

**APPENDICE 1:**  
SCHEDE TECNICHE SORGENTI

**TURBINA VESTAS V126 POTENZA 3.3 MW**

**RESTRICTED**

Restricted  
Document no.: 0034-7616 V10  
2014-11-12

# General Specification

## V126-3.3 MW 50/60 Hz

Original Instruction: T05 0034-7616 VER 10



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## 1 General Description

The Vestas V126-3.3 MW wind turbine is a pitch regulated upwind turbine with active yaw and a three-blade rotor. The Vestas V126-3.3 MW turbine has a rotor diameter of 126 m and a rated output power of 3.3 MW. The turbine utilises the OptiTip<sup>®</sup> 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 maintaining the power output at or near rated power even in high wind speed. At low wind speed, the OptiTip<sup>®</sup> concept and the power system work together to maximise the power output by operating at the optimal rotor speed and pitch angle.

## 2 Mechanical Design

### 2.1 Rotor

The V126-3.3 MW is equipped with a 126-meter rotor consisting of three blades and a hub. The blades are controlled by the microprocessor pitch control system OptiTip<sup>®</sup>. Based on the prevailing wind conditions, the blades are continuously positioned to optimise the pitch angle.

Rotor	
Diameter	126 m
Swept Area	12469 m <sup>2</sup>
Speed, Dynamic Operation Range	5.3-16.5
Rotational Direction	Clockwise (front view)
Orientation	Upwind
Tilt	6°
Blade Coning	4°
Number of Blades	3
Aerodynamic Brakes	Full feathering

Table 2-1: Rotor data

### 2.2 Blades

The blades are made of carbon and fibreglass and consist of two infused structural airfoil shells.

Blades	
Type Description	Infused structural airfoil shell
Blade Length	61.66 m
Material	Fibreglass reinforced epoxy, carbon fibres and Solid Metal Tip (SMT)
Blade Connection	Steel roots inserted
Airfoils	High-lift profile

Blades	
Maximum Chord	4.0 m

Table 2-2: *Blades data*

### 2.3 Blade Bearing

The blade bearings are double-row four-point contact ball bearings.

Blade Bearing	
Lubrication	Grease

Table 2-3: *Blade bearing data*

### 2.4 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 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	-9.5° to 90°

Table 2-4: *Pitch system data*

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

Table 2-5: *Hydraulic system data*

### 2.5 Hub

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

Hub	
Type	Cast ball shell hub
Material	Cast iron

Table 2-6: Hub data

## 2.6 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

Table 2-7: Main shaft data

## 2.7 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 2-8: Main bearing housing data

## 2.8 Main Bearing

The main bearing carries all thrust loads.

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

Table 2-9: Main bearing data

## 2.9 Gearbox

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

The disc brake is installed 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

Gearbox	
Lubrication System	Pressure oil lubrication
Backup Lubrication System	Oil sump filled from external gravity tank
Total Gear Oil Volume	1000-1200
Oil Cleanliness Codes	ISO 4406-/15/12
Shaft Seals	Labyrinth

Table 2-10: Gearbox data

## 2.10 Generator Bearings

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

## 2.11 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.

## 2.12 Yaw System

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

The yaw gears have a torque limiter.

Yaw System	
Type	Plain bearing system
Material	Forged yaw ring heat-treated. Plain bearings PETP
Yawing Speed (50 Hz)	0.46°/sec.
Yawing Speed (60 Hz)	0.60°/sec

Table 2-11: 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 2-12: Yaw gear data

### 2.13 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 2-13: Crane data

### 2.14 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, and such like, 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.

The hub heights listed 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 the tower top flange to the centre of the hub of 2.2 m.

Towers	
Type	Cylindrical/conical tubular
Hub Heights	117 m/128 m/137 m

Table 2-14: Tower structure data

### 2.15 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 sensors and skylights. The skylights can be opened from both 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 mounted on the nacelle bedplate.

**12 Appendices**

**12.1 Mode 0/0\***

**12.1.1 Power Curves, Noise Mode 0/0\***

Wind speed [m/s]	Air density [kg/m <sup>3</sup> ]													
	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	30	13	14	16	17	19	20	22	23	25	27	28	32	33
3.5	97	63	66	69	72	75	78	81	84	87	91	94	100	103
4.0	179	128	133	138	142	147	152	156	161	166	170	175	184	189
4.5	278	205	212	219	225	232	239	245	252	259	265	272	285	292
5.0	397	297	306	315	324	333	342	351	360	369	378	388	406	415
5.5	539	407	420	432	444	455	467	479	491	503	515	527	551	563
6.0	711	541	557	572	588	603	619	634	650	665	680	696	726	742
6.5	913	699	718	738	758	777	797	816	836	855	874	894	933	952
7.0	1150	884	909	933	957	982	1006	1030	1054	1078	1102	1126	1174	1198
7.5	1420	1095	1125	1155	1184	1214	1244	1273	1302	1332	1361	1390	1448	1477
8.0	1723	1336	1371	1407	1442	1478	1513	1548	1584	1619	1654	1688	1757	1791
8.5	2060	1606	1648	1690	1732	1774	1815	1857	1898	1939	1979	2020	2100	2140
9.0	2434	1906	1955	2004	2053	2102	2150	2197	2245	2293	2340	2387	2480	2526
9.5	2804	2232	2287	2343	2399	2455	2507	2559	2611	2664	2710	2757	2845	2886
10.0	3090	2574	2632	2689	2747	2805	2850	2896	2941	2987	3021	3056	3117	3143
10.5	3238	2887	2933	2980	3026	3073	3102	3131	3160	3189	3205	3221	3248	3258
11.0	3290	3100	3130	3161	3191	3222	3235	3248	3261	3275	3280	3285	3293	3295
11.5	3299	3227	3240	3254	3268	3282	3285	3289	3293	3296	3297	3298	3299	3300
12.0	3300	3277	3282	3287	3291	3296	3297	3298	3299	3300	3300	3300	3300	3300
12.5	3300	3293	3295	3296	3298	3299	3299	3300	3300	3300	3300	3300	3300	3300
13.0	3300	3298	3298	3299	3299	3300	3300	3300	3300	3300	3300	3300	3300	3300
13.5	3300	3299	3299	3299	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
14.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
14.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
15.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
15.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
16.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
16.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
17.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
17.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
18.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
18.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
19.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
19.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
20.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
20.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
21.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
21.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
22.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
22.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300

Table 12-1: Power curve, noise mode 0

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**12.1.2 C<sub>t</sub> Values, Noise Mode 0/0<sup>+</sup>**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.918	0.927	0.926	0.925	0.924	0.924	0.923	0.922	0.921	0.920	0.920	0.919	0.917	0.917
3.5	0.886	0.893	0.892	0.892	0.891	0.890	0.890	0.889	0.889	0.888	0.887	0.887	0.885	0.885
4.0	0.844	0.850	0.850	0.849	0.849	0.848	0.847	0.847	0.846	0.846	0.845	0.845	0.843	0.843
4.5	0.814	0.820	0.819	0.819	0.818	0.817	0.817	0.816	0.816	0.815	0.815	0.814	0.814	0.813
5.0	0.801	0.807	0.807	0.806	0.806	0.805	0.805	0.804	0.804	0.803	0.803	0.802	0.801	0.800
5.5	0.797	0.804	0.804	0.803	0.802	0.802	0.801	0.800	0.800	0.799	0.798	0.798	0.796	0.795
6.0	0.790	0.799	0.798	0.797	0.796	0.796	0.795	0.794	0.793	0.792	0.791	0.790	0.789	0.788
6.5	0.782	0.793	0.792	0.791	0.790	0.789	0.788	0.787	0.786	0.785	0.784	0.783	0.781	0.779
7.0	0.772	0.786	0.784	0.783	0.782	0.781	0.780	0.778	0.777	0.776	0.775	0.773	0.771	0.770
7.5	0.763	0.779	0.777	0.776	0.774	0.773	0.772	0.770	0.769	0.767	0.766	0.764	0.761	0.760
8.0	0.753	0.771	0.769	0.768	0.766	0.764	0.763	0.761	0.759	0.758	0.756	0.754	0.751	0.749
8.5	0.742	0.764	0.762	0.760	0.758	0.756	0.754	0.752	0.750	0.748	0.746	0.744	0.741	0.739
9.0	0.733	0.756	0.754	0.752	0.750	0.748	0.746	0.744	0.742	0.740	0.738	0.735	0.731	0.728
9.5	0.706	0.748	0.745	0.743	0.740	0.737	0.734	0.730	0.726	0.722	0.717	0.712	0.700	0.693
10.0	0.646	0.731	0.726	0.721	0.716	0.711	0.702	0.694	0.685	0.677	0.666	0.656	0.635	0.623
10.5	0.556	0.690	0.680	0.669	0.659	0.649	0.636	0.623	0.610	0.597	0.583	0.570	0.543	0.530
11.0	0.469	0.617	0.603	0.590	0.577	0.563	0.549	0.535	0.521	0.507	0.494	0.481	0.457	0.446
11.5	0.396	0.536	0.522	0.507	0.493	0.478	0.468	0.453	0.440	0.427	0.417	0.406	0.387	0.378
12.0	0.340	0.459	0.446	0.433	0.420	0.407	0.397	0.386	0.376	0.366	0.357	0.349	0.333	0.325
12.5	0.296	0.395	0.384	0.373	0.362	0.351	0.343	0.334	0.326	0.317	0.310	0.303	0.290	0.284
13.0	0.260	0.343	0.334	0.325	0.316	0.307	0.299	0.292	0.285	0.278	0.272	0.266	0.255	0.250
13.5	0.232	0.303	0.295	0.288	0.280	0.272	0.266	0.259	0.253	0.247	0.242	0.237	0.227	0.222
14.0	0.207	0.269	0.262	0.255	0.248	0.241	0.236	0.231	0.225	0.220	0.216	0.211	0.203	0.199
14.5	0.185	0.239	0.234	0.228	0.222	0.216	0.211	0.207	0.202	0.197	0.193	0.189	0.182	0.178
15.0	0.166	0.214	0.209	0.204	0.198	0.193	0.189	0.185	0.181	0.177	0.173	0.170	0.163	0.160
15.5	0.151	0.193	0.188	0.184	0.179	0.175	0.171	0.167	0.164	0.160	0.157	0.154	0.148	0.145
16.0	0.137	0.175	0.171	0.167	0.163	0.159	0.155	0.152	0.149	0.146	0.143	0.140	0.135	0.132
16.5	0.125	0.159	0.156	0.152	0.148	0.145	0.142	0.139	0.136	0.133	0.130	0.128	0.123	0.121
17.0	0.115	0.146	0.142	0.139	0.136	0.132	0.130	0.127	0.124	0.122	0.119	0.117	0.113	0.111
17.5	0.106	0.134	0.131	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.110	0.108	0.104	0.102
18.0	0.098	0.123	0.120	0.117	0.115	0.112	0.110	0.108	0.105	0.103	0.101	0.099	0.096	0.094
18.5	0.090	0.113	0.111	0.108	0.106	0.104	0.101	0.099	0.097	0.095	0.094	0.092	0.089	0.087
19.0	0.083	0.104	0.102	0.100	0.098	0.095	0.094	0.092	0.090	0.088	0.088	0.085	0.082	0.081
19.5	0.078	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.076	0.075
20.0	0.072	0.090	0.088	0.086	0.084	0.083	0.081	0.079	0.078	0.076	0.075	0.074	0.071	0.070
20.5	0.068	0.084	0.082	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.065
21.0	0.063	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.066	0.064	0.062	0.061
21.5	0.060	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063	0.062	0.061	0.059	0.058
22.0	0.056	0.070	0.068	0.067	0.065	0.064	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055
22.5	0.053	0.065	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.052

Table 12-2: C<sub>t</sub> values, noise mode 0

### 12.1.3 Noise Curve, Noise Mode 0

Sound Power Level at Hub Height, Noise Mode 0 (Blades without optional serrated trailing edge)	
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at 10 metre height: 16% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height ) [dBA]
3.0	91.7
4.0	92.0
5.0	94.5
6.0	97.4
7.0	101.4
8.0	105.1
9.0	107.9
10.0	108.5
11.0	108.4
12.0	108.4
13.0	108.3
14.0	108.3
15.0	108.2
16.0	108.2
17.0	108.1
18.0	108.1
19.0	108.0
20.0	107.9

Table 12-3: Noise curve, noise mode 0

**12.1.4 Noise Curve, Noise Mode 0<sup>+</sup>**

Sound Power Level at Hub Height, Noise Mode 0 <sup>+</sup> (Blades with optional serrated trailing edge)	
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at 10 metre height: 16% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height ) [dBA]
3.0	89.4
4.0	89.5
5.0	90.4
6.0	94.3
7.0	97.1
8.0	101.2
9.0	104.2
10.0	104.9
11.0	105.3
12.0	105.5
13.0	105.7
14.0	105.9
15.0	106.0
16.0	106.0
17.0	106.0
18.0	106.0
19.0	106.0
20.0	106.0

*Table 12-4: Noise curve, noise mode 0<sup>+</sup>*

Original Instruction: T05 0034-7616 VER 10

T05 0034-7616 Ver 10 - Approved - Exported from DMS: 2014-11-17 by DOKOC

## 12.2 Mode 1

### 12.2.1 Power Curves, Noise Mode 1

Wind speed [m/s]	Air density [kg/m <sup>3</sup> ]													
	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	30	13	14	16	17	19	20	22	23	25	27	28	32	33
3.5	97	63	66	69	72	75	78	81	84	87	91	94	100	103
4.0	179	128	133	138	142	147	152	156	161	166	170	175	184	189
4.5	278	205	212	219	225	232	239	245	252	259	265	272	285	292
5.0	396	297	306	315	324	333	342	351	360	369	378	387	406	415
5.5	539	407	419	432	444	455	467	479	491	503	515	527	551	563
6.0	711	541	557	572	588	603	619	634	650	665	680	696	726	742
6.5	913	699	718	738	758	777	797	816	836	855	874	894	932	952
7.0	1150	884	909	933	957	982	1006	1030	1054	1078	1102	1126	1174	1198
7.5	1419	1096	1125	1155	1185	1214	1244	1273	1302	1332	1361	1390	1448	1478
8.0	1723	1336	1371	1407	1443	1478	1513	1549	1584	1619	1654	1689	1758	1792
8.5	2046	1595	1637	1679	1720	1762	1803	1844	1884	1925	1965	2005	2085	2125
9.0	2354	1849	1896	1943	1989	2036	2082	2128	2173	2219	2264	2309	2397	2441
9.5	2632	2083	2134	2186	2237	2288	2338	2388	2438	2488	2536	2584	2678	2724
10.0	2856	2288	2343	2398	2453	2508	2559	2611	2663	2715	2762	2809	2896	2937
10.5	3036	2498	2555	2612	2668	2725	2774	2823	2872	2921	2969	2998	3065	3095
11.0	3168	2728	2779	2830	2881	2932	2972	3011	3051	3090	3116	3142	3185	3203
11.5	3250	2939	2981	3023	3064	3106	3131	3157	3182	3207	3221	3235	3257	3265
12.0	3285	3114	3141	3168	3194	3221	3233	3246	3258	3270	3275	3280	3288	3290
12.5	3297	3226	3238	3251	3264	3277	3281	3285	3289	3293	3294	3296	3297	3298
13.0	3300	3279	3283	3287	3291	3295	3296	3297	3298	3299	3299	3299	3300	3300
13.5	3300	3288	3290	3292	3294	3296	3297	3298	3299	3300	3300	3300	3300	3300
14.0	3300	3296	3297	3298	3299	3300	3300	3300	3300	3300	3300	3300	3300	3300
14.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
15.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
15.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
16.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
16.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
17.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
17.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
18.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
18.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
19.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
19.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
20.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
20.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
21.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
21.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
22.0	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
22.5	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300

Table 12-5: Power curve, noise mode 1

12.2.2 C<sub>t</sub> Values, Noise Mode 1

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.918	0.927	0.926	0.925	0.924	0.924	0.923	0.922	0.921	0.920	0.920	0.919	0.917	0.917
3.5	0.886	0.893	0.892	0.892	0.891	0.890	0.890	0.889	0.889	0.888	0.887	0.887	0.885	0.885
4.0	0.844	0.850	0.850	0.849	0.849	0.848	0.847	0.847	0.846	0.846	0.845	0.845	0.843	0.843
4.5	0.814	0.820	0.819	0.819	0.818	0.817	0.817	0.816	0.816	0.815	0.815	0.814	0.814	0.813
5.0	0.801	0.807	0.807	0.806	0.806	0.805	0.805	0.804	0.804	0.803	0.803	0.802	0.801	0.800
5.5	0.797	0.804	0.804	0.803	0.802	0.802	0.801	0.800	0.800	0.799	0.798	0.798	0.796	0.795
6.0	0.790	0.799	0.798	0.797	0.796	0.796	0.795	0.794	0.793	0.792	0.791	0.790	0.789	0.788
6.5	0.782	0.793	0.792	0.791	0.790	0.789	0.788	0.787	0.786	0.785	0.784	0.783	0.781	0.779
7.0	0.772	0.786	0.784	0.783	0.782	0.781	0.780	0.778	0.777	0.776	0.775	0.773	0.771	0.770
7.5	0.763	0.779	0.777	0.776	0.774	0.773	0.772	0.770	0.769	0.767	0.766	0.764	0.761	0.760
8.0	0.752	0.770	0.769	0.767	0.765	0.764	0.762	0.760	0.759	0.757	0.755	0.754	0.750	0.749
8.5	0.729	0.749	0.747	0.746	0.744	0.742	0.740	0.738	0.737	0.735	0.733	0.731	0.727	0.726
9.0	0.685	0.705	0.704	0.702	0.700	0.698	0.696	0.694	0.693	0.691	0.689	0.687	0.683	0.681
9.5	0.627	0.649	0.647	0.645	0.643	0.641	0.639	0.638	0.636	0.634	0.632	0.630	0.625	0.622
10.0	0.559	0.584	0.583	0.581	0.579	0.577	0.575	0.573	0.571	0.569	0.566	0.563	0.555	0.551
10.5	0.497	0.533	0.531	0.529	0.526	0.524	0.521	0.518	0.514	0.511	0.506	0.501	0.491	0.484
11.0	0.439	0.495	0.491	0.487	0.483	0.479	0.474	0.469	0.464	0.459	0.452	0.446	0.432	0.425
11.5	0.386	0.459	0.453	0.447	0.442	0.436	0.429	0.422	0.415	0.408	0.401	0.394	0.379	0.371
12.0	0.338	0.422	0.414	0.407	0.399	0.392	0.384	0.376	0.368	0.360	0.353	0.345	0.331	0.324
12.5	0.296	0.381	0.373	0.364	0.356	0.347	0.339	0.332	0.324	0.316	0.309	0.302	0.289	0.283
13.0	0.260	0.340	0.331	0.323	0.314	0.306	0.299	0.292	0.285	0.278	0.272	0.266	0.255	0.250
13.5	0.232	0.301	0.294	0.286	0.279	0.271	0.265	0.259	0.253	0.247	0.242	0.237	0.227	0.222
14.0	0.207	0.268	0.261	0.255	0.248	0.241	0.236	0.231	0.225	0.220	0.216	0.211	0.203	0.199
14.5	0.185	0.239	0.234	0.228	0.222	0.216	0.211	0.207	0.202	0.197	0.193	0.189	0.182	0.178
15.0	0.166	0.214	0.209	0.204	0.198	0.193	0.189	0.185	0.181	0.177	0.173	0.170	0.163	0.160
15.5	0.151	0.193	0.188	0.184	0.179	0.175	0.171	0.167	0.164	0.160	0.157	0.154	0.148	0.145
16.0	0.137	0.175	0.171	0.167	0.163	0.159	0.155	0.152	0.149	0.146	0.143	0.140	0.135	0.132
16.5	0.125	0.159	0.156	0.152	0.148	0.145	0.142	0.139	0.136	0.133	0.130	0.128	0.123	0.121
17.0	0.115	0.146	0.142	0.139	0.136	0.132	0.130	0.127	0.124	0.122	0.119	0.117	0.113	0.111
17.5	0.106	0.134	0.131	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.110	0.108	0.104	0.102
18.0	0.098	0.123	0.120	0.117	0.115	0.112	0.110	0.108	0.105	0.103	0.101	0.099	0.096	0.094
18.5	0.090	0.113	0.111	0.108	0.106	0.104	0.101	0.099	0.097	0.095	0.094	0.092	0.089	0.087
19.0	0.083	0.104	0.102	0.100	0.098	0.095	0.094	0.092	0.090	0.088	0.086	0.085	0.082	0.081
19.5	0.078	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.076	0.075
20.0	0.072	0.090	0.088	0.086	0.084	0.083	0.081	0.079	0.078	0.076	0.075	0.074	0.071	0.070
20.5	0.068	0.084	0.082	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.069	0.067	0.065
21.0	0.063	0.079	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.066	0.064	0.062	0.061
21.5	0.060	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063	0.062	0.061	0.059	0.058
22.0	0.056	0.070	0.068	0.067	0.065	0.064	0.063	0.062	0.061	0.059	0.058	0.057	0.056	0.055
22.5	0.053	0.065	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.052	0.052

