

Appendix 11.2: Methodology for calculating from different hub heights and standardising hub height wind speed

Supplementary Guidance Note 4: Wind Shear Equations

a) Standardising from hub height (hh) to 10m

$$v_{10} = v_{hh} * (\text{LN}(10/0.05)/\text{LN}(hh/0.05)) \quad [\text{EQUATION 1}]$$

v_{10} = Standardised 10m wind speed

v_{hh} = Hub height wind speed Hub heights (hh) = 102.5m and 110.5m

0.05 = Standard ground roughness length which remains constant (fixed)

b) Calculating from different heights

$$v_1 = v_2 * (h_1/h_2)^m \quad [\text{EQUATION 2}]$$

v_1 = wind speed at h_1

v_2 = Wind speed at h_2

h_2 = 10m

m = Wind shear

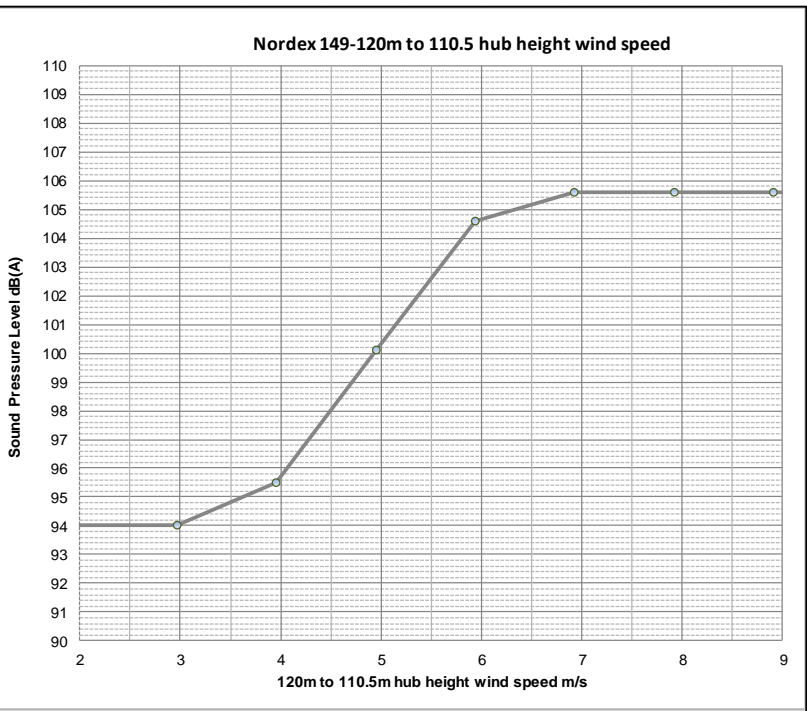
- c) Equation **b** can be re-arranged to determine wind shear exponent 'm' based on known data at two different Met mast heights (80m and 61m). With wind shear calculated this can be applied to the wind speed at higher (differing) height of 80m to determine hub height wind speed (higher hub height being 110.5m).

$$m = \text{LN}(v_2/v_1) / \text{LN}(h_2/h_1) \quad [\text{EQUATION 3}]$$

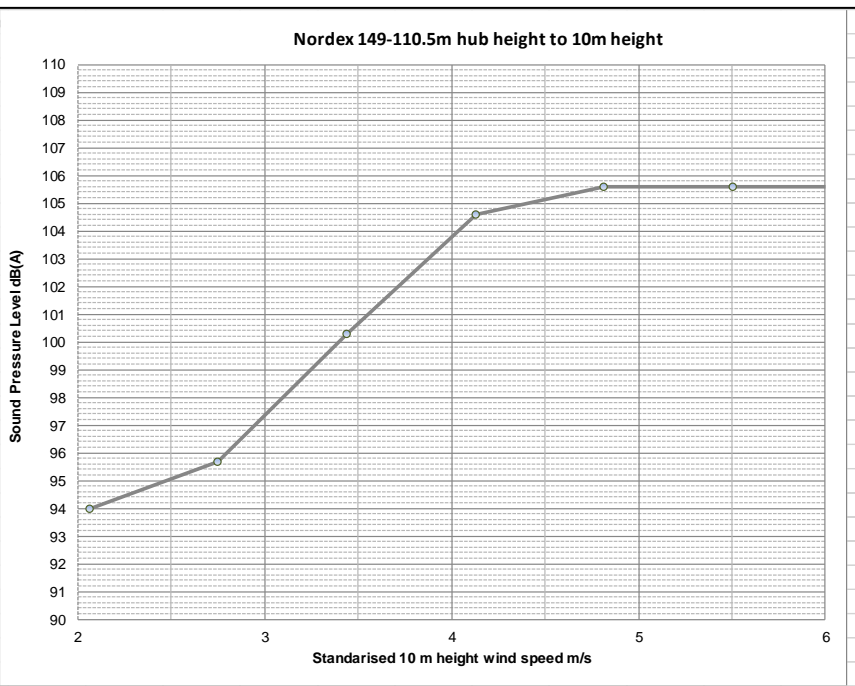
The calculations for hub height 102.5m was derived using equation **a** (from hub height of 105m in manufactures specification and then standardised).

