.513	0.499
9.0	**0.433**	0.601	0.583	0.564	0.545	0.527	0.512	0.498	0.483	0.469	0.457	0.445	0.423	0.412
9.5	**0.365**	0.498	0.483	0.468	0.453	0.438	0.427	0.415	0.404	0.392	0.383	0.374	0.357	0.349
10.0	**0.313**	0.419	0.407	0.395	0.383	0.371	0.362	0.353	0.344	0.335	0.327	0.320	0.306	0.299
10.5	**0.271**	0.361	0.350	0.340	0.330	0.320	0.313	0.305	0.297	0.290	0.283	0.277	0.265	0.260
11.0	**0.238**	0.318	0.309	0.300	0.291	0.282	0.276	0.269	0.262	0.255	0.250	0.244	0.234	0.229
11.5	**0.211**	0.281	0.274	0.266	0.258	0.250	0.244	0.238	0.232	0.226	0.221	0.216	0.207	0.203
12.0	**0.190**	0.252	0.245	0.238	0.231	0.224	0.219	0.214	0.208	0.203	0.199	0.194	0.186	0.182
12.5	**0.172**	0.228	0.222	0.216	0.209	0.203	0.199	0.194	0.189	0.184	0.180	0.176	0.169	0.165
13.0	**0.157**	0.206	0.201	0.196	0.190	0.185	0.180	0.176	0.172	0.167	0.164	0.160	0.154	0.150
13.5	**0.144**	0.188	0.183	0.178	0.173	0.169	0.165	0.161	0.157	0.153	0.150	0.147	0.141	0.138
14.0	**0.131**	0.171	0.167	0.162	0.158	0.153	0.150	0.147	0.143	0.140	0.137	0.134	0.128	0.126
14.5	**0.120**	0.157	0.153	0.149	0.145	0.141	0.138	0.135	0.131	0.128	0.126	0.123	0.118	0.116
15.0	**0.113**	0.146	0.143	0.139	0.135	0.132	0.129	0.126	0.123	0.120	0.118	0.115	0.111	0.108
15.5	**0.106**	0.136	0.133	0.130	0.126	0.123	0.120	0.118	0.115	0.112	0.110	0.108	0.104	0.102
16.0	**0.099**	0.128	0.125	0.122	0.119	0.116	0.113	0.111	0.108	0.106	0.104	0.102	0.098	0.096
16.5	**0.093**	0.119	0.116	0.114	0.111	0.108	0.106	0.104	0.101	0.099	0.097	0.095	0.092	0.090
17.0	**0.087**	0.110	0.108	0.105	0.103	0.100	0.098	0.096	0.094	0.092	0.090	0.089	0.085	0.084
17.5	**0.081**	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.079	0.078
18.0	**0.075**	0.094	0.092	0.090	0.088	0.086	0.084	0.082	0.081	0.079	0.078	0.076	0.073	0.072
18.5	**0.069**	0.087	0.086	0.084	0.082	0.080	0.078	0.077	0.075	0.073	0.072	0.071	0.068	0.067
19.0	**0.065**	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063
19.5	**0.061**	0.077	0.075	0.074	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.060	0.059
20.0	**0.058**	0.073	0.071	0.070	0.068	0.067	0.065	0.064	0.063	0.061	0.060	0.059	0.057	0.056
20.5	**0.055**	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054
21.0	**0.053**	0.065	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.051
21.5	**0.050**	0.063	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049
22.0	**0.048**	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.049	0.047	0.046
22.5	**0.045**	0.056	0.055	0.054	0.053	0.051	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044
23.0	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
23.5	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040	0.039
24.0	**0.039**	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038
24.5	**0.037**	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036
25.0	**0.035**	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035	0.034	0.034
25.5	**0.033**	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.032
26.0	**0.032**	0.038	0.038	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031
26.5	**0.030**	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.029
27.0	**0.028**	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028
27.5	**0.026**	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.028	0.027	0.027	0.026	0.026	0.025
28.0	**0.023**	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022
28.5	**0.019**	0.023	0.022	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019
29.0	**0.016**	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015
29.5	**0.013**	0.015	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013
30.0	**0.011**	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011
30.5	**0.010**	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010
31.0	**0.009**	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009
31.5	**0.008**	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008
32.0	**0.008**	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008

Table 13-2: C_t values, Sound Optimized Mode SO2 (HWO)

13.3 Sound Curves, Sound Optimized Mode SO2 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO2 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.0
8	99.4
9	99.4
10	99.5
11	99.5
12	99.5
13	99.5
14	99.5
15	99.5
16	99.5
17	99.5
18	99.5
19	99.5
20	99.5

Table 13-3: Sound curves, Sound Optimized Mode SO2 (HWO)

14 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO11

NOTE The power curves and Ct values presented in Section 14 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

14.1 Power Curves, Sound Optimized Mode SO11

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	401	412	423	434	445	456	466	488	499
5.5	**642**	486	501	515	529	543	557	572	586	600	614	628	656	670
6.0	**820**	627	644	662	680	697	715	732	750	768	785	803	838	855
6.5	**1001**	768	790	811	832	853	875	896	917	938	959	980	1022	1043
7.0	**1185**	912	937	962	987	1012	1036	1061	1086	1111	1136	1160	1209	1234
7.5	**1362**	1052	1080	1109	1137	1166	1194	1222	1250	1278	1306	1334	1390	1417
8.0	**1535**	1193	1225	1257	1289	1321	1352	1384	1416	1447	1476	1506	1561	1588
8.5	**1715**	1412	1444	1476	1508	1540	1568	1595	1623	1651	1672	1694	1734	1752
9.0	**1907**	1722	1745	1768	1790	1812	1828	1844	1859	1874	1885	1896	1915	1923
9.5	**2058**	1980	1991	2002	2013	2024	2030	2036	2042	2048	2051	2055	2061	2063
10.0	**2157**	2131	2135	2139	2143	2147	2149	2150	2152	2154	2155	2156	2157	2158
10.5	**2218**	2206	2208	2210	2212	2214	2214	2215	2216	2217	2217	2218	2218	2218
11.0	**2267**	2260	2261	2262	2264	2265	2265	2266	2266	2266	2266	2267	2267	2266
11.5	**2309**	2307	2307	2308	2308	2309	2309	2310	2310	2310	2310	2310	2309	2309
12.0	**2344**	2343	2344	2344	2344	2344	2344	2344	2344	2344	2344	2344	2343	2343
12.5	**2372**	2373	2373	2373	2373	2373	2373	2373	2373	2372	2372	2372	2371	2371
13.0	**2398**	2400	2400	2400	2400	2400	2400	2399	2399	2399	2399	2398	2398	2398
13.5	**2420**	2421	2421	2421	2421	2421	2421	2421	2420	2420	2420	2420	2420	2419
14.0	**2435**	2436	2436	2436	2436	2436	2436	2436	2436	2436	2435	2435	2435	2435
14.5	**2449**	2451	2451	2451	2451	2451	2450	2450	2450	2450	2450	2449	2449	2449
15.0	**2464**	2466	2466	2466	2466	2466	2465	2465	2465	2465	2465	2464	2464	2464
15.5	**2480**	2482	2482	2482	2482	2482	2482	2481	2481	2481	2481	2480	2480	2480
16.0	**2498**	2500	2500	2500	2500	2500	2499	2499	2499	2498	2498	2498	2497	2497
16.5	**2517**	2521	2521	2520	2520	2520	2519	2519	2519	2518	2518	2518	2517	2516
17.0	**2540**	2544	2544	2544	2544	2543	2543	2542	2542	2541	2541	2540	2539	2538
17.5	**2566**	2572	2571	2571	2570	2570	2569	2569	2568	2568	2567	2566	2565	2564
18.0	**2598**	2606	2605	2605	2604	2604	2603	2602	2602	2601	2600	2599	2597	2596
18.5	**2636**	2646	2645	2644	2644	2643	2642	2641	2640	2639	2638	2637	2635	2634
19.0	**2676**	2685	2684	2684	2683	2682	2681	2680	2679	2678	2678	2676	2674	2674
19.5	**2715**	2724	2724	2723	2722	2722	2721	2720	2719	2718	2717	2716	2714	2713
20.0	**2748**	2756	2755	2755	2754	2754	2753	2752	2752	2751	2750	2749	2748	2747
20.5	**2773**	2778	2778	2777	2777	2776	2776	2776	2775	2775	2774	2774	2773	2772
21.0	**2789**	2793	2793	2793	2792	2792	2791	2791	2791	2790	2790	2790	2789	2788
21.5	**2804**	2812	2811	2810	2810	2809	2808	2808	2807	2806	2805	2805	2803	2803
22.0	**2833**	2847	2846	2844	2843	2842	2841	2840	2839	2837	2836	2835	2832	2831
22.5	**2878**	2893	2891	2890	2889	2888	2886	2885	2884	2882	2881	2879	2876	2875
23.0	**2914**	2923	2922	2922	2921	2920	2919	2918	2918	2917	2916	2915	2913	2912
23.5	**2942**	2951	2950	2949	2948	2948	2947	2946	2945	2945	2944	2943	2941	2940
24.0	**2965**	2970	2970	2969	2969	2969	2968	2968	2967	2967	2966	2965	2964	2964

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
24.5	**2978**	2981	2980	2980	2980	2980	2979	2979	2979	2979	2979	2978	2978	2977
25.0	**2984**	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2983	2983
25.5	**2986**	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2985	2985
26.0	**2986**	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986
26.5	**2986**	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986
27.0	**2986**	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986

Table 14-1: Power curve, Sound Optimized Mode SO11

14.2 Ct Values, Sound Optimized Mode SO11

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.841**	0.845	0.845	0.845	0.845	0.844	0.844	0.843	0.843	0.843	0.842	0.842	0.841	0.840
5.5	**0.785**	0.791	0.790	0.790	0.789	0.789	0.788	0.788	0.787	0.787	0.786	0.786	0.785	0.784
6.0	**0.708**	0.713	0.713	0.712	0.712	0.711	0.711	0.710	0.710	0.709	0.709	0.708	0.707	0.707
6.5	**0.637**	0.642	0.642	0.641	0.641	0.640	0.640	0.639	0.639	0.639	0.638	0.638	0.637	0.636
7.0	**0.575**	0.579	0.578	0.578	0.578	0.577	0.577	0.577	0.576	0.576	0.576	0.575	0.574	0.574
7.5	**0.518**	0.522	0.522	0.522	0.521	0.521	0.521	0.520	0.520	0.520	0.519	0.519	0.518	0.517
8.0	**0.468**	0.474	0.474	0.473	0.473	0.473	0.472	0.472	0.471	0.471	0.470	0.469	0.466	0.464
8.5	**0.427**	0.461	0.459	0.457	0.454	0.452	0.449	0.446	0.443	0.439	0.435	0.431	0.422	0.418
9.0	**0.394**	0.477	0.469	0.462	0.454	0.446	0.439	0.431	0.424	0.416	0.409	0.402	0.387	0.381
9.5	**0.358**	0.468	0.456	0.445	0.433	0.422	0.412	0.402	0.393	0.383	0.375	0.367	0.351	0.344
10.0	**0.318**	0.424	0.412	0.400	0.389	0.377	0.368	0.359	0.350	0.341	0.333	0.325	0.311	0.304
10.5	**0.279**	0.369	0.359	0.349	0.340	0.330	0.322	0.314	0.306	0.298	0.292	0.286	0.273	0.268
11.0	**0.246**	0.323	0.314	0.306	0.298	0.289	0.283	0.276	0.269	0.263	0.257	0.251	0.241	0.236
11.5	**0.218**	0.284	0.277	0.270	0.263	0.255	0.250	0.244	0.238	0.232	0.227	0.223	0.213	0.209
12.0	**0.194**	0.252	0.245	0.239	0.233	0.227	0.221	0.216	0.211	0.206	0.202	0.198	0.190	0.186
12.5	**0.173**	0.224	0.218	0.213	0.207	0.202	0.197	0.193	0.188	0.184	0.180	0.177	0.170	0.166
13.0	**0.155**	0.200	0.195	0.190	0.186	0.181	0.177	0.173	0.169	0.165	0.162	0.159	0.152	0.149
13.5	**0.141**	0.181	0.176	0.172	0.168	0.163	0.160	0.156	0.153	0.149	0.146	0.144	0.138	0.135
14.0	**0.127**	0.163	0.159	0.155	0.151	0.147	0.144	0.141	0.138	0.135	0.132	0.130	0.125	0.122
14.5	**0.115**	0.147	0.144	0.140	0.137	0.133	0.131	0.128	0.125	0.122	0.120	0.118	0.113	0.111
15.0	**0.105**	0.133	0.130	0.127	0.124	0.121	0.118	0.116	0.113	0.111	0.109	0.107	0.103	0.101
15.5	**0.096**	0.121	0.119	0.116	0.113	0.110	0.108	0.106	0.104	0.101	0.099	0.098	0.094	0.092
16.0	**0.088**	0.111	0.109	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.090	0.086	0.085
16.5	**0.081**	0.103	0.100	0.098	0.096	0.093	0.092	0.090	0.088	0.086	0.084	0.083	0.080	0.078
17.0	**0.075**	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.077	0.074	0.073
17.5	**0.070**	0.088	0.086	0.084	0.082	0.080	0.079	0.077	0.076	0.074	0.073	0.071	0.069	0.068
18.0	**0.066**	0.082	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.064	0.063
18.5	**0.062**	0.077	0.076	0.074	0.072	0.071	0.069	0.068	0.066	0.065	0.064	0.063	0.061	0.060
19.0	**0.058**	0.072	0.071	0.069	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056
19.5	**0.055**	0.068	0.067	0.065	0.064	0.062	0.061	0.060	0.059	0.058	0.057	0.056	0.054	0.053
20.0	**0.052**	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.055	0.054	0.053	0.053	0.051	0.050
20.5	**0.049**	0.060	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.050	0.048	0.047
21.0	**0.046**	0.057	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048	0.048	0.047	0.045	0.045
21.5	**0.044**	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.043	0.042
22.0	**0.042**	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.040
22.5	**0.040**	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.039	0.039
23.0	**0.038**	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037
23.5	**0.036**	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035
24.0	**0.034**	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.033
24.5	**0.033**	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032	0.032
25.0	**0.031**	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.030
25.5	**0.030**	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029
26.0	**0.029**	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.030	0.029	0.028	0.028
26.5	**0.027**	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027
27.0	**0.026**	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.027	0.026	0.025

Table 14-2: C_t values, Sound Optimized Mode SO11

14.3 Sound Curves, Sound Optimized Mode SO11

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO11 (Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	94.5
7	95.6
8	96.9
9	98.0
10	98.8
11	99.1
12	99.2
13	99.2
14	99.2
15	99.2
16	99.2
17	99.2
18	99.2
19	99.2
20	99.2

Table 14-3: Sound curves, Sound Optimized Mode SO11

15 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO11 (HWO)

NOTE The power curves and Ct values presented in Section 15 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

15.1 Power Curves, Sound Optimized Mode SO11 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	401	412	423	434	445	456	466	488	499
5.5	**642**	486	501	515	529	543	557	572	586	600	614	628	656	670
6.0	**820**	627	644	662	680	697	715	732	750	768	785	803	838	855
6.5	**1001**	768	790	811	832	853	875	896	917	938	959	980	1022	1043
7.0	**1185**	912	937	962	987	1012	1036	1061	1086	1111	1136	1160	1209	1234
7.5	**1362**	1052	1080	1109	1137	1166	1194	1222	1250	1278	1306	1334	1390	1417
8.0	**1535**	1193	1225	1257	1289	1321	1352	1384	1416	1447	1476	1506	1561	1588
8.5	**1715**	1412	1444	1476	1508	1540	1568	1595	1623	1651	1672	1694	1734	1752
9.0	**1907**	1722	1745	1768	1790	1812	1828	1844	1859	1874	1885	1896	1915	1923
9.5	**2058**	1980	1991	2002	2013	2024	2030	2036	2042	2048	2051	2055	2061	2063
10.0	**2157**	2131	2135	2139	2143	2147	2149	2150	2152	2154	2155	2156	2157	2158
10.5	**2218**	2206	2208	2210	2212	2214	2214	2215	2216	2217	2217	2218	2218	2218
11.0	**2267**	2260	2261	2262	2264	2265	2265	2266	2266	2266	2266	2267	2267	2266
11.5	**2309**	2307	2307	2308	2308	2309	2309	2310	2310	2310	2310	2310	2309	2309
12.0	**2344**	2343	2344	2344	2344	2344	2344	2344	2344	2344	2344	2344	2343	2343
12.5	**2372**	2373	2373	2373	2373	2373	2373	2373	2373	2372	2372	2372	2371	2371
13.0	**2398**	2400	2400	2400	2400	2400	2400	2399	2399	2399	2399	2398	2398	2398
13.5	**2420**	2421	2421	2421	2421	2421	2421	2421	2420	2420	2420	2420	2420	2419
14.0	**2435**	2436	2436	2436	2436	2436	2436	2436	2436	2436	2435	2435	2435	2435
14.5	**2449**	2451	2451	2451	2451	2451	2450	2450	2450	2450	2450	2449	2449	2449
15.0	**2464**	2466	2466	2466	2466	2466	2465	2465	2465	2465	2465	2464	2464	2464
15.5	**2480**	2482	2482	2482	2482	2482	2482	2481	2481	2481	2481	2480	2480	2480
16.0	**2498**	2500	2500	2500	2500	2500	2499	2499	2499	2498	2498	2498	2497	2497
16.5	**2517**	2521	2521	2520	2520	2520	2519	2519	2519	2518	2518	2518	2517	2516
17.0	**2540**	2544	2544	2544	2544	2543	2543	2542	2542	2541	2541	2540	2539	2538
17.5	**2566**	2572	2571	2571	2570	2570	2569	2569	2568	2568	2567	2566	2565	2564
18.0	**2598**	2606	2605	2605	2604	2604	2603	2602	2602	2601	2600	2599	2597	2596
18.5	**2636**	2646	2645	2644	2644	2643	2642	2641	2640	2639	2638	2637	2635	2634
19.0	**2676**	2685	2684	2684	2683	2682	2681	2680	2679	2678	2678	2676	2674	2674
19.5	**2715**	2724	2724	2723	2722	2722	2721	2720	2719	2718	2717	2716	2714	2713
20.0	**2749**	2756	2755	2755	2754	2754	2753	2752	2752	2751	2750	2749	2748	2747
20.5	**2773**	2778	2778	2777	2777	2776	2776	2776	2775	2775	2774	2774	2773	2772
21.0	**2789**	2793	2793	2793	2792	2792	2791	2791	2791	2790	2790	2790	2789	2788
21.5	**2804**	2812	2811	2810	2810	2809	2808	2808	2807	2806	2805	2805	2803	2803
22.0	**2833**	2847	2846	2844	2843	2842	2841	2840	2839	2837	2836	2835	2832	2831
22.5	**2878**	2893	2891	2890	2889	2888	2886	2885	2884	2882	2881	2879	2876	2875
23.0	**2914**	2923	2922	2922	2921	2920	2919	2918	2918	2917	2916	2915	2913	2912
23.5	**2942**	2951	2950	2949	2948	2948	2947	2946	2945	2945	2944	2943	2941	2940
24.0	**2965**	2970	2970	2969	2969	2969	2968	2968	2967	2967	2966	2965	2964	2964
24.5	**2978**	2981	2980	2980	2980	2980	2979	2979	2979	2979	2979	2978	2978	2977
25.0	**2984**	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2983	2983
25.5	**2986**	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2985	2985
26.0	**2986**	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986	2986
26.5	**2979**	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
27.0	**2955**	2955	2955	2955	2955	2955	2955	2955	2955	2955	2955	2955	2955	2955
27.5	**2834**	2834	2834	2834	2834	2834	2834	2834	2834	2834	2834	2834	2834	2834

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**2635**	2635	2635	2635	2635	2635	2635	2635	2635	2635	2635	2635	2635	2635
28.5	**2333**	2333	2333	2333	2333	2333	2333	2333	2333	2333	2333	2333	2333	2333
29.0	**2052**	2052	2052	2052	2052	2052	2052	2052	2052	2052	2052	2052	2052	2052
29.5	**1846**	1846	1845	1845	1845	1845	1845	1845	1845	1846	1846	1846	1845	1845
30.0	**1703**	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703
30.5	**1599**	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599
31.0	**1524**	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524
31.5	**1471**	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471
32.0	**1443**	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443

Table 15-1: Power curve, Sound Optimized Mode SO11 (HWO)

