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# Technical Documentation

## Wind Turbine Generator Systems

### 4.x/5.x-158 - 50 Hz



# Product Acoustic Specifications

## According to IEC 61400-11

Incl. Octave and 1/3<sup>rd</sup> Octave Band Spectra

LNTE: Included

Rev. 02 - EN 2021-01-19

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# 1 Introduction

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## 1.1 General

This document summarizes the acoustic emission characteristics of the 5.x-158 50Hz wind turbine for all available modes of operation, including apparent sound power levels  $L_{WA,k}$ , as well as uncertainty levels associated with the sound power levels, and octave and  $1/3^{\text{rd}}$ -octave band apparent sound power levels.

All provided sound power levels are A-weighted.

GE continuously verifies specifications with measurements, including those performed by independent institutes.

## 1.2 Wind Farm Noise Management (available as an option)

In noise-constrained areas it is often necessary to adapt the wind turbine operation to satisfy far-field noise limits. GE offers a dedicated Farm Noise Management system that provides greater flexibility and higher energy yield than standard turbine controls. This advanced scheme allows to continuously adjust the farm operation based on the environmental variables that influence farm noise emission, essentially wind speed and wind direction.

The Wind Farm Noise Management package includes the following service and hardware:

- Park level noise propagation modeling and optimization of wind farm operation,
- Table with optimum turbine set-points across the park as a function of wind speed and wind sector, and
- Installation and commissioning of the Farm Noise Management Software Package.

## 2 Overview of Configurations

The following table presents an overview of the configurations associated with each nominal apparent sound power level.

For each nominal sound power level, there is a corresponding nominal rotor speed and in some cases several nominal electrical power levels. For example, 106 dBA can be achieved at 9.7 rpm with nominal electrical power levels of 5300 kW or 5500 kW. Please note that the 120.9 m hub height is not compatible with operating modes 104 and 105 dBA.

The electrical power rating values may vary with actual turbulent conditions on site. More detailed information to the power performance can be found in the NRO power curve documents for this product.

The 105 dBA, 103 dBA, and lower NRO modes are intended and designed to achieve lower peak noise emission levels while optimizing turbine power performance. The main objective is to provide sound power levels aligned with the stricter noise emission requirements typically enforced during limited periods of time only. It is not expected that wind turbines would permanently operate in a given NRO setting, but rather would switch from Normal Operation to Noise Reduced Operation as needed for a fraction of the day. A continuous NRO activity would require a dedicated assessment from GE.

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Nominal Sound Power Level (dBA)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)			
		101.0m Hub Height	120.9m Hub Height	150.0m Hub Height	161.0m Hub Height
106.0	9.70	5300, 5500	5300, 5500	5300, 5500	5300, 5500
105.0	9.35	5300	N/A	5300	5300
104.0	9.00	4800, 5100	N/A	4500, 4800, 5100	4500, 4800, 5100
103.0	8.54	4800	4500, 4800	4500, 4800	4500, 4800
102.0	8.20	4650	4500, 4650	4500, 4650	4500, 4650
101.0	7.66	4340	4340	4340	4340
100.0	7.22	4090	4090	4090	4090

Table 1: Overview of configurations for each apparent sound power level.

### 3 Apparent Sound Power Levels as a Function of Wind Speed

The following table presents calculated reference apparent sound power levels as a function of hub height wind speed.

Hub Height Wind Speed (m/s)	106.0 dBA Mode	105.0 dBA Mode	104.0 dBA Mode	103.0 dBA Mode	102.0 dBA Mode	101.0 dBA Mode	100.0 dBA Mode
4	93.8	93.8	93.8	93.8	93.8	93.8	93.8
5	94.5	94.5	94.5	94.5	94.5	94.5	94.5
6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
7	101.0	101.0	101.0	101.0	101.0	101.0	100.0
8	103.9	103.7	103.5	103.0	102.0	101.0	100.0
9	106.0	105.0	104.0	103.0	102.0	101.0	100.0
10	106.0	105.0	104.0	103.0	102.0	101.0	100.0
11	106.0	105.0	104.0	103.0	102.0	101.0	100.0
12	106.0	105.0	104.0	103.0	102.0	101.0	100.0
13	106.0	105.0	104.0	103.0	102.0	101.0	100.0
14	106.0	105.0	104.0	103.0	102.0	101.0	100.0
15	106.0	105.0	104.0	103.0	102.0	101.0	100.0

Table 2: Reference apparent sound power levels

The corresponding wind speed at 10 m height depends on hub height. It can be calculated for a given surface roughness using a logarithmic trend for wind shear:



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$$V_{10m\ height} = V_{hub} \frac{\ln\left(\frac{10m}{z_0}\right)}{\ln\left(\frac{hub\ height}{z_0}\right)}$$

Typical values for on land surface roughness (z0) are 0.05 m, depending on terrain conditions. Assuming this surface roughness, wind speeds at 10 m height for each hub height are listed in Annex I.

**4 Octave Band Spectra and 1/3<sup>rd</sup> Octave Band Spectra**

Octave band and 1/3<sup>rd</sup> octave band apparent sound power level values are provided for all available operational modes at different hub height wind speeds. The corresponding wind speeds at 10 m height for all available hub heights are provided in Annex I. Operational information, including rated electrical power and rotor speed are listed along with each set of spectra. Additionally, the list of compatible hub heights for each mode is also provided.