The calculations for hub height 110.5m was derived using equation **a** (from hub height of 120m in manufactures specification and then standardised).

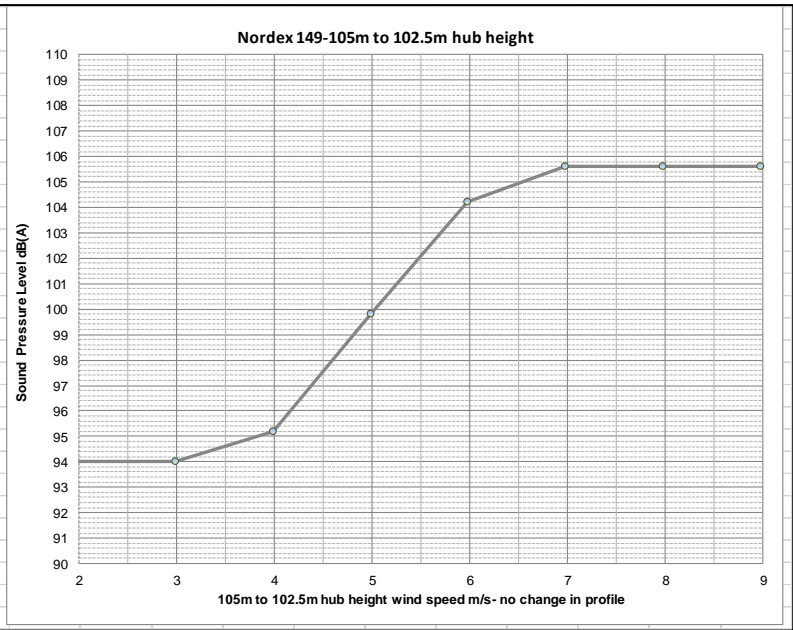
Hub height 120m	Wind 120m	120m to	120m to 110.5
values	Mean	110.5	values
94.0	2.0	2.0	
94	3.0	3.0	94
95.5	4.0	4.0	95.7
100.1	5.0	4.9	100.3
104.6	6.0	5.9	104.6
105.6	7.0	6.9	105.6
105.6	8.0	7.9	105.6
105.6	9.0	8.9	105.6
105.6	10.0	9.9	105.6
105.6	11.0	10.9	105.6
105.6	12.0	11.9	105.6
105.6	13.0	12.9	
105.6	14.0	13.9	
105.6	15.0	14.8	
105.6	16.0	15.8	
105.6	17.0	16.8	
105.6	18.0	17.8	
105.6	19.0	18.8	
105.6	20.0	19.8	
105.6	21.0	20.8	
105.6	22.0	21.8	
105.6	23.0	22.8	
105.6	24.0	23.7	
105.6	25.0	24.7	
	26.0	25.7	



Hub height 110.5	Wind 110.5m	110.5 to	110.5m to 10m
values	Mean	10m	values
	2.0	1.4	
94	3.0	2.1	97.4
95.7	4.0	2.8	103.8
100.3	5.0	3.4	105.6
104.6	6.0	4.1	105.6
105.6	7.0	4.8	105.6
105.6	8.0	5.5	105.6
105.6	9.0	6.2	105.6
105.6	10.0	6.9	105.6
105.6	11.0	7.6	105.6
105.6	12.0	8.3	105.6
105.6	13.0	8.9	
105.6	14.0	9.6	
105.6	15.0	10.3	
105.6	16.0	11.0	
105.6	17.0	11.7	
105.6	18.0	12.4	
105.6	19.0	13.1	
105.6	20.0	13.8	
105.6	21.0	14.4	
105.6	22.0	15.1	
105.6	23.0	15.8	
105.6	24.0	16.5	
105.6	25.0	17.2	
	26.0	17.9	

