No. 34 Standard Wave Data

(1992) (Rev.1 June 2000) (Corr.1 Nov 2001) (Rev.2 Dec 2022 Complete Revision)

1. This recommendation is intended for sea-going ships of length 90 m and greater operating in unrestricted service, excluding vessels that operate at a fixed location focusing on design wave loads for both strength and fatigue assessments.

2. The scatter diagram given in Table 1 describes the wave data of the North Atlantic as defined in Figure 1.

3. It is recommended to use a design lifetime of 25 years for strength and fatigue assessments.

4. The extreme design wave loads for the strength assessment are evaluated at a return period of 25 years.

5. The design wave loads at the probability level of 10^{-2} are selected for the fatigue assessment as the reference value to derive their long-term prediction distribution.

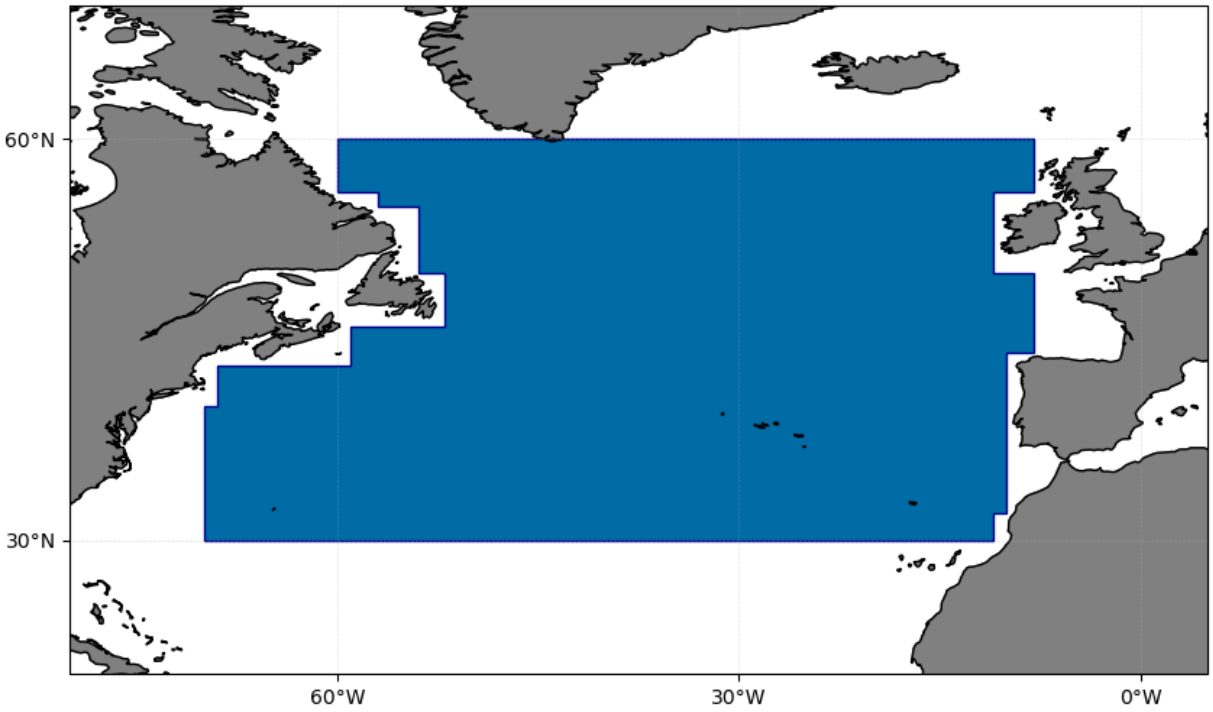

Figure 1: Definition of the extent of the North Atlantic

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Table 1: Probability of sea-states in the North Atlantic described as occurrence per 100,000 observations.