**4.1 5.x-158 – 106.0 dBA Apparent Sound Power Level**

The octave band spectra and 1/3<sup>rd</sup> octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	9.70	5300, 5500
120.9	9.70	5300, 5500
150.0	9.70	5300, 5500
161.0	9.70	5300, 5500

\* Simplified from IEC 61400-11: 2006 equation 7

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		A-weighted Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>16</b>	53.9	54.0	56.3	59.4	62.0	64.5	64.5	64.5	64.5	64.5	64.5	64.5
	<b>32</b>	67.4	67.3	69.6	72.8	75.5	78.0	78.0	78.0	78.0	78.0	78.0	78.0
	<b>63</b>	76.3	77.1	79.2	82.0	84.6	87.2	87.2	87.2	87.2	87.2	87.2	87.2
	<b>125</b>	83.0	85.0	87.1	89.0	91.0	92.6	92.6	92.6	92.6	92.6	92.6	92.6
	<b>250</b>	86.8	88.7	91.8	94.1	96.1	97.2	97.2	97.2	97.2	97.2	97.2	97.2
	<b>500</b>	87.2	87.7	91.7	95.5	98.3	99.7	99.7	99.7	99.7	99.7	99.7	99.7
	<b>1000</b>	87.6	87.0	90.6	95.1	98.7	101.3	101.3	101.3	101.3	101.3	101.3	101.3
	<b>2000</b>	86.4	86.4	88.7	92.4	95.9	99.1	99.1	99.1	99.1	99.1	99.1	99.1
	<b>4000</b>	80.9	82.2	84.0	86.6	89.1	91.7	91.7	91.7	91.7	91.7	91.7	91.7
	<b>8000</b>	65.1	67.2	69.6	72.4	74.6	76.0	76.0	76.0	76.0	76.0	76.0	76.0
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>103.9</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>

Table 3:5.x-158 – 106.0 dBA Octave Band Sound Power Levels as a function of wind speed



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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>12.5</b>	40.6	40.9	43.2	46.3	48.9	51.5	51.5	51.5	51.5	51.5	51.5	51.5
	<b>16</b>	47.3	47.4	49.7	52.8	55.4	57.9	57.9	57.9	57.9	57.9	57.9	57.9
	<b>20</b>	52.6	52.6	54.9	58.0	60.6	63.1	63.1	63.1	63.1	63.1	63.1	63.1
	<b>25</b>	57.3	57.3	59.6	62.7	65.3	67.8	67.8	67.8	67.8	67.8	67.8	67.8
	<b>32</b>	61.5	61.6	63.9	67.0	69.6	72.2	72.2	72.2	72.2	72.2	72.2	72.2
	<b>40</b>	65.4	65.4	67.7	70.9	73.6	76.1	76.1	76.1	76.1	76.1	76.1	76.1
	<b>50</b>	68.4	68.5	70.8	74.0	76.7	79.4	79.4	79.4	79.4	79.4	79.4	79.4
	<b>63</b>	71.2	71.8	73.9	76.9	79.6	82.2	82.2	82.2	82.2	82.2	82.2	82.2
	<b>80</b>	73.6	74.7	76.7	79.3	81.8	84.4	84.4	84.4	84.4	84.4	84.4	84.4
	<b>100</b>	75.8	77.4	79.3	81.6	83.8	86.1	86.1	86.1	86.1	86.1	86.1	86.1
	<b>125</b>	78.1	80.2	82.2	84.1	86.0	87.7	87.7	87.7	87.7	87.7	87.7	87.7
	<b>160</b>	79.8	82.0	84.3	86.0	87.9	89.2	89.2	89.2	89.2	89.2	89.2	89.2
	<b>200</b>	81.1	83.3	85.9	87.9	89.7	90.8	90.8	90.8	90.8	90.8	90.8	90.8
	<b>250</b>	82.1	84.0	87.1	89.4	91.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3
	<b>315</b>	82.7	84.2	87.8	90.5	92.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6
	<b>400</b>	82.4	83.3	87.3	90.6	92.9	94.1	94.1	94.1	94.1	94.1	94.1	94.1
	<b>500</b>	82.5	83.0	87.0	90.9	93.6	94.9	94.9	94.9	94.9	94.9	94.9	94.9
	<b>630</b>	82.4	82.6	86.5	90.8	93.9	95.5	95.5	95.5	95.5	95.5	95.5	95.5
	<b>800</b>	82.4	82.1	86.1	90.4	93.9	96.0	96.0	96.0	96.0	96.0	96.0	96.0
	<b>1000</b>	82.7	82.1	85.7	90.2	93.9	96.5	96.5	96.5	96.5	96.5	96.5	96.5
<b>1250</b>	83.3	82.5	85.8	90.4	94.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	
<b>1600</b>	82.4	82.0	84.6	88.9	92.5	95.7	95.7	95.7	95.7	95.7	95.7	95.7	
<b>2000</b>	81.7	81.8	83.9	87.6	91.1	94.3	94.3	94.3	94.3	94.3	94.3	94.3	
<b>2500</b>	80.5	81.0	82.9	86.0	89.2	92.3	92.3	92.3	92.3	92.3	92.3	92.3	
<b>3150</b>	78.6	79.7	81.5	84.1	86.9	89.7	89.7	89.7	89.7	89.7	89.7	89.7	
<b>4000</b>	75.6	77.0	78.9	81.5	83.7	85.9	85.9	85.9	85.9	85.9	85.9	85.9	
<b>5000</b>	71.5	73.2	75.3	77.9	80.0	81.8	81.8	81.8	81.8	81.8	81.8	81.8	
<b>6300</b>	64.8	66.8	69.2	71.9	74.1	75.5	75.5	75.5	75.5	75.5	75.5	75.5	
<b>8000</b>	54.2	56.6	59.3	62.2	64.6	65.9	65.9	65.9	65.9	65.9	65.9	65.9	
<b>10000</b>	40.1	42.5	45.7	49.1	51.8	53.3	53.3	53.3	53.3	53.3	53.3	53.3	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>103.9</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>	<b>106.0</b>