Table 12-6: C<sub>t</sub> values, noise mode 1

### 12.2.3 Noise Curve, Noise Mode 1

Sound Power Level at Hub Height, Noise Mode 1 (Blades with optional serrated trailing edge)	
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at 10 metre height: 16% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height ) [dBA]
3.0	89.4
4.0	89.5
5.0	90.4
6.0	94.3
7.0	97.1
8.0	101.1
9.0	103.4
10.0	104.3
11.0	104.8
12.0	105.5
13.0	105.7
14.0	105.9
15.0	106.0
16.0	106.0
17.0	106.0
18.0	106.0
19.0	106.0
20.0	106.0

Table 12-7: Noise curve, noise mode 1

## 12.3 Mode 2

### 12.3.1 Power Curves, Noise Mode 2

Wind speed [m/s]	Air density [kg/m <sup>3</sup> ]													
	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	30	13	14	16	17	19	20	22	23	25	27	28	32	33
3.5	97	63	66	69	72	75	78	81	84	87	91	94	100	103
4.0	179	128	133	138	142	147	152	156	161	166	170	175	184	189
4.5	278	205	212	219	225	232	239	245	252	259	265	272	285	292
5.0	396	297	306	315	324	333	342	351	360	369	378	387	405	415
5.5	539	407	419	431	443	455	467	479	491	503	515	527	551	563
6.0	711	541	557	572	588	603	619	634	649	665	680	696	726	742
6.5	913	698	718	738	757	777	796	816	835	855	874	893	932	951
7.0	1146	882	906	931	955	979	1003	1027	1051	1075	1099	1123	1170	1194
7.5	1403	1085	1114	1143	1172	1201	1230	1259	1288	1317	1345	1374	1431	1460
8.0	1672	1300	1335	1369	1403	1437	1471	1505	1539	1573	1606	1639	1705	1738
8.5	1944	1520	1560	1599	1638	1677	1716	1754	1793	1831	1869	1906	1981	2018
9.0	2213	1741	1785	1828	1872	1916	1959	2002	2045	2088	2129	2171	2254	2295
9.5	2470	1964	2013	2061	2109	2158	2204	2250	2296	2342	2385	2427	2508	2546
10.0	2689	2198	2249	2301	2353	2405	2449	2494	2539	2584	2619	2654	2717	2745
10.5	2846	2441	2491	2541	2591	2640	2675	2709	2744	2778	2801	2823	2861	2876
11.0	2946	2656	2697	2738	2779	2820	2844	2867	2890	2913	2924	2935	2952	2958
11.5	3000	2834	2862	2890	2918	2946	2956	2967	2978	2989	2992	2996	3001	3003
12.0	3036	2955	2971	2986	3001	3017	3021	3025	3029	3033	3034	3035	3037	3037
12.5	3068	3026	3034	3042	3050	3059	3061	3062	3064	3066	3067	3067	3068	3068
13.0	3094	3060	3067	3073	3079	3085	3087	3089	3091	3092	3093	3093	3094	3094
13.5	3120	3098	3102	3106	3110	3114	3116	3117	3118	3119	3119	3120	3120	3120
14.0	3138	3107	3112	3118	3123	3129	3131	3132	3134	3136	3136	3137	3138	3138
14.5	3151	3113	3120	3127	3133	3140	3142	3144	3146	3148	3149	3150	3151	3152
15.0	3157	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
15.5	3163	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
16.0	3167	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
16.5	3170	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
17.0	3172	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
17.5	3173	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
18.0	3174	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
18.5	3174	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
19.0	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
19.5	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
20.0	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
20.5	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
21.0	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
21.5	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
22.0	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
22.5	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175

Table 12-8: Power curve, noise mode 2

**RESTRICTED**

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**12.3.2 C<sub>t</sub> Values, Noise Mode 2**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.918	0.927	0.926	0.925	0.924	0.924	0.923	0.922	0.921	0.920	0.920	0.919	0.917	0.917
3.5	0.886	0.893	0.892	0.892	0.891	0.890	0.890	0.889	0.889	0.888	0.887	0.887	0.885	0.885
4.0	0.844	0.850	0.850	0.849	0.849	0.848	0.847	0.847	0.846	0.846	0.845	0.845	0.843	0.843
4.5	0.814	0.820	0.819	0.819	0.818	0.817	0.817	0.816	0.816	0.815	0.815	0.814	0.813	0.813
5.0	0.801	0.807	0.807	0.806	0.806	0.805	0.805	0.804	0.804	0.803	0.802	0.802	0.801	0.800
5.5	0.797	0.804	0.804	0.803	0.802	0.802	0.801	0.800	0.800	0.799	0.798	0.797	0.796	0.795
6.0	0.789	0.799	0.798	0.797	0.796	0.795	0.795	0.794	0.793	0.792	0.791	0.790	0.789	0.788
6.5	0.779	0.791	0.790	0.789	0.788	0.787	0.786	0.785	0.784	0.783	0.781	0.780	0.778	0.777
7.0	0.763	0.776	0.775	0.774	0.772	0.771	0.770	0.769	0.768	0.766	0.765	0.764	0.762	0.760
7.5	0.735	0.750	0.749	0.747	0.746	0.745	0.743	0.742	0.740	0.739	0.738	0.736	0.733	0.732
8.0	0.696	0.712	0.710	0.709	0.708	0.706	0.705	0.703	0.702	0.700	0.699	0.697	0.695	0.693
8.5	0.651	0.667	0.665	0.664	0.662	0.661	0.660	0.658	0.657	0.655	0.654	0.652	0.649	0.648
9.0	0.605	0.620	0.619	0.618	0.616	0.615	0.614	0.612	0.611	0.609	0.608	0.607	0.604	0.602
9.5	0.559	0.579	0.577	0.576	0.575	0.573	0.572	0.570	0.568	0.566	0.564	0.562	0.556	0.553
10.0	0.509	0.544	0.542	0.540	0.538	0.537	0.533	0.530	0.527	0.524	0.519	0.514	0.503	0.497
10.5	0.455	0.514	0.511	0.507	0.504	0.501	0.495	0.489	0.483	0.477	0.469	0.462	0.447	0.439
11.0	0.400	0.478	0.473	0.467	0.462	0.456	0.449	0.441	0.433	0.426	0.417	0.409	0.392	0.384
11.5	0.349	0.440	0.432	0.425	0.417	0.409	0.401	0.392	0.383	0.374	0.366	0.358	0.342	0.334
12.0	0.306	0.397	0.388	0.379	0.371	0.362	0.354	0.345	0.337	0.328	0.321	0.314	0.300	0.293
12.5	0.271	0.353	0.345	0.336	0.328	0.319	0.312	0.304	0.297	0.289	0.283	0.277	0.265	0.259
13.0	0.241	0.313	0.305	0.298	0.290	0.283	0.276	0.270	0.263	0.257	0.252	0.246	0.236	0.231
13.5	0.217	0.281	0.274	0.267	0.260	0.254	0.248	0.242	0.237	0.231	0.226	0.221	0.212	0.208
14.0	0.195	0.250	0.244	0.239	0.233	0.227	0.222	0.217	0.212	0.207	0.203	0.199	0.191	0.187
14.5	0.176	0.224	0.219	0.214	0.209	0.204	0.200	0.195	0.191	0.187	0.183	0.179	0.172	0.169
15.0	0.158	0.200	0.196	0.191	0.187	0.183	0.179	0.175	0.172	0.168	0.165	0.161	0.155	0.152
15.5	0.144	0.181	0.177	0.173	0.170	0.166	0.162	0.159	0.156	0.152	0.150	0.147	0.141	0.139
16.0	0.131	0.165	0.161	0.158	0.154	0.151	0.148	0.145	0.142	0.139	0.136	0.134	0.129	0.126
16.5	0.120	0.151	0.148	0.144	0.141	0.138	0.135	0.133	0.130	0.127	0.125	0.122	0.118	0.116
17.0	0.110	0.139	0.136	0.133	0.130	0.127	0.124	0.122	0.119	0.117	0.114	0.112	0.108	0.106
17.5	0.101	0.127	0.125	0.122	0.119	0.116	0.114	0.112	0.109	0.107	0.105	0.103	0.100	0.098
18.0	0.094	0.118	0.115	0.112	0.110	0.107	0.105	0.103	0.101	0.099	0.097	0.095	0.092	0.090
18.5	0.087	0.109	0.106	0.104	0.102	0.099	0.097	0.095	0.093	0.091	0.090	0.088	0.085	0.084
19.0	0.080	0.100	0.098	0.096	0.094	0.092	0.090	0.088	0.086	0.084	0.083	0.081	0.079	0.077
19.5	0.074	0.093	0.091	0.089	0.087	0.085	0.083	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	0.079	0.078	0.076	0.075	0.073	0.072	0.071	0.068	0.067
20.5	0.065	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063
21.0	0.061	0.075	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.064	0.063	0.062	0.060	0.059
21.5	0.058	0.071	0.070	0.068	0.067	0.065	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	0.061	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052
22.5	0.051	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.049

Table 12-9: C<sub>t</sub> values, noise mode 2

### 12.3.3 Noise Curve, Noise Mode 2

Sound Power Level at Hub Height, Noise Mode 2 (Blades with optional serrated trailing edge)	
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at 10 metre height: 16% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height ) [dBA]
3.0	89.4
4.0	89.5
5.0	90.4
6.0	94.3
7.0	97.1
8.0	100.9
9.0	101.8
10.0	102.5
11.0	103.1
12.0	103.8
13.0	104.2
14.0	104.5
15.0	104.5
16.0	104.5
17.0	104.5
18.0	104.5
19.0	104.5
20.0	104.5

Table 12-10: Noise curve, noise mode 2

## 12.4 Mode 3

### 12.4.1 Power Curves, Noise Mode 3

Wind speed [m/s]	Air density [kg/m <sup>3</sup> ]													
	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	30	13	14	16	17	19	20	22	23	25	27	28	32	33
3.5	97	63	66	69	72	75	78	81	84	87	91	94	100	103
4.0	179	128	133	138	142	147	152	156	161	166	170	175	184	189
4.5	278	205	212	219	225	232	239	245	252	259	265	272	285	292
5.0	396	297	306	315	324	333	342	351	360	369	378	387	405	414
5.5	535	405	417	429	440	452	464	476	488	500	511	523	547	558
6.0	696	531	546	561	576	591	606	621	636	651	666	681	711	725
6.5	873	671	690	708	727	745	764	782	800	819	837	855	891	909
7.0	1062	822	844	866	888	910	932	954	976	997	1019	1041	1084	1105
7.5	1252	974	999	1025	1051	1076	1102	1127	1152	1177	1202	1227	1277	1302
8.0	1457	1137	1166	1196	1225	1255	1284	1313	1342	1371	1400	1429	1486	1514
8.5	1688	1320	1354	1388	1422	1456	1489	1523	1556	1589	1622	1655	1720	1752
9.0	1939	1522	1561	1600	1639	1678	1716	1753	1791	1829	1865	1902	1973	2008
9.5	2182	1735	1778	1821	1864	1907	1947	1987	2028	2068	2106	2144	2216	2250
10.0	2410	1970	2016	2061	2106	2152	2192	2233	2273	2314	2346	2378	2435	2460
10.5	2572	2205	2250	2295	2340	2385	2417	2448	2480	2511	2531	2552	2586	2600
11.0	2675	2416	2453	2490	2527	2564	2584	2605	2625	2646	2655	2665	2680	2685
11.5	2733	2593	2617	2640	2664	2688	2697	2706	2715	2724	2727	2730	2734	2735
12.0	2777	2710	2723	2735	2748	2760	2764	2767	2770	2774	2775	2776	2777	2778
12.5	2818	2787	2793	2799	2805	2811	2812	2814	2815	2816	2817	2817	2818	2818
13.0	2856	2842	2845	2847	2850	2853	2854	2854	2855	2855	2855	2856	2856	2856
13.5	2894	2885	2887	2889	2890	2892	2893	2893	2893	2893	2893	2893	2893	2894
14.0	2922	2918	2919	2920	2921	2922	2922	2922	2922	2922	2922	2922	2922	2922
14.5	2944	2942	2942	2943	2943	2943	2943	2943	2944	2944	2944	2944	2944	2944
15.0	2956	2954	2955	2955	2955	2956	2956	2956	2956	2956	2956	2956	2956	2956
15.5	2965	2964	2965	2965	2965	2965	2965	2965	2965	2965	2965	2965	2965	2965
16.0	2971	2970	2970	2971	2971	2971	2971	2971	2971	2971	2971	2971	2971	2971
16.5	2974	2974	2974	2974	2974	2974	2974	2974	2974	2974	2974	2974	2974	2974
17.0	2976	2976	2976	2976	2976	2976	2976	2976	2976	2976	2976	2976	2976	2976
17.5	2978	2978	2978	2978	2978	2978	2978	2978	2978	2978	2978	2978	2978	2978
18.0	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
18.5	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
19.0	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
19.5	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
20.0	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
20.5	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
21.0	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
21.5	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
22.0	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979
22.5	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979	2979

Table 12-11: Power curve, noise mode 3

**12.4.2 C<sub>i</sub> Values, Noise Mode 3**

Air density kg/m <sup>3</sup>														
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	0.918	0.927	0.926	0.925	0.924	0.924	0.923	0.922	0.921	0.920	0.920	0.919	0.917	0.917
3.5	0.886	0.893	0.892	0.892	0.891	0.890	0.890	0.889	0.889	0.888	0.887	0.887	0.885	0.885
4.0	0.844	0.850	0.850	0.849	0.849	0.848	0.847	0.847	0.846	0.846	0.845	0.845	0.843	0.843
4.5	0.813	0.819	0.819	0.818	0.818	0.817	0.817	0.816	0.816	0.815	0.815	0.814	0.813	0.813
5.0	0.792	0.798	0.798	0.797	0.797	0.796	0.796	0.795	0.795	0.794	0.793	0.793	0.792	0.791
5.5	0.766	0.774	0.773	0.773	0.772	0.771	0.771	0.770	0.769	0.768	0.768	0.767	0.766	0.765
6.0	0.732	0.741	0.740	0.739	0.739	0.738	0.737	0.736	0.735	0.734	0.734	0.733	0.731	0.730
6.5	0.692	0.703	0.702	0.701	0.700	0.699	0.698	0.697	0.696	0.695	0.694	0.693	0.691	0.690
7.0	0.645	0.656	0.655	0.654	0.653	0.652	0.651	0.650	0.649	0.648	0.647	0.646	0.643	0.642
7.5	0.594	0.605	0.604	0.603	0.602	0.601	0.600	0.599	0.598	0.597	0.596	0.595	0.593	0.592
8.0	0.551	0.562	0.561	0.560	0.559	0.558	0.557	0.556	0.555	0.554	0.553	0.552	0.550	0.549
8.5	0.520	0.531	0.530	0.529	0.528	0.527	0.526	0.525	0.524	0.523	0.522	0.521	0.519	0.518
9.0	0.497	0.507	0.506	0.505	0.504	0.504	0.503	0.502	0.501	0.500	0.499	0.498	0.495	0.493
9.5	0.470	0.485	0.484	0.483	0.482	0.481	0.480	0.478	0.477	0.475	0.474	0.472	0.468	0.465
10.0	0.441	0.469	0.468	0.466	0.464	0.463	0.460	0.458	0.455	0.453	0.449	0.445	0.436	0.431
10.5	0.401	0.451	0.448	0.446	0.443	0.440	0.435	0.430	0.425	0.420	0.414	0.407	0.394	0.388
11.0	0.357	0.426	0.421	0.416	0.411	0.406	0.400	0.393	0.386	0.379	0.372	0.364	0.349	0.342
11.5	0.314	0.396	0.389	0.382	0.375	0.367	0.360	0.352	0.344	0.336	0.328	0.321	0.307	0.300
12.0	0.277	0.359	0.351	0.343	0.335	0.327	0.319	0.312	0.304	0.296	0.290	0.283	0.271	0.265
12.5	0.246	0.322	0.314	0.306	0.298	0.290	0.283	0.277	0.270	0.263	0.257	0.252	0.241	0.236
13.0	0.220	0.288	0.281	0.274	0.266	0.259	0.253	0.247	0.241	0.235	0.230	0.225	0.216	0.211
13.5	0.199	0.260	0.253	0.247	0.240	0.234	0.228	0.223	0.218	0.213	0.208	0.204	0.195	0.191
14.0	0.180	0.234	0.228	0.222	0.216	0.211	0.206	0.201	0.197	0.192	0.188	0.184	0.177	0.173
14.5	0.163	0.211	0.206	0.201	0.195	0.190	0.186	0.182	0.178	0.174	0.170	0.167	0.160	0.157
15.0	0.147	0.190	0.185	0.180	0.176	0.171	0.168	0.164	0.160	0.157	0.153	0.150	0.145	0.142
15.5	0.134	0.172	0.168	0.164	0.160	0.156	0.152	0.149	0.146	0.142	0.140	0.137	0.132	0.129
16.0	0.122	0.156	0.153	0.149	0.145	0.142	0.139	0.136	0.133	0.130	0.127	0.125	0.120	0.118
16.5	0.112	0.143	0.139	0.136	0.133	0.129	0.127	0.124	0.121	0.119	0.117	0.114	0.110	0.108
17.0	0.103	0.131	0.128	0.125	0.122	0.119	0.116	0.114	0.111	0.109	0.107	0.105	0.101	0.099
17.5	0.095	0.120	0.117	0.115	0.112	0.109	0.107	0.105	0.102	0.100	0.098	0.097	0.093	0.091
18.0	0.087	0.110	0.108	0.106	0.103	0.101	0.099	0.097	0.095	0.093	0.091	0.089	0.086	0.084
18.5	0.081	0.102	0.100	0.098	0.095	0.093	0.091	0.089	0.087	0.086	0.084	0.083	0.080	0.078
19.0	0.075	0.094	0.092	0.090	0.088	0.086	0.084	0.082	0.081	0.079	0.078	0.076	0.074	0.072
19.5	0.070	0.087	0.085	0.083	0.082	0.080	0.078	0.077	0.075	0.074	0.072	0.071	0.068	0.067
20.0	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
20.5	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
21.0	0.057	0.071	0.069	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.059	0.058	0.056	0.055
21.5	0.054	0.067	0.065	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052
22.0	0.051	0.063	0.061	0.060	0.059	0.058	0.056	0.055	0.054	0.053	0.052	0.052	0.050	0.049
22.5	0.048	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.049	0.047	0.046