15.2 Ct Values, Sound Optimized Mode SO11 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.841**	0.845	0.845	0.845	0.845	0.844	0.844	0.843	0.843	0.843	0.842	0.842	0.841	0.840
5.5	**0.785**	0.791	0.790	0.790	0.789	0.789	0.788	0.788	0.787	0.787	0.786	0.786	0.785	0.784
6.0	**0.708**	0.713	0.713	0.712	0.712	0.711	0.711	0.710	0.710	0.709	0.709	0.708	0.707	0.707
6.5	**0.637**	0.642	0.642	0.641	0.641	0.640	0.640	0.639	0.639	0.639	0.638	0.638	0.637	0.636
7.0	**0.575**	0.579	0.578	0.578	0.578	0.577	0.577	0.577	0.576	0.576	0.576	0.575	0.574	0.574
7.5	**0.518**	0.522	0.522	0.522	0.521	0.521	0.521	0.520	0.520	0.520	0.519	0.519	0.518	0.517
8.0	**0.468**	0.474	0.474	0.473	0.473	0.473	0.472	0.472	0.471	0.471	0.470	0.469	0.466	0.464
8.5	**0.427**	0.461	0.459	0.457	0.454	0.452	0.449	0.446	0.443	0.439	0.435	0.431	0.422	0.418
9.0	**0.394**	0.477	0.469	0.462	0.454	0.446	0.439	0.431	0.424	0.416	0.409	0.402	0.387	0.381
9.5	**0.358**	0.468	0.456	0.445	0.433	0.422	0.412	0.402	0.393	0.383	0.375	0.367	0.351	0.344
10.0	**0.318**	0.424	0.412	0.400	0.389	0.377	0.368	0.359	0.350	0.341	0.333	0.325	0.311	0.304
10.5	**0.279**	0.369	0.359	0.349	0.340	0.330	0.322	0.314	0.306	0.298	0.292	0.286	0.273	0.268
11.0	**0.246**	0.323	0.314	0.306	0.298	0.289	0.283	0.276	0.269	0.263	0.257	0.251	0.241	0.236
11.5	**0.218**	0.284	0.277	0.270	0.263	0.255	0.250	0.244	0.238	0.232	0.227	0.223	0.213	0.209
12.0	**0.194**	0.252	0.245	0.239	0.233	0.227	0.221	0.216	0.211	0.206	0.202	0.198	0.190	0.186
12.5	**0.173**	0.224	0.218	0.213	0.207	0.202	0.197	0.193	0.188	0.184	0.180	0.177	0.170	0.166
13.0	**0.155**	0.200	0.195	0.190	0.186	0.181	0.177	0.173	0.169	0.165	0.162	0.159	0.152	0.149
13.5	**0.141**	0.181	0.176	0.172	0.168	0.163	0.160	0.156	0.153	0.149	0.146	0.144	0.138	0.135
14.0	**0.127**	0.163	0.159	0.155	0.151	0.147	0.144	0.141	0.138	0.135	0.132	0.130	0.125	0.122
14.5	**0.115**	0.147	0.144	0.140	0.137	0.133	0.131	0.128	0.125	0.122	0.120	0.118	0.113	0.111
15.0	**0.105**	0.133	0.130	0.127	0.124	0.121	0.118	0.116	0.113	0.111	0.109	0.107	0.103	0.101
15.5	**0.096**	0.121	0.119	0.116	0.113	0.110	0.108	0.106	0.104	0.101	0.099	0.098	0.094	0.092
16.0	**0.088**	0.111	0.109	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.090	0.086	0.085
16.5	**0.081**	0.103	0.100	0.098	0.096	0.093	0.092	0.090	0.088	0.086	0.084	0.083	0.080	0.078
17.0	**0.075**	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.077	0.074	0.073
17.5	**0.070**	0.088	0.086	0.084	0.082	0.080	0.079	0.077	0.076	0.074	0.073	0.071	0.069	0.068
18.0	**0.066**	0.082	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.064	0.063
18.5	**0.062**	0.077	0.076	0.074	0.072	0.071	0.069	0.068	0.066	0.065	0.064	0.063	0.061	0.060
19.0	**0.058**	0.072	0.071	0.069	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056
19.5	**0.055**	0.068	0.067	0.065	0.064	0.062	0.061	0.060	0.059	0.058	0.057	0.056	0.054	0.053
20.0	**0.052**	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.055	0.054	0.053	0.053	0.051	0.050
20.5	**0.049**	0.060	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.050	0.048	0.047
21.0	**0.046**	0.057	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048	0.048	0.047	0.045	0.045
21.5	**0.044**	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.043	0.042
22.0	**0.042**	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.040
22.5	**0.040**	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.039	0.039
23.0	**0.038**	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037
23.5	**0.036**	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035
24.0	**0.034**	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.033
24.5	**0.033**	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032	0.032
25.0	**0.031**	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.030
25.5	**0.030**	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029
26.0	**0.029**	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.030	0.029	0.028	0.028
26.5	**0.027**	0.033	0.032	0.032	0.031	0.030	0.030	0.029	0.029	0.029	0.028	0.028	0.027	0.027
27.0	**0.026**	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.028	0.027	0.027	0.026	0.026	0.025
27.5	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.024	0.024	0.023
28.0	**0.022**	0.026	0.025	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.021
28.5	**0.019**	0.022	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.019	0.019	0.019
29.0	**0.016**	0.019	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016
29.5	**0.014**	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.015	0.014	0.014
30.0	**0.013**	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013
30.5	**0.012**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
31.0	**0.011**	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010
31.5	**0.010**	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.009
32.0	**0.009**	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009

Table 15-2: C_t values, Sound Optimized Mode SO11 (HWO)

15.3 Sound Curves, Sound Optimized Mode SO11 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO11 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	94.5
7	95.6
8	96.9
9	98.0
10	98.8
11	99.1
12	99.2
13	99.2
14	99.2
15	99.2
16	99.2
17	99.2
18	99.2
19	99.2
20	99.2

Table 15-3: Sound curves, Sound Optimized Mode SO11 (HWO)

16 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO12

NOTE

The power curves and Ct values presented in Section 16 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

16.1 Power Curves, Sound Optimized Mode SO12

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	402	412	423	434	445	456	467	488	499
5.5	**646**	489	504	518	532	547	561	575	589	604	618	632	660	674
6.0	**840**	641	659	677	696	714	732	750	768	786	804	822	858	876
6.5	**1048**	804	827	849	871	893	916	938	960	982	1004	1026	1070	1092
7.0	**1253**	965	992	1018	1044	1071	1097	1123	1149	1176	1202	1228	1279	1305
7.5	**1422**	1098	1127	1157	1187	1217	1246	1276	1305	1334	1364	1393	1451	1480
8.0	**1581**	1224	1257	1290	1322	1355	1387	1420	1452	1485	1517	1549	1613	1645
8.5	**1823**	1452	1488	1524	1560	1596	1629	1663	1696	1730	1761	1792	1852	1882
9.0	**2118**	1842	1872	1903	1933	1964	1988	2012	2036	2060	2079	2098	2135	2151
9.5	**2310**	2166	2187	2207	2228	2248	2259	2269	2279	2290	2296	2303	2315	2320
10.0	**2385**	2343	2350	2358	2366	2374	2376	2378	2380	2382	2383	2384	2385	2386
10.5	**2425**	2409	2412	2414	2417	2420	2420	2421	2422	2423	2424	2424	2425	2425
11.0	**2460**	2452	2453	2454	2456	2458	2458	2459	2459	2460	2460	2460	2460	2460
11.5	**2487**	2484	2485	2485	2486	2486	2487	2487	2487	2487	2487	2487	2487	2487
12.0	**2511**	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511
12.5	**2536**	2538	2538	2538	2538	2538	2538	2537	2537	2537	2537	2537	2536	2536
13.0	**2572**	2575	2575	2575	2575	2574	2574	2574	2574	2573	2573	2572	2571	2571
13.5	**2626**	2630	2630	2630	2630	2629	2629	2628	2628	2628	2627	2626	2625	2624
14.0	**2684**	2690	2689	2689	2689	2688	2688	2687	2686	2686	2685	2684	2683	2682
14.5	**2744**	2751	2751	2750	2750	2750	2749	2748	2747	2747	2746	2745	2743	2742
15.0	**2808**	2816	2815	2814	2814	2814	2813	2812	2811	2810	2810	2808	2806	2806
15.5	**2868**	2876	2876	2875	2875	2874	2874	2873	2872	2871	2870	2869	2867	2866
16.0	**2928**	2936	2936	2935	2935	2934	2933	2932	2931	2930	2930	2928	2926	2925
16.5	**2983**	2992	2991	2990	2990	2989	2988	2988	2987	2986	2985	2984	2982	2981
17.0	**3035**	3044	3044	3043	3042	3042	3041	3040	3039	3038	3037	3036	3034	3033
17.5	**3085**	3095	3094	3094	3093	3092	3091	3090	3089	3088	3087	3086	3084	3083
18.0	**3136**	3146	3145	3145	3144	3143	3142	3141	3140	3139	3138	3137	3134	3133
18.5	**3188**	3200	3199	3198	3197	3196	3195	3194	3193	3192	3190	3189	3186	3185
19.0	**3242**	3255	3254	3253	3252	3251	3250	3249	3247	3246	3245	3244	3241	3239
19.5	**3296**	3308	3307	3306	3305	3304	3303	3302	3301	3300	3298	3297	3294	3293
20.0	**3345**	3357	3356	3355	3354	3353	3352	3351	3350	3349	3347	3346	3343	3342
20.5	**3390**	3401	3400	3399	3399	3398	3397	3396	3394	3393	3392	3391	3388	3387
21.0	**3433**	3444	3443	3443	3442	3441	3440	3439	3437	3436	3435	3434	3432	3430
21.5	**3474**	3485	3484	3484	3483	3482	3481	3480	3479	3478	3476	3475	3472	3471
22.0	**3514**	3525	3524	3523	3522	3522	3520	3519	3518	3517	3516	3515	3513	3511
22.5	**3550**	3559	3559	3558	3557	3556	3555	3554	3553	3553	3552	3551	3548	3547
23.0	**3577**	3585	3584	3584	3583	3583	3582	3581	3580	3580	3579	3578	3576	3576
23.5	**3600**	3605	3605	3604	3604	3603	3603	3602	3601	3601	3600	3600	3599	3598
24.0	**3615**	3619	3618	3618	3618	3617	3617	3617	3616	3616	3616	3615	3615	3614

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
24.5	**3625**	3627	3627	3627	3627	3626	3626	3626	3626	3626	3625	3625	3625	3624
25.0	**3631**	3632	3632	3632	3632	3632	3631	3631	3631	3631	3631	3631	3631	3631
25.5	**3634**	3635	3635	3635	3635	3635	3635	3635	3635	3635	3634	3634	3634	3634
26.0	**3635**	3635	3635	3635	3635	3635	3635	3635	3635	3635	3635	3635	3635	3635
26.5	**3636**	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636
27.0	**3636**	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636	3636

Table 16-1: Power curve, Sound Optimized Mode SO12

16.2 Ct Values, Sound Optimized Mode SO12

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.845**	0.850	0.849	0.849	0.849	0.848	0.848	0.848	0.847	0.847	0.846	0.846	0.845	0.844
5.5	**0.808**	0.814	0.813	0.813	0.812	0.812	0.811	0.811	0.810	0.810	0.809	0.809	0.808	0.807
6.0	**0.752**	0.758	0.758	0.757	0.757	0.756	0.756	0.755	0.755	0.754	0.754	0.753	0.752	0.751
6.5	**0.697**	0.703	0.702	0.702	0.701	0.701	0.700	0.700	0.699	0.698	0.698	0.697	0.696	0.696
7.0	**0.633**	0.638	0.638	0.637	0.637	0.636	0.636	0.635	0.635	0.634	0.634	0.633	0.632	0.632
7.5	**0.557**	0.562	0.561	0.561	0.560	0.560	0.559	0.559	0.559	0.558	0.558	0.557	0.556	0.556
8.0	**0.491**	0.496	0.496	0.495	0.495	0.494	0.494	0.494	0.493	0.493	0.492	0.492	0.491	0.490
8.5	**0.462**	0.483	0.481	0.480	0.478	0.476	0.475	0.473	0.471	0.469	0.467	0.464	0.460	0.457
9.0	**0.449**	0.528	0.520	0.512	0.505	0.497	0.490	0.483	0.476	0.469	0.462	0.455	0.442	0.436
9.5	**0.412**	0.533	0.521	0.509	0.497	0.485	0.474	0.463	0.452	0.441	0.431	0.422	0.404	0.395
10.0	**0.358**	0.483	0.469	0.456	0.442	0.428	0.417	0.407	0.396	0.385	0.376	0.367	0.350	0.342
10.5	**0.308**	0.413	0.401	0.390	0.378	0.366	0.357	0.348	0.340	0.331	0.323	0.316	0.302	0.295
11.0	**0.269**	0.356	0.346	0.337	0.327	0.318	0.310	0.303	0.295	0.288	0.281	0.275	0.263	0.258
11.5	**0.236**	0.309	0.301	0.293	0.285	0.277	0.271	0.265	0.258	0.252	0.246	0.241	0.231	0.226
12.0	**0.208**	0.271	0.265	0.258	0.251	0.244	0.238	0.233	0.227	0.222	0.217	0.213	0.204	0.200
12.5	**0.185**	0.240	0.234	0.228	0.223	0.217	0.212	0.207	0.202	0.197	0.193	0.189	0.182	0.178
13.0	**0.167**	0.215	0.210	0.205	0.200	0.194	0.190	0.186	0.182	0.177	0.174	0.170	0.163	0.160
13.5	**0.152**	0.197	0.192	0.187	0.182	0.178	0.174	0.170	0.166	0.162	0.159	0.156	0.149	0.147
14.0	**0.140**	0.180	0.175	0.171	0.167	0.162	0.159	0.155	0.152	0.148	0.145	0.142	0.137	0.134
14.5	**0.128**	0.165	0.161	0.157	0.153	0.149	0.146	0.143	0.140	0.137	0.134	0.131	0.126	0.124
15.0	**0.118**	0.152	0.148	0.144	0.141	0.137	0.134	0.132	0.129	0.126	0.123	0.121	0.116	0.114
15.5	**0.110**	0.140	0.137	0.134	0.130	0.127	0.125	0.122	0.119	0.117	0.114	0.112	0.108	0.106
16.0	**0.102**	0.130	0.127	0.124	0.121	0.118	0.116	0.113	0.111	0.108	0.106	0.104	0.100	0.098
16.5	**0.095**	0.121	0.118	0.116	0.113	0.110	0.108	0.105	0.103	0.101	0.099	0.097	0.093	0.092
17.0	**0.089**	0.113	0.110	0.108	0.105	0.103	0.100	0.098	0.096	0.094	0.092	0.091	0.087	0.086
17.5	**0.083**	0.105	0.103	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.085	0.081	0.080
18.0	**0.078**	0.099	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.082	0.081	0.079	0.076	0.075
18.5	**0.073**	0.093	0.090	0.088	0.086	0.084	0.083	0.081	0.079	0.077	0.076	0.075	0.072	0.071
19.0	**0.069**	0.087	0.085	0.083	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.067	0.066
19.5	**0.065**	0.082	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.066	0.064	0.063
20.0	**0.061**	0.077	0.075	0.074	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.063	0.060	0.059
20.5	**0.058**	0.073	0.071	0.070	0.068	0.067	0.065	0.064	0.063	0.061	0.060	0.059	0.057	0.056
21.0	**0.055**	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.054	0.053
21.5	**0.053**	0.066	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.051
22.0	**0.050**	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
22.5	**0.048**	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046
23.0	**0.045**	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.046	0.044	0.044
23.5	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.041
24.0	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040	0.039
24.5	**0.039**	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.037
25.0	**0.037**	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036
25.5	**0.035**	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034
26.0	**0.034**	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033	0.033
26.5	**0.032**	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.032	0.032	0.031
27.0	**0.031**	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030

Table 16-2: C_t values, Sound Optimized Mode SO12

16.3 Sound Curves, Sound Optimized Mode SO12

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO12 (Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	95.0
7	97.1
8	98.8
9	99.7
10	99.9
11	99.9
12	99.9
13	99.9
14	99.9
15	99.9
16	99.9
17	99.9
18	99.9
19	99.9
20	99.9

Table 16-3: Sound curves, Sound Optimized Mode SO12

17 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO12 (HWO)

NOTE The power curves and Ct values presented in Section 17 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

17.1 Power Curves, Sound Optimized Mode SO12 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**336**	250	257	265	273	281	289	297	305	313	321	329	344	352
5.0	**477**	358	369	380	391	402	412	423	434	445	456	467	488	499
5.5	**646**	489	504	518	532	547	561	575	589	604	618	632	660	674
6.0	**840**	641	659	677	696	714	732	750	768	786	804	822	858	876
6.5	**1048**	804	827	849	871	893	916	938	960	982	1004	1026	1070	1092
7.0	**1253**	965	992	1018	1044	1071	1097	1123	1149	1176	1202	1228	1279	1305
7.5	**1422**	1098	1127	1157	1187	1217	1246	1276	1305	1334	1364	1393	1451	1480
8.0	**1581**	1224	1257	1290	1322	1355	1387	1420	1452	1485	1517	1549	1613	1645
8.5	**1823**	1452	1488	1524	1560	1596	1629	1663	1696	1730	1761	1792	1852	1882
9.0	**2118**	1842	1872	1903	1933	1964	1988	2012	2036	2060	2079	2098	2135	2151
9.5	**2310**	2166	2187	2207	2228	2248	2259	2269	2279	2290	2296	2303	2315	2320
10.0	**2385**	2343	2350	2358	2366	2374	2376	2378	2380	2382	2383	2384	2385	2386
10.5	**2425**	2409	2412	2414	2417	2420	2420	2421	2422	2423	2424	2424	2425	2425
11.0	**2460**	2452	2453	2454	2456	2458	2458	2459	2459	2460	2460	2460	2460	2460
11.5	**2487**	2484	2485	2485	2486	2486	2487	2487	2487	2487	2487	2487	2487	2487
12.0	**2511**	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511	2511
12.5	**2536**	2538	2538	2538	2538	2538	2538	2537	2537	2537	2537	2537	2536	2536
13.0	**2572**	2575	2575	2575	2575	2574	2574	2574	2574	2573	2573	2572	2571	2571
13.5	**2626**	2630	2630	2630	2630	2629	2629	2628	2628	2628	2627	2626	2625	2624
14.0	**2684**	2690	2689	2689	2689	2688	2688	2687	2686	2686	2685	2684	2683	2682
14.5	**2744**	2751	2751	2750	2750	2750	2749	2748	2747	2747	2746	2745	2743	2742
15.0	**2808**	2816	2815	2814	2814	2814	2813	2812	2811	2810	2810	2808	2806	2806
15.5	**2868**	2876	2876	2875	2875	2874	2874	2873	2872	2871	2870	2869	2867	2866
16.0	**2928**	2936	2936	2935	2935	2934	2933	2932	2931	2930	2930	2928	2926	2925
16.5	**2983**	2992	2991	2990	2990	2989	2988	2988	2987	2986	2985	2984	2982	2981
17.0	**3035**	3044	3044	3043	3042	3042	3041	3040	3039	3038	3037	3036	3034	3033
17.5	**3085**	3095	3094	3094	3093	3092	3091	3090	3089	3088	3087	3086	3084	3083
18.0	**3136**	3146	3145	3145	3144	3143	3142	3141	3140	3139	3138	3137	3134	3133
18.5	**3188**	3200	3199	3198	3197	3196	3195	3194	3193	3192	3190	3189	3186	3185
19.0	**3242**	3255	3254	3253	3252	3251	3250	3249	3247	3246	3245	3244	3241	3239
19.5	**3296**	3308	3307	3306	3305	3304	3303	3302	3301	3300	3298	3297	3294	3293
20.0	**3345**	3356	3356	3355	3354	3353	3352	3351	3350	3349	3347	3346	3343	3342
20.5	**3390**	3401	3400	3399	3399	3398	3397	3396	3394	3393	3392	3391	3388	3387
21.0	**3433**	3444	3443	3443	3442	3441	3440	3439	3437	3436	3435	3434	3432	3430
21.5	**3474**	3485	3484	3484	3483	3482	3481	3480	3479	3478	3476	3475	3472	3471
22.0	**3514**	3525	3524	3523	3522	3522	3520	3519	3518	3517	3516	3515	3513	3511
22.5	**3550**	3559	3559	3558	3557	3556	3555	3554	3553	3553	3552	3551	3548	3547
23.0	**3577**	3585	3584	3584	3583	3583	3582	3581	3580	3580	3579	3578	3576	3576
23.5	**3600**	3605	3605	3604	3604	3603	3603	3602	3601	3601	3600	3600	3599	3598
24.0	**3615**	3619	3618	3618	3618	3617	3617	3617	3616	3616	3616	3615	3615	3614
24.5	**3625**	3627	3627	3627	3627	3626	3626	3626	3626	3626	3625	3625	3625	3624
25.0	**3631**	3632	3632	3632	3632	3632	3631	3631	3631	3631	3631	3631	3631	3631
25.5	**3634**	3635	3635	3635	3635	3635	3635	3635	3635	3635	3634	3634	3634	3634
26.0	**3634**	3635	3635	3635	3635	3635	3635	3635	3634	3634	3634	3634	3634	3634
26.5	**3604**	3604	3604	3604	3604	3604	3604	3604	3604	3604	3604	3604	3604	3604
27.0	**3527**	3527	3527	3527	3527	3527	3527	3527	3527	3527	3527	3527	3527	3527
27.5	**3271**	3271	3271	3271	3271	3271	3271	3271	3271	3271	3271	3271	3271	3271

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**2895**	2895	2895	2895	2895	2895	2895	2895	2895	2895	2895	2895	2895	2895
28.5	**2404**	2404	2404	2404	2404	2404	2404	2404	2404	2404	2404	2404	2404	2404
29.0	**2064**	2064	2064	2064	2064	2064	2064	2064	2064	2064	2064	2064	2064	2064
29.5	**1849**	1849	1849	1849	1849	1849	1849	1849	1849	1849	1849	1849	1849	1849
30.0	**1703**	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703	1703
30.5	**1599**	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599	1599
31.0	**1524**	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524	1524
31.5	**1471**	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471	1471
32.0	**1443**	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443	1443

Table 17-1: Power curve, Sound Optimized Mode SO12 (HWO)