Table 4: 5.x-158 – 106.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

**4.2 5.x-158 – 105.0 dBA Apparent Sound Power Level**

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The octave band spectra and 1/3rd octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Please note that the 120.9 m hub height is not compatible with this operating mode.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	9.35	5300
120.9	N/A	N/A
150.0	9.35	5300
161.0	9.35	5300

A-weighted Octave Spectra [dBA]													
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15	
Frequency [Hz]	16	53.9	54.0	56.3	59.4	61.7	63.5	63.5	63.5	63.5	63.5	63.5	63.5
	32	67.4	67.3	69.6	72.8	75.3	76.9	76.9	76.9	76.9	76.9	76.9	76.9
	63	76.3	77.1	79.2	82.0	84.4	86.2	86.2	86.2	86.2	86.2	86.2	86.2
	125	83.0	85.0	87.1	89.0	90.8	91.9	91.9	91.9	91.9	91.9	91.9	91.9
	250	86.8	88.7	91.8	94.1	95.9	96.6	96.6	96.6	96.6	96.6	96.6	96.6
	500	87.2	87.7	91.7	95.5	98.0	98.9	98.9	98.9	98.9	98.9	98.9	98.9
	1000	87.6	87.0	90.6	95.1	98.5	100.1	100.1	100.1	100.1	100.1	100.1	100.1
	2000	86.4	86.4	88.7	92.4	95.7	97.7	97.7	97.7	97.7	97.7	97.7	97.7
	4000	80.9	82.2	84.0	86.6	88.9	90.4	90.4	90.4	90.4	90.4	90.4	90.4
	8000	65.1	67.2	69.6	72.4	74.4	75.2	75.2	75.2	75.2	75.2	75.2	75.2
Total Sound Power Level [dBA]	93.8	94.5	97.6	101.0	103.7	105.0	105.0	105.0	105.0	105.0	105.0	105.0	

Table 5: 5.x-158 – 105.0 dBA Octave Band Sound Power Levels as a function of wind speed

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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>12.5</b>	40.6	40.9	43.2	46.3	48.7	50.5	50.5	50.5	50.5	50.5	50.5	50.5
	<b>16</b>	47.3	47.4	49.7	52.8	55.2	56.9	56.9	56.9	56.9	56.9	56.9	56.9
	<b>20</b>	52.6	52.6	54.9	58.0	60.4	62.1	62.1	62.1	62.1	62.1	62.1	62.1
	<b>25</b>	57.3	57.3	59.6	62.7	65.1	66.8	66.8	66.8	66.8	66.8	66.8	66.8
	<b>32</b>	61.5	61.6	63.9	67.0	69.4	71.1	71.1	71.1	71.1	71.1	71.1	71.1
	<b>40</b>	65.4	65.4	67.7	70.9	73.4	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	<b>50</b>	68.4	68.5	70.8	74.0	76.5	78.3	78.3	78.3	78.3	78.3	78.3	78.3
	<b>63</b>	71.2	71.8	73.9	76.9	79.3	81.2	81.2	81.2	81.2	81.2	81.2	81.2
	<b>80</b>	73.6	74.7	76.7	79.3	81.6	83.4	83.4	83.4	83.4	83.4	83.4	83.4
	<b>100</b>	75.8	77.4	79.3	81.6	83.6	85.2	85.2	85.2	85.2	85.2	85.2	85.2
	<b>125</b>	78.1	80.2	82.2	84.1	85.8	87.0	87.0	87.0	87.0	87.0	87.0	87.0
	<b>160</b>	79.8	82.0	84.3	86.0	87.7	88.6	88.6	88.6	88.6	88.6	88.6	88.6
	<b>200</b>	81.1	83.3	85.9	87.9	89.5	90.2	90.2	90.2	90.2	90.2	90.2	90.2
	<b>250</b>	82.1	84.0	87.1	89.4	91.1	91.7	91.7	91.7	91.7	91.7	91.7	91.7
	<b>315</b>	82.7	84.2	87.8	90.5	92.4	93.0	93.0	93.0	93.0	93.0	93.0	93.0
	<b>400</b>	82.4	83.3	87.3	90.6	92.7	93.4	93.4	93.4	93.4	93.4	93.4	93.4
	<b>500</b>	82.5	83.0	87.0	90.9	93.4	94.2	94.2	94.2	94.2	94.2	94.2	94.2
	<b>630</b>	82.4	82.6	86.5	90.8	93.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
	<b>800</b>	82.4	82.1	86.1	90.4	93.7	95.0	95.0	95.0	95.0	95.0	95.0	95.0
	<b>1000</b>	82.7	82.1	85.7	90.2	93.7	95.3	95.3	95.3	95.3	95.3	95.3	95.3
<b>1250</b>	83.3	82.5	85.8	90.4	93.8	95.7	95.7	95.7	95.7	95.7	95.7	95.7	
<b>1600</b>	82.4	82.0	84.6	88.9	92.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3	
<b>2000</b>	81.7	81.8	83.9	87.6	90.9	93.0	93.0	93.0	93.0	93.0	93.0	93.0	
<b>2500</b>	80.5	81.0	82.9	86.0	88.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	
<b>3150</b>	78.6	79.7	81.5	84.1	86.6	88.3	88.3	88.3	88.3	88.3	88.3	88.3	
<b>4000</b>	75.6	77.0	78.9	81.5	83.5	84.8	84.8	84.8	84.8	84.8	84.8	84.8	
<b>5000</b>	71.5	73.2	75.3	77.9	79.8	80.8	80.8	80.8	80.8	80.8	80.8	80.8	
<b>6300</b>	64.8	66.8	69.2	71.9	73.9	74.7	74.7	74.7	74.7	74.7	74.7	74.7	
<b>8000</b>	54.2	56.6	59.3	62.2	64.4	65.2	65.2	65.2	65.2	65.2	65.2	65.2	
<b>10000</b>	40.1	42.5	45.7	49.1	51.5	52.6	52.6	52.6	52.6	52.6	52.6	52.6	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>103.7</b>	<b>105.0</b>	<b>105.0</b>	<b>105.0</b>	<b>105.0</b>	<b>105.0</b>	<b>105.0</b>	<b>105.0</b>