Table 12-12: C<sub>i</sub> values, noise mode 3

### 12.4.3 Noise Curve, Noise Mode 3

Sound Power Level at Hub Height, Noise Mode 3 (Blades with optional serrated trailing edge)	
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at 10 metre height: 16% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height ) [dBA]
3.0	89.4
4.0	89.5
5.0	90.4
6.0	94.2
7.0	97.1
8.0	98.8
9.0	99.5
10.0	100.3
11.0	101.1
12.0	101.8
13.0	102.3
14.0	102.5
15.0	102.5
16.0	102.5
17.0	102.5
18.0	102.5
19.0	102.5
20.0	102.5

Table 12-13: Noise curves, noise mode 3

## 12.5 Mode 4

### 12.5.1 Power Curves, Noise Mode 4

Wind speed [m/s]	Air density [kg/m <sup>3</sup> ]													
	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	30	13	14	16	17	19	20	22	23	25	27	28	32	33
3.5	97	63	66	69	72	75	78	81	84	87	91	94	100	103
4.0	179	128	133	138	142	147	152	156	161	166	170	175	184	189
4.5	278	205	212	219	225	232	239	245	252	259	265	272	285	292
5.0	396	297	306	315	324	333	342	351	360	369	378	387	405	415
5.5	539	407	419	431	443	455	467	479	491	503	515	527	551	563
6.0	711	541	557	572	588	603	619	634	649	665	680	696	726	742
6.5	912	698	717	737	757	776	796	815	835	854	874	893	931	951
7.0	1132	879	903	927	951	975	998	1022	1045	1068	1089	1111	1149	1166
7.5	1274	1067	1092	1117	1142	1167	1184	1202	1220	1238	1250	1262	1282	1290
8.0	1318	1218	1234	1250	1266	1282	1288	1295	1302	1308	1312	1315	1320	1321
8.5	1325	1294	1300	1305	1311	1317	1318	1320	1322	1324	1324	1324	1325	1325
9.0	1325	1318	1320	1321	1323	1324	1324	1325	1325	1325	1325	1325	1325	1325
9.5	1325	1322	1323	1323	1324	1324	1324	1325	1325	1325	1325	1325	1325	1325
10.0	1325	1324	1324	1324	1324	1325	1325	1325	1325	1325	1325	1325	1325	1325
10.5	1325	1324	1324	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
11.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
11.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
12.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
12.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
13.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
13.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
14.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
14.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
15.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
15.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
16.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
16.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
17.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
17.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
18.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
18.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
19.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
19.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
20.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
20.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
21.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
21.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
22.0	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325
22.5	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325	1325

Table 12-14: Power curve, noise mode 4

**12.5.2 C<sub>t</sub> Values, Noise Mode 4**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.918	0.927	0.926	0.925	0.924	0.924	0.923	0.922	0.921	0.920	0.920	0.919	0.917	0.917
3.5	0.886	0.893	0.892	0.892	0.891	0.890	0.890	0.889	0.888	0.888	0.887	0.887	0.885	0.885
4.0	0.844	0.850	0.850	0.849	0.849	0.848	0.847	0.847	0.846	0.846	0.845	0.845	0.843	0.843
4.5	0.814	0.820	0.819	0.819	0.818	0.817	0.817	0.816	0.816	0.815	0.815	0.814	0.813	0.813
5.0	0.801	0.807	0.807	0.806	0.806	0.805	0.805	0.804	0.804	0.803	0.802	0.802	0.801	0.800
5.5	0.797	0.804	0.804	0.803	0.802	0.802	0.801	0.800	0.800	0.799	0.798	0.797	0.796	0.795
6.0	0.790	0.799	0.798	0.797	0.797	0.796	0.795	0.794	0.793	0.792	0.791	0.790	0.789	0.788
6.5	0.782	0.793	0.792	0.791	0.790	0.789	0.788	0.787	0.786	0.785	0.784	0.783	0.781	0.780
7.0	0.749	0.779	0.778	0.777	0.776	0.775	0.772	0.770	0.767	0.765	0.759	0.754	0.739	0.730
7.5	0.633	0.740	0.734	0.729	0.723	0.717	0.706	0.695	0.684	0.673	0.660	0.647	0.619	0.604
8.0	0.496	0.650	0.638	0.625	0.612	0.600	0.584	0.569	0.553	0.537	0.524	0.510	0.484	0.471
8.5	0.393	0.535	0.520	0.506	0.491	0.477	0.464	0.451	0.438	0.425	0.414	0.404	0.384	0.374
9.0	0.321	0.433	0.421	0.409	0.396	0.384	0.374	0.364	0.354	0.345	0.337	0.329	0.314	0.307
9.5	0.268	0.356	0.346	0.337	0.327	0.317	0.310	0.302	0.295	0.287	0.281	0.274	0.263	0.257
10.0	0.227	0.298	0.291	0.283	0.275	0.267	0.261	0.255	0.249	0.243	0.238	0.233	0.223	0.218
10.5	0.195	0.254	0.248	0.241	0.235	0.229	0.223	0.218	0.213	0.208	0.204	0.199	0.191	0.188
11.0	0.169	0.219	0.213	0.208	0.203	0.197	0.193	0.189	0.184	0.180	0.176	0.173	0.166	0.163
11.5	0.148	0.190	0.186	0.181	0.177	0.172	0.168	0.165	0.161	0.157	0.154	0.151	0.145	0.142
12.0	0.130	0.167	0.163	0.159	0.155	0.151	0.148	0.145	0.141	0.138	0.136	0.133	0.128	0.125
12.5	0.115	0.147	0.144	0.141	0.137	0.134	0.131	0.128	0.125	0.123	0.120	0.118	0.113	0.111
13.0	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
13.5	0.093	0.118	0.115	0.112	0.110	0.107	0.105	0.103	0.101	0.098	0.096	0.095	0.091	0.090
14.0	0.084	0.106	0.103	0.101	0.099	0.096	0.094	0.092	0.091	0.089	0.087	0.085	0.082	0.081
14.5	0.076	0.096	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.077	0.074	0.073
15.0	0.069	0.086	0.084	0.083	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.067	0.066
15.5	0.063	0.079	0.077	0.075	0.073	0.072	0.070	0.069	0.068	0.066	0.065	0.064	0.062	0.061
16.0	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
16.5	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
17.0	0.049	0.061	0.059	0.058	0.057	0.056	0.055	0.053	0.052	0.051	0.051	0.050	0.048	0.047
17.5	0.045	0.056	0.055	0.054	0.052	0.051	0.050	0.049	0.048	0.048	0.047	0.046	0.044	0.044
18.0	0.042	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.043	0.041	0.041
18.5	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
19.0	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
19.5	0.034	0.042	0.041	0.040	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.034	0.033	0.033
20.0	0.032	0.039	0.038	0.037	0.037	0.036	0.035	0.035	0.034	0.033	0.033	0.032	0.031	0.031
20.5	0.030	0.036	0.036	0.035	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.029
21.0	0.028	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.029	0.029	0.028	0.027
21.5	0.027	0.032	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.028	0.027	0.026	0.026
22.0	0.025	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025
22.5	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

Table 12-15: C<sub>t</sub> values, noise mode 4

### 12.5.3 Noise Curve, Noise Mode 4

Sound Power Level at Hub Height, Noise Mode 4 (Blades with optional serrated trailing edge)	
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at 10 metre height: 16% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height ) [dBA]
3.0	89.4
4.0	89.5
5.0	90.4
6.0	94.2
7.0	96.1
8.0	97.3
9.0	98.0
10.0	98.8
11.0	99.6
12.0	100.3
13.0	100.8
14.0	101.0
15.0	101.0
16.0	101.0
17.0	101.0
18.0	101.0
19.0	101.0
20.0	101.0

Table 12-16: Noise curves, noise mode 4

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# Performance Specification

## EnVentus™

### V150-6.0 MW 50/60 Hz

Original Instruction: T05 0098-0749 VER 01



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**1 General Description**

The Vestas V150-6.0 MW is a wind turbine variant within the EnVentus™ turbine range. It is a pitch regulated upwind turbine with active yaw and a three-blade rotor. The V150-6.0 MW turbine has a rotor diameter of 150 m and a rated power of 6.0 MW.

For more details, please refer to the General Description of the EnVentus™ turbine range (General Description EnVentus™ - 0081-5017).

**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
IECRE OD-501	IEC S	105 m, 125 m, 155 m



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### 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 do 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 S	IEC S	IEC S
<b>Power Rating</b>	<b>6.0 MW</b>	<b>6.0 MW</b>	<b>6.0 MW</b>
<b>Hub Height</b>	<b>105</b>	<b>125</b>	<b>155</b>
<b>Average design parameters - IEC</b>			
Wind Speed (10 min average), $V_{ave}$	8.5 m/s	8.5 m/s	8.0 m/s
Weibull Scale Factor, $C$	9.6 m/s	9.6 m/s	9.0 m/s
Weibull Shape Factor, $k$	2.3	2.3	2.48
$I_{ref}$ acc. to IEC 61400-1	0.14	0.14	0.15
Turbulence Intensity acc. to IEC 61400-1, Including Wind Farm Turbulence (@15 m/s) $I_{90}$ (90% quantile)	15.7%	15.7%	16.9 %
Wind Shear, $\alpha$	0.20	0.20	0.30
Inflow Angle (vertical)	8°	8°	8°
<b>Extreme design parameters - IEC</b>			
Extr. Wind Speed (10 min average), $V_{50}$	37.5 m/s	37.5 m/s	40.1 m/s
Survival Wind Speed (3 s gust), $V_{e50}$	52.5 m/s	52.5 m/s	56.1 m/s
Turbulence Intensity, $I_{V50}$	11 %	11%	11 %

**NOTE** The turbine is intended for low to medium wind speed sites but is also applicable on high wind speed sites, depending on site specific conditions. It is classified as IEC S. Please contact Vestas Wind Systems A/S for further information if needed.

#### 3.1.1 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.

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### 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 S	
	PO6000	SO0, SO2, SO3, SO4, SO5, SO6
Cut-In, $V_{in}$	3 m/s	3 m/s
Cut-Out (10 min exponential avg.), $V_{out}$	25 m/s	20 m/s
Re-Cut In (10 min exponential avg.)	23 m/s	18 m/s

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### 3.3 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	-20° to +45°C
Ambient Temperature Interval (Low Temperature operation)	-30° to +45°C

**NOTE** The wind turbine will stop producing power at ambient temperatures above 45°C. For low temperature operation of the wind turbine please 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.

#### 3.3.1 Temperature dependent operation

Values below refer to hub height and are determined by the sensors and control system of the turbine. At ambient temperatures above the thresholds shown for each operating mode, the turbine will maintain derated production.

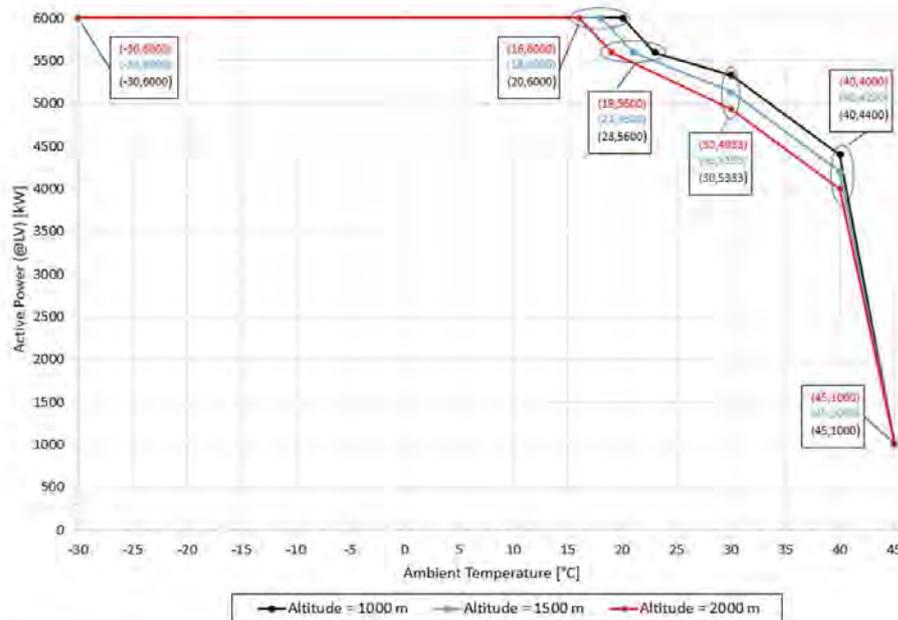


Figure 3-1: Temperature dependant derated operation

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### 3.4 Operational Envelope – Conditions for Power Curve and $C_t$ Values (at Hub Height)

Please consult section 6 and subsequent, for power curves and  $C_t$  values.

Conditions for Power Curve and $C_t$ Values (at Hub Height)	
Wind Shear, $\alpha$	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 $\pm$ 2°
Grid Voltage	Nominal Voltage $\pm$ 2.5%
Grid Frequency	Nominal Frequency $\pm$ 0.5 Hz
Grid Active Power (LV-side)	Per tabulated values in Section 6 and following sections
Grid Reactive Power (LV-side)	Power Factor 1.0

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### 3.5 Operational Envelope – Reactive Power Capability

The turbine has a reactive power capability on the low voltage side of the HV transformer as illustrated in Figure 3-2:

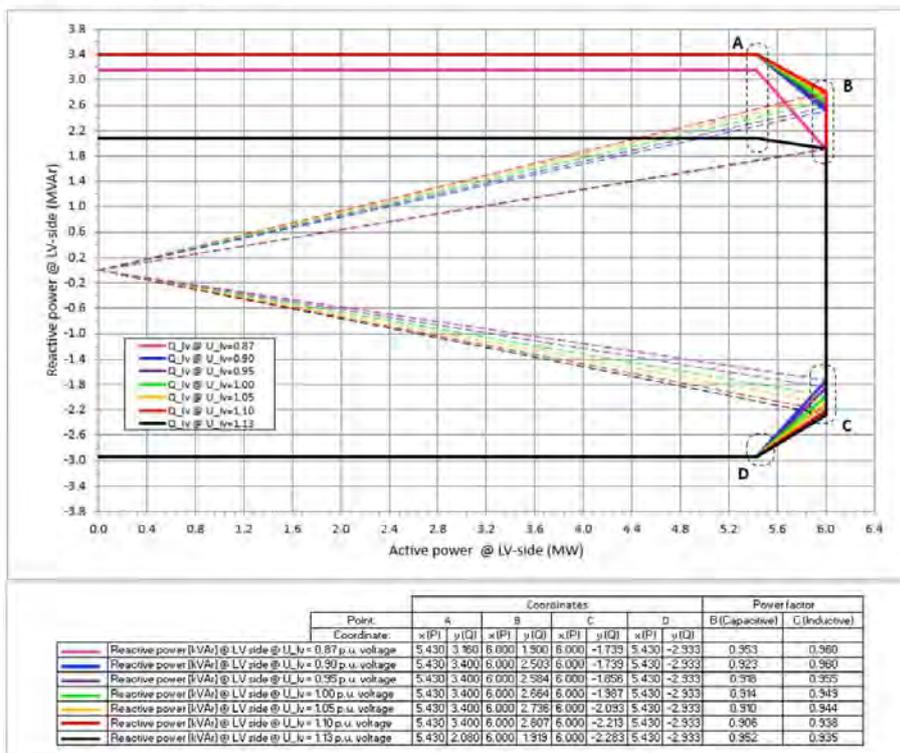


Figure 3-2: Reactive power capability

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

### 3.6 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
PO6000	104.9 dBA	Yes (standard)	105 m, 125 m, 155 m
PO6000-0S	107.7 dBA	No (option)	105 m, 125 m, 155 m

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
SO0	104 dBA	Yes (standard)	105 / 125 / 155 m
SO2	102 dBA	Yes (standard)	105 / 125 / 155 m
SO3	101 dBA	Yes (standard)	105 / 125 / 155 m
SO4	100 dBA	Yes (standard)	105 / 125 / 155 m
SO5	99 dBA	Yes (standard)	105 / 125 / 155 m
SO6	98 dBA	Yes (standard)	Site specific

**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, please contact Vestas Wind Systems A/S.

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**4 Drawings**

Overview drawings describing the wind turbines, tower and foundation are shown in these documents.

- V150 HH105 – 0077-2108
- V150 HH125 – 0073-8666
- V150 HH155 – 0079-6643

**NOTE** For detailed drawings, please contact Vestas Wind Systems A/S.

**4.1 Turbine visual impression – side view**



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## 5 General Reservations, Notes and Disclaimers

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- The performance specifications described in this document apply to the current version of the V150-6.0 MW wind turbine. Updated versions of the V150-6.0 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 V150-6.0 MW wind turbine, 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.

