

Wilbur Marks Wind and Wave Scale

FULLY RISEN SEAS ²													WIND			
SEA STATE ¹	WAVE HEIGHT (feet)			WIND ³			WIND ³			WIND ³			APPEARANCE OF THE SEA ⁵			
	AVERAGE	SIGNIFICANT	AVG. OF 1/10 HIGHEST	SIGNIFICANT RANGE	T _{max}	T _{max}	L _{max}	WIND SPEED	MINIMUM PERIOD	MINIMUM LENGTH	MINIMUM FETCH	BEAUFORT No.	WIND DESCRIPTION	WIND SPEED (knots)		
	up to 1.2 sec.	up to 1.2 sec.	up to 1.2 sec.	(period of max energy)	(period of max energy)	(period of max energy)	(period of max energy)	(average period, sec.)	(average period, sec.)	(average period, sec.)	(average period, sec.)	(average period, sec.)	(average period, sec.)	(average period, sec.)	(average period, sec.)	(average period, sec.)
0	0	0	0	~	~	~	~	~	~	~	~	0	CALM	<1	Sea like a mirror.	From a table compiled by Wilbur Marks, David Taylor Model Basin
	0.05	0.08	0.10	up to 1.2 sec.	0.7	0.5	0.83	2	5	0.3		1	LIGHT AIRS	1-3	Ripples with the appearance of scales are formed, but without foam crests.	
1	0.18	0.29	0.37	0.4-2.8	2.0	1.4	6.7	5	8	0.7		2	LIGHT BREEZE	4-6	Small wavelets, still short but more pronounced; crests have glassy appearance and do not break.	¹ Sea states refer only to wind waves. Swells from distant or old storms are often superimposed on the wind wave pattern.
	0.6	1.0	1.2	0.8-5.0	3.4	2.4	20	8.5	9.8	1.7		3	GENTLE BREEZE	7-10	Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.	
2	0.88	1.4	1.8	1.0-6.0	4.0	2.9	27	10	10	2.4		4	MODERATE BREEZE	11-16	Small waves, becoming longer; fairly frequent white horses.	² Practical Methods of Observing and Forecasting Ocean Waves, Pierson, Neuman, James, H.O.Pub. 603, 1955.
	1.4	2.2	2.8	1.0-7.0	4.8	3.4	40	12	18	3.8						
	1.8	2.9	3.7	1.4-7.6	5.4	3.9	52	13.5	24	4.8						³ Wind required to create a fully risen sea. To attain a fully risen sea for a certain wind speed, the wind must blow at that speed over a minimum distance (fetch) for a minimum time (duration).
3	2.0	3.3	4.2	1.5-7.8	5.6	4.0	59	14	28	5.2						
	2.9	4.6	5.8	2.0-8.8	6.5	4.6	71	16	40	6.6						⁴ The Beaufort Number is a wind force scale. While wind and seas are causally related, Beaufort Number and sea state are not the same. For example, it is common to have force 7 winds, but because of limited fetch or duration, a sea state of only 2.
4	3.8	6.1	7.8	2.5-10.0	7.2	5.1	90	18	55	8.3		5	FRESH BREEZE	17-21	Moderate waves, taking a more pronounced long form; many white horses are formed. (Chance of some spray.)	
	4.3	6.9	8.7	2.8-10.6	7.7	5.4	99	19	65	9.2						⁵ Manual of Seamanship, Vol. II, Admiralty, H.M. Stationary Office, 1952.
	5.0	8.0	10	3.0-11.1	8.1	5.7	111	20	75	10						
5	6.4	10	13	3.4-12.2	8.9	6.3	134	22	100	12		6	STRONG BREEZE	22-27	Large waves begin to form; the white foam crests are more extensive everywhere. (Probably some spray.)	⁶ For whole gale, storm, and hurricane winds (50 knots or more) the required durations and fetches are rarely attained. Seas are therefore not fully arisen.
	7.9	12	16	3.7-13.5	9.7	6.8	160	24	130	14						
6	8.2	13	17	3.8-13.6	9.9	7.0	164	24.5	140	15						⁷ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	9.6	15	20	4.0-14.5	10.5	7.4	188	26	180	17						
	11	18	23	4.5-15.5	11.3	7.9	212	28	230	20						⁸ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	14	22	28	4.7-16.7	12.1	8.6	250	30	280	23		7	MODERATE GALE	28-33	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. Spindrift begins.	
	14	23	29	4.8-17.0	12.4	8.7	258	30.5	290	24						⁹ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	16	26	33	5.0-17.5	12.9	9.1	285	32	340	27						
7	19	30	38	5.5-18.5	13.6	9.7	322	34	420	30						¹⁰ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	21	35	44	5.8-19.7	14.5	10.3	363	36	500	34						
	23	37	46.7	6.0-20.5	14.9	10.5	376	37	530	37		8	FRESH GALE	34-40	Moderately high waves of greater length; edges of crests break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.	¹¹ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	25	40	50	6.2-20.8	15.4	10.7	392	38	600	38						
8	28	45	58	6.5-21.7	16.1	11.4	444	40	710	42						¹² For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	31	50	64	7.0-23.0	17.0	12.0	492	42	830	47		9	STRONG GALE	41-47	High waves. Dense streaks of foam along the direction of the wind. Sea begins to roll. Spray may affect visibility.	
	36	58	73	7.0-24.2	17.7	12.5	534	44	960	52						¹³ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	40	64	81	7.0-25.0	18.6	13.1	590	46	1110	57						
	44	71	90	7.5-26.0	19.4	13.8	650	48	1250	63						¹⁴ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	49	78	99	7.5-27.0	20.2	14.3	700	50	1420	69						
9	52	83	106	8.0-28.2	20.8	14.7	736	51.5	1560	73		10	WHOLE GALE ⁸	48-55	Very high waves with long overhanging crests. The resulting foam in great patches is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes a white appearance. The rolling of the sea becomes heavy and shock like. Visibility is affected.	¹⁵ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	54	87	110	8.0-28.5	21.0	14.8	750	52	1610	75						
	59	95	121	8.0-29.5	21.8	15.4	810	54	1800	81						¹⁶ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	64	103	130	8.5-31.0	22.6	16.3	910	56	2100	88		11	STORM ⁹	56-63	Exceptionally high waves. (Small and medium-sized ships might for a long time be lost to view behind the waves.) The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.	
	73	116	148	10.0-32.0	24	17.0	985	59.5	2500	101						¹⁷ For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.
	>80	>128	>164	10-(35)	(26)	(18)	~	>64	~	~		12	HURRICANE ⁶	64-71	The air filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.	