Table 6: 5.x-158 – 105.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

### 4.3 4.x/5.x-158 – 104.0 dBA Apparent Sound Power Level

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The octave band spectra and 1/3rd octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Please note that the 120.9 m hub height is not compatible with this operating mode.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	9.00	4800, 5100
120.9	N/A	N/A
150.0	9.00	4500, 4800, 5100
161.0	9.00	4500, 4800, 5100

A-weighted Octave Spectra [dBA]												
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15
Frequency [Hz]	16	53.9	54.0	56.3	59.4	61.5	62.4	62.4	62.4	62.4	62.4	62.4
	32	67.4	67.3	69.6	72.8	75.1	75.9	75.9	75.9	75.9	75.9	75.9
	63	76.3	77.1	79.2	82.0	84.2	85.3	85.3	85.3	85.3	85.3	85.3
	125	83.0	85.0	87.1	89.0	90.6	91.3	91.3	91.3	91.3	91.3	91.3
	250	86.8	88.7	91.8	94.1	95.7	96.0	96.0	96.0	96.0	96.0	96.0
	500	87.2	87.7	91.7	95.5	97.8	98.2	98.2	98.2	98.2	98.2	98.2
	1000	87.6	87.0	90.6	95.1	98.3	98.9	98.9	98.9	98.9	98.9	98.9
	2000	86.4	86.4	88.7	92.4	95.4	96.2	96.2	96.2	96.2	96.2	96.2
	4000	80.9	82.2	84.0	86.6	88.7	89.3	89.3	89.3	89.3	89.3	89.3
	8000	65.1	67.2	69.6	72.4	74.2	74.5	74.5	74.5	74.5	74.5	74.5
Total Sound Power Level [dBA]	93.8	94.5	97.6	101.0	103.5	104.0	104.0	104.0	104.0	104.0	104.0	104.0

Table 7: 5.x-158 – 104.0 dBA Octave Band Sound Power Levels as a function of wind speed

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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>12.5</b>	40.6	40.9	43.2	46.3	48.5	49.4	49.4	49.4	49.4	49.4	49.4	49.4
	<b>16</b>	47.3	47.4	49.7	52.8	54.9	55.8	55.8	55.8	55.8	55.8	55.8	55.8
	<b>20</b>	52.6	52.6	54.9	58.0	60.2	61.0	61.0	61.0	61.0	61.0	61.0	61.0
	<b>25</b>	57.3	57.3	59.6	62.7	64.9	65.7	65.7	65.7	65.7	65.7	65.7	65.7
	<b>32</b>	61.5	61.6	63.9	67.0	69.2	70.0	70.0	70.0	70.0	70.0	70.0	70.0
	<b>40</b>	65.4	65.4	67.7	70.9	73.2	74.0	74.0	74.0	74.0	74.0	74.0	74.0
	<b>50</b>	68.4	68.5	70.8	74.0	76.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3
	<b>63</b>	71.2	71.8	73.9	76.9	79.1	80.3	80.3	80.3	80.3	80.3	80.3	80.3
	<b>80</b>	73.6	74.7	76.7	79.3	81.4	82.5	82.5	82.5	82.5	82.5	82.5	82.5
	<b>100</b>	75.8	77.4	79.3	81.6	83.4	84.4	84.4	84.4	84.4	84.4	84.4	84.4
	<b>125</b>	78.1	80.2	82.2	84.1	85.6	86.4	86.4	86.4	86.4	86.4	86.4	86.4
	<b>160</b>	79.8	82.0	84.3	86.0	87.5	88.1	88.1	88.1	88.1	88.1	88.1	88.1
	<b>200</b>	81.1	83.3	85.9	87.9	89.3	89.7	89.7	89.7	89.7	89.7	89.7	89.7
	<b>250</b>	82.1	84.0	87.1	89.4	90.9	91.2	91.2	91.2	91.2	91.2	91.2	91.2
	<b>315</b>	82.7	84.2	87.8	90.5	92.2	92.5	92.5	92.5	92.5	92.5	92.5	92.5
	<b>400</b>	82.4	83.3	87.3	90.6	92.5	92.8	92.8	92.8	92.8	92.8	92.8	92.8
	<b>500</b>	82.5	83.0	87.0	90.9	93.2	93.5	93.5	93.5	93.5	93.5	93.5	93.5
	<b>630</b>	82.4	82.6	86.5	90.8	93.5	93.9	93.9	93.9	93.9	93.9	93.9	93.9
	<b>800</b>	82.4	82.1	86.1	90.4	93.5	94.0	94.0	94.0	94.0	94.0	94.0	94.0
	<b>1000</b>	82.7	82.1	85.7	90.2	93.4	94.1	94.1	94.1	94.1	94.1	94.1	94.1
<b>1250</b>	83.3	82.5	85.8	90.4	93.5	94.3	94.3	94.3	94.3	94.3	94.3	94.3	
<b>1600</b>	82.4	82.0	84.6	88.9	92.0	92.8	92.8	92.8	92.8	92.8	92.8	92.8	
<b>2000</b>	81.7	81.8	83.9	87.6	90.6	91.4	91.4	91.4	91.4	91.4	91.4	91.4	
<b>2500</b>	80.5	81.0	82.9	86.0	88.7	89.5	89.5	89.5	89.5	89.5	89.5	89.5	
<b>3150</b>	78.6	79.7	81.5	84.1	86.4	87.1	87.1	87.1	87.1	87.1	87.1	87.1	
<b>4000</b>	75.6	77.0	78.9	81.5	83.3	83.8	83.8	83.8	83.8	83.8	83.8	83.8	
<b>5000</b>	71.5	73.2	75.3	77.9	79.6	79.9	79.9	79.9	79.9	79.9	79.9	79.9	
<b>6300</b>	64.8	66.8	69.2	71.9	73.7	74.0	74.0	74.0	74.0	74.0	74.0	74.0	
<b>8000</b>	54.2	56.6	59.3	62.2	64.2	64.5	64.5	64.5	64.5	64.5	64.5	64.5	
<b>10000</b>	40.1	42.5	45.7	49.1	51.3	51.8	51.8	51.8	51.8	51.8	51.8	51.8	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>103.5</b>	<b>104.0</b>	<b>104.0</b>	<b>104.0</b>	<b>104.0</b>	<b>104.0</b>	<b>104.0</b>	<b>104.0</b>