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**6 Power Curves, Ct Values and Sound Curves, Mode PO6000/PO6000-0S**

**6.1 Power Curves, Mode PO6000/PO6000-0S**

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	40	16	17	19	21	22	25	27	29	32	34	37	42	45
3.5	135	85	89	94	99	103	108	112	117	121	126	131	140	144
4.0	250	175	182	189	195	202	209	216	223	230	236	243	257	264
4.5	391	284	294	304	313	323	333	342	352	362	371	381	400	410
5.0	563	419	432	445	458	471	484	498	511	524	537	550	576	589
5.5	775	582	600	617	635	652	670	687	705	722	740	758	793	811
6.0	1032	779	802	825	848	871	894	917	940	963	986	1009	1055	1078
6.5	1337	1015	1044	1073	1102	1132	1161	1190	1219	1249	1278	1307	1366	1395
7.0	1693	1291	1328	1364	1401	1438	1474	1511	1547	1584	1620	1656	1729	1766
7.5	2101	1609	1654	1699	1744	1788	1833	1878	1922	1967	2012	2056	2145	2190
8.0	2565	1970	2024	2079	2133	2187	2241	2295	2349	2403	2457	2511	2619	2672
8.5	3086	2377	2442	2506	2571	2636	2700	2765	2829	2894	2958	3022	3150	3214
9.0	3657	2825	2901	2977	3054	3130	3205	3281	3357	3432	3507	3582	3731	3805
9.5	4231	3304	3391	3478	3565	3651	3735	3819	3903	3988	4069	4150	4310	4388
10.0	4777	3796	3890	3984	4078	4172	4260	4349	4437	4526	4610	4693	4856	4935
10.5	5258	4270	4368	4466	4563	4661	4751	4840	4930	5019	5099	5178	5326	5395
11.0	5642	4717	4816	4915	5015	5114	5198	5282	5366	5450	5514	5578	5692	5741
11.5	5867	5127	5219	5311	5403	5496	5560	5623	5687	5751	5790	5828	5890	5913
12.0	5956	5479	5551	5623	5695	5767	5803	5839	5875	5912	5926	5941	5964	5973
12.5	5988	5736	5780	5824	5868	5912	5926	5941	5955	5969	5976	5982	5991	5995
13.0	5998	5890	5909	5928	5948	5967	5973	5980	5986	5992	5994	5996	5999	6000
13.5	6000	5949	5959	5969	5979	5990	5992	5994	5996	5999	5999	6000	6000	6000
14.0	6000	5982	5986	5990	5994	5998	5999	5999	6000	6000	6000	6000	6000	6000
14.5	6000	5995	5996	5997	5998	6000	6000	6000	6000	6000	6000	6000	6000	6000
15.0	6000	5999	5999	5999	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
15.5	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
16.0	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
16.5	6000	5998	5998	5998	5998	5999	5999	5999	5999	5999	6000	6000	6000	6000
17.0	5842	5780	5785	5789	5794	5799	5805	5811	5817	5823	5829	5836	5849	5856
17.5	5585	5525	5529	5534	5539	5543	5549	5554	5560	5566	5572	5578	5592	5599
18.0	5353	5295	5299	5304	5308	5313	5318	5324	5329	5335	5341	5347	5359	5366
18.5	5121	5062	5066	5071	5076	5080	5086	5091	5096	5102	5108	5114	5127	5133
19.0	4887	4832	4836	4841	4845	4849	4855	4860	4865	4870	4876	4882	4894	4900
19.5	4655	4603	4607	4611	4616	4620	4625	4630	4635	4640	4645	4650	4662	4668
20.0	4424	4375	4379	4383	4387	4391	4396	4400	4404	4409	4414	4419	4430	4435
20.5	4196	4151	4154	4158	4161	4165	4169	4173	4178	4182	4187	4191	4201	4205
21.0	3966	3922	3925	3928	3932	3935	3939	3944	3949	3953	3957	3962	3971	3975
21.5	3723	3687	3690	3693	3696	3699	3702	3705	3708	3711	3715	3719	3728	3733
22.0	3495	3468	3470	3472	3474	3476	3478	3481	3484	3486	3489	3492	3499	3503
22.5	3259	3231	3234	3237	3239	3242	3243	3245	3247	3249	3252	3255	3262	3265
23.0	3012	2991	2992	2993	2995	2996	2998	3000	3002	3004	3006	3009	3015	3018
23.5	2806	2789	2790	2790	2791	2791	2793	2796	2798	2800	2802	2804	2808	2809
24.0	2680	2561	2561	2562	2563	2563	2566	2568	2570	2572	2575	2577	2582	2584
24.5	2288	2266	2267	2268	2269	2270	2272	2274	2276	2278	2281	2285	2291	2295
25.0	2044	2006	2009	2012	2015	2018	2022	2025	2029	2033	2036	2040	2048	2052

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**6.2 Ct Values, Mode PO6000/PO6000-0S**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.862	0.854	0.855	0.857	0.859	0.860	0.861	0.861	0.862	0.862	0.862	0.862	0.862	0.862
3.5	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840	0.840
4.0	0.808	0.809	0.809	0.809	0.808	0.808	0.808	0.807	0.807	0.807	0.807	0.807	0.808	0.808
4.5	0.791	0.791	0.791	0.792	0.792	0.792	0.792	0.792	0.792	0.791	0.791	0.791	0.791	0.790
5.0	0.784	0.789	0.788	0.788	0.787	0.787	0.787	0.786	0.786	0.785	0.785	0.784	0.783	0.783
5.5	0.784	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.784	0.784	0.784
6.0	0.785	0.783	0.783	0.783	0.784	0.784	0.784	0.784	0.785	0.785	0.785	0.785	0.785	0.786
6.5	0.786	0.785	0.785	0.785	0.785	0.785	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786
7.0	0.786	0.785	0.785	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786
7.5	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787
8.0	0.787	0.788	0.788	0.788	0.788	0.788	0.788	0.788	0.788	0.787	0.787	0.787	0.787	0.787
8.5	0.784	0.786	0.786	0.786	0.786	0.786	0.785	0.785	0.785	0.784	0.784	0.784	0.783	0.783
9.0	0.769	0.775	0.775	0.774	0.774	0.774	0.773	0.773	0.772	0.772	0.771	0.770	0.768	0.767
9.5	0.730	0.757	0.756	0.754	0.752	0.751	0.748	0.746	0.743	0.740	0.737	0.734	0.726	0.722
10.0	0.674	0.726	0.722	0.718	0.714	0.710	0.705	0.700	0.696	0.691	0.685	0.680	0.669	0.663
10.5	0.613	0.679	0.674	0.668	0.662	0.657	0.651	0.645	0.638	0.632	0.626	0.619	0.606	0.598
11.0	0.550	0.628	0.622	0.615	0.609	0.602	0.595	0.588	0.581	0.574	0.566	0.558	0.541	0.532
11.5	0.482	0.577	0.569	0.562	0.555	0.547	0.538	0.529	0.521	0.512	0.502	0.492	0.472	0.462
12.0	0.417	0.527	0.517	0.508	0.499	0.490	0.479	0.469	0.459	0.448	0.438	0.428	0.408	0.398
12.5	0.362	0.475	0.464	0.453	0.442	0.431	0.421	0.410	0.400	0.389	0.380	0.371	0.354	0.346
13.0	0.316	0.422	0.411	0.399	0.388	0.377	0.368	0.358	0.349	0.340	0.332	0.324	0.309	0.302
13.5	0.279	0.372	0.362	0.352	0.342	0.332	0.323	0.315	0.307	0.299	0.292	0.285	0.273	0.267
14.0	0.247	0.328	0.320	0.311	0.302	0.293	0.286	0.279	0.272	0.265	0.259	0.253	0.242	0.237
14.5	0.221	0.291	0.284	0.276	0.268	0.260	0.254	0.248	0.242	0.236	0.231	0.226	0.216	0.212
15.0	0.198	0.260	0.253	0.246	0.239	0.233	0.227	0.222	0.217	0.211	0.207	0.202	0.194	0.190
15.5	0.179	0.233	0.227	0.221	0.215	0.209	0.205	0.200	0.195	0.190	0.187	0.183	0.175	0.172
16.0	0.162	0.210	0.205	0.200	0.195	0.189	0.185	0.181	0.177	0.173	0.169	0.166	0.159	0.156
16.5	0.147	0.191	0.186	0.181	0.177	0.172	0.168	0.164	0.161	0.157	0.154	0.151	0.145	0.142
17.0	0.131	0.167	0.163	0.159	0.156	0.152	0.149	0.145	0.142	0.139	0.137	0.134	0.129	0.127
17.5	0.116	0.147	0.143	0.140	0.137	0.133	0.131	0.128	0.125	0.123	0.120	0.118	0.114	0.112
18.0	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
18.5	0.090	0.113	0.111	0.108	0.106	0.103	0.101	0.099	0.097	0.095	0.093	0.092	0.088	0.087
19.0	0.079	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.082	0.080	0.078	0.076
19.5	0.070	0.088	0.086	0.084	0.082	0.080	0.078	0.077	0.075	0.074	0.072	0.071	0.069	0.068
20.0	0.062	0.078	0.076	0.074	0.073	0.071	0.069	0.068	0.067	0.065	0.064	0.063	0.061	0.060
20.5	0.055	0.069	0.067	0.066	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.056	0.054	0.053
21.0	0.049	0.061	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047
21.5	0.043	0.054	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.044	0.042	0.041
22.0	0.038	0.047	0.046	0.045	0.044	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.037	0.037
22.5	0.033	0.042	0.041	0.040	0.039	0.038	0.037	0.037	0.036	0.035	0.034	0.034	0.033	0.032
23.0	0.029	0.036	0.036	0.035	0.034	0.033	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028
23.5	0.026	0.032	0.031	0.031	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.025	0.025
24.0	0.022	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.022	0.022
24.5	0.019	0.024	0.023	0.023	0.022	0.022	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.018
25.0	0.016	0.020	0.020	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016

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**6.3 Sound Curves, Mode PO6000/PO6000-0S**

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): $0 \pm 2^\circ$ Air density: $1.225 \text{ kg/m}^3$	
Wind speed at hub height [m/s]	Sound Power Level at Hub Height [dBA] Mode PO6000 (Blades with serrated trailing edge)	Sound Power Level at Hub Height [dBA] Mode PO6000-0S (Blades without serrated trailing edge)
3	92.0	94.8
4	92.2	95.0
5	94.0	96.8
6	96.9	99.7
7	99.9	102.7
8	102.7	105.5
9	104.6	107.4
10	104.8	107.6
11	104.9	107.7
12	104.9	107.7
13	104.9	107.7
14	104.9	107.7
15	104.9	107.7
16	104.9	107.7
17	104.9	107.7
18	104.9	107.7
19	104.9	107.7
20	104.9	107.7

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**7 Power Curves, Ct Values and Sound Curves, Sound Optimized Modes**

**7.1 Power Curves, Sound Optimized Mode S00**

Wind speed [m/s]	Air density [kg/m <sup>3</sup> ]													
	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	40	13	15	17	19	22	24	27	29	32	35	38	43	46
3.5	137	86	91	95	100	105	109	114	118	123	128	132	141	146
4.0	251	175	182	189	196	203	210	217	223	230	237	244	258	264
4.5	391	284	294	304	313	323	333	342	352	362	371	381	401	410
5.0	564	419	432	445	459	472	485	498	511	524	538	551	577	590
5.5	777	583	600	618	635	653	671	688	706	724	741	759	794	812
6.0	1034	780	803	826	850	873	896	919	942	965	988	1011	1057	1080
6.5	1339	1016	1045	1075	1104	1134	1163	1192	1222	1251	1280	1310	1368	1398
7.0	1696	1293	1330	1367	1403	1440	1477	1513	1550	1587	1623	1660	1733	1769
7.5	2105	1612	1657	1702	1747	1792	1836	1881	1926	1971	2015	2060	2149	2194
8.0	2568	1973	2028	2082	2136	2190	2244	2298	2352	2406	2460	2514	2622	2675
8.5	3087	2378	2443	2508	2572	2637	2702	2766	2831	2895	2959	3023	3151	3215
9.0	3653	2822	2898	2974	3050	3126	3202	3278	3353	3429	3504	3578	3727	3801
9.5	4222	3288	3376	3463	3551	3638	3723	3808	3893	3978	4060	4141	4301	4379
10.0	4748	3748	3846	3944	4042	4140	4231	4322	4413	4504	4585	4667	4820	4893
10.5	5154	4176	4283	4389	4495	4601	4689	4777	4864	4952	5020	5087	5208	5261
11.0	5429	4559	4666	4773	4880	4987	5062	5138	5213	5288	5335	5382	5459	5489
11.5	5541	4884	4978	5073	5168	5263	5315	5368	5421	5473	5496	5519	5552	5564
12.0	5578	5125	5202	5278	5354	5431	5460	5490	5519	5548	5558	5568	5584	5590
12.5	5593	5301	5355	5408	5461	5515	5530	5545	5560	5576	5581	5587	5596	5598
13.0	5598	5414	5448	5483	5518	5552	5561	5570	5579	5588	5592	5595	5599	5600
13.5	5599	5460	5487	5515	5542	5569	5576	5583	5590	5596	5597	5598	5600	5600
14.0	5600	5493	5515	5536	5558	5579	5584	5589	5593	5598	5599	5599	5600	5600
14.5	5600	5515	5532	5550	5567	5584	5588	5592	5595	5599	5599	5599	5600	5600
15.0	5600	5526	5541	5556	5571	5586	5589	5592	5595	5598	5598	5599	5600	5600
15.5	5600	5539	5551	5564	5577	5589	5591	5594	5596	5598	5599	5599	5600	5600
16.0	5600	5549	5559	5570	5581	5591	5593	5595	5597	5599	5599	5599	5600	5600
16.5	5600	5557	5566	5575	5584	5593	5595	5596	5597	5599	5599	5599	5600	5600
17.0	5597	5554	5563	5572	5580	5589	5591	5592	5594	5596	5596	5597	5598	5598
17.5	5563	5487	5499	5511	5523	5535	5539	5544	5548	5553	5556	5559	5565	5568
18.0	5433	5312	5328	5345	5362	5378	5387	5396	5404	5413	5420	5426	5440	5446
18.5	5233	5070	5092	5114	5136	5158	5170	5182	5193	5205	5215	5224	5242	5250
19.0	5006	4806	4833	4860	4887	4914	4928	4942	4957	4972	4983	4994	5016	5026
19.5	4773	4554	4583	4612	4642	4671	4688	4705	4722	4739	4750	4762	4783	4793
20.0	4544	4319	4349	4379	4409	4439	4456	4474	4491	4509	4520	4532	4553	4563

Original Instruction: T05 0098-0749 VER 01

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 Type: T05 - General Description

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**7.2 Ct Values, Sound Optimized Mode S00**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.877	0.869	0.870	0.872	0.874	0.875	0.876	0.876	0.876	0.877	0.877	0.877	0.877	0.877
3.5	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.838
4.0	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
4.5	0.790	0.789	0.790	0.790	0.790	0.791	0.790	0.790	0.790	0.790	0.790	0.790	0.790	0.789
5.0	0.784	0.788	0.788	0.787	0.787	0.786	0.786	0.786	0.785	0.785	0.785	0.784	0.784	0.783
5.5	0.785	0.783	0.783	0.783	0.783	0.783	0.783	0.784	0.784	0.784	0.784	0.784	0.785	0.785
6.0	0.787	0.784	0.784	0.784	0.785	0.785	0.785	0.786	0.786	0.786	0.787	0.787	0.788	0.788
6.5	0.790	0.786	0.787	0.787	0.787	0.788	0.788	0.788	0.789	0.789	0.789	0.789	0.790	0.790
7.0	0.793	0.788	0.789	0.789	0.790	0.790	0.791	0.791	0.792	0.792	0.792	0.793	0.793	0.794
7.5	0.798	0.795	0.795	0.795	0.796	0.796	0.796	0.797	0.797	0.797	0.797	0.798	0.798	0.799
8.0	0.798	0.794	0.795	0.795	0.796	0.796	0.797	0.797	0.797	0.798	0.798	0.798	0.798	0.799
8.5	0.788	0.785	0.785	0.785	0.785	0.786	0.786	0.786	0.787	0.787	0.787	0.787	0.788	0.788
9.0	0.774	0.773	0.773	0.773	0.773	0.774	0.774	0.774	0.774	0.774	0.774	0.774	0.773	0.772
9.5	0.739	0.755	0.754	0.754	0.754	0.753	0.752	0.750	0.749	0.747	0.744	0.741	0.735	0.731
10.0	0.682	0.720	0.719	0.717	0.715	0.714	0.710	0.706	0.702	0.699	0.693	0.687	0.675	0.668
10.5	0.610	0.671	0.668	0.665	0.663	0.660	0.654	0.647	0.641	0.635	0.627	0.618	0.601	0.591
11.0	0.534	0.615	0.611	0.607	0.602	0.598	0.590	0.582	0.574	0.566	0.555	0.545	0.524	0.513
11.5	0.457	0.552	0.546	0.541	0.535	0.529	0.520	0.510	0.500	0.491	0.480	0.469	0.447	0.436
12.0	0.392	0.490	0.483	0.477	0.470	0.463	0.452	0.442	0.432	0.422	0.412	0.402	0.383	0.374
12.5	0.340	0.435	0.427	0.419	0.411	0.402	0.393	0.383	0.374	0.364	0.356	0.348	0.332	0.325
13.0	0.297	0.385	0.377	0.368	0.360	0.351	0.343	0.335	0.327	0.318	0.311	0.304	0.291	0.284
13.5	0.262	0.340	0.332	0.325	0.317	0.310	0.302	0.295	0.288	0.281	0.275	0.268	0.257	0.251
14.0	0.233	0.302	0.295	0.288	0.281	0.274	0.268	0.262	0.256	0.249	0.244	0.238	0.228	0.223
14.5	0.208	0.269	0.263	0.257	0.251	0.245	0.239	0.234	0.228	0.223	0.218	0.213	0.204	0.200
15.0	0.187	0.241	0.236	0.230	0.225	0.219	0.214	0.210	0.205	0.200	0.196	0.192	0.184	0.180
15.5	0.169	0.218	0.213	0.208	0.203	0.198	0.194	0.189	0.185	0.180	0.177	0.173	0.166	0.163
16.0	0.154	0.197	0.193	0.188	0.184	0.179	0.175	0.171	0.168	0.164	0.160	0.157	0.151	0.148
16.5	0.140	0.178	0.175	0.171	0.167	0.163	0.160	0.156	0.153	0.149	0.146	0.143	0.137	0.135
17.0	0.128	0.164	0.160	0.156	0.153	0.149	0.146	0.143	0.139	0.136	0.134	0.131	0.126	0.123
17.5	0.118	0.149	0.145	0.142	0.139	0.136	0.133	0.130	0.127	0.125	0.122	0.120	0.115	0.113
18.0	0.106	0.132	0.129	0.127	0.124	0.121	0.119	0.117	0.114	0.112	0.110	0.108	0.104	0.102
18.5	0.094	0.116	0.114	0.112	0.110	0.107	0.105	0.103	0.101	0.099	0.098	0.096	0.093	0.091
19.0	0.083	0.101	0.100	0.098	0.096	0.094	0.093	0.091	0.089	0.088	0.086	0.085	0.082	0.081
19.5	0.074	0.089	0.088	0.086	0.085	0.083	0.082	0.081	0.079	0.078	0.076	0.075	0.073	0.072
20.0	0.066	0.079	0.078	0.076	0.075	0.074	0.073	0.071	0.070	0.069	0.068	0.067	0.065	0.064

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**7.3 Sound Curves, Sound Optimized Mode SO0**

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 <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height [dBA] Sound Optimized ModeSO0 (Blades with serrated trailing edge)
3	91.3
4	91.8
5	94.1
6	96.9
7	100.0
8	102.6
9	103.7
10	103.9
11	104.0
12	104.0
13	104.0
14	104.0
15	104.0
16	104.0
17	104.0
18	104.0
19	104.0
20	104.0

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**7.4 Power Curves, Sound Optimized Mode SO2**