17.2 Ct Values, Sound Optimized Mode SO12 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.857**	0.856	0.856	0.856	0.856	0.856	0.856	0.857	0.857	0.857	0.857	0.857	0.856	0.856
5.0	**0.845**	0.850	0.849	0.849	0.849	0.848	0.848	0.848	0.847	0.847	0.846	0.846	0.845	0.844
5.5	**0.808**	0.814	0.813	0.813	0.812	0.812	0.811	0.811	0.810	0.810	0.809	0.809	0.808	0.807
6.0	**0.752**	0.758	0.758	0.757	0.757	0.756	0.756	0.755	0.755	0.754	0.754	0.753	0.752	0.751
6.5	**0.697**	0.703	0.702	0.702	0.701	0.701	0.700	0.700	0.699	0.698	0.698	0.697	0.696	0.696
7.0	**0.633**	0.638	0.638	0.637	0.637	0.636	0.636	0.635	0.635	0.634	0.634	0.633	0.632	0.632
7.5	**0.557**	0.562	0.561	0.561	0.560	0.560	0.559	0.559	0.559	0.558	0.558	0.557	0.556	0.556
8.0	**0.491**	0.496	0.496	0.495	0.495	0.494	0.494	0.494	0.493	0.493	0.492	0.492	0.491	0.490
8.5	**0.462**	0.483	0.481	0.480	0.478	0.476	0.475	0.473	0.471	0.469	0.467	0.464	0.460	0.457
9.0	**0.449**	0.528	0.520	0.512	0.505	0.497	0.490	0.483	0.476	0.469	0.462	0.455	0.442	0.436
9.5	**0.412**	0.533	0.521	0.509	0.497	0.485	0.474	0.463	0.452	0.441	0.431	0.422	0.404	0.395
10.0	**0.358**	0.483	0.469	0.456	0.442	0.428	0.417	0.407	0.396	0.385	0.376	0.367	0.350	0.342
10.5	**0.308**	0.413	0.401	0.390	0.378	0.366	0.357	0.348	0.340	0.331	0.323	0.316	0.302	0.295
11.0	**0.269**	0.356	0.346	0.337	0.327	0.318	0.310	0.303	0.295	0.288	0.281	0.275	0.263	0.258
11.5	**0.236**	0.309	0.301	0.293	0.285	0.277	0.271	0.265	0.258	0.252	0.246	0.241	0.231	0.226
12.0	**0.208**	0.271	0.265	0.258	0.251	0.244	0.238	0.233	0.227	0.222	0.217	0.213	0.204	0.200
12.5	**0.185**	0.240	0.234	0.228	0.223	0.217	0.212	0.207	0.202	0.197	0.193	0.189	0.182	0.178
13.0	**0.167**	0.215	0.210	0.205	0.200	0.194	0.190	0.186	0.182	0.177	0.174	0.170	0.163	0.160
13.5	**0.152**	0.197	0.192	0.187	0.182	0.178	0.174	0.170	0.166	0.162	0.159	0.156	0.149	0.147
14.0	**0.140**	0.180	0.175	0.171	0.167	0.162	0.159	0.155	0.152	0.148	0.145	0.142	0.137	0.134
14.5	**0.128**	0.165	0.161	0.157	0.153	0.149	0.146	0.143	0.140	0.137	0.134	0.131	0.126	0.124
15.0	**0.118**	0.152	0.148	0.144	0.141	0.137	0.134	0.132	0.129	0.126	0.123	0.121	0.116	0.114
15.5	**0.110**	0.140	0.137	0.134	0.130	0.127	0.125	0.122	0.119	0.117	0.114	0.112	0.108	0.106
16.0	**0.102**	0.130	0.127	0.124	0.121	0.118	0.116	0.113	0.111	0.108	0.106	0.104	0.100	0.098
16.5	**0.095**	0.121	0.118	0.116	0.113	0.110	0.108	0.105	0.103	0.101	0.099	0.097	0.093	0.092
17.0	**0.089**	0.113	0.110	0.108	0.105	0.103	0.100	0.098	0.096	0.094	0.092	0.091	0.087	0.086
17.5	**0.083**	0.105	0.103	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.085	0.081	0.080
18.0	**0.078**	0.099	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.082	0.081	0.079	0.076	0.075
18.5	**0.073**	0.093	0.090	0.088	0.086	0.084	0.083	0.081	0.079	0.077	0.076	0.075	0.072	0.071
19.0	**0.069**	0.087	0.085	0.083	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.067	0.066
19.5	**0.065**	0.082	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.066	0.064	0.063
20.0	**0.061**	0.077	0.075	0.074	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.063	0.060	0.059
20.5	**0.058**	0.073	0.071	0.070	0.068	0.067	0.065	0.064	0.063	0.061	0.060	0.059	0.057	0.056
21.0	**0.055**	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.054	0.053
21.5	**0.053**	0.066	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.051
22.0	**0.050**	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
22.5	**0.048**	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046
23.0	**0.045**	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.046	0.044	0.044
23.5	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.041
24.0	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040	0.039
24.5	**0.039**	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.037
25.0	**0.037**	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036
25.5	**0.035**	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034
26.0	**0.034**	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033	0.033
26.5	**0.032**	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031
27.0	**0.030**	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.029
27.5	**0.027**	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026
28.0	**0.023**	0.028	0.027	0.027	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023
28.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019
29.0	**0.017**	0.019	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016
29.5	**0.014**	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.015	0.014	0.014
30.0	**0.013**	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013
30.5	**0.012**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
31.0	**0.011**	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010
31.5	**0.010**	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.009
32.0	**0.009**	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009

Table 17-2: C_t values, Sound Optimized Mode SO12 (HWO)

17.3 Sound Curves, Sound Optimized Mode SO12 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO12 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	95.0
7	97.1
8	98.8
9	99.7
10	99.9
11	99.9
12	99.9
13	99.9
14	99.9
15	99.9
16	99.9
17	99.9
18	99.9
19	99.9
20	99.9

Table 17-3: Sound curves, Sound Optimized Mode SO12 (HWO)

18 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO13

NOTE The power curves and Ct values presented in Section 18 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

18.1 Power Curves, Sound Optimized Mode SO13

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**218**	158	164	169	175	180	186	191	197	202	208	213	224	229
4.5	**321**	239	246	254	261	269	276	283	291	298	306	313	328	336
5.0	**429**	323	333	343	352	362	372	381	391	401	410	420	439	449
5.5	**531**	402	414	426	437	449	461	473	484	496	508	520	543	555
6.0	**643**	490	504	518	532	546	560	574	588	602	615	629	657	671
6.5	**773**	592	608	625	642	658	674	691	707	724	740	757	789	806
7.0	**906**	696	715	734	753	772	792	811	830	849	868	887	925	944
7.5	**1038**	799	821	843	864	886	908	930	951	973	994	1016	1059	1080
8.0	**1200**	929	954	979	1003	1028	1053	1078	1103	1128	1152	1176	1222	1245
8.5	**1361**	1063	1091	1120	1148	1177	1205	1232	1260	1288	1312	1337	1382	1403
9.0	**1463**	1157	1188	1219	1250	1281	1309	1338	1366	1395	1418	1440	1482	1501
9.5	**1538**	1270	1301	1331	1361	1392	1415	1439	1463	1487	1504	1521	1551	1564
10.0	**1643**	1449	1474	1498	1523	1548	1564	1580	1596	1612	1622	1632	1650	1657
10.5	**1746**	1647	1661	1675	1689	1703	1710	1718	1725	1733	1737	1741	1749	1752
11.0	**1812**	1785	1789	1794	1799	1803	1805	1807	1808	1810	1811	1811	1812	1812
11.5	**1842**	1841	1841	1842	1842	1842	1842	1842	1842	1842	1842	1842	1842	1842
12.0	**1864**	1865	1865	1865	1865	1865	1865	1864	1864	1864	1864	1864	1864	1864
12.5	**1883**	1884	1884	1884	1884	1884	1884	1884	1883	1883	1883	1883	1883	1883
13.0	**1902**	1903	1903	1903	1903	1903	1902	1902	1902	1902	1902	1902	1902	1901
13.5	**1919**	1920	1920	1920	1920	1920	1920	1920	1919	1919	1919	1919	1919	1918
14.0	**1935**	1936	1936	1936	1936	1936	1936	1936	1936	1936	1935	1935	1935	1935
14.5	**1951**	1953	1953	1952	1952	1952	1952	1952	1952	1952	1952	1951	1951	1951
15.0	**1968**	1969	1969	1969	1969	1969	1969	1968	1968	1968	1968	1968	1967	1967
15.5	**1983**	1985	1985	1985	1984	1984	1984	1984	1984	1984	1984	1983	1983	1983
16.0	**1997**	1999	1999	1999	1999	1998	1998	1998	1998	1998	1998	1998	1997	1997
16.5	**2010**	2012	2012	2012	2011	2011	2011	2011	2011	2011	2011	2010	2010	2010
17.0	**2022**	2023	2023	2023	2023	2023	2023	2023	2022	2022	2022	2022	2022	2021
17.5	**2032**	2034	2034	2034	2034	2034	2034	2033	2033	2033	2033	2033	2032	2032
18.0	**2042**	2044	2044	2044	2044	2044	2043	2043	2043	2043	2043	2042	2042	2042
18.5	**2052**	2053	2053	2053	2053	2052	2052	2052	2052	2052	2052	2052	2051	2051
19.0	**2060**	2061	2061	2061	2061	2061	2061	2061	2060	2060	2060	2060	2060	2060
19.5	**2067**	2068	2068	2068	2068	2068	2068	2068	2068	2068	2068	2067	2067	2067
20.0	**2073**	2074	2074	2074	2074	2074	2074	2074	2073	2073	2073	2073	2073	2073
20.5	**2078**	2079	2079	2079	2079	2079	2079	2078	2078	2078	2078	2078	2078	2078
21.0	**2084**	2085	2085	2085	2085	2085	2084	2084	2084	2084	2084	2084	2083	2083
21.5	**2090**	2093	2093	2092	2092	2092	2092	2092	2091	2091	2091	2091	2090	2090
22.0	**2100**	2103	2102	2102	2102	2102	2102	2101	2101	2101	2101	2100	2100	2099
22.5	**2111**	2114	2113	2113	2113	2113	2112	2112	2112	2112	2111	2111	2110	2110
23.0	**2123**	2126	2125	2125	2125	2125	2124	2124	2124	2124	2123	2123	2122	2122
23.5	**2133**	2135	2135	2135	2135	2135	2134	2134	2134	2134	2133	2133	2133	2132
24.0	**2141**	2143	2142	2142	2142	2142	2142	2142	2141	2141	2141	2141	2140	2140

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
24.5	**2147**	2148	2148	2148	2148	2148	2148	2148	2147	2147	2147	2147	2147	2146
25.0	**2151**	2152	2152	2152	2152	2152	2151	2151	2151	2151	2151	2151	2151	2151
25.5	**2154**	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2153	2153
26.0	**2154**	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154
26.5	**2155**	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155
27.0	**2155**	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155

Table 18-1: Power curve, Sound Optimized Mode SO13

18.2 Ct Values, Sound Optimized Mode SO13

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.785**	0.789	0.789	0.789	0.788	0.788	0.788	0.787	0.787	0.786	0.786	0.785	0.785	0.784
4.5	**0.693**	0.698	0.698	0.697	0.696	0.696	0.695	0.695	0.694	0.694	0.693	0.693	0.692	0.692
5.0	**0.622**	0.625	0.624	0.624	0.624	0.623	0.623	0.623	0.623	0.622	0.622	0.622	0.622	0.621
5.5	**0.546**	0.548	0.548	0.548	0.548	0.547	0.547	0.547	0.547	0.547	0.547	0.547	0.546	0.546
6.0	**0.487**	0.489	0.489	0.489	0.489	0.489	0.489	0.488	0.488	0.488	0.488	0.487	0.487	0.486
6.5	**0.446**	0.449	0.449	0.448	0.448	0.448	0.448	0.447	0.447	0.447	0.447	0.446	0.446	0.445
7.0	**0.407**	0.410	0.409	0.409	0.409	0.409	0.408	0.408	0.408	0.408	0.407	0.407	0.407	0.407
7.5	**0.371**	0.374	0.373	0.373	0.373	0.373	0.373	0.372	0.372	0.372	0.372	0.371	0.371	0.371
8.0	**0.349**	0.352	0.352	0.352	0.351	0.351	0.351	0.351	0.350	0.350	0.350	0.349	0.348	0.347
8.5	**0.327**	0.332	0.332	0.332	0.332	0.332	0.331	0.331	0.330	0.330	0.329	0.328	0.325	0.323
9.0	**0.293**	0.301	0.301	0.301	0.301	0.301	0.300	0.299	0.299	0.298	0.296	0.295	0.291	0.289
9.5	**0.259**	0.278	0.277	0.276	0.275	0.274	0.272	0.271	0.269	0.267	0.264	0.262	0.256	0.253
10.0	**0.236**	0.269	0.267	0.264	0.262	0.260	0.256	0.253	0.250	0.246	0.243	0.239	0.232	0.228
10.5	**0.216**	0.264	0.259	0.255	0.250	0.246	0.242	0.237	0.233	0.228	0.224	0.220	0.212	0.208
11.0	**0.194**	0.248	0.243	0.237	0.232	0.226	0.221	0.217	0.212	0.207	0.203	0.198	0.190	0.187
11.5	**0.172**	0.223	0.218	0.212	0.207	0.201	0.197	0.192	0.188	0.184	0.180	0.176	0.169	0.166
12.0	**0.153**	0.198	0.193	0.188	0.183	0.179	0.175	0.171	0.167	0.163	0.160	0.157	0.150	0.148
12.5	**0.137**	0.176	0.172	0.168	0.164	0.159	0.156	0.153	0.149	0.146	0.143	0.140	0.135	0.132
13.0	**0.123**	0.158	0.154	0.150	0.147	0.143	0.140	0.137	0.134	0.131	0.128	0.126	0.121	0.119
13.5	**0.112**	0.143	0.139	0.136	0.133	0.129	0.127	0.124	0.121	0.119	0.116	0.114	0.110	0.108
14.0	**0.101**	0.129	0.126	0.123	0.120	0.117	0.115	0.112	0.110	0.107	0.105	0.103	0.100	0.098
14.5	**0.092**	0.117	0.115	0.112	0.109	0.107	0.104	0.102	0.100	0.098	0.096	0.094	0.091	0.089
15.0	**0.084**	0.107	0.104	0.102	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.083	0.081
15.5	**0.077**	0.098	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.076	0.075
16.0	**0.071**	0.090	0.088	0.086	0.084	0.082	0.080	0.078	0.077	0.075	0.074	0.073	0.070	0.069
16.5	**0.066**	0.083	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.064
17.0	**0.061**	0.076	0.075	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063	0.062	0.060	0.059
17.5	**0.056**	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055
18.0	**0.053**	0.066	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.055	0.054	0.054	0.052	0.051
18.5	**0.049**	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.048
19.0	**0.046**	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.045	0.044
19.5	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
20.0	**0.040**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039
20.5	**0.038**	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.037	0.037
21.0	**0.036**	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035
21.5	**0.034**	0.042	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033
22.0	**0.032**	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031
22.5	**0.031**	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030
23.0	**0.029**	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.030	0.029	0.028
23.5	**0.028**	0.033	0.033	0.032	0.032	0.031	0.030	0.030	0.029	0.029	0.029	0.028	0.027	0.027
24.0	**0.026**	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
24.5	**0.025**	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025
25.0	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.024	0.024	0.023
25.5	**0.023**	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023	0.023	0.023
26.0	**0.022**	0.026	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022
26.5	**0.021**	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.021	0.021	0.021
27.0	**0.020**	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021	0.021	0.021	0.020	0.020

Table 18-2: C_t values, Sound Optimized Mode SO13

18.3 Sound Curves, Sound Optimized Mode SO13

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO13 (Blades with serrated trailing edge)**
3	90.9
4	91.0
5	91.4
6	92.4
7	93.1
8	94.3
9	95.8
10	96.5
11	96.9
12	97.0
13	97.0
14	97.0
15	97.0
16	97.0
17	97.0
18	97.0
19	97.0
20	97.0

Table 18-3: Sound curves, Sound Optimized Mode SO13

19 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO13 (HWO)

NOTE The power curves and Ct values presented in Section 19 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

19.1 Power Curves, Sound Optimized Mode SO13 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**218**	158	164	169	175	180	186	191	197	202	208	213	224	229
4.5	**321**	239	246	254	261	269	276	283	291	298	306	313	328	336
5.0	**429**	323	333	343	352	362	372	381	391	401	410	420	439	449
5.5	**531**	402	414	426	437	449	461	473	484	496	508	520	543	555
6.0	**643**	490	504	518	532	546	560	574	588	602	615	629	657	671
6.5	**773**	592	608	625	642	658	674	691	707	724	740	757	789	806
7.0	**906**	696	715	734	753	772	792	811	830	849	868	887	925	944
7.5	**1038**	799	821	843	864	886	908	930	951	973	994	1016	1059	1080
8.0	**1200**	929	954	979	1003	1028	1053	1078	1103	1128	1152	1176	1222	1245
8.5	**1361**	1063	1091	1120	1148	1177	1205	1232	1260	1288	1312	1337	1382	1403
9.0	**1463**	1157	1188	1219	1250	1281	1309	1338	1366	1395	1418	1440	1482	1501
9.5	**1538**	1270	1301	1331	1361	1392	1415	1439	1463	1487	1504	1521	1551	1564
10.0	**1643**	1449	1474	1498	1523	1548	1564	1580	1596	1612	1622	1632	1650	1657
10.5	**1746**	1647	1661	1675	1689	1703	1710	1718	1725	1733	1737	1741	1749	1752
11.0	**1812**	1785	1789	1794	1799	1803	1805	1807	1808	1810	1811	1811	1812	1812
11.5	**1842**	1841	1841	1842	1842	1842	1842	1842	1842	1842	1842	1842	1842	1842
12.0	**1864**	1865	1865	1865	1865	1865	1865	1864	1864	1864	1864	1864	1864	1864
12.5	**1883**	1884	1884	1884	1884	1884	1884	1884	1883	1883	1883	1883	1883	1883
13.0	**1902**	1903	1903	1903	1903	1903	1902	1902	1902	1902	1902	1902	1902	1901
13.5	**1919**	1920	1920	1920	1920	1920	1920	1920	1919	1919	1919	1919	1919	1918
14.0	**1935**	1936	1936	1936	1936	1936	1936	1936	1936	1936	1935	1935	1935	1935
14.5	**1951**	1953	1953	1952	1952	1952	1952	1952	1952	1952	1952	1951	1951	1951
15.0	**1968**	1969	1969	1969	1969	1969	1969	1968	1968	1968	1968	1968	1967	1967
15.5	**1983**	1985	1985	1985	1984	1984	1984	1984	1984	1984	1984	1983	1983	1983
16.0	**1997**	1999	1999	1999	1999	1998	1998	1998	1998	1998	1998	1997	1997	1997
16.5	**2010**	2012	2012	2012	2011	2011	2011	2011	2011	2011	2011	2010	2010	2010
17.0	**2022**	2023	2023	2023	2023	2023	2023	2023	2022	2022	2022	2022	2022	2021
17.5	**2032**	2034	2034	2034	2034	2034	2034	2033	2033	2033	2033	2033	2032	2032
18.0	**2042**	2044	2044	2044	2044	2044	2043	2043	2043	2043	2043	2042	2042	2042
18.5	**2052**	2053	2053	2053	2053	2052	2052	2052	2052	2052	2052	2052	2051	2051
19.0	**2060**	2061	2061	2061	2061	2061	2061	2061	2060	2060	2060	2060	2060	2060
19.5	**2067**	2068	2068	2068	2068	2068	2068	2068	2068	2068	2068	2067	2067	2067
20.0	**2073**	2074	2074	2074	2074	2074	2074	2074	2073	2073	2073	2073	2073	2073
20.5	**2078**	2079	2079	2079	2079	2079	2079	2078	2078	2078	2078	2078	2078	2078
21.0	**2084**	2085	2085	2085	2085	2085	2084	2084	2084	2084	2084	2084	2083	2083
21.5	**2090**	2093	2093	2092	2092	2092	2092	2092	2091	2091	2091	2091	2090	2090
22.0	**2100**	2103	2102	2102	2102	2102	2102	2101	2101	2101	2101	2100	2100	2099
22.5	**2111**	2114	2113	2113	2113	2113	2112	2112	2112	2112	2111	2111	2110	2110
23.0	**2123**	2126	2125	2125	2125	2125	2124	2124	2124	2124	2123	2123	2122	2122
23.5	**2133**	2135	2135	2135	2135	2135	2134	2134	2134	2134	2133	2133	2133	2132
24.0	**2141**	2143	2142	2142	2142	2142	2142	2142	2141	2141	2141	2141	2140	2140
24.5	**2147**	2148	2148	2148	2148	2148	2148	2148	2147	2147	2147	2147	2147	2146
25.0	**2151**	2152	2152	2152	2152	2152	2151	2151	2151	2151	2151	2151	2151	2151
25.5	**2154**	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2153	2153
26.0	**2154**	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154	2154
26.5	**2155**	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155
27.0	**2155**	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155	2155
27.5	**2153**	2153	2153	2153	2153	2153	2153	2153	2153	2153	2153	2153	2153	2153

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**2127**	2127	2127	2127	2127	2127	2127	2127	2127	2127	2127	2127	2127	2127
28.5	**2050**	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050
29.0	**1929**	1929	1929	1929	1929	1929	1929	1929	1929	1929	1929	1929	1929	1929
29.5	**1750**	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
30.0	**1600**	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
30.5	**1488**	1488	1488	1488	1488	1488	1488	1488	1488	1488	1488	1488	1488	1488
31.0	**1413**	1413	1413	1413	1413	1413	1413	1413	1413	1413	1413	1413	1413	1413
31.5	**1364**	1363	1363	1363	1363	1363	1363	1363	1363	1364	1364	1364	1364	1364
32.0	**1338**	1338	1338	1338	1338	1338	1338	1338	1338	1338	1338	1338	1338	1338

Table 19-1: Power curve, Sound Optimized Mode SO13 (HWO)

19.2 Ct Values, Sound Optimized Mode SO13 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.785**	0.789	0.789	0.789	0.788	0.788	0.788	0.787	0.787	0.786	0.786	0.785	0.785	0.784
4.5	**0.693**	0.698	0.698	0.697	0.696	0.696	0.695	0.695	0.694	0.694	0.693	0.693	0.692	0.692
5.0	**0.622**	0.625	0.624	0.624	0.624	0.623	0.623	0.623	0.623	0.622	0.622	0.622	0.622	0.621
5.5	**0.546**	0.548	0.548	0.548	0.548	0.547	0.547	0.547	0.547	0.547	0.547	0.547	0.546	0.546
6.0	**0.487**	0.489	0.489	0.489	0.489	0.489	0.489	0.488	0.488	0.488	0.488	0.487	0.487	0.486
6.5	**0.446**	0.449	0.449	0.448	0.448	0.448	0.448	0.447	0.447	0.447	0.447	0.446	0.446	0.445
7.0	**0.407**	0.410	0.409	0.409	0.409	0.409	0.408	0.408	0.408	0.408	0.407	0.407	0.407	0.407
7.5	**0.371**	0.374	0.373	0.373	0.373	0.373	0.373	0.372	0.372	0.372	0.372	0.371	0.371	0.371
8.0	**0.349**	0.352	0.352	0.352	0.351	0.351	0.351	0.351	0.350	0.350	0.350	0.349	0.348	0.347
8.5	**0.327**	0.332	0.332	0.332	0.332	0.332	0.331	0.331	0.330	0.330	0.329	0.328	0.325	0.323
9.0	**0.293**	0.301	0.301	0.301	0.301	0.301	0.300	0.299	0.299	0.298	0.296	0.295	0.291	0.289
9.5	**0.259**	0.278	0.277	0.276	0.275	0.274	0.272	0.271	0.269	0.267	0.264	0.262	0.256	0.253
10.0	**0.236**	0.269	0.267	0.264	0.262	0.260	0.256	0.253	0.250	0.246	0.243	0.239	0.232	0.228
10.5	**0.216**	0.264	0.259	0.255	0.250	0.246	0.242	0.237	0.233	0.228	0.224	0.220	0.212	0.208
11.0	**0.194**	0.248	0.243	0.237	0.232	0.226	0.221	0.217	0.212	0.207	0.203	0.198	0.190	0.187
11.5	**0.172**	0.223	0.218	0.212	0.207	0.201	0.197	0.192	0.188	0.184	0.180	0.176	0.169	0.166
12.0	**0.153**	0.198	0.193	0.188	0.183	0.179	0.175	0.171	0.167	0.163	0.160	0.157	0.150	0.148
12.5	**0.137**	0.176	0.172	0.168	0.164	0.159	0.156	0.153	0.149	0.146	0.143	0.140	0.135	0.132
13.0	**0.123**	0.158	0.154	0.150	0.147	0.143	0.140	0.137	0.134	0.131	0.128	0.126	0.121	0.119
13.5	**0.112**	0.143	0.139	0.136	0.133	0.129	0.127	0.124	0.121	0.119	0.116	0.114	0.110	0.108
14.0	**0.101**	0.129	0.126	0.123	0.120	0.117	0.115	0.112	0.110	0.107	0.105	0.103	0.100	0.098
14.5	**0.092**	0.117	0.115	0.112	0.109	0.107	0.104	0.102	0.100	0.098	0.096	0.094	0.091	0.089
15.0	**0.084**	0.107	0.104	0.102	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.083	0.081
15.5	**0.077**	0.098	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.076	0.075
16.0	**0.071**	0.090	0.088	0.086	0.084	0.082	0.080	0.078	0.077	0.075	0.074	0.073	0.070	0.069
16.5	**0.066**	0.083	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.064
17.0	**0.061**	0.076	0.075	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063	0.062	0.060	0.059
17.5	**0.056**	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055
18.0	**0.053**	0.066	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.055	0.054	0.054	0.052	0.051
18.5	**0.049**	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.048
19.0	**0.046**	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.045	0.044
19.5	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
20.0	**0.040**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039
20.5	**0.038**	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.037	0.037
21.0	**0.036**	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035
21.5	**0.034**	0.042	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033
22.0	**0.032**	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031
22.5	**0.031**	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030
23.0	**0.029**	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.030	0.029	0.028
23.5	**0.028**	0.033	0.033	0.032	0.032	0.031	0.030	0.030	0.029	0.029	0.029	0.028	0.027	0.027
24.0	**0.026**	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
24.5	**0.025**	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025
25.0	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.024	0.024	0.023
25.5	**0.023**	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023	0.023	0.023
26.0	**0.022**	0.026	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022
26.5	**0.021**	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.021	0.021	0.021
27.0	**0.020**	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021	0.021	0.021	0.020	0.020
27.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019
28.0	**0.018**	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019	0.019	0.018	0.018
28.5	**0.017**	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017
29.0	**0.016**	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015
29.5	**0.014**	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014
30.0	**0.012**	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.012
30.5	**0.011**	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011
31.0	**0.010**	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010
31.5	**0.009**	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009
32.0	**0.009**	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009