Table 8: 5.x-158 – 104.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

**4.4 4.x/5.x-158 – 103.0 dBA Apparent Sound Power Level**

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The octave band spectra and 1/3rd octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	8.54	4800
120.9	8.54	4500, 4800
150.0	8.54	4500, 4800
161.0	8.54	4500, 4800

A-weighted Octave Spectra [dBA]												
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15
Frequency [Hz]	16	53.9	54.0	56.3	59.4	61.3	61.3	61.3	61.3	61.3	61.3	61.3
	32	67.4	67.3	69.6	72.8	74.8	74.8	74.8	74.8	74.8	74.8	74.8
	63	76.3	77.1	79.2	82.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
	125	83.0	85.0	87.1	89.0	90.2	90.2	90.2	90.2	90.2	90.2	90.2
	250	86.8	88.7	91.8	94.1	95.2	95.2	95.2	95.2	95.2	95.2	95.2
	500	87.2	87.7	91.7	95.5	97.3	97.3	97.3	97.3	97.3	97.3	97.3
	1000	87.6	87.0	90.6	95.1	97.8	97.8	97.8	97.8	97.8	97.8	97.8
	2000	86.4	86.4	88.7	92.4	95.1	95.1	95.1	95.1	95.1	95.1	95.1
	4000	80.9	82.2	84.0	86.6	88.4	88.4	88.4	88.4	88.4	88.4	88.4
8000	65.1	67.2	69.6	72.4	73.8	73.8	73.8	73.8	73.8	73.8	73.8	
Total Sound Power Level [dBA]	93.8	94.5	97.6	101.0	103.0	103.0	103.0	103.0	103.0	103.0	103.0	103.0

Table 9: 5.x-158 – 103.0 dBA Octave Band Sound Power Levels as a function of wind speed



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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>12.5</b>	40.6	40.9	43.2	46.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3
	<b>16</b>	47.3	47.4	49.7	52.8	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7
	<b>20</b>	52.6	52.6	54.9	58.0	59.9	59.9	59.9	59.9	59.9	59.9	59.9	59.9
	<b>25</b>	57.3	57.3	59.6	62.7	64.6	64.6	64.6	64.6	64.6	64.6	64.6	64.6
	<b>32</b>	61.5	61.6	63.9	67.0	68.9	68.9	68.9	68.9	68.9	68.9	68.9	68.9
	<b>40</b>	65.4	65.4	67.7	70.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9
	<b>50</b>	68.4	68.5	70.8	74.0	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1
	<b>63</b>	71.2	71.8	73.9	76.9	78.9	78.9	78.9	78.9	78.9	78.9	78.9	78.9
	<b>80</b>	73.6	74.7	76.7	79.3	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2
	<b>100</b>	75.8	77.4	79.3	81.6	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.1
	<b>125</b>	78.1	80.2	82.2	84.1	85.3	85.3	85.3	85.3	85.3	85.3	85.3	85.3
	<b>160</b>	79.8	82.0	84.3	86.0	87.1	87.1	87.1	87.1	87.1	87.1	87.1	87.1
	<b>200</b>	81.1	83.3	85.9	87.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9
	<b>250</b>	82.1	84.0	87.1	89.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4
	<b>315</b>	82.7	84.2	87.8	90.5	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7
	<b>400</b>	82.4	83.3	87.3	90.6	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9
	<b>500</b>	82.5	83.0	87.0	90.9	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6
	<b>630</b>	82.4	82.6	86.5	90.8	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
	<b>800</b>	82.4	82.1	86.1	90.4	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
	<b>1000</b>	82.7	82.1	85.7	90.2	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
<b>1250</b>	83.3	82.5	85.8	90.4	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	
<b>1600</b>	82.4	82.0	84.6	88.9	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	
<b>2000</b>	81.7	81.8	83.9	87.6	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	
<b>2500</b>	80.5	81.0	82.9	86.0	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	
<b>3150</b>	78.6	79.7	81.5	84.1	86.1	86.1	86.1	86.1	86.1	86.1	86.1	86.1	
<b>4000</b>	75.6	77.0	78.9	81.5	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	
<b>5000</b>	71.5	73.2	75.3	77.9	79.3	79.3	79.3	79.3	79.3	79.3	79.3	79.3	
<b>6300</b>	64.8	66.8	69.2	71.9	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	
<b>8000</b>	54.2	56.6	59.3	62.2	63.8	63.8	63.8	63.8	63.8	63.8	63.8	63.8	
<b>10000</b>	40.1	42.5	45.7	49.1	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>103.0</b>	<b>103.0</b>	<b>103.0</b>	<b>103.0</b>	<b>103.0</b>	<b>103.0</b>	<b>103.0</b>	<b>103.0</b>