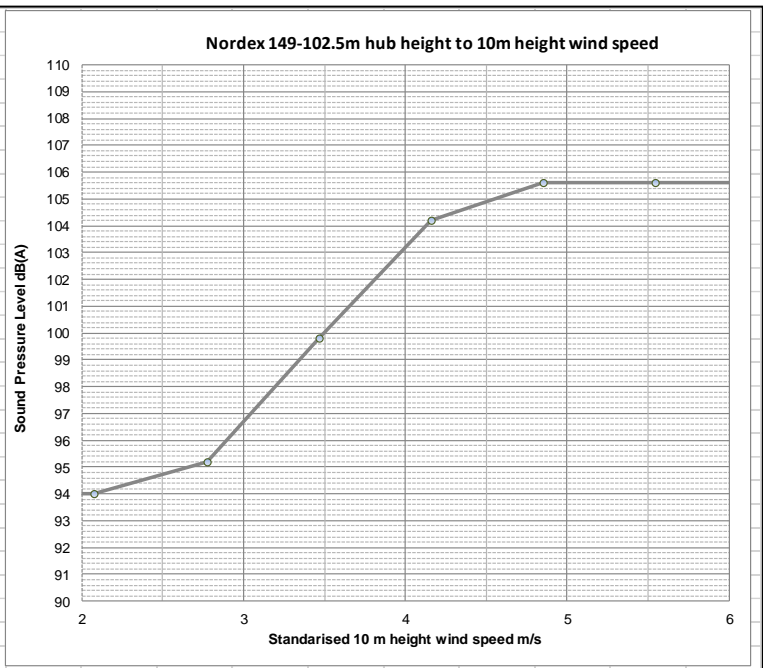


Hub height 105m values	Wind 105.0m Mean	105m 10 102.5m	105m to to values
94.0	2.0	2.0	
94	3.0	3.0	94.0
95.2	4.0	4.0	95.2
99.8	5.0	5.0	99.8
104.2	6.0	6.0	104.2
105.6	7.0	7.0	105.6
105.6	8.0	8.0	105.6
105.6	9.0	9.0	105.6
105.6	10.0	10.0	105.6
105.6	11.0	11.0	105.6
105.6	12.0	12.0	105.6
105.6	13.0	13.0	
105.6	14.0	14.0	
105.6	15.0	15.0	
105.6	16.0	15.9	
105.6	17.0	16.9	
105.6	18.0	17.9	
105.6	19.0	18.9	
105.6	20.0	19.9	
105.6	21.0	20.9	
105.6	22.0	21.9	
105.6	23.0	22.9	
105.6	24.0	23.9	
105.6	25.0	24.9	
	26.0	25.9	



NB: There is no change in sound power levels from 105m to 102.5m hub height over range of wind speeds

Hub height 102.5m values	Wind 102.5.0m Mean	102m to 10m	102.5m to 10m values
94.0	2.0	1.4	1.4
94	3.0	2.1	2.1
95.2	4.0	2.8	2.8
99.8	5.0	3.5	3.5
104.2	6.0	4.2	4.2
105.6	7.0	4.8	4.8
105.6	8.0	5.5	5.5
105.6	9.0	6.2	6.2
105.6	10.0	6.9	6.9
105.6	11.0	7.6	7.6
105.6	12.0	8.3	8.3
105.6	13.0	9.0	9.0
105.6	14.0	9.7	9.7
105.6	15.0	10.4	10.4
105.6	16.0	11.1	11.1
105.6	17.0	11.8	11.8
105.6	18.0	12.5	12.5
105.6	19.0	13.2	13.2
105.6	20.0	13.9	13.9
105.6	21.0	14.5	14.5
105.6	22.0	15.2	15.2
105.6	23.0	15.9	15.9
105.6	24.0	16.6	16.6
105.6	25.0	17.3	17.3
	26.0	18.0	18.0



Derragh WF

Hub height 100m	Wind 100.0m	100m to 10m	100m to 10m values
values	Mean	10m	values
	2.0	1.4	
91.6	3.0	2.1	94.8
93.7	4.0	2.8	102
97.2	5.0	3.5	102.1
101.3	6.0	4.2	102.9
101.9	7.0	4.9	103
102.7	8.0	5.6	103
103	9.0	6.3	103
103	10.0	7.0	103
103	11.0	7.7	103
103	12.0	8.4	103
103	13.0	9.1	
103	14.0	9.8	
103	15.0	10.5	
103	16.0	11.2	
103	17.0	11.9	
103	18.0	12.5	
103	19.0	13.2	
103	20.0	13.9	
103	21.0	14.6	
103	22.0	15.3	
103	23.0	16.0	
103	24.0	16.7	
103	25.0	17.4	
	26.0	18.1	

