

Appendix 11.2: Methodology for calculating wind shear from different hub heights, calculating to hub height and standardising to 10m 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

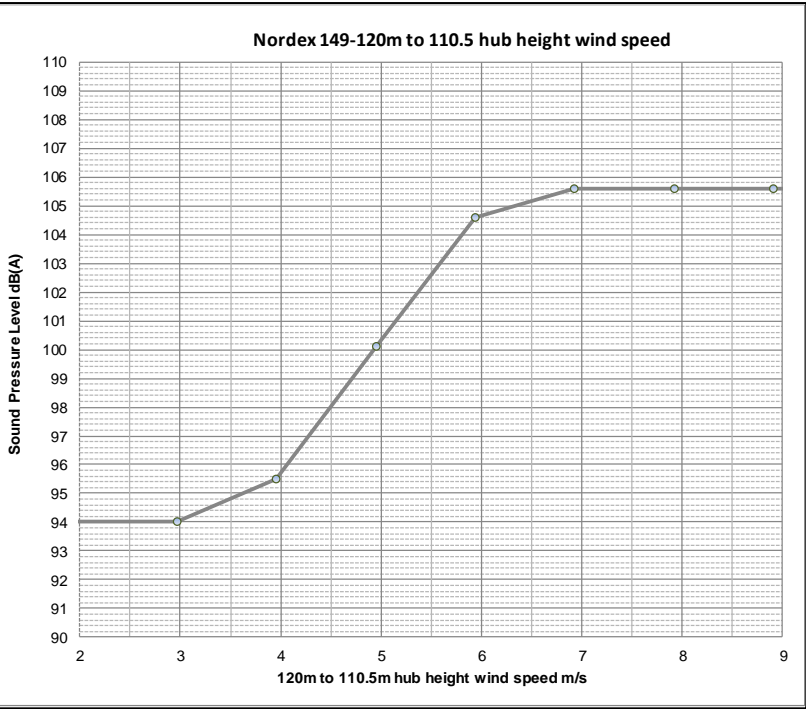
- c) Equation **b** can be re-arranged to determine wind shear exponent 'm' based on known data at two different Met mast heights (80m and 50m). With wind shear calculated this can be applied to the wind speed at higher (differing) height of 80m to determine hub height wind speed (hub heights being 110.5m and 102.5m).

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

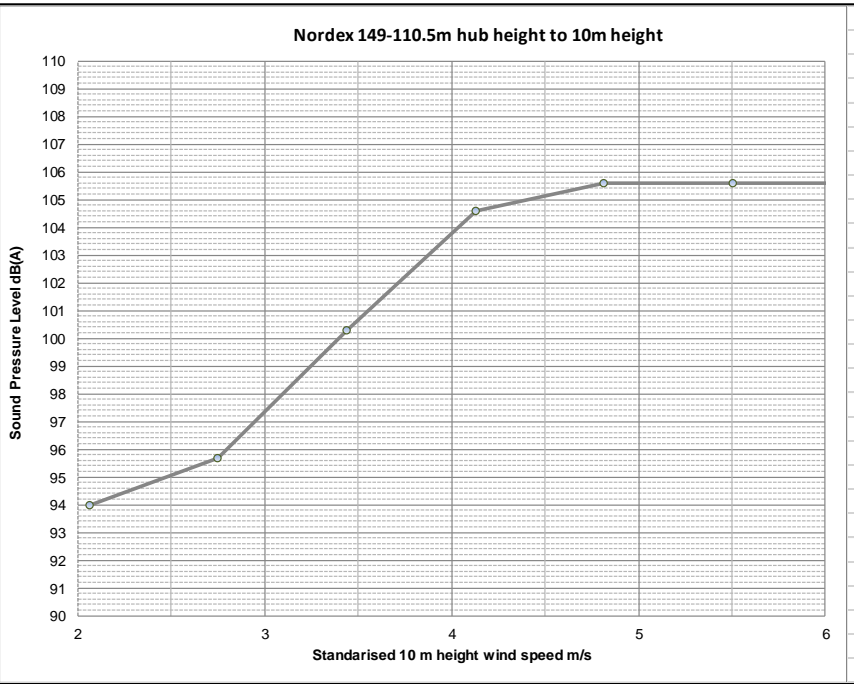
The calculations for hub height 102.5m was derived using equation **a** (from hub height of 105m in manufactures specification and then standardised).

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

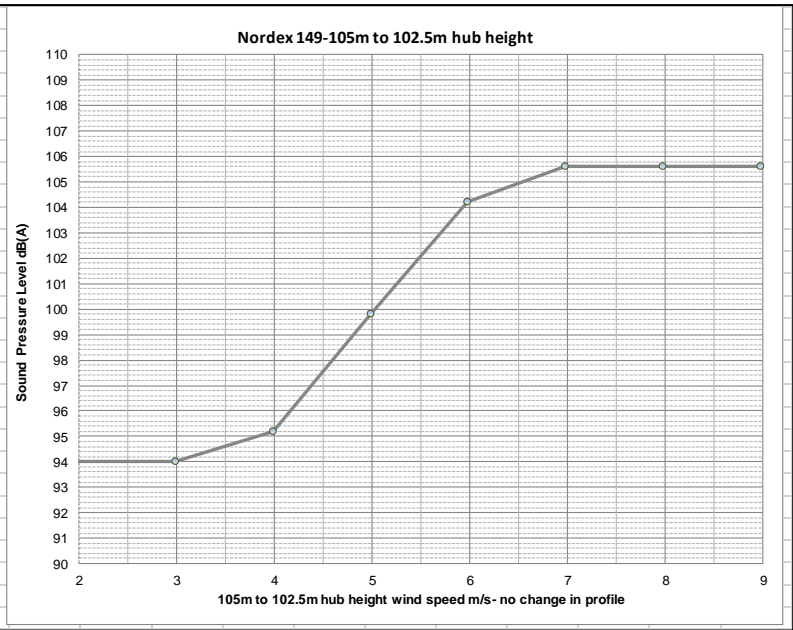
Hub height	Wind	120m	120m to
120m	120m	to	110.5
values	Mean	110.5	values
94.0	2.0	2.0	
94	3.0	3.0	94
95.5	4.0	4.0	95.7
100.1	5.0	4.9	100.3
104.6	6.0	5.9	104.6
105.6	7.0	6.9	105.6
105.6	8.0	7.9	105.6
105.6	9.0	8.9	105.6
105.6	10.0	9.9	105.6
105.6	11.0	10.9	105.6
105.6	12.0	11.9	105.6
105.6	13.0	12.9	
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	
105.6	26.0	25.7	



Hub height	Wind	110.5	110.5m to
110.5	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	
105.6	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