Table 10: 5.x-158 – 103.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

### 4.5 4.x/5.x-158 – 102.0 dBA Apparent Sound Power Level

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The octave band spectra and 1/3rd octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	8.20	4650
120.9	8.20	4500, 4650
150.0	8.20	4500, 4650
161.0	8.20	4500, 4650

A-weighted Octave Spectra [dBA]												
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15
Frequency [Hz]	16	53.9	54.0	56.3	59.4	60.5	60.5	60.5	60.5	60.5	60.5	60.5
	32	67.4	67.3	69.6	72.8	74.0	74.0	74.0	74.0	74.0	74.0	74.0
	63	76.3	77.1	79.2	82.0	83.2	83.2	83.2	83.2	83.2	83.2	83.2
	125	83.0	85.0	87.1	89.0	89.6	89.6	89.6	89.6	89.6	89.6	89.6
	250	86.8	88.7	91.8	94.1	94.5	94.5	94.5	94.5	94.5	94.5	94.5
	500	87.2	87.7	91.7	95.5	96.3	96.3	96.3	96.3	96.3	96.3	96.3
	1000	87.6	87.0	90.6	95.1	96.6	96.6	96.6	96.6	96.6	96.6	96.6
	2000	86.4	86.4	88.7	92.4	94.0	94.0	94.0	94.0	94.0	94.0	94.0
	4000	80.9	82.2	84.0	86.6	87.6	87.6	87.6	87.6	87.6	87.6	87.6
8000	65.1	67.2	69.6	72.4	73.1	73.1	73.1	73.1	73.1	73.1	73.1	
Total Sound Power Level [dBA]	93.8	94.5	97.6	101.0	102.0	102.0	102.0	102.0	102.0	102.0	102.0	102.0

Table 11: 5.x-158 – 102.0 dBA Octave Band Sound Power Levels as a function of wind speed

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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>12.5</b>	40.6	40.9	43.2	46.3	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5
	<b>16</b>	47.3	47.4	49.7	52.8	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9
	<b>20</b>	52.6	52.6	54.9	58.0	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1
	<b>25</b>	57.3	57.3	59.6	62.7	63.8	63.8	63.8	63.8	63.8	63.8	63.8	63.8
	<b>32</b>	61.5	61.6	63.9	67.0	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1
	<b>40</b>	65.4	65.4	67.7	70.9	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1
	<b>50</b>	68.4	68.5	70.8	74.0	75.3	75.3	75.3	75.3	75.3	75.3	75.3	75.3
	<b>63</b>	71.2	71.8	73.9	76.9	78.2	78.2	78.2	78.2	78.2	78.2	78.2	78.2
	<b>80</b>	73.6	74.7	76.7	79.3	80.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5
	<b>100</b>	75.8	77.4	79.3	81.6	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5
	<b>125</b>	78.1	80.2	82.2	84.1	84.7	84.7	84.7	84.7	84.7	84.7	84.7	84.7
	<b>160</b>	79.8	82.0	84.3	86.0	86.5	86.5	86.5	86.5	86.5	86.5	86.5	86.5
	<b>200</b>	81.1	83.3	85.9	87.9	88.2	88.2	88.2	88.2	88.2	88.2	88.2	88.2
	<b>250</b>	82.1	84.0	87.1	89.4	89.7	89.7	89.7	89.7	89.7	89.7	89.7	89.7
	<b>315</b>	82.7	84.2	87.8	90.5	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9
	<b>400</b>	82.4	83.3	87.3	90.6	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1
	<b>500</b>	82.5	83.0	87.0	90.9	91.6	91.6	91.6	91.6	91.6	91.6	91.6	91.6
	<b>630</b>	82.4	82.6	86.5	90.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8
	<b>800</b>	82.4	82.1	86.1	90.4	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8
	<b>1000</b>	82.7	82.1	85.7	90.2	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7
<b>1250</b>	83.3	82.5	85.8	90.4	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	
<b>1600</b>	82.4	82.0	84.6	88.9	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	
<b>2000</b>	81.7	81.8	83.9	87.6	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	
<b>2500</b>	80.5	81.0	82.9	86.0	87.4	87.4	87.4	87.4	87.4	87.4	87.4	87.4	
<b>3150</b>	78.6	79.7	81.5	84.1	85.2	85.2	85.2	85.2	85.2	85.2	85.2	85.2	
<b>4000</b>	75.6	77.0	78.9	81.5	82.2	82.2	82.2	82.2	82.2	82.2	82.2	82.2	
<b>5000</b>	71.5	73.2	75.3	77.9	78.6	78.6	78.6	78.6	78.6	78.6	78.6	78.6	
<b>6300</b>	64.8	66.8	69.2	71.9	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	
<b>8000</b>	54.2	56.6	59.3	62.2	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	
<b>10000</b>	40.1	42.5	45.7	49.1	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>102.0</b>	<b>102.0</b>	<b>102.0</b>	<b>102.0</b>	<b>102.0</b>	<b>102.0</b>	<b>102.0</b>	<b>102.0</b>