Table 19-2: C_t values, Sound Optimized Mode SO13 (HWO)

19.3 Sound Curves, Sound Optimized Mode SO13 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO13 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.0
5	91.4
6	92.4
7	93.1
8	94.3
9	95.8
10	96.5
11	96.9
12	97.0
13	97.0
14	97.0
15	97.0
16	97.0
17	97.0
18	97.0
19	97.0
20	97.0

Table 19-3: Sound curves, Sound Optimized Mode SO13 (HWO)

20 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO6

NOTE The power curves and Ct values presented in Section 20 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

20.1 Power Curves, Sound Optimized Mode SO6

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**46**	24	26	28	30	32	34	36	38	40	42	44	48	50
3.5	**124**	84	88	92	95	99	103	106	110	114	117	121	128	132
4.0	**221**	160	166	171	177	182	188	193	199	204	210	216	227	232
4.5	**336**	249	257	265	273	281	289	297	305	312	320	328	344	352
5.0	**477**	358	369	380	390	401	412	423	434	445	456	466	488	499
5.5	**648**	490	504	519	533	548	562	576	591	605	619	634	662	676
6.0	**854**	650	668	687	706	724	743	761	780	799	817	836	873	891
6.5	**1097**	839	862	886	910	933	957	980	1004	1027	1051	1074	1121	1144
7.0	**1379**	1059	1088	1117	1146	1175	1204	1233	1262	1292	1321	1350	1407	1436
7.5	**1680**	1296	1332	1367	1402	1437	1472	1507	1542	1577	1611	1646	1715	1749
8.0	**1985**	1540	1580	1621	1662	1703	1744	1784	1825	1865	1905	1945	2024	2064
8.5	**2271**	1770	1816	1863	1909	1955	2000	2046	2091	2137	2182	2227	2316	2360
9.0	**2520**	1970	2021	2072	2123	2173	2223	2273	2323	2372	2422	2471	2569	2618
9.5	**2733**	2142	2197	2251	2305	2360	2413	2467	2521	2574	2627	2680	2785	2838
10.0	**2883**	2264	2321	2379	2436	2493	2549	2606	2662	2718	2773	2828	2935	2988
10.5	**2994**	2359	2418	2478	2537	2596	2654	2712	2770	2829	2884	2939	3044	3095
11.0	**3090**	2465	2526	2587	2648	2710	2767	2824	2881	2939	2989	3040	3134	3178
11.5	**3197**	2597	2659	2721	2783	2845	2899	2953	3008	3062	3107	3152	3234	3272
12.0	**3301**	2763	2821	2880	2939	2998	3046	3094	3142	3191	3227	3264	3329	3358
12.5	**3385**	2940	2994	3047	3100	3154	3193	3231	3270	3309	3334	3359	3402	3419
13.0	**3425**	3103	3147	3191	3235	3280	3306	3332	3358	3384	3398	3411	3433	3442
13.5	**3420**	3209	3241	3272	3303	3335	3351	3366	3382	3398	3405	3412	3424	3428
14.0	**3407**	3278	3299	3320	3341	3363	3371	3379	3388	3396	3400	3404	3409	3411
14.5	**3384**	3306	3320	3333	3347	3360	3365	3370	3375	3380	3381	3382	3385	3385
15.0	**3353**	3310	3318	3326	3335	3343	3345	3347	3349	3351	3352	3353	3354	3354
15.5	**3323**	3296	3301	3306	3311	3316	3318	3319	3320	3322	3322	3323	3323	3324
16.0	**3293**	3277	3280	3283	3286	3289	3289	3290	3291	3292	3292	3293	3293	3293
16.5	**3262**	3252	3254	3256	3258	3260	3260	3261	3261	3262	3262	3262	3262	3262
17.0	**3232**	3225	3226	3227	3229	3230	3230	3231	3231	3232	3232	3232	3232	3232
17.5	**3201**	3195	3196	3198	3199	3201	3201	3201	3201	3201	3201	3201	3201	3201
18.0	**3171**	3167	3168	3169	3170	3171	3171	3171	3171	3171	3171	3171	3171	3171
18.5	**3141**	3139	3140	3140	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
19.0	**3113**	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113
19.5	**3086**	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086
20.0	**3064**	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064
20.5	**3047**	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047
21.0	**3035**	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035
21.5	**3027**	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027
22.0	**3024**	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024
22.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
23.0	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
23.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
24.0	**3022**	3021	3021	3021	3021	3022	3022	3022	3022	3022	3022	3022	3022	3022

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
24.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
25.0	**3022**	3021	3021	3021	3021	3022	3022	3022	3022	3022	3022	3022	3022	3022
25.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
26.0	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
26.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
27.0	**3022**	3021	3021	3021	3021	3022	3022	3022	3022	3022	3022	3022	3022	3022

Table 20-1: Power curve, Sound Optimized Mode SO6

20.2 Ct Values, Sound Optimized Mode SO6

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**0.889**	0.895	0.895	0.894	0.894	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.889	0.888
3.5	**0.860**	0.864	0.864	0.864	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.859	0.859
4.0	**0.844**	0.851	0.850	0.849	0.848	0.846	0.846	0.846	0.845	0.845	0.845	0.844	0.843	0.843
4.5	**0.861**	0.858	0.858	0.859	0.860	0.860	0.860	0.860	0.861	0.861	0.861	0.861	0.861	0.860
5.0	**0.859**	0.863	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.861	0.860	0.860	0.858	0.858
5.5	**0.848**	0.854	0.854	0.853	0.853	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.847	0.847
6.0	**0.834**	0.841	0.841	0.840	0.839	0.839	0.838	0.837	0.837	0.836	0.835	0.834	0.833	0.832
6.5	**0.816**	0.825	0.824	0.823	0.823	0.822	0.821	0.820	0.819	0.818	0.817	0.817	0.815	0.814
7.0	**0.787**	0.797	0.796	0.795	0.794	0.794	0.793	0.792	0.791	0.790	0.789	0.788	0.786	0.785
7.5	**0.745**	0.756	0.755	0.754	0.753	0.752	0.751	0.750	0.749	0.748	0.747	0.746	0.744	0.743
8.0	**0.694**	0.704	0.703	0.703	0.702	0.701	0.700	0.699	0.698	0.697	0.696	0.695	0.693	0.692
8.5	**0.636**	0.645	0.645	0.644	0.643	0.642	0.641	0.640	0.639	0.639	0.638	0.637	0.635	0.634
9.0	**0.572**	0.581	0.580	0.579	0.578	0.578	0.577	0.576	0.575	0.574	0.574	0.573	0.571	0.571
9.5	**0.509**	0.516	0.516	0.515	0.514	0.514	0.513	0.512	0.512	0.511	0.510	0.510	0.508	0.508
10.0	**0.445**	0.452	0.451	0.451	0.450	0.450	0.449	0.449	0.448	0.447	0.447	0.446	0.444	0.443
10.5	**0.389**	0.396	0.395	0.395	0.394	0.394	0.393	0.393	0.392	0.392	0.391	0.390	0.388	0.386
11.0	**0.343**	0.353	0.352	0.352	0.351	0.351	0.350	0.349	0.348	0.348	0.346	0.344	0.341	0.339
11.5	**0.307**	0.321	0.321	0.320	0.319	0.319	0.317	0.316	0.314	0.313	0.311	0.309	0.304	0.301
12.0	**0.277**	0.299	0.298	0.297	0.295	0.294	0.292	0.290	0.287	0.285	0.282	0.280	0.274	0.270
12.5	**0.250**	0.282	0.280	0.278	0.275	0.273	0.270	0.267	0.264	0.261	0.257	0.254	0.246	0.242
13.0	**0.224**	0.265	0.262	0.259	0.256	0.253	0.249	0.245	0.241	0.237	0.233	0.228	0.220	0.216
13.5	**0.200**	0.247	0.242	0.238	0.234	0.230	0.226	0.221	0.217	0.213	0.208	0.204	0.196	0.192
14.0	**0.178**	0.226	0.221	0.217	0.212	0.207	0.203	0.199	0.194	0.190	0.186	0.182	0.175	0.171
14.5	**0.159**	0.204	0.200	0.195	0.190	0.186	0.182	0.178	0.174	0.170	0.166	0.162	0.156	0.153
15.0	**0.141**	0.183	0.179	0.174	0.170	0.166	0.162	0.158	0.154	0.151	0.148	0.144	0.139	0.136
15.5	**0.127**	0.165	0.161	0.157	0.153	0.148	0.145	0.142	0.139	0.135	0.132	0.130	0.124	0.122
16.0	**0.114**	0.148	0.145	0.141	0.137	0.134	0.131	0.128	0.125	0.122	0.119	0.117	0.112	0.110
16.5	**0.104**	0.134	0.131	0.127	0.124	0.121	0.118	0.115	0.113	0.110	0.108	0.106	0.102	0.100
17.0	**0.094**	0.121	0.118	0.115	0.112	0.110	0.107	0.105	0.102	0.100	0.098	0.096	0.092	0.091
17.5	**0.086**	0.110	0.107	0.105	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.084	0.082
18.0	**0.078**	0.100	0.098	0.096	0.093	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.077	0.075
18.5	**0.072**	0.092	0.090	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.070	0.069
19.0	**0.066**	0.084	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.064	0.063
19.5	**0.061**	0.077	0.075	0.073	0.072	0.070	0.068	0.067	0.066	0.064	0.063	0.062	0.059	0.058
20.0	**0.056**	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.055	0.054
20.5	**0.052**	0.066	0.064	0.063	0.061	0.060	0.059	0.058	0.056	0.055	0.054	0.053	0.051	0.050
21.0	**0.049**	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.052	0.051	0.050	0.050	0.048	0.047
21.5	**0.046**	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.048	0.047	0.045	0.044
22.0	**0.043**	0.054	0.053	0.052	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.042	0.042
22.5	**0.041**	0.051	0.050	0.049	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.040	0.039
23.0	**0.038**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.039	0.039	0.037	0.037
23.5	**0.036**	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.035	0.035
24.0	**0.034**	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.033	0.033
24.5	**0.032**	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031
25.0	**0.031**	0.038	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030
25.5	**0.029**	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028
26.0	**0.028**	0.034	0.034	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.027	0.027
26.5	**0.026**	0.033	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
27.0	**0.025**	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025

Table 20-2: C_t values, Sound Optimized Mode SO6

20.3 Sound Curves, Sound Optimized Mode SO6

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO6 (Blades with serrated trailing edge)**
3	91.3
4	91.6
5	93.5
6	96.4
7	98.5
8	99.3
9	99.5
10	99.5
11	99.5
12	99.5
13	99.5
14	99.5
15	99.5
16	99.5
17	99.5
18	99.5
19	99.5
20	99.5

Table 20-3: Sound curves, Sound Optimized Mode SO6

21 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO6 (HWO)

NOTE The power curves and Ct values presented in Section 21 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

21.1 Power Curves, Sound Optimized Mode SO6 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**46**	24	26	28	30	32	34	36	38	40	42	44	48	50
3.5	**124**	84	88	92	95	99	103	106	110	114	117	121	128	132
4.0	**221**	160	166	171	177	182	188	193	199	204	210	216	227	232
4.5	**336**	249	257	265	273	281	289	297	305	312	320	328	344	352
5.0	**477**	358	369	380	390	401	412	423	434	445	456	466	488	499
5.5	**648**	490	504	519	533	548	562	576	591	605	619	634	662	676
6.0	**854**	650	668	687	706	724	743	761	780	799	817	836	873	891
6.5	**1097**	839	862	886	910	933	957	980	1004	1027	1051	1074	1121	1144
7.0	**1379**	1059	1088	1117	1146	1175	1204	1233	1262	1292	1321	1350	1407	1436
7.5	**1680**	1296	1332	1367	1402	1437	1472	1507	1542	1577	1611	1646	1715	1749
8.0	**1985**	1540	1580	1621	1662	1703	1744	1784	1825	1865	1905	1945	2024	2064
8.5	**2271**	1770	1816	1863	1909	1955	2000	2046	2091	2137	2182	2227	2316	2360
9.0	**2520**	1970	2021	2072	2123	2173	2223	2273	2323	2372	2422	2471	2569	2618
9.5	**2733**	2142	2197	2251	2305	2360	2413	2467	2521	2574	2627	2680	2785	2838
10.0	**2883**	2264	2321	2379	2436	2493	2549	2606	2662	2718	2773	2828	2935	2988
10.5	**2994**	2359	2418	2478	2537	2596	2654	2712	2770	2829	2884	2939	3044	3095
11.0	**3090**	2465	2526	2587	2648	2710	2767	2824	2881	2939	2989	3040	3134	3178
11.5	**3197**	2597	2659	2721	2783	2845	2899	2953	3008	3062	3107	3152	3234	3272
12.0	**3301**	2763	2821	2880	2939	2998	3046	3094	3142	3191	3227	3264	3329	3358
12.5	**3385**	2940	2994	3047	3100	3154	3193	3231	3270	3309	3334	3359	3402	3419
13.0	**3425**	3103	3147	3191	3235	3280	3306	3332	3358	3384	3398	3411	3433	3442
13.5	**3420**	3209	3241	3272	3303	3335	3351	3366	3382	3398	3405	3412	3424	3428
14.0	**3407**	3278	3299	3320	3341	3363	3371	3379	3388	3396	3400	3404	3409	3411
14.5	**3384**	3306	3320	3333	3347	3360	3365	3370	3375	3380	3381	3382	3385	3385
15.0	**3353**	3310	3318	3326	3335	3343	3345	3347	3349	3351	3352	3353	3354	3354
15.5	**3323**	3296	3301	3306	3311	3316	3318	3319	3320	3322	3322	3323	3323	3324
16.0	**3293**	3277	3280	3283	3286	3289	3289	3290	3291	3292	3292	3293	3293	3293
16.5	**3262**	3252	3254	3256	3258	3260	3260	3261	3261	3262	3262	3262	3262	3262
17.0	**3232**	3225	3226	3227	3229	3230	3230	3231	3231	3232	3232	3232	3232	3232
17.5	**3201**	3195	3196	3198	3199	3201	3201	3201	3201	3201	3201	3201	3201	3201
18.0	**3171**	3167	3168	3169	3170	3171	3171	3171	3171	3171	3171	3171	3171	3171
18.5	**3141**	3139	3140	3140	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
19.0	**3113**	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113	3113
19.5	**3086**	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086	3086
20.0	**3064**	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064	3064
20.5	**3047**	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047	3047
21.0	**3035**	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035	3035
21.5	**3027**	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027	3027
22.0	**3024**	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024	3024
22.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
23.0	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
23.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
24.0	**3022**	3021	3021	3021	3021	3022	3022	3022	3022	3022	3022	3022	3022	3022
24.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
25.0	**3022**	3021	3021	3021	3021	3022	3022	3022	3022	3022	3022	3022	3022	3022
25.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
26.0	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
26.5	**3022**	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022	3022
27.0	**3022**	3021	3021	3021	3021	3022	3022	3022	3022	3022	3022	3022	3022	3022
27.5	**3021**	3022	3021	3021	3021	3021	3021	3021	3021	3021	3021	3021	3021	3021

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**3018**	3018	3018	3018	3018	3018	3018	3018	3018	3018	3018	3018	3018	3018
28.5	**2984**	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984	2984
29.0	**2900**	2900	2900	2900	2900	2900	2900	2900	2900	2900	2900	2900	2900	2900
29.5	**2746**	2746	2746	2746	2746	2746	2746	2746	2746	2746	2746	2746	2746	2746
30.0	**2539**	2540	2540	2540	2540	2540	2539	2539	2539	2539	2539	2539	2539	2539
30.5	**2307**	2307	2306	2306	2306	2306	2306	2306	2306	2306	2306	2306	2307	2307
31.0	**2073**	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073
31.5	**1868**	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868
32.0	**1721**	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1722

Table 21-1: Power curve, Sound Optimized Mode SO6 (HWO)

21.2 Ct Values, Sound Optimized Mode SO6 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.889**	0.895	0.895	0.894	0.894	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.889	0.888
3.5	**0.860**	0.864	0.864	0.864	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.859	0.859
4.0	**0.844**	0.851	0.850	0.849	0.848	0.846	0.846	0.846	0.845	0.845	0.845	0.844	0.843	0.843
4.5	**0.861**	0.858	0.858	0.859	0.860	0.860	0.860	0.860	0.861	0.861	0.861	0.861	0.861	0.860
5.0	**0.859**	0.863	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.861	0.860	0.860	0.858	0.858
5.5	**0.848**	0.854	0.854	0.853	0.853	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.847	0.847
6.0	**0.834**	0.841	0.841	0.840	0.839	0.839	0.838	0.837	0.837	0.836	0.835	0.834	0.833	0.832
6.5	**0.816**	0.825	0.824	0.823	0.823	0.822	0.821	0.820	0.819	0.818	0.817	0.817	0.815	0.814
7.0	**0.787**	0.797	0.796	0.795	0.794	0.794	0.793	0.792	0.791	0.790	0.789	0.788	0.786	0.785
7.5	**0.745**	0.756	0.755	0.754	0.753	0.752	0.751	0.750	0.749	0.748	0.747	0.746	0.744	0.743
8.0	**0.694**	0.704	0.703	0.703	0.702	0.701	0.700	0.699	0.698	0.697	0.696	0.695	0.693	0.692
8.5	**0.636**	0.645	0.645	0.644	0.643	0.642	0.641	0.640	0.639	0.639	0.638	0.637	0.635	0.634
9.0	**0.572**	0.581	0.580	0.579	0.578	0.578	0.577	0.576	0.575	0.574	0.574	0.573	0.571	0.571
9.5	**0.509**	0.516	0.516	0.515	0.514	0.514	0.513	0.512	0.512	0.511	0.510	0.510	0.508	0.508
10.0	**0.445**	0.452	0.451	0.451	0.450	0.450	0.449	0.449	0.448	0.447	0.447	0.446	0.444	0.443
10.5	**0.389**	0.396	0.395	0.395	0.394	0.394	0.393	0.393	0.392	0.392	0.391	0.390	0.388	0.386
11.0	**0.343**	0.353	0.352	0.352	0.351	0.351	0.350	0.349	0.348	0.348	0.346	0.344	0.341	0.339
11.5	**0.307**	0.321	0.321	0.320	0.319	0.319	0.317	0.316	0.314	0.313	0.311	0.309	0.304	0.301
12.0	**0.277**	0.299	0.298	0.297	0.295	0.294	0.292	0.290	0.287	0.285	0.282	0.280	0.274	0.270
12.5	**0.250**	0.282	0.280	0.278	0.275	0.273	0.270	0.267	0.264	0.261	0.257	0.254	0.246	0.242
13.0	**0.224**	0.265	0.262	0.259	0.256	0.253	0.249	0.245	0.241	0.237	0.233	0.228	0.220	0.216
13.5	**0.200**	0.247	0.242	0.238	0.234	0.230	0.226	0.221	0.217	0.213	0.208	0.204	0.196	0.192
14.0	**0.178**	0.226	0.221	0.217	0.212	0.207	0.203	0.199	0.194	0.190	0.186	0.182	0.175	0.171
14.5	**0.159**	0.204	0.200	0.195	0.190	0.186	0.182	0.178	0.174	0.170	0.166	0.162	0.156	0.153
15.0	**0.141**	0.183	0.179	0.174	0.170	0.166	0.162	0.158	0.154	0.151	0.148	0.144	0.139	0.136
15.5	**0.127**	0.165	0.161	0.157	0.153	0.148	0.145	0.142	0.139	0.135	0.132	0.130	0.124	0.122
16.0	**0.114**	0.148	0.145	0.141	0.137	0.134	0.131	0.128	0.125	0.122	0.119	0.117	0.112	0.110
16.5	**0.104**	0.134	0.131	0.127	0.124	0.121	0.118	0.115	0.113	0.110	0.108	0.106	0.102	0.100
17.0	**0.094**	0.121	0.118	0.115	0.112	0.110	0.107	0.105	0.102	0.100	0.098	0.096	0.092	0.091
17.5	**0.086**	0.110	0.107	0.105	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.084	0.082
18.0	**0.078**	0.100	0.098	0.096	0.093	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.077	0.075
18.5	**0.072**	0.092	0.090	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.070	0.069
19.0	**0.066**	0.084	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.064	0.063
19.5	**0.061**	0.077	0.075	0.073	0.072	0.070	0.068	0.067	0.066	0.064	0.063	0.062	0.059	0.058
20.0	**0.056**	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.055	0.054
20.5	**0.052**	0.066	0.064	0.063	0.061	0.060	0.059	0.058	0.056	0.055	0.054	0.053	0.051	0.050
21.0	**0.049**	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.052	0.051	0.050	0.050	0.048	0.047
21.5	**0.046**	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.048	0.047	0.045	0.044
22.0	**0.043**	0.054	0.053	0.052	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.042	0.042
22.5	**0.041**	0.051	0.050	0.049	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.040	0.039
23.0	**0.038**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.039	0.039	0.037	0.037
23.5	**0.036**	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.035	0.035
24.0	**0.034**	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.033	0.033
24.5	**0.032**	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031
25.0	**0.031**	0.038	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030
25.5	**0.029**	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028
26.0	**0.028**	0.034	0.034	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.027	0.027
26.5	**0.026**	0.033	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
27.0	**0.025**	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025
27.5	**0.024**	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.023
28.0	**0.023**	0.028	0.028	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023	0.023	0.022
28.5	**0.022**	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.021
29.0	**0.020**	0.025	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021	0.021	0.020	0.020
29.5	**0.019**	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.018	0.018
30.0	**0.017**	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.016	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.014	0.014
31.0	**0.013**	0.015	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010