Wind speed (m/s)	Air density [kg/m <sup>3</sup> ]													
	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	42	13	16	18	20	23	25	28	31	33	36	39	45	48
3.5	138	87	92	97	101	106	111	115	120	124	129	134	143	147
4.0	252	177	184	191	197	204	211	218	225	232	239	246	259	266
4.5	393	266	285	305	315	325	334	344	354	364	373	383	403	412
5.0	567	421	434	448	461	474	487	501	514	527	540	553	580	593
5.5	780	586	603	621	639	656	674	692	709	727	745	763	798	816
6.0	1039	784	807	831	854	877	900	923	946	970	993	1016	1062	1085
6.5	1345	1021	1051	1080	1110	1139	1169	1198	1228	1257	1287	1316	1375	1404
7.0	1705	1300	1337	1374	1411	1448	1484	1521	1558	1595	1631	1668	1741	1778
7.5	2112	1618	1663	1708	1753	1798	1843	1888	1933	1978	2022	2067	2157	2202
8.0	2570	1974	2029	2083	2137	2192	2246	2300	2354	2408	2462	2516	2624	2678
8.5	3042	2342	2405	2469	2533	2597	2661	2724	2788	2852	2915	2979	3105	3168
9.0	3565	2750	2824	2898	2973	3047	3121	3196	3270	3344	3418	3491	3637	3710
9.5	4097	3176	3262	3347	3432	3517	3601	3685	3770	3854	3935	4016	4169	4241
10.0	4513	3566	3661	3756	3851	3946	4034	4123	4212	4300	4371	4442	4570	4626
10.5	4761	3910	4009	4109	4208	4307	4384	4461	4538	4615	4664	4712	4793	4824
11.0	4892	4210	4302	4393	4485	4576	4635	4694	4752	4811	4838	4865	4904	4917
11.5	4924	4434	4512	4590	4668	4746	4782	4818	4854	4890	4901	4913	4931	4937
12.0	4940	4602	4662	4722	4781	4841	4860	4880	4899	4919	4926	4933	4943	4947
12.5	4947	4711	4754	4798	4842	4886	4897	4909	4921	4933	4938	4942	4948	4950
13.0	4949	4773	4806	4839	4872	4905	4914	4922	4931	4940	4943	4946	4950	4951
13.5	4950	4799	4828	4857	4886	4915	4923	4930	4938	4946	4947	4949	4950	4951
14.0	4950	4826	4850	4874	4899	4923	4929	4935	4941	4947	4948	4949	4951	4951
14.5	4950	4847	4867	4888	4908	4928	4933	4938	4943	4948	4949	4950	4951	4951
15.0	4950	4863	4880	4896	4913	4930	4934	4939	4943	4948	4949	4949	4950	4951
15.5	4950	4877	4891	4906	4920	4934	4938	4941	4945	4948	4949	4950	4951	4951
16.0	4950	4884	4897	4910	4924	4937	4940	4943	4946	4949	4949	4950	4951	4951
16.5	4951	4885	4898	4912	4925	4938	4941	4943	4946	4949	4950	4950	4951	4951
17.0	4950	4884	4897	4910	4924	4937	4940	4943	4946	4949	4949	4950	4951	4951
17.5	4951	4884	4881	4898	4914	4931	4935	4940	4944	4948	4949	4950	4951	4951
18.0	4950	4863	4880	4896	4913	4930	4935	4939	4943	4948	4948	4949	4951	4951
18.5	4946	4842	4860	4879	4898	4916	4922	4928	4934	4940	4942	4944	4947	4948
19.0	4885	4722	4746	4770	4794	4818	4830	4842	4854	4866	4872	4878	4889	4894
19.5	4740	4531	4560	4588	4617	4645	4661	4677	4693	4709	4719	4730	4748	4755
20.0	4532	4308	4336	4365	4395	4425	4443	4461	4479	4498	4509	4520	4542	4551

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**7.5 Ct Values, Sound Optimized Mode SO2**

Air density kg/m <sup>3</sup>														
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	0.885	0.877	0.878	0.880	0.881	0.883	0.883	0.884	0.884	0.884	0.884	0.884	0.884	0.884
3.5	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844
4.0	0.806	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.806	0.806	0.806	0.806	0.805	0.805
4.5	0.795	0.795	0.795	0.795	0.796	0.796	0.796	0.796	0.796	0.796	0.796	0.795	0.795	0.795
5.0	0.789	0.793	0.793	0.792	0.792	0.792	0.791	0.791	0.791	0.790	0.790	0.790	0.789	0.789
5.5	0.790	0.788	0.788	0.788	0.788	0.788	0.789	0.789	0.789	0.789	0.789	0.790	0.790	0.790
6.0	0.792	0.789	0.789	0.790	0.790	0.790	0.791	0.791	0.791	0.792	0.792	0.792	0.793	0.793
6.5	0.796	0.792	0.793	0.793	0.793	0.794	0.794	0.794	0.795	0.795	0.795	0.795	0.796	0.796
7.0	0.798	0.795	0.795	0.795	0.796	0.796	0.796	0.797	0.797	0.797	0.798	0.798	0.798	0.799
7.5	0.797	0.792	0.793	0.793	0.793	0.794	0.794	0.795	0.795	0.795	0.796	0.796	0.797	0.797
8.0	0.778	0.775	0.776	0.776	0.776	0.776	0.776	0.777	0.777	0.777	0.777	0.777	0.778	0.779
8.5	0.733	0.731	0.731	0.731	0.731	0.731	0.732	0.732	0.732	0.732	0.732	0.733	0.733	0.733
9.0	0.709	0.707	0.707	0.707	0.707	0.708	0.708	0.708	0.709	0.709	0.709	0.709	0.709	0.709
9.5	0.690	0.695	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.695	0.694	0.692	0.688	0.682
10.0	0.630	0.657	0.657	0.657	0.657	0.658	0.655	0.653	0.650	0.648	0.642	0.636	0.622	0.613
10.5	0.545	0.599	0.598	0.597	0.596	0.595	0.590	0.585	0.579	0.574	0.564	0.555	0.534	0.523
11.0	0.462	0.539	0.536	0.532	0.529	0.525	0.517	0.510	0.502	0.494	0.484	0.473	0.451	0.441
11.5	0.392	0.477	0.472	0.467	0.462	0.457	0.448	0.439	0.430	0.421	0.411	0.401	0.383	0.374
12.0	0.337	0.423	0.416	0.410	0.403	0.397	0.388	0.379	0.370	0.362	0.353	0.345	0.330	0.322
12.5	0.294	0.374	0.367	0.360	0.353	0.346	0.338	0.330	0.322	0.314	0.307	0.300	0.287	0.281
13.0	0.258	0.330	0.323	0.316	0.310	0.303	0.296	0.289	0.283	0.276	0.270	0.264	0.252	0.247
13.5	0.228	0.292	0.286	0.280	0.274	0.268	0.262	0.256	0.250	0.244	0.239	0.234	0.224	0.219
14.0	0.203	0.260	0.254	0.249	0.244	0.238	0.233	0.228	0.222	0.217	0.213	0.208	0.199	0.195
14.5	0.182	0.233	0.228	0.223	0.218	0.213	0.208	0.204	0.199	0.194	0.190	0.186	0.179	0.175
15.0	0.164	0.210	0.205	0.201	0.196	0.191	0.187	0.183	0.179	0.175	0.171	0.168	0.161	0.158
15.5	0.149	0.190	0.185	0.181	0.177	0.173	0.169	0.166	0.162	0.158	0.155	0.152	0.146	0.143
16.0	0.135	0.172	0.168	0.164	0.161	0.157	0.154	0.150	0.147	0.144	0.141	0.138	0.133	0.130
16.5	0.123	0.156	0.153	0.150	0.146	0.143	0.140	0.137	0.134	0.131	0.128	0.126	0.121	0.119
17.0	0.113	0.143	0.140	0.137	0.134	0.131	0.128	0.125	0.123	0.120	0.118	0.115	0.111	0.109
17.5	0.104	0.131	0.128	0.126	0.123	0.120	0.118	0.116	0.113	0.111	0.109	0.106	0.102	0.100
18.0	0.096	0.120	0.118	0.116	0.113	0.111	0.109	0.106	0.104	0.102	0.100	0.098	0.094	0.093
18.5	0.089	0.111	0.108	0.106	0.104	0.102	0.100	0.098	0.096	0.094	0.092	0.091	0.087	0.086
19.0	0.081	0.099	0.098	0.096	0.094	0.092	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.078
19.5	0.073	0.089	0.087	0.086	0.084	0.083	0.081	0.080	0.078	0.077	0.076	0.074	0.072	0.071
20.0	0.065	0.078	0.077	0.076	0.075	0.073	0.072	0.071	0.070	0.069	0.068	0.068	0.064	0.063

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**7.6 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 <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height [dBA] Sound Optimized Mode SO2 (Blades with serrated trailing edge)
3	91.3
4	91.5
5	93.9
6	96.9
7	99.7
8	102.0
9	102.0
10	102.0
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

Original Instruction: T05 0098-0749 VER 01

T05 0098-0749 Ver 01 - Approved- Exported from DMS: 2021-02-24 by GRACO

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 Document owner: Onshore Turbines  
 Type: T05 - General Description

Performance Specification  
 EnVentus™  
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**7.7 Power Curves, Sound Optimized Mode SO3**

Wind speed (m/s)	Air density [kg/m <sup>3</sup> ]													
	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	42	13	16	18	20	23	25	28	31	33	36	39	45	48
3.5	138	87	92	97	101	106	111	115	120	124	129	134	143	147
4.0	252	177	184	191	197	204	211	218	225	232	239	246	259	266
4.5	393	286	295	305	315	325	334	344	354	364	373	383	403	412
5.0	567	421	434	448	461	474	487	501	514	527	540	553	580	593
5.5	780	586	603	621	639	656	674	692	709	727	745	763	798	816
6.0	1039	784	807	831	854	877	900	923	946	970	993	1016	1062	1085
6.5	1346	1021	1051	1080	1110	1140	1169	1199	1228	1258	1287	1316	1375	1404
7.0	1705	1300	1337	1374	1411	1448	1485	1522	1558	1595	1632	1668	1741	1778
7.5	2108	1614	1659	1704	1749	1794	1839	1884	1929	1974	2018	2063	2152	2196
8.0	2542	1953	2007	2060	2114	2168	2221	2275	2328	2382	2435	2489	2595	2648
8.5	2979	2292	2355	2418	2480	2543	2605	2667	2730	2792	2854	2917	3041	3103
9.0	3450	2660	2732	2804	2876	2948	3020	3092	3164	3236	3307	3378	3520	3590
9.5	3901	3019	3100	3181	3262	3344	3424	3505	3585	3666	3744	3822	3975	4048
10.0	4248	3327	3416	3505	3594	3683	3769	3855	3941	4026	4100	4174	4310	4372
10.5	4470	3587	3682	3776	3870	3965	4047	4129	4211	4293	4352	4411	4512	4554
11.0	4604	3816	3910	4003	4096	4190	4261	4332	4403	4474	4518	4581	4629	4653
11.5	4661	4003	4090	4177	4264	4351	4409	4466	4524	4581	4608	4635	4674	4686
12.0	4684	4131	4212	4292	4373	4454	4499	4543	4588	4633	4650	4687	4692	4700
12.5	4695	4218	4292	4366	4440	4514	4550	4586	4621	4657	4670	4682	4701	4707
13.0	4700	4289	4355	4422	4488	4555	4584	4613	4642	4671	4681	4690	4705	4710
13.5	4707	4338	4397	4456	4515	4574	4601	4627	4653	4679	4688	4698	4711	4715
14.0	4710	4388	4441	4494	4547	4600	4622	4644	4665	4687	4695	4702	4713	4716
14.5	4712	4430	4477	4525	4572	4620	4638	4657	4675	4694	4700	4706	4715	4718
15.0	4713	4457	4500	4544	4587	4630	4646	4662	4678	4695	4701	4707	4715	4717
15.5	4714	4469	4510	4551	4592	4633	4649	4665	4681	4696	4702	4708	4716	4718
16.0	4713	4473	4513	4552	4592	4632	4648	4664	4679	4695	4701	4707	4715	4717
16.5	4712	4474	4514	4553	4592	4631	4646	4662	4678	4693	4700	4706	4714	4717
17.0	4711	4476	4514	4553	4591	4629	4645	4660	4676	4692	4698	4705	4714	4716
17.5	4708	4454	4493	4532	4571	4610	4629	4647	4666	4685	4692	4700	4711	4715
18.0	4708	4464	4501	4539	4578	4614	4632	4650	4668	4686	4693	4701	4711	4714
18.5	4708	4478	4514	4550	4585	4621	4638	4655	4672	4688	4695	4702	4712	4715
19.0	4699	4477	4511	4544	4578	4612	4628	4644	4660	4676	4683	4691	4703	4706
19.5	4641	4421	4453	4485	4516	4548	4564	4581	4597	4614	4623	4632	4647	4653
20.0	4503	4282	4312	4343	4373	4403	4420	4437	4455	4472	4482	4493	4512	4520

Original Instruction: T05 0098-0749 VER 01

T05 0098-0749 Ver 01 - Approved- Exported from DMS: 2021-02-24 by GRACO



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 Type: T05 - General Description

Performance Specification  
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**7.8 Ct Values, Sound Optimized Mode SO3**

Air density kg/m <sup>3</sup>														
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	0.885	0.877	0.878	0.880	0.881	0.883	0.883	0.884	0.884	0.884	0.884	0.884	0.884	0.884
3.5	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844
4.0	0.806	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.806	0.806	0.806	0.806	0.805	0.805
4.5	0.795	0.795	0.795	0.795	0.796	0.796	0.796	0.796	0.796	0.796	0.796	0.795	0.795	0.795
5.0	0.789	0.793	0.793	0.792	0.792	0.792	0.791	0.791	0.791	0.790	0.790	0.790	0.789	0.789
5.5	0.790	0.788	0.788	0.788	0.788	0.788	0.789	0.789	0.789	0.789	0.789	0.790	0.790	0.790
6.0	0.792	0.789	0.789	0.790	0.790	0.790	0.791	0.791	0.791	0.792	0.792	0.792	0.793	0.793
6.5	0.797	0.793	0.794	0.794	0.794	0.795	0.795	0.795	0.796	0.796	0.796	0.796	0.797	0.797
7.0	0.798	0.795	0.795	0.795	0.795	0.796	0.796	0.796	0.797	0.797	0.797	0.797	0.798	0.798
7.5	0.782	0.779	0.779	0.780	0.780	0.780	0.780	0.781	0.781	0.781	0.781	0.782	0.782	0.782
8.0	0.748	0.746	0.746	0.747	0.747	0.747	0.747	0.748	0.748	0.748	0.748	0.748	0.749	0.749
8.5	0.698	0.696	0.696	0.696	0.697	0.697	0.697	0.697	0.697	0.697	0.697	0.698	0.698	0.698
9.0	0.669	0.666	0.667	0.667	0.667	0.667	0.668	0.668	0.668	0.668	0.668	0.669	0.669	0.668
9.5	0.636	0.637	0.637	0.637	0.637	0.638	0.638	0.638	0.638	0.638	0.638	0.637	0.634	0.631
10.0	0.572	0.583	0.583	0.584	0.584	0.584	0.583	0.583	0.582	0.582	0.579	0.575	0.567	0.563
10.5	0.498	0.523	0.523	0.523	0.522	0.522	0.520	0.518	0.516	0.514	0.509	0.503	0.490	0.483
11.0	0.428	0.468	0.467	0.466	0.464	0.463	0.459	0.455	0.451	0.448	0.441	0.434	0.420	0.411
11.5	0.367	0.418	0.416	0.413	0.411	0.409	0.404	0.399	0.394	0.389	0.382	0.374	0.360	0.352
12.0	0.318	0.371	0.368	0.365	0.362	0.359	0.354	0.349	0.343	0.338	0.331	0.325	0.311	0.305
12.5	0.277	0.328	0.325	0.322	0.319	0.316	0.311	0.306	0.300	0.295	0.289	0.283	0.272	0.266
13.0	0.244	0.292	0.289	0.286	0.283	0.279	0.274	0.270	0.265	0.260	0.255	0.249	0.239	0.234
13.5	0.217	0.261	0.258	0.254	0.251	0.248	0.244	0.239	0.235	0.230	0.226	0.221	0.212	0.208
14.0	0.193	0.235	0.231	0.228	0.225	0.222	0.218	0.214	0.210	0.206	0.201	0.197	0.190	0.186
14.5	0.173	0.212	0.209	0.206	0.202	0.199	0.196	0.192	0.188	0.184	0.181	0.177	0.170	0.167
15.0	0.156	0.191	0.189	0.186	0.183	0.180	0.176	0.173	0.169	0.166	0.163	0.160	0.153	0.150
15.5	0.142	0.173	0.171	0.168	0.165	0.162	0.159	0.156	0.153	0.150	0.147	0.144	0.139	0.136
16.0	0.129	0.157	0.155	0.152	0.150	0.147	0.145	0.142	0.139	0.136	0.134	0.131	0.126	0.124
16.5	0.117	0.143	0.141	0.139	0.136	0.134	0.132	0.129	0.127	0.124	0.122	0.120	0.115	0.113
17.0	0.108	0.131	0.129	0.127	0.125	0.123	0.120	0.118	0.116	0.114	0.112	0.110	0.106	0.104
17.5	0.099	0.120	0.118	0.116	0.114	0.113	0.111	0.109	0.107	0.105	0.103	0.101	0.097	0.096
18.0	0.091	0.111	0.109	0.107	0.105	0.104	0.102	0.100	0.098	0.097	0.095	0.093	0.090	0.088
18.5	0.085	0.102	0.101	0.099	0.097	0.096	0.094	0.093	0.091	0.089	0.088	0.086	0.083	0.082
19.0	0.078	0.094	0.093	0.091	0.090	0.088	0.087	0.085	0.084	0.082	0.081	0.079	0.077	0.075
19.5	0.072	0.086	0.085	0.084	0.082	0.081	0.079	0.078	0.077	0.075	0.074	0.073	0.070	0.069
20.0	0.065	0.078	0.077	0.076	0.074	0.073	0.072	0.071	0.069	0.068	0.067	0.066	0.064	0.063

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Performance Specification  
 EnVentus™  
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**7.9 Sound Curves, Sound Optimized Mode SO3**

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 <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height [dBA] Sound Optimized Mode SO3 (Blades with serrated trailing edge)
3	91.3
4	91.5
5	93.9
6	96.9
7	99.7
8	101.0
9	101.0
10	101.0
11	101.0
12	101.0
13	101.0
14	101.0
15	101.0
16	101.0
17	101.0
18	101.0
19	101.0
20	101.0

Original Instruction: T05 0098-0749 VER 01

T05 0098-0749 Ver 01 - Approved- Exported from DMS: 2021-02-24 by GRACO

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**7.10 Power Curves, Sound Optimized Mode SO4**