Significant wave height, H_S (m)	Mean wave period, T_{0m1} (s)																Sum
	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	
0.5	6.82	202.00	333.61	187.76	45.59	4.74	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	780.73
1.5	0.33	2028.35	12750.82	11693.39	7215.76	3006.80	846.07	160.77	20.63	1.79	0.10	0.00	0.00	0.00	0.00	0.00	37724.81
2.5	0.00	3.38	2805.81	8517.74	7835.85	5885.37	3608.30	1805.81	737.71	246.00	66.96	14.88	2.70	0.40	0.05	0.00	31530.96
3.5	0.00	0.00	23.06	2742.51	4666.81	4100.83	2936.41	1713.38	814.68	315.65	99.66	25.64	5.38	0.92	0.13	0.01	17445.07
4.5	0.00	0.00	0.00	82.06	1759.81	2069.19	1715.42	1151.29	625.51	275.12	97.96	28.24	6.59	1.24	0.19	0.02	7812.64
5.5	0.00	0.00	0.00	0.08	149.74	811.81	791.81	609.66	375.67	185.26	73.12	23.09	5.84	1.18	0.19	0.02	3027.47
6.5	0.00	0.00	0.00	0.00	1.02	147.59	305.37	271.71	190.23	104.79	45.42	15.49	4.16	0.88	0.15	0.02	1086.83
7.5	0.00	0.00	0.00	0.00	0.00	4.77	88.62	107.20	86.26	53.35	25.36	9.27	2.60	0.56	0.09	0.01	378.09
8.5	0.00	0.00	0.00	0.00	0.00	0.02	9.40	38.70	36.80	25.95	13.63	5.33	1.55	0.34	0.05	0.01	131.78
9.5	0.00	0.00	0.00	0.00	0.00	0.00	0.20	9.34	15.15	12.51	7.39	3.12	0.94	0.20	0.03	0.00	48.88
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	5.73	5.96	4.08	1.90	0.60	0.13	0.02	0.00	19.23
11.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.29	2.68	2.23	1.18	0.40	0.08	0.01	0.00	7.89
12.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.01	1.14	0.72	0.27	0.06	0.01	0.00	3.32
13.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.51	0.42	0.18	0.04	0.00	0.00	1.37
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.19	0.21	0.12	0.03	0.00	0.00	0.57
15.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.07	0.02	0.00	0.00	0.22
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.01	0.00	0.00	0.08
17.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.04
18.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02
Sum	7.15	2233.73	15913.30	23223.54	21674.58	16031.12	10301.81	5868.69	2909.77	1230.31	437.79	129.62	31.47	6.11	0.92	0.09	100000.00

The H_s and T_{0m1} values are class midpoints. $T_{0m1} = 2\pi \frac{m_{-1}}{m_0}$, where m_n is the spectral moment of order n.

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6. JONSWAP wave spectrum with γ=1.5 is recommended for the North Atlantic, described by the following expression:

$$S(\omega) = \alpha\, S_{PM}(\omega)\, \gamma^{\exp\left[-\frac{(\omega/\omega_p - 1)^2}{2\sigma^2}\right]}$$

Where:

$S_{PM}(\omega)$ is the Bretschneider or two-parameter Pierson-Moskowitz spectrum, expressed as follows:

$$S_{PM}(\omega) = \frac{5}{16} H_s^2 \left(\frac{2\pi}{T_p}\right)^4 \omega^{-5} \exp\left[-\frac{5}{4}\left(\frac{2\pi}{T_p}\right)^4 \omega^{-4}\right]$$

γ is the non-dimensional peak shape parameter, taken as 1.5

α is the normalizing factor, may be taken as $\frac{1}{5}\left(\frac{1}{0.1160+0.0594\sqrt{\gamma}+0.0246\,\gamma}\right)$

H_s is the significant wave height [m]

ω is the angular wave frequency [rad/s]

ω_p is the peak angular frequency [rad/s]

T_p is the peak wave period (s)

$$\sigma = \begin{cases} 0.07 \text{ for } \dfrac{\omega}{\omega_p} \le 1 \\ 0.09 \text{ for } \dfrac{\omega}{\omega_p} > 1 \end{cases}$$

The relationship between the mean wave period, T_{0m1} in the scatter diagram in Table 1 and the peak wave period T_p can be evaluated by the following equation:

$$T_{0m1} = (0.7757 + 0.0965\sqrt{\gamma} - 0.0144\,\gamma)T_p$$

7. It is recommended to use a wave directional spreading, defined as follows:

$$S_w(\omega, \theta) = S(\omega) * G(\theta)$$

Where:

$G(\theta)$ is the spreading function, given by the following equation:

$$G(\theta) = k\cos^n(\theta - \theta_0), -\frac{\pi}{2} \le (\theta - \theta_0) \le \frac{\pi}{2}$$

θ_0 is the mean wave direction

θ is the wave direction at which the spectrum is evaluated

n is the cosine spreading power, recommended value is 3

k is the normalisation factor, expressed as follows:

$$k = \frac{\Gamma(\frac{n}{2}+1)}{\sqrt{\pi}\Gamma(\frac{n}{2}+\frac{1}{2})}$$

Γ is the Gamma function. k = ¾ for n = 3

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8. For evaluation of the design wave loads for strength assessment, it is recommended to use a speed of 5 knots. It is noted that it may be necessary to apply a higher speed when evaluating roll related responses for vessels with very low metacentric height and operating without reduced speed in stern quartering seas. Furthermore, 75% of the design speed is recommended for evaluation of design wave loads for fatigue assessment.

9. In long-term predictions, all wave headings (0-360 deg) can be assumed to have an equal probability of occurrence and at most 30 deg spacing between headings should be applied.

References

1. Technical Background for IACS Recommendation 34 (Rev.2 Dec 2022).

2. Technical Background Rule Reference for IACS Common Structural Rules for Bulk Carriers and Oil Tankers (01 Jan 2020).

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