Table 21-2: C_t values, Sound Optimized Mode SO6 (HWO)

21.3 Sound Curves, Sound Optimized Mode SO6 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO6 (HWO)** **(Blades with serrated trailing edge)**
3	91.3
4	91.6
5	93.5
6	96.4
7	98.5
8	99.3
9	99.5
10	99.5
11	99.5
12	99.5
13	99.5
14	99.5
15	99.5
16	99.5
17	99.5
18	99.5
19	99.5
20	99.5

Table 21-3: Sound curves, Sound Optimized Mode SO6 (HWO)

22 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO7

NOTE The power curves and Ct values presented in Section 22 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

22.1 Power Curves, Sound Optimized Mode SO7

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**46**	24	26	28	30	32	34	36	38	40	42	44	48	50
3.5	**124**	84	88	92	95	99	103	106	110	114	117	121	128	132
4.0	**221**	160	166	171	177	182	188	193	199	204	210	216	227	232
4.5	**336**	249	257	265	273	281	289	297	305	313	321	328	344	352
5.0	**477**	358	368	379	390	401	412	423	433	444	455	466	487	498
5.5	**633**	480	494	508	522	536	550	563	577	591	605	619	646	660
6.0	**796**	608	625	642	660	677	694	711	728	745	762	779	813	830
6.5	**962**	740	760	781	801	822	842	863	883	903	923	942	979	997
7.0	**1131**	879	903	927	951	975	999	1022	1045	1069	1089	1110	1148	1166
7.5	**1313**	1026	1053	1081	1108	1136	1163	1189	1216	1242	1266	1289	1334	1355
8.0	**1537**	1199	1230	1262	1294	1325	1356	1387	1417	1448	1478	1507	1565	1593
8.5	**1801**	1403	1440	1476	1513	1550	1586	1622	1659	1695	1730	1766	1836	1871
9.0	**2088**	1630	1672	1715	1757	1799	1841	1882	1924	1965	2006	2047	2129	2170
9.5	**2393**	1874	1922	1970	2018	2066	2113	2160	2207	2254	2300	2347	2439	2485
10.0	**2716**	2134	2188	2241	2295	2349	2402	2455	2508	2561	2612	2664	2764	2813
10.5	**3030**	2408	2468	2528	2588	2649	2705	2762	2819	2876	2927	2979	3077	3124
11.0	**3277**	2685	2748	2810	2873	2935	2988	3041	3094	3147	3190	3234	3312	3348
11.5	**3455**	2942	3001	3061	3121	3181	3227	3273	3318	3364	3394	3425	3476	3496
12.0	**3550**	3160	3213	3265	3318	3370	3402	3435	3467	3499	3516	3533	3560	3570
12.5	**3593**	3322	3364	3406	3448	3490	3510	3530	3549	3569	3577	3585	3597	3601
13.0	**3611**	3432	3462	3492	3522	3551	3563	3575	3587	3599	3603	3607	3612	3613
13.5	**3601**	3468	3491	3513	3536	3558	3566	3575	3583	3592	3595	3598	3602	3603
14.0	**3575**	3481	3498	3515	3531	3548	3554	3559	3564	3570	3571	3573	3575	3576
14.5	**3538**	3472	3485	3497	3509	3522	3525	3529	3532	3536	3536	3537	3538	3539
15.0	**3497**	3452	3461	3470	3479	3487	3489	3491	3493	3495	3495	3496	3497	3498
15.5	**3455**	3427	3432	3437	3442	3448	3449	3450	3452	3453	3454	3454	3455	3456
16.0	**3412**	3394	3397	3400	3403	3406	3407	3408	3409	3410	3411	3411	3412	3413
16.5	**3368**	3356	3358	3360	3362	3364	3364	3365	3366	3367	3367	3367	3368	3369
17.0	**3323**	3314	3316	3317	3318	3320	3320	3321	3321	3322	3322	3323	3323	3324
17.5	**3281**	3273	3275	3276	3277	3278	3278	3279	3279	3280	3280	3280	3281	3281
18.0	**3244**	3240	3240	3241	3242	3243	3243	3243	3243	3244	3244	3244	3245	3245
18.5	**3215**	3212	3213	3213	3214	3214	3214	3214	3214	3214	3215	3215	3216	3216
19.0	**3192**	3190	3190	3190	3190	3190	3190	3191	3191	3191	3191	3191	3192	3192
19.5	**3172**	3171	3171	3171	3171	3171	3171	3172	3172	3172	3172	3172	3173	3173
20.0	**3154**	3152	3152	3153	3153	3153	3153	3153	3153	3154	3154	3154	3154	3155
20.5	**3136**	3134	3134	3134	3134	3134	3135	3135	3135	3135	3135	3136	3136	3136
21.0	**3118**	3116	3116	3116	3116	3116	3117	3117	3117	3117	3118	3118	3118	3119
21.5	**3102**	3100	3100	3100	3100	3100	3100	3100	3101	3101	3101	3101	3102	3102
22.0	**3085**	3083	3083	3083	3083	3084	3084	3084	3084	3084	3084	3085	3085	3085
22.5	**3069**	3066	3066	3067	3067	3067	3067	3068	3068	3068	3068	3068	3069	3069
23.0	**3053**	3051	3051	3051	3051	3051	3051	3052	3052	3052	3052	3052	3053	3053
23.5	**3040**	3038	3038	3038	3038	3038	3038	3039	3039	3039	3039	3039	3040	3040
24.0	**3029**	3028	3028	3028	3028	3028	3028	3028	3029	3029	3029	3029	3029	3029

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.95**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
24.5	**3022**	3021	3021	3021	3021	3021	3021	3021	3021	3022	3022	3022	3022	3022
25.0	**3017**	3016	3016	3016	3016	3016	3016	3016	3016	3016	3016	3016	3017	3017
25.5	**3013**	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013
26.0	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012
26.5	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012
27.0	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012

Table 22-1: Power curve, Sound Optimized Mode SO7

22.2 Ct Values, Sound Optimized Mode SO7

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.0**	**1.025**	**1.05**	**1.075**	**1.1**	**1.125**	**1.15**	**1.175**	**1.2**	**1.25**	**1.275**
3.0	**0.889**	0.895	0.895	0.894	0.894	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.889	0.888
3.5	**0.860**	0.865	0.864	0.864	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.859	0.859
4.0	**0.844**	0.851	0.850	0.849	0.848	0.846	0.846	0.846	0.845	0.845	0.845	0.844	0.843	0.843
4.5	**0.853**	0.853	0.853	0.853	0.853	0.854	0.854	0.854	0.854	0.854	0.854	0.853	0.853	0.853
5.0	**0.819**	0.824	0.823	0.823	0.822	0.822	0.821	0.821	0.821	0.820	0.820	0.819	0.819	0.818
5.5	**0.736**	0.742	0.741	0.741	0.740	0.740	0.739	0.739	0.738	0.738	0.737	0.737	0.736	0.735
6.0	**0.661**	0.666	0.665	0.665	0.664	0.664	0.663	0.663	0.662	0.662	0.661	0.661	0.660	0.659
6.5	**0.595**	0.601	0.601	0.600	0.600	0.599	0.599	0.598	0.598	0.598	0.597	0.596	0.592	0.590
7.0	**0.536**	0.547	0.547	0.546	0.546	0.545	0.545	0.544	0.543	0.542	0.540	0.538	0.532	0.529
7.5	**0.492**	0.503	0.503	0.502	0.502	0.501	0.501	0.500	0.499	0.498	0.496	0.494	0.489	0.486
8.0	**0.465**	0.474	0.473	0.473	0.472	0.472	0.471	0.470	0.469	0.469	0.468	0.466	0.464	0.462
8.5	**0.449**	0.455	0.455	0.454	0.454	0.453	0.453	0.452	0.452	0.451	0.451	0.450	0.449	0.448
9.0	**0.435**	0.441	0.440	0.440	0.439	0.439	0.438	0.438	0.437	0.437	0.436	0.436	0.435	0.434
9.5	**0.421**	0.427	0.427	0.426	0.426	0.425	0.425	0.424	0.424	0.423	0.423	0.422	0.421	0.420
10.0	**0.409**	0.415	0.414	0.414	0.413	0.413	0.412	0.412	0.411	0.411	0.410	0.409	0.408	0.407
10.5	**0.394**	0.404	0.404	0.403	0.403	0.402	0.401	0.400	0.399	0.398	0.397	0.395	0.392	0.389
11.0	**0.370**	0.394	0.393	0.391	0.390	0.389	0.386	0.384	0.382	0.379	0.376	0.373	0.366	0.362
11.5	**0.339**	0.380	0.378	0.375	0.373	0.370	0.366	0.362	0.358	0.354	0.349	0.344	0.334	0.328
12.0	**0.304**	0.361	0.357	0.353	0.349	0.345	0.339	0.333	0.328	0.322	0.316	0.310	0.298	0.292
12.5	**0.269**	0.334	0.329	0.324	0.318	0.313	0.306	0.300	0.294	0.287	0.281	0.275	0.263	0.257
13.0	**0.238**	0.303	0.297	0.291	0.285	0.279	0.273	0.267	0.261	0.254	0.249	0.243	0.233	0.228
13.5	**0.211**	0.271	0.265	0.260	0.254	0.248	0.243	0.237	0.231	0.226	0.221	0.216	0.207	0.203
14.0	**0.187**	0.242	0.236	0.231	0.225	0.220	0.215	0.210	0.205	0.200	0.196	0.191	0.183	0.180
14.5	**0.166**	0.215	0.210	0.205	0.200	0.195	0.191	0.186	0.182	0.178	0.174	0.170	0.163	0.160
15.0	**0.147**	0.192	0.187	0.182	0.178	0.173	0.169	0.165	0.161	0.157	0.154	0.151	0.145	0.142
15.5	**0.132**	0.172	0.167	0.163	0.159	0.155	0.151	0.148	0.144	0.141	0.138	0.135	0.129	0.127
16.0	**0.119**	0.154	0.150	0.146	0.142	0.139	0.136	0.132	0.129	0.126	0.124	0.121	0.116	0.114
16.5	**0.107**	0.138	0.135	0.132	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.109	0.105	0.103
17.0	**0.097**	0.125	0.122	0.119	0.116	0.113	0.110	0.108	0.105	0.103	0.101	0.099	0.095	0.093
17.5	**0.088**	0.113	0.110	0.107	0.105	0.102	0.100	0.098	0.095	0.093	0.091	0.090	0.086	0.084
18.0	**0.080**	0.103	0.100	0.098	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.082	0.079	0.077
18.5	**0.073**	0.094	0.092	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.072	0.071
19.0	**0.067**	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.066	0.065
19.5	**0.062**	0.079	0.077	0.075	0.074	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.061	0.060
20.0	**0.058**	0.073	0.071	0.070	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056
20.5	**0.053**	0.068	0.066	0.065	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052
21.0	**0.050**	0.063	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
21.5	**0.047**	0.059	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.046	0.045
22.0	**0.044**	0.055	0.054	0.053	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.043	0.042
22.5	**0.041**	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.040	0.040
23.0	**0.038**	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
23.5	**0.036**	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035
24.0	**0.034**	0.042	0.041	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033
24.5	**0.032**	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031
25.0	**0.031**	0.038	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030
25.5	**0.029**	0.036	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028
26.0	**0.028**	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.027	0.027
26.5	**0.026**	0.032	0.032	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
27.0	**0.025**	0.031	0.030	0.030	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.024

Table 22-2: C_t values, Sound Optimized Mode SO7

22.3 Sound Curves, Sound Optimized Mode SO7

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO7 (Blades with serrated trailing edge)**
3	91.3
4	91.6
5	93.4
6	94.4
7	95.3
8	96.8
9	98.0
10	98.9
11	99.1
12	99.1
13	99.1
14	99.1
15	99.1
16	99.1
17	99.1
18	99.1
19	99.1
20	99.1

Table 22-3: Sound curves, Sound Optimized Mode SO7

23 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO7 (HWO)

NOTE The power curves and Ct values presented in Section 23 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

23.1 Power Curves, Sound Optimized Mode SO7 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**46**	24	26	28	30	32	34	36	38	40	42	44	48	50
3.5	**124**	84	88	92	95	99	103	106	110	114	117	121	128	132
4.0	**221**	160	166	171	177	182	188	193	199	204	210	216	227	232
4.5	**336**	249	257	265	273	281	289	297	305	313	321	328	344	352
5.0	**477**	358	368	379	390	401	412	423	433	444	455	466	487	498
5.5	**633**	480	494	508	522	536	550	563	577	591	605	619	646	660
6.0	**796**	608	625	642	660	677	694	711	728	745	762	779	813	830
6.5	**962**	740	760	781	801	822	842	863	883	903	923	942	979	997
7.0	**1131**	879	903	927	951	975	999	1022	1045	1069	1089	1110	1148	1166
7.5	**1313**	1026	1053	1081	1108	1136	1163	1189	1216	1242	1266	1289	1334	1355
8.0	**1537**	1199	1230	1262	1294	1325	1356	1387	1417	1448	1478	1507	1565	1593
8.5	**1801**	1403	1440	1476	1513	1550	1586	1622	1659	1695	1730	1766	1836	1871
9.0	**2088**	1630	1672	1715	1757	1799	1841	1882	1924	1965	2006	2047	2129	2170
9.5	**2393**	1874	1922	1970	2018	2066	2113	2160	2207	2254	2300	2347	2439	2485
10.0	**2716**	2134	2188	2241	2295	2349	2402	2455	2508	2561	2612	2664	2764	2813
10.5	**3030**	2408	2468	2528	2588	2649	2705	2762	2819	2876	2927	2979	3077	3124
11.0	**3277**	2685	2748	2810	2873	2935	2988	3041	3094	3147	3190	3234	3312	3348
11.5	**3455**	2942	3001	3061	3121	3181	3227	3273	3318	3364	3394	3425	3476	3496
12.0	**3550**	3160	3213	3265	3318	3370	3402	3435	3467	3499	3516	3533	3560	3570
12.5	**3593**	3322	3364	3406	3448	3490	3510	3530	3549	3569	3577	3585	3597	3601
13.0	**3611**	3432	3462	3492	3522	3551	3563	3575	3587	3599	3603	3607	3612	3613
13.5	**3601**	3468	3491	3513	3536	3558	3566	3575	3583	3592	3595	3598	3602	3603
14.0	**3575**	3481	3498	3515	3531	3548	3554	3559	3564	3570	3571	3573	3575	3576
14.5	**3538**	3472	3485	3497	3509	3522	3525	3529	3532	3536	3536	3537	3538	3539
15.0	**3497**	3452	3461	3470	3479	3487	3489	3491	3493	3495	3495	3496	3497	3498
15.5	**3455**	3427	3432	3437	3442	3448	3449	3450	3452	3453	3454	3454	3455	3456
16.0	**3412**	3394	3397	3400	3403	3406	3407	3408	3409	3410	3411	3411	3412	3413
16.5	**3368**	3356	3358	3360	3362	3364	3364	3365	3366	3367	3367	3367	3368	3369
17.0	**3323**	3314	3316	3317	3318	3320	3320	3321	3321	3322	3322	3323	3323	3324
17.5	**3281**	3273	3275	3276	3277	3278	3278	3279	3279	3280	3280	3280	3281	3281
18.0	**3244**	3240	3240	3241	3242	3243	3243	3243	3243	3244	3244	3244	3245	3245
18.5	**3215**	3212	3213	3213	3214	3214	3214	3214	3214	3214	3215	3215	3216	3216
19.0	**3192**	3190	3190	3190	3190	3190	3190	3191	3191	3191	3191	3191	3192	3192
19.5	**3172**	3171	3171	3171	3171	3171	3171	3172	3172	3172	3172	3172	3173	3173
20.0	**3154**	3152	3152	3153	3153	3153	3153	3153	3153	3154	3154	3154	3154	3155
20.5	**3136**	3134	3134	3134	3134	3134	3135	3135	3135	3135	3135	3136	3136	3136
21.0	**3118**	3116	3116	3116	3116	3116	3117	3117	3117	3117	3118	3118	3118	3119
21.5	**3102**	3100	3100	3100	3100	3100	3100	3100	3101	3101	3101	3101	3102	3102
22.0	**3085**	3083	3083	3083	3083	3084	3084	3084	3084	3084	3084	3085	3085	3085
22.5	**3069**	3066	3066	3067	3067	3067	3067	3068	3068	3068	3068	3068	3069	3069
23.0	**3053**	3051	3051	3051	3051	3051	3051	3052	3052	3052	3052	3052	3053	3053
23.5	**3040**	3038	3038	3038	3038	3038	3038	3039	3039	3039	3039	3039	3040	3040
24.0	**3029**	3028	3028	3028	3028	3028	3028	3028	3029	3029	3029	3029	3029	3029
24.5	**3022**	3021	3021	3021	3021	3021	3021	3021	3021	3022	3022	3022	3022	3022
25.0	**3017**	3016	3016	3016	3016	3016	3016	3016	3016	3016	3016	3016	3017	3017
25.5	**3013**	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013	3013
26.0	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012
26.5	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012
27.0	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012
27.5	**3012**	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012	3012

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**3008**	3008	3008	3008	3008	3008	3008	3008	3008	3008	3008	3008	3008	3008
28.5	**2977**	2977	2977	2977	2977	2977	2977	2977	2977	2977	2977	2977	2977	2977
29.0	**2894**	2895	2894	2894	2894	2894	2894	2894	2894	2894	2894	2894	2894	2894
29.5	**2744**	2744	2744	2744	2744	2744	2744	2744	2744	2744	2744	2744	2744	2744
30.0	**2539**	2539	2539	2539	2539	2539	2539	2539	2539	2539	2539	2539	2539	2539
30.5	**2306**	2306	2306	2306	2306	2306	2306	2306	2306	2306	2306	2306	2306	2306
31.0	**2073**	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073
31.5	**1868**	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868
32.0	**1721**	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721

Table 23-1: Power curve, Sound Optimized Mode SO7 (HWO)

23.2 Ct Values, Sound Optimized Mode SO7 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.889**	0.895	0.895	0.894	0.894	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.889	0.888
3.5	**0.860**	0.865	0.864	0.864	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.859	0.859
4.0	**0.844**	0.851	0.850	0.849	0.848	0.846	0.846	0.846	0.845	0.845	0.845	0.844	0.843	0.843
4.5	**0.853**	0.853	0.853	0.853	0.853	0.854	0.854	0.854	0.854	0.854	0.854	0.853	0.853	0.853
5.0	**0.819**	0.824	0.823	0.823	0.822	0.822	0.821	0.821	0.821	0.820	0.820	0.819	0.819	0.818
5.5	**0.736**	0.742	0.741	0.741	0.740	0.740	0.739	0.739	0.738	0.738	0.737	0.737	0.736	0.735
6.0	**0.661**	0.666	0.665	0.665	0.664	0.664	0.663	0.663	0.662	0.662	0.661	0.661	0.660	0.659
6.5	**0.595**	0.601	0.601	0.600	0.600	0.599	0.599	0.598	0.598	0.598	0.597	0.596	0.592	0.590
7.0	**0.536**	0.547	0.547	0.546	0.546	0.545	0.545	0.544	0.543	0.542	0.540	0.538	0.532	0.529
7.5	**0.492**	0.503	0.503	0.502	0.502	0.501	0.501	0.500	0.499	0.498	0.496	0.494	0.489	0.486
8.0	**0.465**	0.474	0.473	0.473	0.472	0.472	0.471	0.470	0.469	0.469	0.468	0.466	0.464	0.462
8.5	**0.449**	0.455	0.455	0.454	0.454	0.453	0.453	0.452	0.452	0.451	0.451	0.450	0.449	0.448
9.0	**0.435**	0.441	0.440	0.440	0.439	0.439	0.438	0.438	0.437	0.437	0.436	0.436	0.435	0.434
9.5	**0.421**	0.427	0.427	0.426	0.426	0.425	0.425	0.424	0.424	0.423	0.423	0.422	0.421	0.420
10.0	**0.409**	0.415	0.414	0.414	0.413	0.413	0.412	0.412	0.411	0.411	0.410	0.409	0.408	0.407
10.5	**0.394**	0.404	0.404	0.403	0.403	0.402	0.401	0.400	0.399	0.398	0.397	0.395	0.392	0.389
11.0	**0.370**	0.394	0.393	0.391	0.390	0.389	0.386	0.384	0.382	0.379	0.376	0.373	0.366	0.362
11.5	**0.339**	0.380	0.378	0.375	0.373	0.370	0.366	0.362	0.358	0.354	0.349	0.344	0.334	0.328
12.0	**0.304**	0.361	0.357	0.353	0.349	0.345	0.339	0.333	0.328	0.322	0.316	0.310	0.298	0.292
12.5	**0.269**	0.334	0.329	0.324	0.318	0.313	0.306	0.300	0.294	0.287	0.281	0.275	0.263	0.257
13.0	**0.238**	0.303	0.297	0.291	0.285	0.279	0.273	0.267	0.261	0.254	0.249	0.243	0.233	0.228
13.5	**0.211**	0.271	0.265	0.260	0.254	0.248	0.243	0.237	0.231	0.226	0.221	0.216	0.207	0.203
14.0	**0.187**	0.242	0.236	0.231	0.225	0.220	0.215	0.210	0.205	0.200	0.196	0.191	0.183	0.180
14.5	**0.166**	0.215	0.210	0.205	0.200	0.195	0.191	0.186	0.182	0.178	0.174	0.170	0.163	0.160
15.0	**0.147**	0.192	0.187	0.182	0.178	0.173	0.169	0.165	0.161	0.157	0.154	0.151	0.145	0.142
15.5	**0.132**	0.172	0.167	0.163	0.159	0.155	0.151	0.148	0.144	0.141	0.138	0.135	0.129	0.127
16.0	**0.119**	0.154	0.150	0.146	0.142	0.139	0.136	0.132	0.129	0.126	0.124	0.121	0.116	0.114
16.5	**0.107**	0.138	0.135	0.132	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.109	0.105	0.103
17.0	**0.097**	0.125	0.122	0.119	0.116	0.113	0.110	0.108	0.105	0.103	0.101	0.099	0.095	0.093
17.5	**0.088**	0.113	0.110	0.107	0.105	0.102	0.100	0.098	0.095	0.093	0.091	0.090	0.086	0.084
18.0	**0.080**	0.103	0.100	0.098	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.082	0.079	0.077
18.5	**0.073**	0.094	0.092	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.072	0.071
19.0	**0.067**	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.066	0.065
19.5	**0.062**	0.079	0.077	0.075	0.074	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.061	0.060
20.0	**0.058**	0.073	0.071	0.070	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056
20.5	**0.053**	0.068	0.066	0.065	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052
21.0	**0.050**	0.063	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048
21.5	**0.047**	0.059	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.046	0.045
22.0	**0.044**	0.055	0.054	0.053	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.043	0.042
22.5	**0.041**	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.040	0.040
23.0	**0.038**	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
23.5	**0.036**	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035
24.0	**0.034**	0.042	0.041	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033
24.5	**0.032**	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031
25.0	**0.031**	0.038	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.030	0.030
25.5	**0.029**	0.036	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028
26.0	**0.028**	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.027	0.027
26.5	**0.026**	0.032	0.032	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
27.0	**0.025**	0.031	0.030	0.030	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.024
27.5	**0.024**	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.023
28.0	**0.023**	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023	0.023	0.022
28.5	**0.022**	0.026	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.022	0.022	0.021	0.021
29.0	**0.020**	0.025	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021	0.021	0.020	0.020
29.5	**0.019**	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.018	0.018
30.0	**0.017**	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.016	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.014	0.014
31.0	**0.013**	0.015	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010