Wind speed (m/s)	Air density [kg/m <sup>3</sup> ]													
	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	42	13	16	18	20	23	25	28	31	33	36	39	45	48
3.5	138	87	92	97	101	106	111	115	120	124	129	134	143	147
4.0	252	177	184	191	197	204	211	218	225	232	239	246	259	266
4.5	393	286	295	305	315	325	334	344	354	364	373	383	403	412
5.0	567	421	434	448	461	474	487	501	514	527	540	553	580	593
5.5	780	586	603	621	639	656	674	692	709	727	745	763	798	816
6.0	1039	785	808	831	854	877	900	923	947	970	993	1016	1062	1088
6.5	1346	1021	1051	1080	1110	1140	1169	1199	1228	1258	1287	1317	1375	1404
7.0	1702	1299	1336	1373	1409	1446	1483	1520	1556	1593	1630	1666	1739	1776
7.5	2092	1603	1647	1692	1736	1781	1825	1870	1914	1959	2003	2048	2136	2180
8.0	2498	1919	1972	2025	2077	2130	2183	2236	2288	2341	2394	2446	2551	2604
8.5	2898	2229	2290	2351	2412	2473	2534	2594	2655	2716	2777	2837	2958	3018
9.0	3303	2547	2616	2685	2754	2823	2892	2960	3029	3098	3166	3235	3372	3440
9.5	3664	2830	2907	2983	3059	3136	3212	3288	3364	3440	3515	3589	3736	3808
10.0	3945	3066	3148	3230	3313	3395	3476	3558	3639	3720	3795	3870	4010	4075
10.5	4147	3266	3354	3441	3528	3616	3698	3780	3863	3945	4012	4080	4197	4247
11.0	4271	3434	3525	3616	3707	3798	3873	3948	4024	4099	4157	4214	4310	4349
11.5	4338	3555	3646	3736	3826	3917	3987	4057	4128	4198	4245	4292	4367	4396
12.0	4375	3650	3737	3824	3911	3998	4063	4127	4192	4256	4296	4336	4396	4417
12.5	4396	3731	3814	3898	3982	4065	4124	4182	4240	4299	4331	4364	4413	4430
13.0	4412	3804	3883	3962	4042	4121	4174	4227	4280	4333	4359	4386	4425	4438
13.5	4420	3869	3942	4016	4089	4162	4209	4256	4302	4349	4373	4396	4432	4445
14.0	4429	3922	3992	4061	4131	4200	4242	4284	4327	4369	4389	4409	4440	4451
14.5	4434	3955	4022	4088	4155	4221	4260	4300	4339	4378	4396	4415	4444	4454
15.0	4430	3963	4028	4094	4159	4225	4262	4300	4338	4376	4394	4412	4440	4450
15.5	4429	3970	4034	4099	4163	4227	4264	4301	4338	4375	4393	4411	4439	4448
16.0	4427	3977	4040	4103	4166	4229	4265	4301	4338	4374	4392	4409	4437	4447
16.5	4426	3988	4050	4111	4172	4234	4269	4304	4339	4374	4392	4409	4436	4446
17.0	4426	4004	4064	4124	4184	4243	4276	4310	4343	4376	4393	4410	4436	4446
17.5	4419	4010	4065	4120	4175	4230	4263	4296	4329	4362	4381	4400	4430	4442
18.0	4424	4038	4091	4143	4195	4247	4278	4309	4340	4370	4388	4406	4434	4445
18.5	4429	4071	4120	4169	4218	4267	4295	4324	4352	4381	4397	4413	4439	4448
19.0	4427	4093	4140	4188	4235	4282	4308	4334	4359	4385	4399	4413	4436	4445
19.5	4430	4129	4171	4214	4256	4299	4322	4345	4368	4391	4404	4417	4437	4445
20.0	4384	4123	4159	4196	4232	4268	4288	4309	4329	4349	4360	4372	4392	4400

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**7.11 Ct Values, Sound Optimized Mode SO4**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.885	0.877	0.878	0.880	0.881	0.883	0.883	0.884	0.884	0.884	0.884	0.884	0.884	0.884
3.5	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844
4.0	0.806	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.806	0.806	0.806	0.806	0.805	0.805
4.5	0.795	0.795	0.795	0.795	0.795	0.796	0.796	0.796	0.796	0.796	0.796	0.795	0.795	0.795
5.0	0.789	0.793	0.793	0.792	0.792	0.792	0.791	0.791	0.791	0.790	0.790	0.790	0.789	0.789
5.5	0.790	0.789	0.788	0.788	0.788	0.788	0.789	0.789	0.789	0.789	0.790	0.790	0.790	0.790
6.0	0.794	0.790	0.791	0.791	0.791	0.792	0.792	0.792	0.792	0.793	0.793	0.793	0.794	0.794
6.5	0.796	0.792	0.793	0.793	0.793	0.794	0.794	0.794	0.795	0.795	0.795	0.795	0.796	0.796
7.0	0.791	0.788	0.788	0.789	0.789	0.789	0.789	0.790	0.790	0.790	0.791	0.791	0.791	0.791
7.5	0.761	0.759	0.759	0.759	0.759	0.760	0.760	0.760	0.760	0.760	0.761	0.761	0.761	0.761
8.0	0.717	0.715	0.715	0.716	0.716	0.716	0.716	0.716	0.717	0.717	0.717	0.717	0.718	0.718
8.5	0.665	0.663	0.663	0.663	0.663	0.663	0.664	0.664	0.664	0.664	0.664	0.665	0.665	0.665
9.0	0.626	0.624	0.624	0.624	0.624	0.625	0.625	0.625	0.625	0.625	0.625	0.626	0.626	0.626
9.5	0.576	0.575	0.575	0.575	0.575	0.575	0.576	0.576	0.576	0.576	0.576	0.576	0.575	0.574
10.0	0.512	0.516	0.516	0.516	0.516	0.516	0.516	0.516	0.516	0.515	0.513	0.510	0.510	0.507
10.5	0.449	0.459	0.459	0.459	0.460	0.460	0.459	0.458	0.457	0.457	0.454	0.452	0.444	0.440
11.0	0.390	0.409	0.409	0.409	0.409	0.409	0.407	0.405	0.403	0.401	0.397	0.394	0.385	0.380
11.5	0.338	0.362	0.362	0.361	0.361	0.360	0.358	0.356	0.353	0.351	0.347	0.343	0.333	0.328
12.0	0.295	0.321	0.320	0.319	0.318	0.317	0.315	0.312	0.310	0.307	0.303	0.299	0.290	0.285
12.5	0.259	0.286	0.285	0.284	0.283	0.281	0.279	0.276	0.273	0.271	0.267	0.263	0.254	0.250
13.0	0.229	0.256	0.255	0.254	0.252	0.251	0.248	0.245	0.243	0.240	0.236	0.232	0.225	0.220
13.5	0.203	0.231	0.229	0.228	0.226	0.224	0.222	0.219	0.216	0.214	0.210	0.207	0.200	0.196
14.0	0.182	0.209	0.207	0.205	0.204	0.202	0.199	0.197	0.194	0.191	0.188	0.185	0.179	0.175
14.5	0.163	0.188	0.187	0.185	0.183	0.182	0.179	0.177	0.174	0.172	0.169	0.166	0.160	0.158
15.0	0.147	0.170	0.168	0.167	0.165	0.164	0.161	0.159	0.157	0.155	0.152	0.150	0.145	0.142
15.5	0.133	0.154	0.152	0.151	0.150	0.148	0.146	0.144	0.142	0.140	0.138	0.135	0.131	0.129
16.0	0.121	0.140	0.138	0.137	0.136	0.134	0.133	0.131	0.129	0.127	0.125	0.123	0.119	0.117
16.5	0.110	0.128	0.126	0.125	0.124	0.123	0.121	0.119	0.118	0.116	0.114	0.112	0.109	0.107
17.0	0.101	0.117	0.116	0.115	0.114	0.113	0.111	0.109	0.108	0.106	0.105	0.103	0.099	0.098
17.5	0.093	0.108	0.107	0.106	0.105	0.103	0.102	0.101	0.099	0.098	0.096	0.095	0.092	0.090
18.0	0.086	0.100	0.099	0.098	0.097	0.096	0.094	0.093	0.092	0.090	0.089	0.087	0.085	0.083
18.5	0.080	0.093	0.092	0.091	0.090	0.089	0.087	0.086	0.085	0.084	0.082	0.081	0.078	0.077
19.0	0.074	0.086	0.085	0.084	0.083	0.082	0.081	0.080	0.078	0.077	0.076	0.075	0.072	0.071
19.5	0.068	0.081	0.080	0.079	0.078	0.077	0.075	0.074	0.073	0.072	0.071	0.070	0.067	0.066
20.0	0.063	0.075	0.074	0.073	0.072	0.071	0.070	0.069	0.067	0.066	0.065	0.064	0.062	0.061

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**7.12 Sound Curves, Sound Optimized Mode SO4**

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 <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height [dBA] Sound Optimized Mode SO4 (Blades with serrated trailing edge)
3	91.3
4	91.5
5	93.9
6	96.9
7	99.5
8	100.0
9	100.0
10	100.0
11	100.0
12	100.0
13	100.0
14	100.0
15	100.0
16	100.0
17	100.0
18	100.0
19	100.0
20	100.0

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**7.13 Power Curves, Sound Optimized Mode S05**

Wind speed (m/s)	Air density [kg/m <sup>3</sup> ]													
	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	42	13	16	18	20	23	25	28	31	33	36	39	45	48
3.5	138	87	92	97	101	106	111	115	120	124	129	134	143	147
4.0	252	177	184	191	197	204	211	218	225	232	239	246	259	266
4.5	393	286	295	305	315	325	334	344	354	364	373	383	403	412
5.0	567	421	434	448	461	474	487	501	514	527	540	553	580	593
5.5	781	586	604	621	639	656	674	692	710	727	745	763	798	816
6.0	1040	785	808	831	854	878	901	924	947	970	993	1017	1063	1088
6.5	1343	1019	1049	1078	1108	1137	1167	1196	1225	1255	1284	1313	1372	1401
7.0	1689	1289	1325	1362	1398	1435	1471	1508	1544	1580	1617	1653	1726	1762
7.5	2056	1575	1619	1662	1706	1750	1794	1838	1881	1925	1969	2012	2100	2143
8.0	2428	1865	1916	1968	2019	2070	2121	2173	2224	2275	2326	2377	2480	2531
8.5	2780	2139	2197	2256	2314	2373	2431	2489	2548	2606	2664	2722	2838	2898
9.0	3101	2390	2454	2519	2584	2649	2714	2778	2843	2908	2972	3037	3166	3230
9.5	3365	2594	2665	2735	2805	2875	2945	3016	3086	3156	3225	3295	3434	3504
10.0	3588	2770	2845	2920	2995	3070	3144	3219	3293	3368	3441	3515	3659	3730
10.5	3758	2910	2988	3067	3145	3224	3301	3379	3456	3534	3609	3683	3828	3898
11.0	3873	3017	3098	3179	3260	3341	3421	3501	3581	3661	3732	3802	3936	3998
11.5	3952	3098	3181	3264	3347	3430	3510	3590	3669	3749	3817	3884	4009	4065
12.0	4012	3172	3258	3341	3426	3510	3588	3665	3743	3820	3884	3948	4064	4115
12.5	4066	3246	3332	3418	3504	3590	3665	3739	3814	3889	3948	4007	4113	4160
13.0	4112	3317	3403	3489	3575	3661	3733	3804	3876	3948	4002	4057	4155	4197
13.5	4131	3369	3454	3539	3623	3708	3775	3842	3910	3977	4028	4080	4169	4208
14.0	4140	3398	3481	3565	3648	3731	3796	3861	3926	3992	4041	4090	4176	4213
14.5	4140	3413	3495	3577	3659	3741	3805	3868	3931	3995	4043	4092	4176	4212
15.0	4143	3427	3507	3587	3667	3746	3810	3873	3936	4000	4047	4095	4177	4211
15.5	4145	3445	3524	3602	3680	3758	3821	3883	3945	4007	4053	4099	4178	4212
16.0	4153	3470	3547	3624	3700	3777	3838	3898	3959	4019	4064	4108	4184	4216
16.5	4166	3504	3579	3654	3729	3804	3863	3922	3980	4039	4081	4124	4196	4226
17.0	4184	3548	3621	3694	3768	3841	3897	3954	4010	4066	4106	4145	4211	4239
17.5	4173	3586	3655	3724	3793	3862	3913	3964	4015	4066	4102	4138	4200	4227
18.0	4195	3638	3705	3772	3838	3905	3953	4001	4049	4097	4130	4163	4219	4244
18.5	4219	3697	3761	3825	3889	3953	3997	4042	4086	4130	4160	4189	4240	4262
19.0	4236	3760	3818	3876	3934	3992	4034	4075	4117	4158	4184	4210	4254	4271
19.5	4260	3830	3884	3939	3993	4047	4084	4121	4157	4194	4216	4238	4276	4291
20.0	4260	3884	3933	3982	4031	4080	4111	4142	4173	4204	4223	4241	4273	4286

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**7.14 Ct Values, Sound Optimized Mode S05**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.885	0.877	0.878	0.880	0.881	0.883	0.883	0.884	0.884	0.884	0.884	0.884	0.884	0.884
3.5	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844
4.0	0.806	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.806	0.806	0.806	0.806	0.805	0.805
4.5	0.795	0.794	0.795	0.795	0.795	0.796	0.796	0.796	0.796	0.796	0.796	0.795	0.795	0.795
5.0	0.789	0.793	0.793	0.792	0.792	0.792	0.791	0.791	0.791	0.790	0.790	0.790	0.789	0.789
5.5	0.791	0.789	0.789	0.789	0.789	0.789	0.790	0.790	0.790	0.790	0.791	0.791	0.791	0.792
6.0	0.795	0.792	0.792	0.792	0.793	0.793	0.793	0.794	0.794	0.794	0.794	0.795	0.795	0.795
6.5	0.785	0.782	0.783	0.783	0.783	0.784	0.784	0.784	0.785	0.785	0.785	0.785	0.785	0.786
7.0	0.764	0.762	0.762	0.762	0.762	0.762	0.763	0.763	0.763	0.763	0.764	0.764	0.764	0.764
7.5	0.726	0.724	0.724	0.724	0.724	0.725	0.725	0.725	0.725	0.725	0.726	0.726	0.726	0.726
8.0	0.681	0.679	0.679	0.679	0.679	0.680	0.680	0.680	0.680	0.681	0.681	0.681	0.681	0.681
8.5	0.627	0.626	0.626	0.626	0.626	0.626	0.626	0.627	0.627	0.627	0.627	0.627	0.628	0.628
9.0	0.572	0.570	0.571	0.571	0.571	0.571	0.571	0.571	0.571	0.572	0.572	0.572	0.572	0.572
9.5	0.509	0.508	0.508	0.508	0.509	0.509	0.509	0.509	0.509	0.509	0.509	0.509	0.510	0.510
10.0	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.450
10.5	0.397	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.397	0.396	0.395
11.0	0.348	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.350	0.349	0.346	0.344
11.5	0.305	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.308	0.307	0.306	0.303	0.300
12.0	0.268	0.275	0.275	0.275	0.275	0.275	0.274	0.274	0.273	0.273	0.271	0.270	0.266	0.264
12.5	0.238	0.246	0.246	0.246	0.246	0.246	0.245	0.244	0.244	0.243	0.241	0.240	0.236	0.234
13.0	0.212	0.222	0.222	0.222	0.221	0.221	0.220	0.219	0.219	0.218	0.216	0.214	0.210	0.208
13.5	0.190	0.200	0.200	0.200	0.199	0.199	0.198	0.197	0.196	0.195	0.193	0.191	0.188	0.186
14.0	0.170	0.180	0.180	0.179	0.179	0.179	0.178	0.177	0.176	0.174	0.173	0.171	0.168	0.166
14.5	0.152	0.162	0.162	0.161	0.161	0.161	0.160	0.159	0.158	0.157	0.155	0.154	0.151	0.149
15.0	0.138	0.147	0.146	0.146	0.145	0.145	0.144	0.143	0.142	0.141	0.140	0.139	0.136	0.134
15.5	0.125	0.133	0.133	0.133	0.132	0.132	0.131	0.130	0.129	0.128	0.127	0.126	0.123	0.122
16.0	0.114	0.122	0.122	0.121	0.121	0.120	0.119	0.119	0.118	0.117	0.116	0.115	0.112	0.111
16.5	0.104	0.112	0.112	0.111	0.111	0.110	0.110	0.109	0.108	0.107	0.106	0.105	0.103	0.102
17.0	0.096	0.104	0.104	0.103	0.103	0.102	0.101	0.101	0.100	0.099	0.098	0.097	0.095	0.093
17.5	0.088	0.097	0.096	0.096	0.095	0.095	0.094	0.093	0.092	0.091	0.090	0.089	0.087	0.086
18.0	0.082	0.091	0.090	0.089	0.089	0.088	0.087	0.086	0.086	0.085	0.084	0.083	0.081	0.080
18.5	0.076	0.085	0.084	0.084	0.083	0.082	0.082	0.081	0.080	0.079	0.078	0.077	0.075	0.074
19.0	0.070	0.080	0.079	0.078	0.077	0.077	0.076	0.075	0.074	0.073	0.072	0.071	0.069	0.069
19.5	0.066	0.075	0.074	0.074	0.073	0.072	0.071	0.070	0.070	0.069	0.068	0.067	0.065	0.064
20.0	0.061	0.071	0.070	0.069	0.069	0.068	0.067	0.066	0.065	0.064	0.063	0.062	0.061	0.060

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**7.15 Sound Curves, Sound Optimized Mode SO5**

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 <sup>3</sup>
Wind speed at hub height [m/s]	Sound Power Level at Hub Height [dBA] Sound Optimized Mode SO5 (Blades with serrated trailing edge)
3	91.3
4	91.5
5	93.9
6	96.9
7	98.7
8	99.0
9	99.0
10	99.0
11	99.0
12	99.0
13	99.0
14	99.0
15	99.0
16	99.0
17	99.0
18	99.0
19	99.0
20	99.0

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**7.16 Power Curves, Sound Optimized Mode S06**

Wind speed (m/s)	Air density [kg/m <sup>3</sup> ]													
	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	42	13	16	18	20	23	25	28	31	33	36	39	45	48
3.5	138	87	92	97	101	106	111	115	120	124	129	134	143	147
4.0	252	177	184	191	197	204	211	218	225	232	239	246	259	266
4.5	393	286	295	305	315	325	334	344	354	364	373	383	403	412
5.0	567	421	434	448	461	474	487	501	514	527	540	553	580	593
5.5	781	586	604	621	639	657	674	692	710	727	745	763	798	816
6.0	1039	785	808	831	854	877	900	923	947	970	993	1016	1062	1086
6.5	1337	1016	1045	1074	1104	1133	1162	1191	1221	1250	1279	1308	1366	1396
7.0	1667	1272	1308	1344	1380	1416	1452	1488	1524	1560	1595	1631	1702	1738
7.5	2000	1532	1575	1617	1660	1702	1745	1788	1830	1872	1915	1957	2042	2084
8.0	2316	1779	1828	1877	1926	1975	2024	2073	2121	2170	2219	2268	2365	2414
8.5	2596	1997	2052	2108	2161	2215	2270	2324	2378	2433	2487	2541	2650	2704
9.0	2828	2177	2236	2296	2355	2414	2473	2532	2591	2650	2710	2769	2887	2946
9.5	3018	2325	2388	2451	2514	2577	2640	2703	2766	2829	2892	2955	3081	3144
10.0	3169	2442	2509	2575	2641	2707	2773	2839	2905	2971	3037	3103	3234	3299
10.5	3280	2530	2599	2667	2735	2804	2872	2940	3009	3077	3145	3213	3347	3414
11.0	3371	2601	2671	2741	2812	2882	2952	3022	3092	3162	3232	3301	3437	3502
11.5	3448	2666	2737	2809	2881	2953	3025	3096	3168	3240	3309	3379	3511	3573
12.0	3522	2733	2807	2880	2954	3027	3100	3173	3246	3319	3387	3454	3582	3642
12.5	3580	2790	2864	2939	3014	3089	3163	3236	3310	3383	3449	3515	3637	3694
13.0	3611	2824	2900	2976	3052	3128	3201	3273	3346	3419	3483	3547	3665	3720
13.5	3617	2843	2919	2995	3070	3146	3218	3289	3361	3433	3494	3555	3668	3719
14.0	3623	2858	2934	3010	3085	3161	3232	3303	3373	3444	3504	3563	3673	3723
14.5	3631	2876	2952	3028	3104	3180	3250	3319	3389	3458	3516	3574	3681	3730
15.0	3645	2900	2975	3051	3126	3202	3269	3337	3404	3472	3530	3588	3694	3743
15.5	3669	2934	3010	3085	3160	3235	3301	3368	3434	3500	3556	3612	3716	3764
16.0	3701	2980	3055	3130	3205	3280	3344	3409	3474	3538	3592	3647	3747	3793
16.5	3738	3033	3108	3182	3256	3330	3393	3456	3519	3582	3634	3686	3781	3824
17.0	3777	3094	3167	3239	3312	3385	3446	3507	3568	3630	3679	3728	3818	3858
17.5	3796	3160	3230	3299	3369	3438	3495	3551	3608	3664	3708	3752	3831	3866
18.0	3843	3239	3307	3374	3441	3509	3562	3616	3670	3723	3763	3803	3874	3908
18.5	3890	3324	3389	3455	3520	3585	3635	3684	3734	3784	3819	3855	3917	3944
19.0	3922	3408	3468	3527	3587	3646	3691	3736	3781	3826	3858	3890	3946	3970
19.5	3963	3494	3550	3606	3662	3718	3758	3798	3839	3879	3907	3935	3982	4002
20.0	3997	3580	3632	3684	3736	3788	3823	3858	3893	3928	3951	3974	4013	4029