Table 12: 5.x-158 – 102.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

**4.6 4.x/5.x-158 – 101.0 dBA Apparent Sound Power Level**

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The octave band spectra and 1/3rd octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	7.66	4340
120.9	7.66	4340
150.0	7.66	4340
161.0	7.66	4340

A-weighted Octave Spectra [dBA]												
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15
Frequency [Hz]	16	53.9	54.0	56.3	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
	32	67.4	67.3	69.6	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1
	63	76.3	77.1	79.2	82.2	82.2	82.2	82.2	82.2	82.2	82.2	82.2
	125	83.0	85.0	87.1	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0
	250	86.8	88.7	91.8	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.9
	500	87.2	87.7	91.7	95.4	95.4	95.4	95.4	95.4	95.4	95.4	95.4
	1000	87.6	87.0	90.6	95.2	95.2	95.2	95.2	95.2	95.2	95.2	95.2
	2000	86.4	86.4	88.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7
	4000	80.9	82.2	84.0	86.9	86.9	86.9	86.9	86.9	86.9	86.9	86.9
8000	65.1	67.2	69.6	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	
Total Sound Power Level [dBA]	93.8	94.5	97.6	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 13: 5.x-158 – 101.0 dBA Octave Band Sound Power Levels as a function of wind speed

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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
Frequency [Hz]	12.5	40.6	40.9	43.2	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6
	16	47.3	47.4	49.7	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0
	20	52.6	52.6	54.9	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2
	25	57.3	57.3	59.6	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
	32	61.5	61.6	63.9	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2
	40	65.4	65.4	67.7	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2
	50	68.4	68.5	70.8	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2
	63	71.2	71.8	73.9	77.1	77.1	77.1	77.1	77.1	77.1	77.1	77.1	77.1
	80	73.6	74.7	76.7	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5
	100	75.8	77.4	79.3	81.7	81.7	81.7	81.7	81.7	81.7	81.7	81.7	81.7
	125	78.1	80.2	82.2	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
	160	79.8	82.0	84.3	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9
	200	81.1	83.3	85.9	87.7	87.7	87.7	87.7	87.7	87.7	87.7	87.7	87.7
	250	82.1	84.0	87.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
	315	82.7	84.2	87.8	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2
	400	82.4	83.3	87.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3
	500	82.5	83.0	87.0	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7
	630	82.4	82.6	86.5	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8
	800	82.4	82.1	86.1	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5
	1000	82.7	82.1	85.7	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4
1250	83.3	82.5	85.8	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	
1600	82.4	82.0	84.6	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	
2000	81.7	81.8	83.9	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	
2500	80.5	81.0	82.9	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	
3150	78.6	79.7	81.5	84.4	84.4	84.4	84.4	84.4	84.4	84.4	84.4	84.4	
4000	75.6	77.0	78.9	81.7	81.7	81.7	81.7	81.7	81.7	81.7	81.7	81.7	
5000	71.5	73.2	75.3	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	
6300	64.8	66.8	69.2	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	
8000	54.2	56.6	59.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	
10000	40.1	42.5	45.7	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>	<b>101.0</b>

Table 14: 5.x-158 – 101.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

**4.7 4.x/5.x-158 – 100.0 dBA Apparent Sound Power Level**

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The octave band spectra and 1/3rd octave band spectra in this section are applicable to the following nominal electrical power, nominal rotor speed, and hub heights.

Hub Height (m)	Nominal Rotor Speed (rpm)	Nominal Electrical Power (kW)
101.0	7.22	4090
120.9	7.22	4090
150.0	7.22	4090
161.0	7.22	4090

A-weighted Octave Spectra [dBA]													
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15	
Frequency [Hz]	16	53.9	54.0	56.3	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9
	32	67.4	67.3	69.6	72.3	72.3	72.3	72.3	72.3	72.3	72.3	72.3	72.3
	63	76.3	77.1	79.2	81.6	81.6	81.6	81.6	81.6	81.6	81.6	81.6	81.6
	125	83.0	85.0	87.1	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
	250	86.8	88.7	91.8	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1
	500	87.2	87.7	91.7	94.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3
	1000	87.6	87.0	90.6	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0
	2000	86.4	86.4	88.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7
	4000	80.9	82.2	84.0	86.2	86.2	86.2	86.2	86.2	86.2	86.2	86.2	86.2
	8000	65.1	67.2	69.6	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8
Total Sound Power Level [dBA]	93.8	94.5	97.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Table 15: 5.x-158 – 100.0 dBA Octave Band Sound Power Levels as a function of wind speed