Table 23-2: C_t values, Sound Optimized Mode SO7 (HWO)

23.3 Sound Curves, Sound Optimized Mode SO7 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO7 (HWO)** **(Blades with serrated trailing edge)**
3	91.3
4	91.6
5	93.4
6	94.4
7	95.3
8	96.8
9	98.0
10	98.9
11	99.1
12	99.1
13	99.1
14	99.1
15	99.1
16	99.1
17	99.1
18	99.1
19	99.1
20	99.1

Table 23-3: Sound curves, Sound Optimized Mode SO7 (HWO)

24 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO8

NOTE The power curves and Ct values presented in Section 26 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

24.1 Power Curves, Sound Optimized Mode SO8

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**46**	24	26	28	30	32	34	36	38	40	42	44	48	50
3.5	**124**	84	88	92	95	99	103	106	110	114	117	121	128	132
4.0	**221**	160	166	171	177	182	188	193	199	204	210	216	227	232
4.5	**336**	249	257	265	273	281	289	297	305	313	321	328	344	352
5.0	**477**	358	369	380	390	401	412	423	434	445	456	466	488	499
5.5	**645**	488	502	516	531	545	559	573	588	602	616	631	659	673
6.0	**840**	637	655	674	692	711	729	747	766	784	803	821	858	876
6.5	**1070**	816	839	863	886	909	932	956	979	1002	1025	1048	1091	1112
7.0	**1330**	1028	1056	1084	1112	1141	1169	1196	1224	1252	1278	1304	1354	1378
7.5	**1591**	1232	1266	1299	1332	1365	1398	1430	1463	1496	1527	1559	1622	1652
8.0	**1822**	1411	1449	1486	1524	1562	1599	1636	1674	1711	1748	1785	1859	1895
8.5	**2012**	1562	1604	1645	1686	1727	1768	1809	1850	1891	1931	1972	2052	2093
9.0	**2245**	1753	1798	1844	1889	1934	1979	2023	2068	2113	2157	2201	2289	2333
9.5	**2536**	1986	2037	2088	2138	2189	2239	2289	2339	2389	2438	2487	2585	2634
10.0	**2852**	2244	2301	2357	2414	2470	2526	2581	2637	2692	2745	2799	2902	2952
10.5	**3161**	2521	2584	2646	2709	2772	2830	2888	2946	3004	3057	3109	3207	3253
11.0	**3389**	2808	2870	2932	2994	3056	3108	3161	3213	3265	3307	3348	3423	3457
11.5	**3547**	3061	3119	3178	3236	3294	3336	3379	3421	3464	3492	3519	3565	3583
12.0	**3629**	3275	3325	3374	3424	3474	3502	3530	3558	3587	3601	3615	3637	3645
12.5	**3663**	3444	3479	3514	3550	3585	3601	3616	3631	3647	3652	3658	3666	3668
13.0	**3669**	3541	3564	3587	3609	3632	3640	3647	3655	3663	3665	3667	3670	3671
13.5	**3658**	3562	3580	3597	3614	3631	3637	3642	3648	3654	3655	3656	3658	3659
14.0	**3645**	3582	3594	3605	3617	3629	3633	3636	3639	3643	3644	3644	3645	3646
14.5	**3628**	3587	3595	3603	3611	3618	3621	3623	3625	3627	3627	3628	3628	3629
15.0	**3609**	3583	3588	3593	3598	3603	3604	3605	3607	3608	3608	3609	3610	3610
15.5	**3592**	3575	3578	3581	3584	3587	3588	3588	3589	3590	3591	3591	3592	3592
16.0	**3575**	3563	3565	3567	3569	3572	3572	3573	3573	3574	3574	3575	3576	3576
16.5	**3560**	3551	3552	3554	3556	3557	3558	3558	3558	3559	3559	3560	3560	3560
17.0	**3545**	3538	3540	3541	3542	3543	3543	3544	3544	3545	3545	3545	3545	3545
17.5	**3532**	3526	3527	3528	3529	3530	3531	3531	3531	3531	3531	3531	3532	3532
18.0	**3520**	3517	3517	3518	3519	3520	3520	3520	3520	3520	3520	3520	3521	3521
18.5	**3511**	3508	3509	3509	3510	3510	3510	3511	3511	3511	3511	3511	3511	3511
19.0	**3503**	3502	3502	3502	3502	3502	3503	3503	3503	3503	3503	3503	3503	3503
19.5	**3495**	3494	3494	3494	3494	3494	3494	3494	3494	3494	3495	3495	3495	3495
20.0	**3484**	3483	3483	3483	3483	3484	3484	3484	3484	3484	3484	3484	3485	3485
20.5	**3473**	3472	3472	3472	3472	3472	3472	3472	3472	3473	3473	3473	3473	3474
21.0	**3462**	3461	3461	3461	3461	3462	3462	3462	3462	3462	3462	3462	3463	3463
21.5	**3455**	3454	3454	3454	3454	3454	3455	3455	3455	3455	3455	3455	3456	3456
22.0	**3448**	3446	3447	3447	3447	3447	3447	3448	3448	3448	3448	3448	3448	3448
22.5	**3438**	3435	3435	3436	3436	3436	3436	3436	3437	3437	3437	3438	3438	3438
23.0	**3415**	3411	3411	3412	3412	3412	3413	3413	3413	3414	3414	3415	3416	3416
23.5	**3393**	3389	3389	3390	3390	3391	3391	3391	3392	3392	3392	3393	3394	3394
24.0	**3373**	3369	3370	3370	3370	3370	3371	3371	3371	3372	3372	3372	3373	3373
24.5	**3356**	3353	3353	3353	3354	3354	3354	3354	3355	3355	3355	3355	3356	3356
25.0	**3341**	3339	3339	3339	3339	3339	3340	3340	3340	3340	3341	3341	3341	3342
25.5	**3330**	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330
26.0	**3326**	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326
26.5	**3325**	3325	3325	3325	3325	3324	3324	3324	3324	3324	3325	3325	3325	3325
27.0	**3324**	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324

Table 10-1: Power curve, Sound Optimized Mode SO8

24.2 Ct Values, Sound Optimized Mode SO8

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.889**	0.895	0.895	0.894	0.894	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.889	0.888
3.5	**0.860**	0.865	0.864	0.864	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.859	0.859
4.0	**0.844**	0.851	0.850	0.849	0.848	0.846	0.846	0.846	0.845	0.845	0.845	0.844	0.843	0.843
4.5	**0.853**	0.853	0.853	0.853	0.854	0.854	0.854	0.854	0.854	0.854	0.854	0.854	0.853	0.853
5.0	**0.859**	0.863	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.860	0.859	0.858	0.857
5.5	**0.858**	0.863	0.863	0.862	0.862	0.861	0.861	0.860	0.860	0.859	0.858	0.858	0.857	0.856
6.0	**0.827**	0.833	0.833	0.832	0.832	0.832	0.831	0.831	0.831	0.830	0.829	0.828	0.824	0.820
6.5	**0.778**	0.792	0.791	0.791	0.791	0.790	0.790	0.789	0.789	0.788	0.785	0.781	0.772	0.766
7.0	**0.714**	0.730	0.730	0.729	0.728	0.728	0.727	0.725	0.724	0.723	0.720	0.717	0.709	0.703
7.5	**0.655**	0.666	0.665	0.664	0.664	0.663	0.662	0.661	0.660	0.659	0.658	0.656	0.653	0.651
8.0	**0.590**	0.597	0.596	0.595	0.595	0.594	0.594	0.593	0.592	0.592	0.591	0.591	0.590	0.589
8.5	**0.522**	0.527	0.526	0.526	0.525	0.525	0.524	0.524	0.524	0.523	0.523	0.522	0.521	0.521
9.0	**0.478**	0.484	0.483	0.483	0.482	0.482	0.481	0.480	0.480	0.479	0.479	0.478	0.477	0.477
9.5	**0.453**	0.459	0.458	0.458	0.457	0.457	0.456	0.456	0.455	0.455	0.454	0.453	0.452	0.452
10.0	**0.434**	0.441	0.440	0.440	0.439	0.439	0.438	0.437	0.437	0.436	0.435	0.434	0.432	0.431
10.5	**0.414**	0.426	0.426	0.425	0.424	0.424	0.423	0.421	0.420	0.419	0.417	0.415	0.411	0.408
11.0	**0.383**	0.414	0.412	0.410	0.408	0.406	0.404	0.401	0.398	0.395	0.391	0.387	0.379	0.375
11.5	**0.348**	0.396	0.393	0.389	0.386	0.383	0.378	0.374	0.369	0.365	0.359	0.354	0.342	0.336
12.0	**0.310**	0.374	0.369	0.364	0.359	0.354	0.348	0.342	0.336	0.329	0.323	0.317	0.304	0.298
12.5	**0.274**	0.347	0.340	0.334	0.327	0.321	0.314	0.307	0.300	0.293	0.287	0.280	0.268	0.262
13.0	**0.241**	0.313	0.306	0.299	0.292	0.285	0.278	0.272	0.265	0.258	0.253	0.247	0.236	0.231
13.5	**0.214**	0.278	0.272	0.265	0.259	0.252	0.247	0.241	0.235	0.229	0.224	0.219	0.210	0.205
14.0	**0.190**	0.248	0.242	0.236	0.230	0.224	0.219	0.214	0.209	0.204	0.199	0.195	0.187	0.183
14.5	**0.170**	0.221	0.216	0.211	0.205	0.200	0.195	0.191	0.186	0.182	0.178	0.174	0.167	0.163
15.0	**0.152**	0.198	0.193	0.188	0.183	0.178	0.174	0.170	0.166	0.162	0.159	0.155	0.149	0.146
15.5	**0.137**	0.178	0.173	0.169	0.165	0.160	0.157	0.153	0.149	0.146	0.143	0.140	0.134	0.132
16.0	**0.124**	0.161	0.157	0.153	0.149	0.145	0.142	0.138	0.135	0.132	0.129	0.127	0.122	0.119
16.5	**0.113**	0.146	0.142	0.139	0.135	0.131	0.129	0.126	0.123	0.120	0.118	0.115	0.111	0.108
17.0	**0.103**	0.133	0.129	0.126	0.123	0.120	0.117	0.115	0.112	0.109	0.107	0.105	0.101	0.099
17.5	**0.094**	0.121	0.118	0.115	0.112	0.109	0.107	0.105	0.102	0.100	0.098	0.096	0.092	0.091
18.0	**0.087**	0.111	0.108	0.106	0.103	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.085	0.083
18.5	**0.080**	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.081	0.078	0.077
19.0	**0.073**	0.094	0.092	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.072	0.071
19.5	**0.068**	0.087	0.085	0.083	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.067	0.066
20.0	**0.063**	0.080	0.078	0.077	0.075	0.073	0.071	0.070	0.068	0.067	0.066	0.065	0.062	0.061
20.5	**0.059**	0.075	0.073	0.071	0.070	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.058	0.057
21.0	**0.055**	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.054	0.053
21.5	**0.052**	0.065	0.064	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.051	0.050
22.0	**0.049**	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.052	0.051	0.050	0.050	0.048	0.047
22.5	**0.046**	0.057	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.045	0.044
23.0	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041
23.5	**0.040**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.039	0.039
24.0	**0.038**	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.036
24.5	**0.035**	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.034
25.0	**0.034**	0.041	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.032
25.5	**0.032**	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032	0.031	0.031
26.0	**0.030**	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.029
26.5	**0.029**	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028
27.0	**0.028**	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027

Table 10-2: C_t values, Sound Optimized Mode SO8

24.3 Sound Curves, Sound Optimized Mode SO8

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO8** **(Blades with serrated trailing edge)**
3	91.3
4	91.6
5	93.5
6	95.0
7	96.9
8	98.7
9	99.2
10	99.7
11	99.8
12	99.8
13	99.8
14	99.8
15	99.8
16	99.8
17	99.8
18	99.8
19	99.8
20	99.8

Table 10-3: Sound curves, Sound Optimized Mode SO8

25 Power Curves, Ct Values and Sound Curves, Sound Optimized Mode SO8 (HWO)

NOTE The power curves and Ct values presented in Section 11 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

25.1 Power Curves, Sound Optimized Mode SO8 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**46**	24	26	28	30	32	34	36	38	40	42	44	48	50
3.5	**124**	84	88	92	95	99	103	106	110	114	117	121	128	132
4.0	**221**	160	166	171	177	182	188	193	199	204	210	216	227	232
4.5	**336**	249	257	265	273	281	289	297	305	313	321	328	344	352
5.0	**477**	358	369	380	390	401	412	423	434	445	456	466	488	499
5.5	**645**	488	502	516	531	545	559	573	588	602	616	631	659	673
6.0	**840**	637	655	674	692	711	729	747	766	784	803	821	858	876
6.5	**1070**	816	839	863	886	909	932	956	979	1002	1025	1048	1091	1112
7.0	**1330**	1028	1056	1084	1112	1141	1169	1196	1224	1252	1278	1304	1354	1378
7.5	**1591**	1232	1266	1299	1332	1365	1397	1430	1463	1496	1527	1559	1622	1652
8.0	**1822**	1411	1449	1486	1524	1562	1599	1636	1674	1711	1748	1785	1859	1895
8.5	**2012**	1562	1604	1645	1686	1727	1768	1809	1850	1891	1931	1972	2052	2093
9.0	**2245**	1753	1798	1844	1889	1934	1979	2023	2068	2113	2157	2201	2289	2333
9.5	**2536**	1986	2037	2088	2138	2189	2239	2289	2339	2389	2438	2487	2585	2634
10.0	**2852**	2244	2301	2357	2414	2470	2526	2581	2637	2692	2745	2799	2902	2952
10.5	**3161**	2521	2584	2646	2709	2772	2830	2888	2946	3004	3057	3109	3207	3253
11.0	**3389**	2808	2870	2932	2994	3056	3108	3161	3213	3265	3307	3348	3423	3457
11.5	**3547**	3061	3119	3178	3236	3294	3336	3379	3421	3464	3492	3519	3565	3583
12.0	**3629**	3275	3325	3374	3424	3474	3502	3530	3558	3587	3601	3615	3637	3645
12.5	**3663**	3444	3479	3514	3550	3585	3601	3616	3631	3647	3652	3658	3666	3668
13.0	**3669**	3541	3564	3587	3609	3632	3640	3647	3655	3663	3665	3667	3670	3671
13.5	**3658**	3562	3580	3597	3614	3631	3637	3642	3648	3654	3655	3656	3658	3659
14.0	**3645**	3582	3594	3605	3617	3629	3633	3636	3639	3643	3644	3644	3645	3646
14.5	**3628**	3587	3595	3603	3611	3618	3621	3623	3625	3627	3627	3628	3628	3629
15.0	**3609**	3583	3588	3593	3598	3603	3604	3605	3607	3608	3608	3609	3610	3610
15.5	**3592**	3575	3578	3581	3584	3587	3588	3588	3589	3590	3591	3591	3592	3592
16.0	**3575**	3563	3565	3567	3569	3572	3572	3573	3573	3574	3574	3575	3576	3576
16.5	**3560**	3551	3552	3554	3556	3557	3558	3558	3558	3559	3559	3560	3560	3560
17.0	**3545**	3538	3540	3541	3542	3543	3543	3544	3544	3545	3545	3545	3545	3545
17.5	**3532**	3526	3527	3528	3529	3530	3531	3531	3531	3531	3531	3531	3532	3532
18.0	**3520**	3517	3517	3518	3519	3520	3520	3520	3520	3520	3520	3520	3521	3521
18.5	**3511**	3508	3509	3509	3510	3510	3510	3511	3511	3511	3511	3511	3511	3511
19.0	**3503**	3502	3502	3502	3502	3502	3503	3503	3503	3503	3503	3503	3503	3503
19.5	**3495**	3494	3494	3494	3494	3494	3494	3494	3494	3494	3495	3495	3495	3495
20.0	**3484**	3483	3483	3483	3483	3484	3484	3484	3484	3484	3484	3484	3485	3485
20.5	**3473**	3472	3472	3472	3472	3472	3472	3472	3472	3473	3473	3473	3473	3474
21.0	**3462**	3461	3461	3461	3461	3462	3462	3462	3462	3462	3462	3462	3463	3463
21.5	**3455**	3454	3454	3454	3454	3454	3455	3455	3455	3455	3455	3455	3456	3456
22.0	**3448**	3446	3447	3447	3447	3447	3447	3448	3448	3448	3448	3448	3448	3448
22.5	**3438**	3435	3435	3436	3436	3436	3436	3436	3437	3437	3437	3438	3438	3438
23.0	**3415**	3411	3411	3412	3412	3412	3413	3413	3413	3414	3414	3415	3416	3416
23.5	**3393**	3389	3389	3390	3390	3391	3391	3391	3392	3392	3392	3393	3394	3394
24.0	**3373**	3369	3370	3370	3370	3370	3371	3371	3371	3372	3372	3372	3373	3373
24.5	**3356**	3353	3353	3353	3354	3354	3354	3354	3355	3355	3355	3355	3356	3356
25.0	**3341**	3339	3339	3339	3339	3339	3340	3340	3340	3340	3341	3341	3341	3342
25.5	**3330**	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330
26.0	**3326**	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326	3326
26.5	**3325**	3325	3325	3325	3325	3324	3324	3324	3324	3324	3325	3325	3325	3325
27.0	**3324**	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324	3324

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
27.5	**3317**	3317	3317	3317	3317	3317	3317	3317	3317	3317	3317	3317	3317	3317
28.0	**3273**	3272	3272	3272	3272	3272	3272	3272	3272	3272	3273	3273	3273	3273
28.5	**3175**	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
29.0	**3011**	3011	3011	3011	3011	3011	3011	3011	3011	3011	3011	3011	3011	3011
29.5	**2784**	2784	2784	2784	2784	2784	2784	2784	2784	2784	2784	2784	2784	2784
30.0	**2547**	2547	2547	2547	2547	2547	2547	2547	2547	2547	2547	2547	2547	2547
30.5	**2308**	2308	2307	2307	2307	2307	2307	2308	2308	2308	2308	2308	2308	2308
31.0	**2073**	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073	2073
31.5	**1868**	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868	1868
32.0	**1721**	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721

Table 11-1: Power curve, Sound Optimized Mode SO8 (HWO)