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**7.17 Ct Values, Sound Optimized Mode SO6**

Wind speed [m/s]	Air density kg/m <sup>3</sup>													
	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	0.885	0.877	0.878	0.880	0.881	0.883	0.883	0.884	0.884	0.884	0.884	0.884	0.884	0.884
3.5	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844	0.844
4.0	0.806	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.806	0.806	0.806	0.806	0.805	0.805
4.5	0.795	0.794	0.795	0.795	0.796	0.796	0.796	0.796	0.796	0.796	0.796	0.795	0.795	0.795
5.0	0.789	0.793	0.793	0.792	0.792	0.792	0.791	0.791	0.791	0.790	0.790	0.790	0.789	0.789
5.5	0.792	0.790	0.790	0.790	0.790	0.790	0.790	0.791	0.791	0.791	0.791	0.792	0.792	0.792
6.0	0.793	0.790	0.790	0.790	0.791	0.791	0.791	0.792	0.792	0.792	0.792	0.793	0.793	0.794
6.5	0.776	0.774	0.774	0.774	0.774	0.775	0.775	0.775	0.775	0.776	0.776	0.776	0.777	0.777
7.0	0.740	0.738	0.739	0.739	0.739	0.739	0.739	0.739	0.740	0.740	0.740	0.740	0.741	0.741
7.5	0.692	0.690	0.691	0.691	0.691	0.691	0.691	0.691	0.692	0.692	0.692	0.692	0.692	0.692
8.0	0.639	0.637	0.637	0.638	0.638	0.638	0.638	0.638	0.638	0.639	0.639	0.639	0.639	0.639
8.5	0.575	0.573	0.573	0.574	0.574	0.574	0.574	0.574	0.574	0.574	0.574	0.574	0.575	0.575
9.0	0.505	0.504	0.504	0.504	0.504	0.504	0.504	0.504	0.504	0.504	0.504	0.504	0.505	0.505
9.5	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.443	0.443
10.0	0.387	0.386	0.386	0.387	0.387	0.387	0.387	0.387	0.387	0.387	0.387	0.387	0.387	0.387
10.5	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338
11.0	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.296
11.5	0.262	0.262	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.262	0.262	0.261
12.0	0.233	0.235	0.235	0.235	0.235	0.235	0.235	0.235	0.235	0.235	0.234	0.234	0.233	0.232
12.5	0.208	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.209	0.207	0.207
13.0	0.186	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.187	0.186	0.185	0.184
13.5	0.166	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.167	0.166	0.165	0.164
14.0	0.148	0.151	0.151	0.151	0.151	0.151	0.151	0.151	0.151	0.150	0.150	0.149	0.147	0.146
14.5	0.134	0.137	0.137	0.137	0.137	0.137	0.136	0.136	0.136	0.136	0.135	0.134	0.133	0.132
15.0	0.121	0.124	0.124	0.124	0.124	0.124	0.124	0.123	0.123	0.123	0.122	0.122	0.120	0.119
15.5	0.110	0.114	0.114	0.114	0.114	0.114	0.113	0.113	0.113	0.112	0.112	0.111	0.110	0.109
16.0	0.101	0.105	0.105	0.105	0.105	0.105	0.104	0.104	0.104	0.103	0.103	0.102	0.101	0.100
16.5	0.094	0.098	0.098	0.097	0.097	0.097	0.097	0.096	0.096	0.095	0.095	0.094	0.093	0.092
17.0	0.087	0.091	0.091	0.091	0.091	0.090	0.090	0.090	0.089	0.089	0.088	0.087	0.086	0.085
17.5	0.080	0.086	0.086	0.085	0.085	0.085	0.084	0.084	0.083	0.083	0.082	0.081	0.080	0.079
18.0	0.075	0.081	0.081	0.080	0.080	0.080	0.079	0.078	0.078	0.077	0.077	0.076	0.074	0.074
18.5	0.070	0.077	0.076	0.076	0.076	0.075	0.075	0.074	0.073	0.073	0.072	0.071	0.070	0.069
19.0	0.065	0.073	0.072	0.072	0.071	0.070	0.070	0.069	0.068	0.068	0.067	0.066	0.065	0.064
19.5	0.061	0.069	0.068	0.068	0.067	0.067	0.066	0.065	0.065	0.064	0.063	0.062	0.061	0.060
20.0	0.058	0.066	0.065	0.064	0.064	0.063	0.062	0.062	0.061	0.060	0.059	0.059	0.057	0.056

Original Instruction: T05 0098-0749 VER 01

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Document no.: 0098-0749 V01  
Document owner: Onshore Turbines  
Type: T05 - General Description

Performance Specification  
EnVentus™  
V150-6.0 MW 50/60 Hz

Date: 2020-10-13  
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**7.18 Sound Curves, Sound Optimized Mode SO6**

Sound Power Level at Hub Height	
<b>Conditions for Sound Power Level:</b>	Measurement standard IEC 61400-11 ed. 3 Maximum turbulence at hub height: 30% Inflow angle (vertical): 0 ±2° Air density: 1.225 kg/m <sup>3</sup>
<b>Wind speed at hub height [m/s]</b>	<b>Sound Power Level at Hub Height [dBA] Sound Optimized Mode SO6 (Blades with serrated trailing edge)</b>
3	91.3
4	91.5
5	93.9
6	96.9
7	97.8
8	98.0
9	98.0
10	98.0
11	98.0
12	98.0
13	98.0
14	98.0
15	98.0
16	98.0
17	98.0
18	98.0
19	98.0
20	98.0

Original Instruction: T05 0098-0749 VER 01

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2021-01-29

# RPM Curves

## EnVentus™

### V150-6.0 MW 50/60 Hz

Original Instruction: T05 0098-0883 VER 00



T05 0098-0883 Ver 00 - Approved- Exported from DMS: 2022-04-11 by PIDEI

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EnVentus™  
V150-6.0 MW 50/60 Hz

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Original Instruction: T05 0098-0883 VER 00

## 1 Introduction

This document contains the RPM curves as a function of wind speed for the following turbine configurations:

- V150 – 6.0MW

Note:

The RPM curves in this document are based on an early technical maturity on the V150-6.0MW design, and may therefore change, as the technical maturity increases.

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RPM Curves  
EnVentus™  
V150-6.0 MW 50/60 Hz

Date: 2021-01-29  
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Original Instruction: T05 0098-0883 VER 00

## 2 Average rotor speed vs. wind speed

	V150
	6.0 MW
Wind Speed [m/s]	Speed [RPM]
3.0	4,82
3.5	4,90
4.0	4,93
4.5	5,23
5.0	5,74
5.5	6,30
6.0	6,88
6.5	7,47
7.0	8,06
7.5	8,64
8.0	9,22
8.5	9,76
9.0	10,04
9.5	10,10
10.0	10,12
10.5	10,12
11.0	10,11
11.5	10,12
12.0	10,12
12.5	10,12
13.0	10,12
13.5	10,12
14.0	10,12
14.5	10,12
15.0	10,12
15.5	10,12
16.0	10,12
16.5	10,12
17.0	10,12
17.5	10,09
18.0	9,81
18.5	9,51
19.0	9,22
19.5	8,91
20.0	8,61
20.5	8,31
21.0	8,00
21.5	7,62
22.0	7,27
22.5	6,91
23.0	6,60
23.5	6,35
24.0	6,07
24.5	5,88
25.0	5,88

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RPM Curves  
 EnVentus™  
 V150-6.0 MW 50/60 Hz

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V150						
	SO0 (104dB)	Mode SO2 (101dB)	Mode SO3 (100dB)	Mode SO4 (100dB)	Mode SO5 (99dB)	Mode SO6 (98dB)
Wind Speed [m/s]	Speed [RPM]	Speed [RPM]	Speed [RPM]	Speed [RPM]	Speed [RPM]	Speed [RPM]
3.0	4.89	4.89	4.89	4.89	4.89	4.89
3.5	4.91	4.91	4.91	4.91	4.91	4.91
4.0	5.01	5.01	5.01	5.01	5.01	5.01
4.5	5.49	5.51	5.51	5.51	5.51	5.51
5.0	6.03	6.06	6.06	6.06	6.06	6.06
5.5	6.63	6.63	6.63	6.63	6.63	6.63
6.0	7.25	7.25	7.25	7.25	7.18	7.13
6.5	7.86	7.86	7.86	7.79	7.57	7.34
7.0	8.48	8.43	8.37	8.23	7.82	7.41
7.5	9.10	8.94	8.64	8.34	7.89	7.43
8.0	9.60	9.23	8.75	8.34	7.89	7.43
8.5	9.83	9.33	8.80	8.34	7.89	7.43
9.0	9.87	9.33	8.80	8.34	7.89	7.43
9.5	9.87	9.33	8.80	8.34	7.89	7.43
10.0	9.87	9.33	8.80	8.34	7.89	7.43
10.5	9.87	9.35	8.80	8.34	7.89	7.43
11.0	9.85	9.35	8.80	8.37	7.89	7.43
11.5	9.87	9.33	8.80	8.37	7.91	7.43
12.0	9.87	9.33	8.80	8.37	7.91	7.43
12.5	9.87	9.33	8.80	8.37	7.91	7.43
13.0	9.87	9.33	8.80	8.37	7.91	7.45
13.5	9.87	9.33	8.80	8.37	7.91	7.45
14.0	9.87	9.33	8.80	8.34	7.91	7.45
14.5	9.87	9.33	8.80	8.37	7.91	7.45
15.0	9.87	9.33	8.80	8.34	7.91	7.45
15.5	9.87	9.33	8.80	8.34	7.91	7.45
16.0	9.87	9.33	8.80	8.37	7.91	7.45
16.5	9.87	9.33	8.80	8.37	7.91	7.45
17.0	9.87	9.33	8.80	8.37	7.91	7.45
17.5	9.87	9.33	8.80	8.37	7.91	7.45
18.0	9.81	9.33	8.80	8.37	7.91	7.45
18.5	9.65	9.33	8.80	8.37	7.91	7.45
19.0	9.37	9.23	8.80	8.37	7.91	7.45
19.5	9.10	9.05	8.78	8.37	7.91	7.45
20.0	8.80	8.78	8.69	8.34	7.91	7.45

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**3 10 min Average/1 sec max rotor speed vs. wind speed in Idle**

Wind Speed [m/s]	V150 Average Speed [RPM]	V150 Max Speed [RPM]
0.0	0,00	0,00
1.0	0,09	0,12
2.0	0,18	0,25
3.0	0,28	0,37
4.0	0,37	0,50
5.0	0,46	0,62
6.0	0,55	0,74
7.0	0,64	0,87
8.0	0,74	0,99
9.0	0,83	1,12
10.0	0,92	1,24
11.0	1,01	1,36
12.0	1,10	1,49
13.0	1,20	1,61
14.0	1,29	1,74
15.0	1,38	1,86
16.0	1,47	1,98
17.0	1,56	2,11
18.0	1,66	2,23
19.0	1,75	2,36
20.0	1,84	2,48
21.0	1,93	2,60
22.0	2,02	2,73
23.0	2,12	2,85
24.0	2,21	2,98
25.0	2,30	3,10

Note: Values for V150 are based on extrapolations from values measured on V117, V126 and V136.

#### **4 Transition time from Production to Idle**

Based on numerous simulations, the duration from a shutdown (pause) command is sent to the turbine and until the turbine reaches steady state Idle rotor speed below 2 RPM, has been determined to be between 20 and 40 seconds.

Actual timing is dependent on windspeed, turbulence etc., but not significantly dependent on the rotor size

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# TURBINA VESTAS V105 POTENZA 3,45 MW

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DOCUMENT: [0056-6108] VER 04	DESCRIPTION: 3MW RPM curves	RESTRICTED
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Original Instruction: T05 0056-6108 VER 04

## 3MW RPM curves

- V105 – 3.45/3.6MW
- V112 – 3.45/3.6MW
- V117 – 3.45/3.6MW
- V126 – 3.45MW Low Torque
- V126 – 3.45/3.6MW High Torque
- V136 – 3.45/3.6MW



DNIS 00091 VER 00

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DOCUMENT [0056-6108] 3	DESCRIPTION 3MW RPM curves	RESTRICTED	PAGE 4/13

## 2. Average rotor speed vs. wind speed

	V105	V105	V112	V112	V117	V117	V126	V126	V126	V126	V126	V136	V136
	3.45MW	3.6MW	3.45MW	3.6MW	3.45MW	3.6MW	3.45MW	3.45MW	3.6MW	3.45MW	3.45MW	3.45MW	3.6MW
							Low Torque	High Torque	High Torque	High Torque	High Torque		
	Mode 0	PO1	Mode 0	PO1	Mode 0	PO1	Mode 0	Mode 0	PO1	SO1	SO2	Mode 0	PO1
Wind Speed [m/s]	Speed [RPM]												
3.0	7.77	7.77	8.02	8.02	6.69	6.69	6.18	5.93	5.93	5.93	5.93	5.56	5.56
3.5	8.33	8.33	8.05	8.05	6.69	6.69	6.18	5.93	5.93	5.93	5.93	5.56	5.56
4.0	8.33	8.33	8.05	8.05	6.69	6.69	6.18	5.93	5.93	5.93	5.93	5.57	5.57
4.5	8.33	8.33	8.05	8.05	6.91	6.91	6.28	6.18	6.18	6.18	6.18	5.97	5.97
5.0	8.34	8.34	8.13	8.13	7.62	7.62	6.84	6.83	6.83	6.83	6.83	6.61	6.61
5.5	8.68	8.68	8.68	8.68	8.38	8.38	7.50	7.49	7.49	7.49	7.49	7.25	7.25
6.0	9.38	9.38	9.44	9.44	9.12	9.12	8.17	8.17	8.17	8.17	8.17	7.91	7.91
6.5	10.14	10.14	10.22	10.22	9.89	9.89	8.85	8.84	8.84	8.84	8.83	8.56	8.56
7.0	10.94	10.94	11.01	11.01	10.68	10.68	9.51	9.49	9.49	9.49	9.35	9.21	9.21
7.5	11.72	11.72	11.80	11.80	11.38	11.38	10.13	10.13	10.13	10.11	9.58	9.87	9.87
8.0	12.49	12.49	12.57	12.57	12.16	12.16	10.86	10.84	10.84	10.85	9.69	10.51	10.51
8.5	13.22	13.25	13.28	13.31	12.90	12.90	11.52	11.43	11.49	10.88	9.76	11.12	11.12
9.0	13.66	13.77	13.70	13.81	13.49	13.55	12.16	11.73	11.94	10.96	9.82	11.52	11.52
9.5	13.83	14.00	13.84	14.01	13.79	13.94	12.75	11.83	12.12	10.97	9.87	11.65	11.65
10.0	13.85	14.04	13.85	14.04	13.84	14.02	13.18	11.82	12.13	10.99	9.91	11.65	11.65
10.5	13.84	14.03	13.84	14.02	13.83	14.02	13.37	11.82	12.13	11.02	9.94	11.67	11.66
11.0	13.83	14.01	13.83	14.01	13.84	14.02	13.41	11.83	12.13	11.08	9.97	11.67	11.67
11.5	13.82	14.01	13.84	14.01	13.84	14.02	13.42	11.83	12.14	11.13	9.98	11.67	11.67
12.0	13.85	14.02	13.84	14.02	13.85	14.04	13.42	11.83	12.14	11.19	9.98	11.67	11.67
12.5	13.85	14.04	13.85	14.03	13.85	14.04	13.42	11.83	12.15	11.25	9.97	11.67	11.67
13.0	13.86	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.15	11.30	9.97	11.67	11.67
13.5	13.86	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.34	9.97	11.67	11.67
14.0	13.85	14.05	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.38	9.97	11.67	11.67

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14.5	13.85	14.05	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.38	9.96	11.67	11.67
15.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.40	9.96	11.67	11.67
15.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.44	9.96	11.67	11.67
16.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.49	9.96	11.67	11.67
16.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.54	9.96	11.67	11.67
17.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.57	9.96	11.67	11.67
17.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.59	9.96	11.67	11.67
18.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.60	9.96	11.67	11.67
18.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.61	9.96	11.67	11.67
19.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.61	9.97	11.67	11.67
19.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.15	11.64	9.96	11.67	11.67
20.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.15	11.68	9.96	11.67	11.67
20.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.15	11.71	9.96	11.67	11.67
21.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.15	11.74	9.96	11.67	11.67
21.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.76	9.97	11.67	11.67
22.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.79	9.97	11.67	11.67
22.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.81	9.97	11.67	11.67
23.0	13.86	14.05	13.85	14.04	13.86	14.05	-	11.83	12.15	11.82	9.97	-	-
23.5	13.86	14.05	13.85	14.04	13.86	14.05	-	11.83	12.15	11.83	9.97	-	-
24.0	13.86	14.04	13.86	14.04	13.86	14.05	-	11.83	12.15	11.84	9.97	-	-
24.5	13.86	14.04	13.86	14.04	13.86	14.05	-	11.83	12.15	11.84	9.97	-	-
25.0	13.86	14.04	13.86	14.04	13.86	14.05	-	11.83	12.15	11.84	9.97	-	-

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Original Instruction: T05 0056-6108 VER 04

T05 0056-6108 Ver 04 - Approved- Exported from DMS: 2022-06-06 by FRPIC

Original Instruction: T05 0056-6108 VER 04

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### 3. Average generator speed vs. wind speed