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		A-weighted 1/3 <sup>rd</sup> - Octave Spectra [dBA]											
Hub Height Wind Speed [m/s]		4	5	6	7	8	9	10	11	12	13	14	15
<b>Frequency [Hz]</b>	<b>12.5</b>	40.6	40.9	43.2	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9
	<b>16</b>	47.3	47.4	49.7	52.3	52.3	52.3	52.3	52.3	52.3	52.3	52.3	52.3
	<b>20</b>	52.6	52.6	54.9	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
	<b>25</b>	57.3	57.3	59.6	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2
	<b>32</b>	61.5	61.6	63.9	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5
	<b>40</b>	65.4	65.4	67.7	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
	<b>50</b>	68.4	68.5	70.8	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5
	<b>63</b>	71.2	71.8	73.9	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4
	<b>80</b>	73.6	74.7	76.7	78.9	78.9	78.9	78.9	78.9	78.9	78.9	78.9	78.9
	<b>100</b>	75.8	77.4	79.3	81.1	81.1	81.1	81.1	81.1	81.1	81.1	81.1	81.1
	<b>125</b>	78.1	80.2	82.2	83.5	83.5	83.5	83.5	83.5	83.5	83.5	83.5	83.5
	<b>160</b>	79.8	82.0	84.3	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4
	<b>200</b>	81.1	83.3	85.9	87.0	87.0	87.0	87.0	87.0	87.0	87.0	87.0	87.0
	<b>250</b>	82.1	84.0	87.1	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
	<b>315</b>	82.7	84.2	87.8	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4
	<b>400</b>	82.4	83.3	87.3	89.3	89.3	89.3	89.3	89.3	89.3	89.3	89.3	89.3
	<b>500</b>	82.5	83.0	87.0	89.6	89.6	89.6	89.6	89.6	89.6	89.6	89.6	89.6
	<b>630</b>	82.4	82.6	86.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5
	<b>800</b>	82.4	82.1	86.1	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2	89.2
	<b>1000</b>	82.7	82.1	85.7	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
<b>1250</b>	83.3	82.5	85.8	89.3	89.3	89.3	89.3	89.3	89.3	89.3	89.3	89.3	
<b>1600</b>	82.4	82.0	84.6	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	
<b>2000</b>	81.7	81.8	83.9	86.9	86.9	86.9	86.9	86.9	86.9	86.9	86.9	86.9	
<b>2500</b>	80.5	81.0	82.9	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	
<b>3150</b>	78.6	79.7	81.5	83.7	83.7	83.7	83.7	83.7	83.7	83.7	83.7	83.7	
<b>4000</b>	75.6	77.0	78.9	81.0	81.0	81.0	81.0	81.0	81.0	81.0	81.0	81.0	
<b>5000</b>	71.5	73.2	75.3	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	
<b>6300</b>	64.8	66.8	69.2	71.3	71.3	71.3	71.3	71.3	71.3	71.3	71.3	71.3	
<b>8000</b>	54.2	56.6	59.3	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	
<b>10000</b>	40.1	42.5	45.7	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	
<b>Total Sound Power Level [dBA]</b>		<b>93.8</b>	<b>94.5</b>	<b>97.6</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Table 16: 5.x-158 – 100.0 dBA 1/3<sup>rd</sup> -Octave Band Sound Power Levels as a function of wind speed

## 5 Uncertainty Levels

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The apparent sound power levels given above are mean values of representative batches of turbines under evaluation. Uncertainty levels are not included. The uncertainty levels  $u_c$ ,  $\sigma_P$ ,  $\sigma_R$  and  $\sigma_T$  associated with measurements and mean values are described in IEC 61400-11 and IEC/TS 61400-14.

For GE wind turbines, a typical value of  $\sigma_P = 0.8$  dB can be assumed.

The uncertainties for octave and 1/3<sup>rd</sup>-octave sound power levels are generally higher than for total sound power levels. Guidance is given in IEC 61400-11.

## 6 IEC 61400-11 and IEC/TS 61400-14 Terminology

- $L_{WA,k}$  is the wind turbine apparent sound power level (referenced to  $10^{-12}$ W) measured with A-weighting as a function of wind speed. Derived from multiple measurement reports per IEC 61400-11, it is considered to be a mean value.
- $u_c$  is the measurement uncertainty for acoustic testing as defined in IEC 61400-11. It is not a characteristic of the product, but of the measurement, and cannot be specified by GE. For average testing conditions, typical values of  $u_c$  are 0,7 dB – 1,0 dB.
- $\sigma_P$  is the 5.x-158 unit-to-unit product variation according to IEC/TS 61400-14. It is a characteristic of the product and can therefore be specified by GE (see chapter 5).
- $\sigma_R$  is the overall measurement testing reproducibility as defined in IEC/TS 61400-14. It is not a characteristic of the product, but of the measurements, and cannot be specified by GE. For typical testing according to IEC 61400-11, a value of  $\sigma_R = 0,5$  dB is widely accepted.
- $\sigma_T$  is the total standard deviation combining both  $\sigma_P$  and  $\sigma_R$  (see IEC/TS 61400-14).

## 7 Reference Documents PDF Compressor Free Version

- IEC 61400-11, wind turbine generator systems part 11: Acoustic noise measurement techniques, ed. 2.1 (2006-11), or ed. 3 (2012-11).
- IEC/TS 61400-14, Wind turbines – part 14: Declaration of apparent sound power level and tonality values, ed. 1 (2005-03).
- MNPT – Machine Noise Performance Test, Technical documentation.

### Annex I - 10 m Wind Speeds for all hub heights

10 m Wind Speeds for all hub heights												
Hub Height Wind Speed [m/s]	4	5	6	7	8	9	10	11	12	13	14	15
Wind speed at 10 m height for a hub height of 101.0 m [m/s]	2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.0	9.7	10.4
Wind speed at 10 m height for a hub height of 120.9 m [m/s]	2.7	3.4	4.1	4.8	5.4	6.1	6.8	7.5	8.2	8.8	9.5	10.2
Wind speed at 10 m height for a hub height of 150.0 m [m/s]	2.6	3.3	4.0	4.6	5.3	6.0	6.6	7.3	7.9	8.6	9.3	9.9
Wind speed at 10 m height for a hub height of 161.0 m [m/s]	2.6	3.3	3.9	4.6	5.2	5.9	6.6	7.2	7.9	8.5	9.2	9.8