25.2 Ct Values, Sound Optimized Mode SO8 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.889**	0.895	0.895	0.894	0.894	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.889	0.888
3.5	**0.860**	0.865	0.864	0.864	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.859	0.859
4.0	**0.844**	0.851	0.850	0.849	0.848	0.846	0.846	0.846	0.845	0.845	0.845	0.844	0.843	0.843
4.5	**0.853**	0.853	0.853	0.853	0.854	0.854	0.854	0.854	0.854	0.854	0.854	0.854	0.853	0.853
5.0	**0.859**	0.863	0.863	0.863	0.862	0.862	0.862	0.861	0.861	0.860	0.860	0.859	0.858	0.857
5.5	**0.858**	0.863	0.863	0.862	0.862	0.861	0.861	0.860	0.860	0.859	0.858	0.858	0.857	0.856
6.0	**0.827**	0.833	0.833	0.832	0.832	0.832	0.831	0.831	0.831	0.830	0.829	0.828	0.824	0.820
6.5	**0.778**	0.792	0.791	0.791	0.791	0.790	0.790	0.789	0.789	0.788	0.785	0.781	0.772	0.766
7.0	**0.714**	0.730	0.730	0.729	0.728	0.728	0.727	0.725	0.724	0.723	0.720	0.717	0.709	0.703
7.5	**0.655**	0.666	0.665	0.664	0.664	0.663	0.662	0.661	0.660	0.659	0.658	0.656	0.653	0.651
8.0	**0.590**	0.597	0.596	0.595	0.595	0.594	0.594	0.593	0.592	0.592	0.591	0.591	0.590	0.589
8.5	**0.522**	0.527	0.526	0.526	0.525	0.525	0.524	0.524	0.524	0.523	0.523	0.522	0.521	0.521
9.0	**0.478**	0.484	0.483	0.483	0.482	0.482	0.481	0.480	0.480	0.479	0.479	0.478	0.477	0.477
9.5	**0.453**	0.459	0.458	0.458	0.457	0.457	0.456	0.456	0.455	0.455	0.454	0.453	0.452	0.452
10.0	**0.434**	0.441	0.440	0.440	0.439	0.439	0.438	0.437	0.437	0.436	0.435	0.434	0.432	0.431
10.5	**0.414**	0.426	0.426	0.425	0.424	0.424	0.423	0.421	0.420	0.419	0.417	0.415	0.411	0.408
11.0	**0.383**	0.414	0.412	0.410	0.408	0.406	0.404	0.401	0.398	0.395	0.391	0.387	0.379	0.375
11.5	**0.348**	0.396	0.393	0.389	0.386	0.383	0.378	0.374	0.369	0.365	0.359	0.354	0.342	0.336
12.0	**0.310**	0.374	0.369	0.364	0.359	0.354	0.348	0.342	0.336	0.329	0.323	0.317	0.304	0.298
12.5	**0.274**	0.347	0.340	0.334	0.327	0.321	0.314	0.307	0.300	0.293	0.287	0.280	0.268	0.262
13.0	**0.241**	0.313	0.306	0.299	0.292	0.285	0.278	0.272	0.265	0.258	0.253	0.247	0.236	0.231
13.5	**0.214**	0.278	0.272	0.265	0.259	0.252	0.247	0.241	0.235	0.229	0.224	0.219	0.210	0.205
14.0	**0.190**	0.248	0.242	0.236	0.230	0.224	0.219	0.214	0.209	0.204	0.199	0.195	0.187	0.183
14.5	**0.170**	0.221	0.216	0.211	0.205	0.200	0.195	0.191	0.186	0.182	0.178	0.174	0.167	0.163
15.0	**0.152**	0.198	0.193	0.188	0.183	0.178	0.174	0.170	0.166	0.162	0.159	0.155	0.149	0.146
15.5	**0.137**	0.178	0.173	0.169	0.165	0.160	0.157	0.153	0.149	0.146	0.143	0.140	0.134	0.132
16.0	**0.124**	0.161	0.157	0.153	0.149	0.145	0.142	0.138	0.135	0.132	0.129	0.127	0.122	0.119
16.5	**0.113**	0.146	0.142	0.139	0.135	0.131	0.129	0.126	0.123	0.120	0.118	0.115	0.111	0.108
17.0	**0.103**	0.133	0.129	0.126	0.123	0.120	0.117	0.115	0.112	0.109	0.107	0.105	0.101	0.099
17.5	**0.094**	0.121	0.118	0.115	0.112	0.109	0.107	0.105	0.102	0.100	0.098	0.096	0.092	0.091
18.0	**0.087**	0.111	0.108	0.106	0.103	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.085	0.083
18.5	**0.080**	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.081	0.078	0.077
19.0	**0.073**	0.094	0.092	0.089	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.072	0.071
19.5	**0.068**	0.087	0.085	0.083	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.067	0.066
20.0	**0.063**	0.080	0.078	0.077	0.075	0.073	0.071	0.070	0.068	0.067	0.066	0.065	0.062	0.061
20.5	**0.059**	0.075	0.073	0.071	0.070	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.058	0.057
21.0	**0.055**	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.054	0.053
21.5	**0.052**	0.065	0.064	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.051	0.050
22.0	**0.049**	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.052	0.051	0.050	0.050	0.048	0.047
22.5	**0.046**	0.057	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.045	0.044
23.0	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041
23.5	**0.040**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.039	0.039
24.0	**0.038**	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.036
24.5	**0.035**	0.044	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.034
25.0	**0.034**	0.041	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.032
25.5	**0.032**	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032	0.031	0.031
26.0	**0.030**	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.029
26.5	**0.029**	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028
27.0	**0.028**	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027
27.5	**0.026**	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.025
28.0	**0.025**	0.030	0.030	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.024	0.024
28.5	**0.023**	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.022
29.0	**0.021**	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.021	0.021	0.021
29.5	**0.019**	0.023	0.022	0.022	0.022	0.021	0.021	0.020	0.020	0.020	0.020	0.019	0.019	0.018
30.0	**0.017**	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014
31.0	**0.013**	0.015	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010

Table 11-2: C_t values, Sound Optimized Mode SO8 (HWO)

25.3 Sound Curves, Sound Optimized Mode SO8 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO8 (HWO)** **(Blades with serrated trailing edge)**
3	91.3
4	91.6
5	93.5
6	95.0
7	96.9
8	98.7
9	99.2
10	99.7
11	99.8
12	99.8
13	99.8
14	99.8
15	99.8
16	99.8
17	99.8
18	99.8
19	99.8
20	99.8

Table 11-3: Sound curves, Sound Optimized Mode SO8 (HWO)

26 Power Curves, Ct Values and Sound Curves, Load Optimized Mode LO1

NOTE The power curves and Ct values presented in Section 26 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

26.1 Power Curves, Load Optimized Mode LO1

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	345	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	633	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1072	1119	1142
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1704**	1312	1347	1383	1419	1455	1491	1526	1562	1598	1633	1668	1739	1774
8.0	**2070**	1600	1643	1686	1730	1773	1816	1858	1901	1944	1986	2028	2112	2153
8.5	**2472**	1924	1975	2026	2077	2128	2178	2228	2278	2327	2376	2424	2520	2567
9.0	**2874**	2273	2330	2388	2446	2504	2558	2612	2667	2721	2772	2823	2923	2972
9.5	**3230**	2621	2681	2742	2803	2864	2919	2974	3029	3084	3132	3181	3274	3318
10.0	**3512**	2950	3010	3070	3131	3191	3242	3292	3342	3393	3432	3472	3543	3574
10.5	**3686**	3244	3298	3353	3408	3462	3500	3537	3575	3612	3637	3662	3703	3720
11.0	**3769**	3474	3515	3556	3597	3639	3662	3686	3710	3733	3745	3757	3775	3782
11.5	**3795**	3643	3669	3694	3720	3745	3755	3765	3775	3785	3788	3792	3796	3798
12.0	**3800**	3739	3751	3762	3774	3786	3789	3792	3795	3798	3798	3799	3800	3800
12.5	**3800**	3779	3784	3788	3793	3798	3798	3799	3799	3800	3800	3800	3800	3800
13.0	**3800**	3793	3795	3796	3798	3800	3800	3800	3800	3800	3800	3800	3800	3800
13.5	**3800**	3796	3797	3798	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800
14.0	**3800**	3798	3799	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
14.5	**3800**	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
15.0	**3800**	3799	3799	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
15.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
16.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
16.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
17.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
17.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
18.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
18.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
19.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
19.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
20.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
20.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
21.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
21.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
22.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
22.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
23.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
23.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
24.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
24.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
25.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
25.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
26.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
26.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
27.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800

Table 26-1: Power curve, Load Optimized Mode LO1

26.2 Ct Values, Load Optimized Mode LO1

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.856	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.847**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.844	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.832	0.831	0.830	0.829	0.827	0.826
7.5	**0.821**	0.832	0.831	0.830	0.829	0.828	0.827	0.826	0.825	0.824	0.823	0.822	0.820	0.818
8.0	**0.822**	0.837	0.836	0.835	0.834	0.833	0.831	0.830	0.829	0.827	0.826	0.824	0.821	0.819
8.5	**0.802**	0.838	0.836	0.833	0.831	0.828	0.825	0.821	0.818	0.814	0.810	0.806	0.798	0.793
9.0	**0.745**	0.810	0.805	0.800	0.795	0.790	0.784	0.777	0.771	0.765	0.759	0.752	0.739	0.732
9.5	**0.670**	0.753	0.746	0.738	0.731	0.724	0.717	0.709	0.701	0.694	0.686	0.678	0.663	0.655
10.0	**0.594**	0.687	0.679	0.671	0.663	0.654	0.646	0.638	0.629	0.621	0.612	0.603	0.585	0.575
10.5	**0.517**	0.623	0.614	0.605	0.596	0.587	0.577	0.567	0.558	0.548	0.537	0.527	0.506	0.496
11.0	**0.444**	0.559	0.549	0.538	0.528	0.518	0.507	0.496	0.486	0.475	0.465	0.454	0.434	0.424
11.5	**0.380**	0.497	0.486	0.475	0.463	0.452	0.441	0.430	0.419	0.409	0.399	0.390	0.371	0.363
12.0	**0.327**	0.437	0.425	0.414	0.402	0.391	0.381	0.371	0.362	0.352	0.344	0.336	0.320	0.313
12.5	**0.285**	0.381	0.370	0.360	0.349	0.339	0.331	0.322	0.314	0.306	0.299	0.292	0.279	0.273
13.0	**0.251**	0.332	0.323	0.314	0.305	0.296	0.289	0.282	0.275	0.268	0.262	0.257	0.246	0.241
13.5	**0.223**	0.294	0.286	0.278	0.271	0.263	0.257	0.251	0.245	0.239	0.234	0.229	0.219	0.215
14.0	**0.199**	0.260	0.254	0.247	0.240	0.234	0.228	0.223	0.218	0.212	0.208	0.204	0.195	0.191
14.5	**0.179**	0.232	0.226	0.220	0.215	0.209	0.204	0.200	0.195	0.190	0.186	0.183	0.175	0.172
15.0	**0.160**	0.207	0.202	0.197	0.192	0.187	0.183	0.179	0.175	0.171	0.167	0.164	0.157	0.154
15.5	**0.145**	0.187	0.183	0.178	0.174	0.169	0.165	0.162	0.158	0.155	0.151	0.148	0.143	0.140
16.0	**0.132**	0.170	0.166	0.162	0.158	0.153	0.150	0.147	0.144	0.140	0.138	0.135	0.130	0.127
16.5	**0.121**	0.154	0.151	0.147	0.144	0.140	0.137	0.134	0.131	0.128	0.126	0.123	0.119	0.116
17.0	**0.111**	0.141	0.138	0.135	0.131	0.128	0.125	0.123	0.120	0.117	0.115	0.113	0.109	0.107
17.5	**0.102**	0.129	0.126	0.123	0.120	0.117	0.115	0.113	0.110	0.108	0.106	0.104	0.100	0.098
18.0	**0.094**	0.119	0.116	0.114	0.111	0.108	0.106	0.104	0.102	0.099	0.097	0.096	0.092	0.090
18.5	**0.087**	0.110	0.107	0.105	0.102	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.085	0.084
19.0	**0.080**	0.101	0.099	0.096	0.094	0.092	0.090	0.088	0.087	0.085	0.083	0.082	0.079	0.077
19.5	**0.074**	0.094	0.092	0.090	0.087	0.085	0.084	0.082	0.080	0.079	0.077	0.076	0.073	0.072
20.0	**0.069**	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.072	0.071	0.068	0.067
20.5	**0.065**	0.081	0.079	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.066	0.064	0.063
21.0	**0.061**	0.076	0.074	0.073	0.071	0.069	0.068	0.067	0.065	0.064	0.063	0.062	0.060	0.059
21.5	**0.058**	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.057	0.056
22.0	**0.054**	0.067	0.066	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052
22.5	**0.051**	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.049
23.0	**0.048**	0.059	0.058	0.057	0.056	0.054	0.053	0.052	0.051	0.050	0.050	0.049	0.047	0.046
23.5	**0.045**	0.056	0.055	0.054	0.052	0.051	0.050	0.049	0.049	0.048	0.047	0.046	0.045	0.044
24.0	**0.043**	0.053	0.052	0.051	0.050	0.048	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
24.5	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040	0.040
25.0	**0.039**	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038
25.5	**0.037**	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.038	0.036	0.036
26.0	**0.035**	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034
26.5	**0.034**	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.033	0.033
27.0	**0.032**	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.033	0.032	0.031

Table 26-2: C_t values, Load Optimized Mode LO1

26.3 Sound Curves, Load Optimized Mode LO1

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Load Optimized Mode LO1** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.6
8	102.8
9	103.9
10	103.9
11	103.9
12	103.9
13	103.9
14	103.9
15	103.9
16	103.9
17	103.9
18	103.9
19	103.9
20	103.9

Table 26-3: Sound curves, Load Optimized Mode LO1

27 Power Curves, Ct Values and Sound Curves, Load Optimized Mode LO1 (HWO)

NOTE The power curves and Ct values presented in Section 27 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

27.1 Power Curves, Load Optimized Mode LO1 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	345	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	633	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1072	1119	1142
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1704**	1312	1347	1383	1419	1455	1491	1526	1562	1598	1633	1668	1739	1774
8.0	**2070**	1600	1643	1686	1730	1773	1816	1858	1901	1944	1986	2028	2112	2153
8.5	**2472**	1924	1975	2026	2077	2128	2178	2228	2278	2327	2376	2424	2520	2567
9.0	**2874**	2273	2330	2388	2446	2504	2558	2612	2667	2721	2772	2823	2923	2972
9.5	**3230**	2621	2681	2742	2803	2864	2919	2974	3029	3084	3132	3181	3274	3318
10.0	**3512**	2950	3010	3070	3131	3191	3242	3292	3342	3393	3432	3472	3543	3574
10.5	**3686**	3244	3298	3353	3408	3462	3500	3537	3575	3612	3637	3662	3703	3720
11.0	**3769**	3474	3515	3556	3597	3639	3662	3686	3710	3733	3745	3757	3775	3782
11.5	**3795**	3643	3669	3694	3720	3745	3755	3765	3775	3785	3788	3792	3796	3798
12.0	**3800**	3739	3751	3762	3774	3786	3789	3792	3795	3798	3798	3799	3800	3800
12.5	**3800**	3779	3784	3788	3793	3798	3798	3799	3799	3800	3800	3800	3800	3800
13.0	**3800**	3793	3795	3796	3798	3800	3800	3800	3800	3800	3800	3800	3800	3800
13.5	**3800**	3796	3797	3798	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800
14.0	**3800**	3798	3799	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
14.5	**3800**	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
15.0	**3800**	3799	3799	3799	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
15.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
16.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
16.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
17.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
17.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
18.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
18.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
19.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
19.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
20.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
20.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
21.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
21.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
22.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
22.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
23.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
23.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
24.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
24.5	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
25.0	**3800**	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
25.5	**3798**	3798	3798	3798	3798	3798	3798	3798	3798	3798	3798	3798	3798	3798
26.0	**3790**	3790	3790	3790	3790	3790	3790	3790	3790	3790	3790	3790	3790	3790
26.5	**3759**	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759
27.0	**3722**	3722	3722	3722	3722	3722	3722	3722	3722	3722	3722	3722	3722	3722

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
27.5	**3621**	3621	3621	3621	3621	3621	3621	3621	3621	3621	3621	3621	3621	3621
28.0	**3467**	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467	3467
28.5	**3275**	3275	3275	3275	3275	3275	3275	3275	3275	3275	3275	3275	3275	3274
29.0	**3049**	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049
29.5	**2805**	2806	2806	2806	2806	2806	2806	2806	2806	2806	2805	2805	2805	2805
30.0	**2565**	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565
30.5	**2324**	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324
31.0	**2090**	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090
31.5	**1884**	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884
32.0	**1732**	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732

Table 27-1: Power curve, Load Optimized Mode LO1 (HWO)

27.2 Ct Values, Load Optimized Mode LO1 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.856	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.847**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.844	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.832	0.831	0.830	0.829	0.827	0.826
7.5	**0.821**	0.832	0.831	0.830	0.829	0.828	0.827	0.826	0.825	0.824	0.823	0.822	0.820	0.818
8.0	**0.822**	0.837	0.836	0.835	0.834	0.833	0.831	0.830	0.829	0.827	0.826	0.824	0.821	0.819
8.5	**0.802**	0.838	0.836	0.833	0.831	0.828	0.825	0.821	0.818	0.814	0.810	0.806	0.798	0.793
9.0	**0.745**	0.810	0.805	0.800	0.795	0.790	0.784	0.777	0.771	0.765	0.759	0.752	0.739	0.732
9.5	**0.670**	0.753	0.746	0.738	0.731	0.724	0.717	0.709	0.701	0.694	0.686	0.678	0.663	0.655
10.0	**0.594**	0.687	0.679	0.671	0.663	0.654	0.646	0.638	0.629	0.621	0.612	0.603	0.585	0.575
10.5	**0.517**	0.623	0.614	0.605	0.596	0.587	0.577	0.567	0.558	0.548	0.537	0.527	0.506	0.496
11.0	**0.444**	0.559	0.549	0.538	0.528	0.518	0.507	0.496	0.486	0.475	0.465	0.454	0.434	0.424
11.5	**0.380**	0.497	0.486	0.475	0.463	0.452	0.441	0.430	0.419	0.409	0.399	0.390	0.371	0.363
12.0	**0.327**	0.437	0.425	0.414	0.402	0.391	0.381	0.371	0.362	0.352	0.344	0.336	0.320	0.313
12.5	**0.285**	0.381	0.370	0.360	0.349	0.339	0.331	0.322	0.314	0.306	0.299	0.292	0.279	0.273
13.0	**0.251**	0.332	0.323	0.314	0.305	0.296	0.289	0.282	0.275	0.268	0.262	0.257	0.246	0.241
13.5	**0.223**	0.294	0.286	0.278	0.271	0.263	0.257	0.251	0.245	0.239	0.234	0.229	0.219	0.215
14.0	**0.199**	0.260	0.254	0.247	0.240	0.234	0.228	0.223	0.218	0.212	0.208	0.204	0.195	0.191
14.5	**0.179**	0.232	0.226	0.220	0.215	0.209	0.204	0.200	0.195	0.190	0.186	0.183	0.175	0.172
15.0	**0.160**	0.207	0.202	0.197	0.192	0.187	0.183	0.179	0.175	0.171	0.167	0.164	0.157	0.154
15.5	**0.145**	0.187	0.183	0.178	0.174	0.169	0.165	0.162	0.158	0.155	0.151	0.148	0.143	0.140
16.0	**0.132**	0.170	0.166	0.162	0.158	0.153	0.150	0.147	0.144	0.140	0.138	0.135	0.130	0.127
16.5	**0.121**	0.154	0.151	0.147	0.144	0.140	0.137	0.134	0.131	0.128	0.126	0.123	0.119	0.116
17.0	**0.111**	0.141	0.138	0.135	0.131	0.128	0.125	0.123	0.120	0.117	0.115	0.113	0.109	0.107
17.5	**0.102**	0.129	0.126	0.123	0.120	0.117	0.115	0.113	0.110	0.108	0.106	0.104	0.100	0.098
18.0	**0.094**	0.119	0.116	0.114	0.111	0.108	0.106	0.104	0.102	0.099	0.097	0.096	0.092	0.090
18.5	**0.087**	0.110	0.107	0.105	0.102	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.085	0.084
19.0	**0.080**	0.101	0.099	0.096	0.094	0.092	0.090	0.088	0.087	0.085	0.083	0.082	0.079	0.077
19.5	**0.074**	0.094	0.092	0.090	0.087	0.085	0.084	0.082	0.080	0.079	0.077	0.076	0.073	0.072
20.0	**0.069**	0.087	0.085	0.083	0.081	0.080	0.078	0.076	0.075	0.073	0.072	0.071	0.068	0.067
20.5	**0.065**	0.081	0.079	0.078	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.066	0.064	0.063
21.0	**0.061**	0.076	0.074	0.073	0.071	0.069	0.068	0.067	0.065	0.064	0.063	0.062	0.060	0.059
21.5	**0.058**	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.057	0.056
22.0	**0.054**	0.067	0.066	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052
22.5	**0.051**	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.049
23.0	**0.048**	0.059	0.058	0.057	0.056	0.054	0.053	0.052	0.051	0.050	0.050	0.049	0.047	0.046
23.5	**0.045**	0.056	0.055	0.054	0.052	0.051	0.050	0.049	0.049	0.048	0.047	0.046	0.045	0.044
24.0	**0.043**	0.053	0.052	0.051	0.050	0.048	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
24.5	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.040	0.040
25.0	**0.039**	0.047	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038
25.5	**0.037**	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036
26.0	**0.035**	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035	0.034	0.034
26.5	**0.033**	0.040	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032	0.032
27.0	**0.031**	0.038	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.030	0.030
27.5	**0.029**	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028
28.0	**0.026**	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026
28.5	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023
29.0	**0.021**	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021
29.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019
30.0	**0.017**	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014
31.0	**0.013**	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010

Table 27-2: C_t values, Load Optimized Mode LO1 (HWO)

27.3 Sound Curves, Load Optimized Mode LO1 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Load Optimized Mode LO1 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.6
8	102.9
9	103.9
10	103.9
11	103.9
12	103.9
13	103.9
14	103.9
15	103.9
16	103.9
17	103.9
18	103.9
19	103.9
20	103.9

Table 27-3: Sound curves, Load Optimized Mode LO1 (HWO)

28 Power Curves, Ct Values and Sound Curves, Load Optimized Mode LO2

NOTE The power curves and Ct values presented in Section 28 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

28.1 Power Curves, Load Optimized Mode LO2

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	344	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	633	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1073	1119	1142
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1706**	1312	1348	1384	1420	1456	1492	1528	1564	1600	1635	1670	1741	1776
8.0	**2072**	1601	1644	1687	1731	1774	1817	1859	1902	1945	1987	2029	2114	2156
8.5	**2466**	1912	1963	2014	2066	2117	2167	2218	2268	2319	2368	2417	2515	2563
9.0	**2861**	2227	2287	2347	2407	2468	2525	2583	2640	2698	2752	2806	2912	2962
9.5	**3197**	2528	2598	2667	2736	2806	2866	2926	2987	3047	3097	3147	3239	3280
10.0	**3429**	2819	2891	2962	3034	3106	3161	3215	3270	3324	3359	3394	3454	3478
10.5	**3542**	3073	3141	3208	3275	3342	3379	3415	3451	3488	3506	3524	3553	3563
11.0	**3587**	3263	3317	3370	3423	3477	3498	3519	3540	3561	3570	3578	3591	3594
11.5	**3597**	3428	3458	3489	3520	3551	3560	3570	3579	3589	3592	3595	3598	3599
12.0	**3599**	3520	3536	3552	3567	3583	3586	3590	3594	3598	3598	3599	3599	3600
12.5	**3600**	3566	3573	3580	3587	3594	3595	3596	3598	3599	3599	3600	3600	3600
13.0	**3600**	3585	3588	3592	3595	3598	3599	3599	3600	3600	3600	3600	3600	3600
13.5	**3600**	3589	3592	3594	3596	3598	3599	3599	3600	3600	3600	3600	3600	3600
14.0	**3600**	3595	3596	3597	3598	3599	3600	3600	3600	3600	3600	3600	3600	3600
14.5	**3600**	3598	3598	3599	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600
15.0	**3600**	3597	3598	3598	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600
15.5	**3600**	3598	3599	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
16.0	**3600**	3599	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
16.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
17.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
17.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
18.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
18.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
19.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
19.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
20.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
20.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
21.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
21.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
22.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
22.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
23.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
23.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
24.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
24.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
25.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
25.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
26.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
26.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
27.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600