	V105	V105	V112	V112	V117	V117	V126	V126	V126	V126	V126	V136	V136
	3.45MW	3.6MW	3.45MW	3.6MW	3.45MW	3.6MW	3.45MW	3.45MW	3.6MW	3.45MW	3.45MW	3.45MW	3.6MW
							Low Torque	High Torque	High Torque	High Torque	High Torque		
	Mode 0	PO1	Mode 0	PO1	Mode 0	PO1	Mode 0	Mode 0	PO1	SO1	SO2	Mode 0	PO1
Wind Speed [m/s]	Speed [RPM]												
3.0	814	814	840	840	700	700	700	747	747	747	747	700	700
3.5	872	872	843	843	700	700	700	747	747	747	747	700	700
4.0	872	872	843	843	700	700	700	747	747	747	747	702	702
4.5	872	872	843	843	724	724	712	779	779	779	779	752	752
5.0	873	873	851	851	798	798	775	860	860	860	860	833	833
5.5	909	909	909	909	877	877	850	944	944	944	944	914	914
6.0	982	982	988	988	955	955	926	1029	1029	1029	1029	997	997
6.5	1062	1062	1070	1070	1036	1036	1003	1114	1114	1114	1114	1079	1079
7.0	1145	1145	1153	1153	1116	1118	1078	1196	1196	1196	1196	1178	1161
7.5	1227	1227	1235	1235	1192	1192	1148	1276	1276	1276	1276	1243	1243
8.0	1308	1308	1316	1316	1273	1273	1230	1366	1366	1366	1366	1324	1324
8.5	1384	1387	1390	1390	1351	1351	1305	1440	1448	1448	1448	1401	1401
9.0	1430	1442	1434	1446	1412	1419	1378	1478	1504	1504	1504	1452	1451
9.5	1448	1466	1449	1467	1444	1459	1445	1490	1527	1527	1527	1468	1468
10.0	1450	1470	1450	1470	1449	1468	1493	1489	1529	1529	1529	1468	1468
10.5	1449	1469	1449	1468	1448	1468	1515	1489	1528	1528	1528	1469	1469
11.0	1448	1467	1448	1467	1449	1468	1519	1490	1528	1528	1528	1470	1470
11.5	1447	1467	1449	1467	1449	1468	1520	1490	1530	1530	1530	1471	1471
12.0	1450	1468	1449	1468	1450	1470	1520	1491	1530	1530	1530	1471	1471
12.5	1450	1470	1450	1469	1450	1470	1520	1491	1531	1531	1531	1471	1471
13.0	1451	1470	1450	1470	1450	1470	1520	1491	1531	1531	1531	1470	1470
13.5	1451	1470	1450	1470	1450	1470	1520	1490	1530	1530	1530	1470	1470
14.0	1450	1471	1450	1470	1450	1470	1520	1490	1530	1530	1530	1470	1470
14.5	1450	1471	1450	1470	1450	1470	1520	1490	1530	1530	1530	1470	1470
15.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1530	1530	1470	1470

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15.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1441	1255	1470	1470
16.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1447	1255	1470	1470
16.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1454	1255	1470	1470
17.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1458	1255	1470	1470
17.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1460	1255	1470	1470
18.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1461	1255	1470	1470
18.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1462	1255	1470	1470
19.0	1450	1470	1450	1470	1450	1470	1520	1491	1530	1463	1256	1470	1470
19.5	1450	1470	1450	1470	1450	1470	1520	1491	1531	1466	1255	1470	1470
20.0	1450	1470	1450	1470	1450	1470	1520	1491	1531	1471	1255	1470	1470
20.5	1450	1470	1450	1470	1450	1470	1520	1491	1531	1475	1255	1470	1470
21.0	1450	1470	1450	1470	1450	1470	1520	1490	1531	1479	1255	1470	1470
21.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1482	1256	1470	1470
22.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1485	1256	1470	1470
22.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1488	1256	1470	1470
23.0	1451	1471	1450	1470	1451	1471	-	1491	1531	1489	1256	-	-
23.5	1451	1471	1450	1470	1451	1471	-	1491	1531	1490	1256	-	-
24.0	1451	1470	1451	1470	1451	1471	-	1491	1531	1491	1256	-	-
24.5	1451	1470	1451	1470	1451	1471	-	1491	1531	1491	1256	-	-
25.0	1451	1470	1451	1470	1451	1471	-	1491	1531	1491	1256	-	-

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Original Instruction: T05 0056-6108 VER 04

T05 0056-6108 Ver 04 - Approved- Exported from DMS: 2022-06-06 by FRPIC

Original Instruction: T05 0056-6108 VER 04

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#### 4. Average rotor speed vs. wind speed (HWO)

	V105	V105	V112	V112	V117	V117	V126	V126	V126	V126	V126	V136	V136
	3.45MW	3.6MW	3.6MW										
							Low Torque	High Torque	High Torque	High Torque	High Torque		
	Mode 0	PO1	Mode 0	PO1	Mode 0	PO1	Mode 0	Mode 0	PO1	SO1	SO2	Mode 0	PO1
Wind Speed [m/s]	Speed [RPM]												
3.0	7.77	7.77	8.02	8.02	6.69	6.69	6.18	5.93	5.93	5.93	5.93	5.56	5.56
3.5	8.33	8.33	8.05	8.05	6.69	6.69	6.18	5.93	5.93	5.93	5.93	5.56	5.56
4.0	8.33	8.33	8.05	8.05	6.69	6.69	6.18	5.93	5.93	5.93	5.93	5.57	5.57
4.5	8.33	8.33	8.05	8.05	6.91	6.91	6.28	6.18	6.18	6.18	6.18	5.97	5.97
5.0	8.34	8.34	8.13	8.13	7.62	7.62	6.84	6.83	6.83	6.83	6.83	6.61	6.61
5.5	8.68	8.68	8.65	8.68	8.38	8.38	7.50	7.49	7.49	7.49	7.49	7.25	7.25
6.0	9.38	9.38	9.44	9.44	9.12	9.12	8.17	8.17	8.17	8.17	8.15	7.91	7.91
6.5	10.15	10.15	10.22	10.22	9.89	9.89	8.85	8.84	8.84	8.84	8.83	8.56	8.56
7.0	10.94	10.94	11.01	11.01	10.67	10.68	9.51	9.50	9.49	9.49	9.35	9.21	9.21
7.5	11.72	11.72	11.80	11.80	11.38	11.38	10.13	10.13	10.13	10.11	9.58	9.87	9.87
8.0	12.49	12.49	12.57	12.57	12.16	12.16	10.86	10.84	10.84	10.85	9.69	10.51	10.51
8.5	13.22	13.25	13.28	13.31	12.90	12.90	11.52	11.43	11.49	10.88	9.76	11.12	11.12
9.0	13.67	13.77	13.70	13.81	13.50	13.55	12.16	11.73	11.94	10.96	9.82	11.52	11.52
9.5	13.83	14.00	13.84	14.01	13.79	13.94	12.75	11.83	12.12	10.97	9.87	11.64	11.65
10.0	13.85	14.04	13.85	14.04	13.84	14.02	13.18	11.82	12.13	10.99	9.91	11.65	11.65
10.5	13.84	14.03	13.84	14.03	13.84	14.02	13.37	11.82	12.13	11.02	9.95	11.67	11.66
11.0	13.83	14.01	13.83	14.01	13.84	14.02	13.41	11.83	12.13	11.08	9.97	11.67	11.67
11.5	13.82	14.01	13.84	14.01	13.84	14.03	13.42	11.83	12.14	11.13	9.98	11.67	11.67
12.0	13.85	14.02	13.84	14.02	13.85	14.04	13.42	11.83	12.15	11.19	9.98	11.67	11.67
12.5	13.86	14.04	13.85	14.03	13.85	14.04	13.42	11.83	12.15	11.25	9.98	11.67	11.67
13.0	13.86	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.15	11.30	9.97	11.67	11.67
13.5	13.86	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.34	9.97	11.67	11.67
14.0	13.86	14.05	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.36	9.97	11.67	11.67
14.5	13.85	14.05	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.38	9.96	11.67	11.67

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15.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.40	9.96	11.67	11.67
15.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.44	9.96	11.67	11.67
16.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.49	9.96	11.67	11.67
16.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.54	9.96	11.67	11.67
17.0	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.57	9.96	11.67	11.67
17.5	13.86	14.05	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.60	9.96	11.67	11.67
18.0	13.85	14.05	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.60	9.96	11.67	11.67
18.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.61	9.96	11.67	11.67
19.0	13.86	14.05	13.86	14.05	13.86	14.05	13.42	11.83	12.15	11.61	9.97	11.67	11.67
19.5	13.86	14.05	13.86	14.05	13.86	14.05	13.42	11.83	12.15	11.65	9.96	11.67	11.67
20.0	13.86	14.05	13.86	14.05	13.86	14.05	13.42	11.83	12.15	11.68	9.96	11.67	11.67
20.5	13.86	14.05	13.86	14.05	13.85	14.04	13.42	11.83	12.15	11.71	9.96	11.60	11.60
21.0	13.86	14.05	13.86	14.04	13.85	14.04	13.42	11.83	12.15	11.74	9.96	11.29	11.29
21.5	13.85	14.04	13.85	14.04	13.85	14.04	13.42	11.83	12.14	11.76	9.97	10.83	10.83
22.0	13.85	14.04	13.85	14.04	13.85	14.04	13.33	11.83	12.14	11.79	9.97	10.27	10.27
22.5	13.85	14.04	13.85	14.03	13.85	14.04	12.83	11.83	12.14	11.81	9.97	9.71	9.71
23.0	13.80	13.94	13.78	13.93	13.80	13.94	12.04	11.83	12.15	11.82	9.97	9.20	9.20
23.5	13.61	13.70	13.57	13.66	13.60	13.70	11.17	11.83	12.13	11.83	9.97	8.66	8.67
24.0	13.25	13.29	13.20	13.22	13.24	13.27	10.42	11.76	12.00	11.76	9.97	8.17	8.16
24.5	12.78	12.78	12.68	12.68	12.74	12.74	9.67	11.43	11.59	11.45	9.97	7.76	7.76
25.0	12.26	12.27	12.14	12.14	12.17	12.14	8.91	10.89	10.93	10.89	9.97	7.45	7.45
25.5	11.74	11.75	11.60	11.60	11.48	11.47	8.20	10.30	10.34	10.30	9.95	7.29	7.29
26.0	11.23	11.22	11.04	11.03	10.90	10.89	7.60	9.88	9.88	9.88	9.90	7.19	7.19
26.5	10.72	10.72	10.48	10.49	10.29	10.30	7.23	9.67	9.67	9.68	9.78	7.15	7.15
27.0	10.17	10.17	9.89	9.89	9.89	9.87	7.06	9.53	9.54	9.53	9.55	7.14	7.14
27.5	9.61	9.61	9.32	9.32	9.43	9.44	7.06	9.25	9.25	9.26	9.12	7.14	7.14
28.0	9.12	9.13	8.87	8.87	9.02	9.01	-	8.81	8.81	8.81	8.63	-	-
28.5	8.82	8.82	8.66	8.66	8.72	8.72	-	8.32	8.31	8.32	8.11	-	-
29.0	8.65	8.65	8.61	8.61	8.62	8.62	-	7.83	7.83	7.83	7.78	-	-
29.5	8.60	8.60	8.59	8.59	8.59	8.60	-	7.46	7.46	7.46	7.45	-	-
30.0	8.59	8.59	8.59	8.59	8.59	8.59	-	7.27	7.27	7.27	7.27	-	-

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5. Average generator speed vs. wind speed (HWO)

	V105	V105	V112	V112	V117	V117	V126	V126	V126	V126	V126	V136	V136
	3.45MW	3.6MW	3.45MW	3.6MW	3.45MW	3.6MW	3.45MW	3.45MW	3.6MW	3.6MW	3.45MW	3.45MW	3.6MW
							Low Torque	High Torque	High Torque	High Torque	High Torque		
	Mode 0	PO1	Mode 0	PO1	Mode 0	PO1	Mode 0	Mode 0	PO1	SO1	SO2	Mode 0	PO1
Wind Speed [m/s]	Speed [RPM]												
3.0	814	814	840	840	700	700	700	747	747	747	747	700	700
3.5	872	872	843	843	700	700	700	747	747	747	747	700	700
4.0	872	872	843	843	700	700	700	747	747	747	747	702	702
4.5	872	872	843	843	724	724	712	779	779	779	779	752	752
5.0	873	873	851	851	798	798	775	860	860	860	860	833	833
5.5	909	909	909	909	877	877	850	944	944	944	944	914	914
6.0	982	982	988	988	955	955	928	1029	1029	1029	1029	997	997
6.5	1063	1063	1070	1070	1036	1036	1003	1114	1114	1114	1112	1079	1079
7.0	1145	1145	1153	1153	1117	1117	1118	1078	1197	1196	1196	1178	1161
7.5	1227	1227	1235	1235	1192	1192	1148	1276	1276	1276	1274	1207	1243
8.0	1308	1308	1316	1316	1273	1273	1230	1366	1366	1366	1342	1221	1324
8.5	1384	1387	1390	1390	1351	1351	1305	1440	1448	1448	1370	1230	1401
9.0	1431	1442	1434	1446	1413	1419	1378	1478	1504	1380	1237	1452	1451
9.5	1448	1466	1449	1467	1444	1459	1445	1490	1527	1382	1243	1467	1468
10.0	1450	1470	1450	1470	1449	1468	1493	1489	1529	1384	1248	1468	1468
10.5	1449	1469	1449	1469	1449	1468	1515	1489	1528	1388	1253	1470	1469
11.0	1448	1467	1448	1467	1449	1468	1519	1490	1529	1396	1256	1470	1470
11.5	1447	1467	1449	1467	1449	1469	1520	1490	1530	1402	1257	1471	1471
12.0	1450	1468	1449	1468	1450	1470	1520	1491	1531	1409	1257	1471	1471
12.5	1451	1470	1450	1469	1450	1470	1520	1491	1531	1417	1257	1470	1471
13.0	1451	1470	1450	1470	1450	1470	1520	1491	1531	1424	1256	1470	1470
13.5	1451	1470	1450	1470	1450	1470	1520	1490	1530	1428	1256	1470	1470
14.0	1451	1471	1450	1470	1450	1470	1520	1490	1530	1431	1256	1470	1470
14.5	1450	1471	1450	1470	1450	1470	1520	1490	1530	1433	1255	1470	1470

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15.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1436	1255	1470	1470
15.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1441	1255	1470	1470
16.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1447	1255	1470	1470
16.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1454	1255	1470	1470
17.0	1450	1470	1450	1470	1450	1470	1520	1490	1530	1458	1255	1470	1470
17.5	1451	1471	1450	1470	1450	1470	1520	1490	1530	1461	1255	1470	1470
18.0	1450	1471	1450	1470	1450	1470	1520	1490	1530	1461	1255	1470	1470
18.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1462	1255	1470	1470
19.0	1451	1471	1451	1471	1451	1471	1521	1491	1531	1463	1256	1470	1470
19.5	1451	1471	1451	1471	1451	1471	1521	1491	1531	1467	1255	1470	1470
20.0	1451	1471	1451	1471	1451	1471	1521	1491	1531	1471	1255	1470	1470
20.5	1451	1471	1451	1471	1450	1470	1521	1491	1531	1475	1255	1461	1461
21.0	1451	1471	1451	1470	1450	1470	1521	1491	1531	1479	1255	1423	1423
21.5	1450	1470	1450	1470	1450	1470	1520	1490	1530	1482	1256	1364	1364
22.0	1450	1470	1450	1470	1450	1470	1510	1490	1530	1485	1256	1294	1294
22.5	1450	1470	1450	1469	1450	1470	1454	1490	1530	1488	1256	1224	1223
23.0	1445	1460	1443	1458	1445	1460	1364	1491	1531	1489	1256	1159	1159
23.5	1425	1434	1421	1430	1424	1434	1266	1491	1529	1490	1256	1091	1092
24.0	1387	1391	1382	1384	1386	1389	1181	1482	1512	1481	1256	1029	1028
24.5	1338	1338	1328	1328	1334	1334	1096	1440	1460	1442	1256	978	978
25.0	1284	1285	1271	1271	1274	1274	1010	1372	1377	1372	1256	939	939
25.5	1229	1230	1214	1214	1202	1201	929	1298	1303	1298	1253	918	918
26.0	1176	1175	1156	1155	1141	1140	861	1245	1245	1245	1247	906	906
26.5	1122	1122	1097	1098	1077	1078	819	1219	1219	1219	1232	901	901
27.0	1065	1065	1035	1035	1035	1033	802	1201	1202	1201	1203	900	900
27.5	1006	1006	976	976	987	988	800	1166	1166	1166	1166	1149	900
28.0	955	956	929	929	944	943	-	1110	1110	1110	1087	-	-
28.5	923	923	907	907	913	913	-	1048	1047	1048	1022	-	-
29.0	906	906	901	901	902	902	-	986	986	986	980	-	-
29.5	900	900	899	899	899	900	-	940	940	940	939	-	-
30.0	899	899	899	899	899	899	-	916	916	916	916	-	-

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### 6. 10 min Average/1 sec max rotor speed vs. wind speed in Idle

Wind Speed [m/s]	V105 Average Speed [RPM]	V105 Max Speed [RPM]	V112 Average Speed [RPM]	V112 Max Speed [RPM]	V117 Average Speed [RPM]	V117 Max Speed [RPM]	V126 Average Speed [RPM]	V126 Max Speed [RPM]	V136 Average Speed [RPM]	V136 Max Speed [RPM]
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.0	0.05	0.11	0.05	0.11	0.06	0.11	0.06	0.12	0.08	0.12
2.0	0.11	0.21	0.11	0.21	0.12	0.21	0.12	0.23	0.15	0.24
3.0	0.16	0.32	0.16	0.32	0.18	0.32	0.18	0.35	0.23	0.36
4.0	0.22	0.42	0.22	0.42	0.23	0.42	0.24	0.46	0.30	0.48
5.0	0.27	0.53	0.27	0.53	0.29	0.53	0.30	0.58	0.38	0.60
6.0	0.32	0.64	0.32	0.64	0.35	0.64	0.36	0.70	0.46	0.72
7.0	0.38	0.74	0.38	0.74	0.41	0.74	0.42	0.81	0.53	0.84
8.0	0.43	0.85	0.43	0.85	0.47	0.85	0.48	0.93	0.61	0.96
9.0	0.49	0.95	0.49	0.95	0.53	0.95	0.54	1.04	0.68	1.08
10.0	0.54	1.06	0.54	1.06	0.58	1.06	0.60	1.16	0.76	1.20
11.0	0.59	1.17	0.59	1.17	0.64	1.17	0.66	1.28	0.84	1.32
12.0	0.65	1.27	0.65	1.27	0.70	1.27	0.72	1.39	0.91	1.44
13.0	0.70	1.38	0.70	1.38	0.76	1.38	0.78	1.51	0.99	1.56
14.0	0.76	1.48	0.76	1.48	0.82	1.48	0.84	1.62	1.06	1.68
15.0	0.81	1.59	0.81	1.59	0.88	1.59	0.90	1.74	1.14	1.80
16.0	0.86	1.70	0.86	1.70	0.93	1.70	0.96	1.86	1.22	1.92
17.0	0.92	1.80	0.92	1.80	0.99	1.80	1.02	1.97	1.29	2.04
18.0	0.97	1.91	0.97	1.91	1.05	1.91	1.08	2.09	1.37	2.16
19.0	1.03	2.01	1.03	2.01	1.11	2.01	1.14	2.20	1.44	2.28
20.0	1.08	2.12	1.08	2.12	1.17	2.12	1.20	2.32	1.52	2.40
21.0	1.13	2.23	1.13	2.23	1.23	2.23	1.26	2.44	1.60	2.52
22.0	1.19	2.33	1.19	2.33	1.28	2.33	1.32	2.55	1.67	2.64
23.0	1.24	2.44	1.24	2.44	1.34	2.44	1.38	2.67	1.75	2.76
24.0	1.30	2.54	1.30	2.54	1.40	2.54	1.44	2.78	1.82	2.88
25.0	1.35	2.65	1.35	2.65	1.46	2.65	1.50	2.90	1.90	3.00

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### 7. Transition time from Production to Idle.

Based on numerous simulations, the duration from a shutdown (pause) command is sent to the turbine and until the turbine reaches steady state Idle rotor speed below 2 RPM, has been determined to be between 20 and 40 seconds. Actual timing is dependent on windspeed, turbulence etc., but not significantly dependent on the rotor size

### 8. Additional remarks

The listed RPM curves are not valid for noise modes, load modes or other power modes. Only noise modes for V126-3.45MW High Torque SO1 and SO2 is included.

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