Table 28-1: Power curve, Load Optimized Mode LO2

28.2 Ct Values, Load Optimized Mode LO2

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.856	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.847**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.844	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.832	0.831	0.830	0.829	0.827	0.826
7.5	**0.831**	0.842	0.841	0.840	0.839	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.830	0.828
8.0	**0.831**	0.845	0.844	0.842	0.841	0.840	0.839	0.838	0.837	0.835	0.834	0.833	0.830	0.828
8.5	**0.805**	0.828	0.827	0.826	0.825	0.823	0.821	0.819	0.817	0.815	0.812	0.809	0.802	0.798
9.0	**0.746**	0.788	0.785	0.783	0.780	0.778	0.774	0.770	0.766	0.762	0.757	0.752	0.740	0.735
9.5	**0.668**	0.730	0.727	0.723	0.719	0.715	0.709	0.703	0.697	0.691	0.683	0.676	0.659	0.650
10.0	**0.581**	0.670	0.665	0.659	0.653	0.648	0.639	0.630	0.622	0.613	0.603	0.592	0.570	0.559
10.5	**0.494**	0.608	0.600	0.592	0.583	0.575	0.564	0.552	0.541	0.529	0.518	0.506	0.483	0.471
11.0	**0.419**	0.540	0.530	0.520	0.509	0.499	0.487	0.475	0.464	0.452	0.441	0.430	0.409	0.399
11.5	**0.357**	0.476	0.464	0.452	0.440	0.428	0.417	0.407	0.396	0.385	0.375	0.366	0.348	0.340
12.0	**0.308**	0.413	0.402	0.391	0.379	0.368	0.359	0.349	0.340	0.331	0.323	0.315	0.301	0.294
12.5	**0.268**	0.358	0.348	0.338	0.329	0.319	0.311	0.303	0.295	0.288	0.281	0.275	0.263	0.257
13.0	**0.236**	0.313	0.304	0.296	0.288	0.279	0.273	0.266	0.259	0.253	0.247	0.242	0.231	0.227
13.5	**0.211**	0.277	0.270	0.262	0.255	0.248	0.242	0.236	0.231	0.225	0.220	0.215	0.206	0.202
14.0	**0.188**	0.246	0.239	0.233	0.227	0.220	0.215	0.210	0.205	0.200	0.196	0.192	0.184	0.180
14.5	**0.169**	0.219	0.214	0.208	0.203	0.197	0.193	0.189	0.184	0.180	0.176	0.172	0.165	0.162
15.0	**0.151**	0.196	0.191	0.186	0.182	0.177	0.173	0.169	0.165	0.161	0.158	0.155	0.149	0.146
15.5	**0.137**	0.177	0.173	0.168	0.164	0.160	0.156	0.153	0.149	0.146	0.143	0.140	0.135	0.132
16.0	**0.125**	0.161	0.157	0.153	0.149	0.145	0.142	0.139	0.136	0.133	0.130	0.127	0.123	0.120
16.5	**0.114**	0.146	0.143	0.139	0.136	0.132	0.130	0.127	0.124	0.121	0.119	0.116	0.112	0.110
17.0	**0.105**	0.134	0.131	0.127	0.124	0.121	0.119	0.116	0.114	0.111	0.109	0.107	0.103	0.101
17.5	**0.096**	0.122	0.120	0.117	0.114	0.111	0.109	0.106	0.104	0.102	0.100	0.098	0.094	0.093
18.0	**0.089**	0.113	0.110	0.107	0.105	0.102	0.100	0.098	0.096	0.094	0.092	0.090	0.087	0.085
18.5	**0.082**	0.104	0.102	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.081	0.079
19.0	**0.076**	0.096	0.094	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.077	0.074	0.073
19.5	**0.070**	0.089	0.087	0.085	0.083	0.081	0.079	0.078	0.076	0.074	0.073	0.072	0.069	0.068
20.0	**0.066**	0.083	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.063
20.5	**0.061**	0.077	0.075	0.074	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.063	0.060	0.059
21.0	**0.057**	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.057	0.056
21.5	**0.054**	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053
22.0	**0.051**	0.064	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.050
22.5	**0.048**	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.047	0.047
23.0	**0.045**	0.056	0.055	0.054	0.053	0.051	0.050	0.050	0.049	0.048	0.047	0.046	0.045	0.044
23.5	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
24.0	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.039
24.5	**0.038**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
25.0	**0.037**	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.035
25.5	**0.035**	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.036	0.034	0.034
26.0	**0.033**	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.032
26.5	**0.032**	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031
27.0	**0.030**	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.030

Table 28-2: C_t values, Load Optimized Mode LO2

28.3 Sound Curves, Load Optimized Mode LO2

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Load Optimized Mode LO2** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.6
8	102.2
9	102.5
10	102.5
11	102.5
12	102.5
13	102.5
14	102.5
15	102.5
16	102.5
17	102.5
18	102.5
19	102.5
20	102.5

Table 28-3: Sound curves, Load Optimized Mode LO2

29 Power Curves, Ct Values and Sound Curves, Load Optimized Mode LO2 (HWO)

NOTE The power curves and Ct values presented in Section 29 are not valid for hub heights ≤ 104 m. For hub heights ≤ 104 m, Vestas must be consulted for project specific evaluation.

29.1 Power Curves, Load Optimized Mode LO2 (HWO)

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**57**	32	35	37	39	41	43	46	48	50	52	55	59	61
3.5	**132**	91	95	99	102	106	110	114	117	121	125	128	136	140
4.0	**224**	162	168	173	179	185	190	196	201	207	213	218	229	235
4.5	**337**	250	258	265	273	281	289	297	305	313	321	329	344	352
5.0	**478**	358	369	380	391	402	413	423	434	445	456	467	488	499
5.5	**648**	490	505	519	533	548	562	576	591	605	619	633	662	676
6.0	**853**	649	668	687	705	724	742	761	779	798	816	835	872	890
6.5	**1096**	838	861	885	908	932	955	979	1002	1026	1049	1073	1119	1142
7.0	**1380**	1059	1088	1118	1147	1176	1206	1235	1264	1293	1322	1351	1410	1439
7.5	**1706**	1312	1348	1384	1420	1456	1492	1528	1564	1600	1635	1670	1741	1776
8.0	**2072**	1601	1644	1687	1731	1774	1817	1860	1902	1945	1987	2029	2114	2156
8.5	**2466**	1912	1963	2014	2066	2117	2167	2218	2268	2319	2368	2417	2515	2563
9.0	**2861**	2227	2287	2347	2407	2468	2525	2583	2640	2698	2752	2806	2912	2962
9.5	**3197**	2528	2598	2667	2736	2806	2866	2926	2987	3047	3097	3147	3239	3280
10.0	**3429**	2819	2891	2962	3034	3106	3161	3215	3270	3324	3359	3394	3454	3478
10.5	**3542**	3073	3141	3208	3275	3342	3379	3415	3451	3488	3506	3524	3553	3563
11.0	**3587**	3263	3317	3370	3423	3477	3498	3519	3540	3561	3570	3578	3591	3594
11.5	**3597**	3428	3458	3489	3520	3551	3560	3570	3579	3589	3592	3595	3598	3599
12.0	**3599**	3520	3536	3552	3567	3583	3586	3590	3594	3598	3598	3599	3599	3600
12.5	**3600**	3566	3573	3580	3587	3594	3595	3596	3598	3599	3599	3600	3600	3600
13.0	**3600**	3585	3588	3592	3595	3598	3599	3599	3600	3600	3600	3600	3600	3600
13.5	**3600**	3589	3592	3594	3596	3598	3599	3599	3600	3600	3600	3600	3600	3600
14.0	**3600**	3595	3596	3597	3598	3599	3600	3600	3600	3600	3600	3600	3600	3600
14.5	**3600**	3598	3598	3599	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600
15.0	**3600**	3597	3598	3598	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600
15.5	**3600**	3598	3599	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
16.0	**3600**	3599	3599	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
16.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
17.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
17.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
18.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
18.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
19.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
19.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
20.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
20.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
21.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
21.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
22.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
22.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
23.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
23.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
24.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
24.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
25.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
25.5	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
26.0	**3600**	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
26.5	**3595**	3595	3595	3595	3595	3595	3595	3595	3595	3595	3595	3595	3595	3595
27.0	**3589**	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589
27.5	**3543**	3543	3543	3543	3543	3543	3543	3543	3543	3543	3543	3543	3543	3543

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
28.0	**3440**	3439	3439	3439	3439	3440	3440	3440	3440	3440	3440	3440	3440	3440
28.5	**3270**	3270	3270	3270	3270	3270	3270	3270	3270	3270	3270	3270	3270	3270
29.0	**3049**	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049
29.5	**2806**	2806	2806	2806	2806	2806	2806	2806	2805	2805	2805	2806	2806	2806
30.0	**2565**	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565
30.5	**2324**	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324	2324
31.0	**2090**	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090	2090
31.5	**1884**	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884	1884
32.0	**1732**	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732	1732

Table 29-1: Power curve, Load Optimized Mode LO2 (HWO)

29.2 Ct Values, Load Optimized Mode LO2 (HWO)

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.878**	0.883	0.882	0.882	0.882	0.881	0.881	0.880	0.880	0.880	0.879	0.879	0.878	0.878
3.5	**0.852**	0.855	0.855	0.855	0.855	0.854	0.854	0.854	0.853	0.853	0.853	0.852	0.851	0.851
4.0	**0.852**	0.859	0.857	0.856	0.855	0.853	0.853	0.853	0.853	0.853	0.853	0.852	0.852	0.853
4.5	**0.855**	0.854	0.854	0.855	0.855	0.855	0.855	0.856	0.856	0.856	0.856	0.856	0.855	0.855
5.0	**0.851**	0.855	0.855	0.855	0.855	0.854	0.854	0.853	0.853	0.853	0.852	0.852	0.851	0.850
5.5	**0.847**	0.852	0.852	0.851	0.851	0.850	0.850	0.849	0.849	0.848	0.848	0.847	0.846	0.846
6.0	**0.841**	0.847	0.847	0.846	0.846	0.845	0.845	0.844	0.844	0.843	0.842	0.842	0.840	0.840
6.5	**0.835**	0.843	0.842	0.842	0.841	0.840	0.840	0.839	0.838	0.837	0.837	0.836	0.834	0.833
7.0	**0.828**	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.832	0.831	0.830	0.829	0.827	0.826
7.5	**0.831**	0.842	0.841	0.840	0.839	0.838	0.837	0.836	0.835	0.834	0.833	0.832	0.830	0.828
8.0	**0.831**	0.845	0.844	0.842	0.841	0.840	0.839	0.838	0.837	0.835	0.834	0.833	0.830	0.828
8.5	**0.805**	0.828	0.827	0.826	0.825	0.823	0.821	0.819	0.817	0.815	0.812	0.809	0.802	0.798
9.0	**0.746**	0.788	0.785	0.783	0.780	0.778	0.774	0.770	0.766	0.762	0.757	0.752	0.740	0.735
9.5	**0.668**	0.730	0.727	0.723	0.719	0.715	0.709	0.703	0.697	0.691	0.683	0.676	0.659	0.650
10.0	**0.581**	0.670	0.665	0.659	0.653	0.648	0.639	0.630	0.622	0.613	0.603	0.592	0.570	0.559
10.5	**0.494**	0.608	0.600	0.592	0.583	0.575	0.564	0.552	0.541	0.529	0.518	0.506	0.483	0.471
11.0	**0.419**	0.540	0.530	0.520	0.509	0.499	0.487	0.475	0.464	0.452	0.441	0.430	0.409	0.399
11.5	**0.357**	0.476	0.464	0.452	0.440	0.428	0.417	0.407	0.396	0.385	0.375	0.366	0.348	0.340
12.0	**0.308**	0.413	0.402	0.391	0.379	0.368	0.359	0.349	0.340	0.331	0.323	0.315	0.301	0.294
12.5	**0.268**	0.358	0.348	0.338	0.329	0.319	0.311	0.303	0.295	0.288	0.281	0.275	0.263	0.257
13.0	**0.236**	0.313	0.304	0.296	0.288	0.279	0.273	0.266	0.259	0.253	0.247	0.242	0.231	0.227
13.5	**0.211**	0.277	0.270	0.262	0.255	0.248	0.242	0.236	0.231	0.225	0.220	0.215	0.206	0.202
14.0	**0.188**	0.246	0.239	0.233	0.227	0.220	0.215	0.210	0.205	0.200	0.196	0.192	0.184	0.180
14.5	**0.169**	0.219	0.214	0.208	0.203	0.197	0.193	0.189	0.184	0.180	0.176	0.172	0.165	0.162
15.0	**0.151**	0.196	0.191	0.186	0.182	0.177	0.173	0.169	0.165	0.161	0.158	0.155	0.149	0.146
15.5	**0.137**	0.177	0.173	0.168	0.164	0.160	0.156	0.153	0.149	0.146	0.143	0.140	0.135	0.132
16.0	**0.125**	0.161	0.157	0.153	0.149	0.145	0.142	0.139	0.136	0.133	0.130	0.127	0.123	0.120
16.5	**0.114**	0.146	0.143	0.139	0.136	0.132	0.130	0.127	0.124	0.121	0.119	0.116	0.112	0.110
17.0	**0.105**	0.134	0.131	0.127	0.124	0.121	0.119	0.116	0.114	0.111	0.109	0.107	0.103	0.101
17.5	**0.096**	0.122	0.120	0.117	0.114	0.111	0.109	0.106	0.104	0.102	0.100	0.098	0.094	0.093
18.0	**0.089**	0.113	0.110	0.107	0.105	0.102	0.100	0.098	0.096	0.094	0.092	0.090	0.087	0.085
18.5	**0.082**	0.104	0.102	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.081	0.079
19.0	**0.076**	0.096	0.094	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.077	0.074	0.073
19.5	**0.070**	0.089	0.087	0.085	0.083	0.081	0.079	0.078	0.076	0.074	0.073	0.072	0.069	0.068
20.0	**0.066**	0.083	0.081	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.063
20.5	**0.061**	0.077	0.075	0.074	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.063	0.060	0.059
21.0	**0.057**	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.059	0.057	0.056
21.5	**0.054**	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053
22.0	**0.051**	0.064	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.050
22.5	**0.048**	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.047	0.047
23.0	**0.045**	0.056	0.055	0.054	0.053	0.051	0.050	0.050	0.049	0.048	0.047	0.046	0.045	0.044
23.5	**0.043**	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.042
24.0	**0.041**	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.039
24.5	**0.038**	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.040	0.040	0.039	0.038	0.037
25.0	**0.037**	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.035
25.5	**0.035**	0.043	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.036	0.034	0.034
26.0	**0.033**	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.032
26.5	**0.032**	0.038	0.038	0.037	0.036	0.035	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031
27.0	**0.030**	0.037	0.036	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029
27.5	**0.028**	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.028	0.027
28.0	**0.026**	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.027	0.026	0.025
28.5	**0.024**	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.023
29.0	**0.021**	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021	0.021
29.5	**0.019**	0.023	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019
30.0	**0.017**	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.016
30.5	**0.015**	0.018	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.014
31.0	**0.013**	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013
31.5	**0.011**	0.014	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
32.0	**0.010**	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010

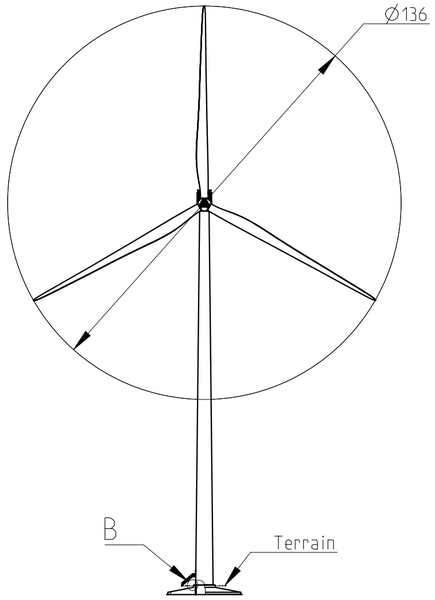
Table 29-2: C_t values, Load Optimized Mode LO2 (HWO)

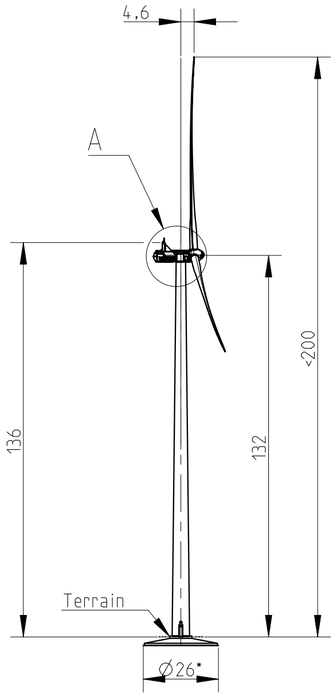
29.3 Sound Curves, Load Optimized Mode LO2 (HWO)

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Load Optimized Mode LO2 (HWO)** **(Blades with serrated trailing edge)**
3	90.9
4	91.1
5	92.9
6	96.0
7	99.6
8	102.2
9	102.5
10	102.5
11	102.5
12	102.5
13	102.5
14	102.5
15	102.5
16	102.5
17	102.5
18	102.5
19	102.5
20	102.5

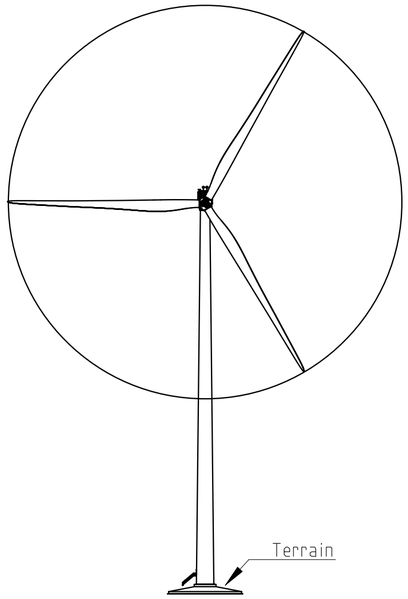
Table 29-3: Sound curves, Load Optimized Mode LO2 (HWO)

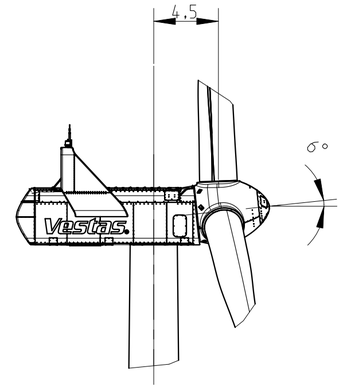
Blade in Inverted-Y Position



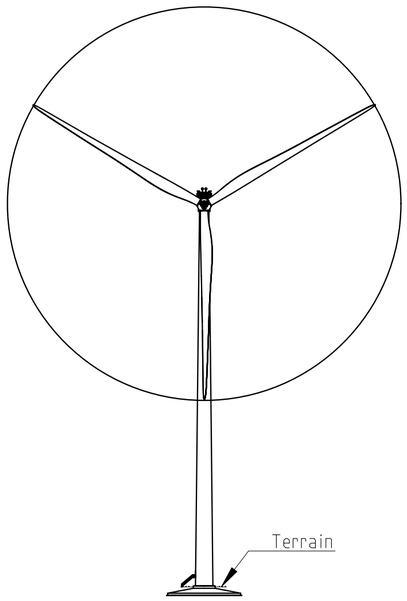


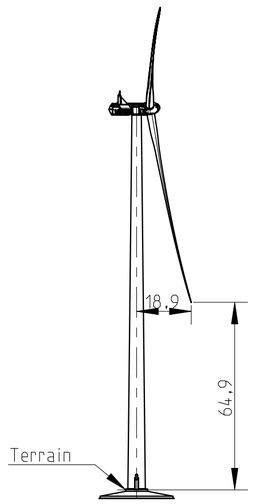
Blade in Horizontal Position

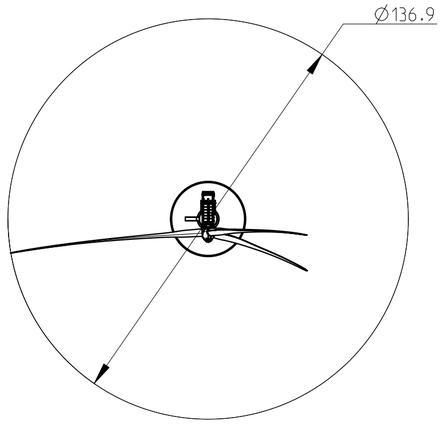


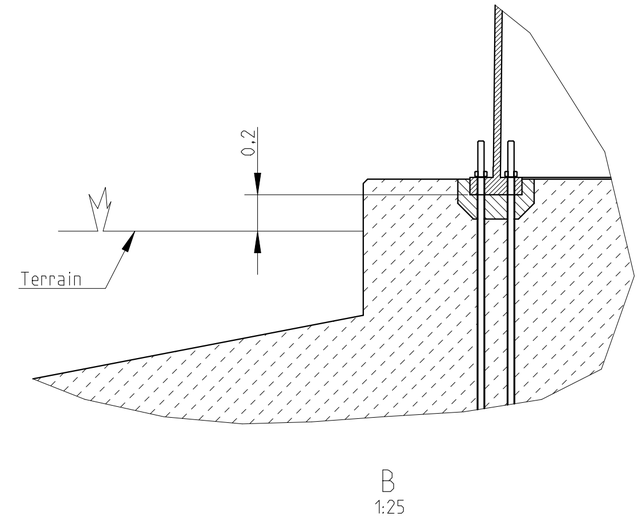


Blade in Y Position









* Foundation diameter is indicative and depends on actual site condition

All dimensions are shown in meters

Item no. 0060-8449	Mass (kg) 0	Certificate –	Format A2	Status –	Revised by –	Created date –	Created by –
Material specification – –			Scale 1:1500	Change no. –	PDM ver. –	Approved date –	Approved by –
Vestas vestas.com			Proj. Pro/E	Item description V136 HH132 –			
			Metric Dimensions shown in mm unless otherwise specified	Replaces / Copy of –	Drawing no. 0060-8449	Ver. 3	Sheet 1 of 1