Accidental oil outflow performance: Regulation 23

1. This regulation shall apply to oil tankers delivered on or after 1 January 2010, as defined in regulation 1.28.8.
2. For the purpose of this regulation, the following definitions shall apply:
    1. *Loadline draught* (d_s) is the vertical distance, in metres, from the moulded baseline at mid-length to the waterline corresponding to the summer freeboard to be assigned to the ship. Calculations pertaining to this regulation should be based on draught d_s, notwithstanding assigned draughts that may exceed ds, such as the tropical load line.
    2. *Waterline* (d_B) is the vertical distance, in metres, from the moulded baseline at mid-length to the waterline corresponding to 30 of the depth D_s.
    3. *Breadth* (B_s) is the greatest moulded breadth of the ship, in metres, at or below the deepest load line draught d_s.
    4. *Breadth* (B_B) is the greatest moulded breadth of the ship, in metres, at or below the waterline d_B.
    5. *Depth* (D_s) is the moulded depth, in metres, measured at mid-length to the upper deck at side.
    6. *Length* (L) and deadweight (DW) are as defined in regulations 1.19 and 1.23, respectively.

4. The following general assumptions shall apply when calculating the mean oil outflow parameter:
    1. The cargo block length extends between the forward and aft extremities of all tanks arranged for the carriage of cargo oil, including slop tanks.
    2. Where this regulation refers to cargo tanks, it shall be understood to include all cargo tanks, slop tanks and fuel tanks located within the cargo block length.
    3. The ship shall be assumed loaded to the load line draught d_s without trim or heel.
    4. All cargo oil tanks shall be assumed loaded to 98% of their volumetric capacity.
    5. For the purposes of these outflow calculations, the permeability shall be taken as 0.99, unless proven otherwise.

5. The following assumptions shall be used when combining the oil outflow parameters:

1. The mean oil outflow shall be calculated independently for side damage and for bottom damage and then combined into the non-dimensional oil outflow parameter O_M, as follows:

$$O_M \frac{0.4\ O_{Ms} + 0.6 O_{MB}}{C}$$

Where:

O_{MS} = mean outflow for side damage, in m^3; and

O_{MB} = mean outflow for bottom damage, in m^3.

2. For bottom damage, independent calculations for mean outflow shall be done for 0 m and minus 2.5 m tide conditions, and then combined as follows:

$$O_{MB} = 0.7\ O_{MB(0)} + 0.3\ O_{MB(2.5)}$$

Where:

$O_{MB(0)}$ = mean outflow for 0 m tide condition; and

$O_{MB(2.5)}$ = mean outflow for minus 2.5 m tide condition, in m^3.'

6. The mean outflow for side damage O_{MS} shall be calculated as follows:

$$O_{MS} = C_3 \sum_{i}^{n} P_{s(i)} O_{s(i)} \qquad (m^3)$$

Where:

i represents each cargo tank under consideration;

n = total number of cargo tanks;

$P_{s(i)}$ = the probability of penetrating cargo tank *i* from side damage

$O_{s(i)}$ = the outflow, in m^3, from side damage to cargo tank *i*, which is assumed equal to the total volume in cargo tank *i* at 98% filling, unless it is proven through the application of the Guidelines referred to in regulation 19.5 that any significant cargo volume will be retained; and

C_3 = 0.77 for ships having two longitudinal bulkheads inside the cargo tanks, provided these bulkheads are continuous over the cargo block and $P_{s(i)}$ us developed in accordance with this regulation. C_3 equals 1.0 for all other ships or when $P_{s(i)}$ is developed in accordance with paragraph 10 of this regulation.

7. The mean outflow for bottom damage shall be calculated for each tidal condition as follows:

   1. $O_{\mathrm{MB}(0)} = \sum_i^n P_{B(i)} O_{B(i)} C_{DB(i)}$ (m^3)

      Where:

      i represents each cargo tank under consideration;

      n = the total number of cargo tanks;

      $P_{B(i)}$ = the probability of penetrating cargo tank I from bottom damage, calculated in accordance with paragraph 9.1 of this regulation;

      $O_{B(i)}$ = the outflow from cargo tank I, in m^3, calculated in accordance with paragraph 7.3 of this regulation; and

      $C_{DB(i)}$ = factor to account for oil capture as defined in paragraph 7.4 of this regulation

8. The probability P_S of breaching a compartment from side damage shall be calculated as follows:

   1. $P_S = P_{SL} \bullet P_{Sv} \bullet P_{ST}$

      where:

      P_{SL} = 1 - P_{Sf} – P_{Sa} = probability the damage will extend into the longitudinal zone bounded by X_a and X_f;

      P_{Sv} = 1 - P_{Su} – P_{Sl} = probability the damage will extend into the vertical zone bounded by Z_l and Z_u; and

      P_{ST} = 1 - P_{Sy} = probability the damage will extend transversely beyond the boundary defined by *y*.

2. P_{Sa}, P_{Sf}, P_{Sl}, P_{Su} and P_{Sy} shall be determined by linear interpolation from the tables of probabilities for side damage provided in this regulation, where:

P_{Sa} = the probability the damage will lie entirely aft of location $\frac{X_a}{L}$;

P_{Sf} = the probability the damage will lie entirely forward of location $\frac{X_f}{L}$;

P_{Sl} = the probability the damage will lie entirely below the tank;

P_{Su} = the probability the damage will lie entirely above the tank; and

P_{Sy} = the probability the damage will lie entirely outboard of the tank.

Compartment boundaries X_a, X_f, Z_l, Z_u and y shall be developed as follows:

X_a = the longitudinal distance from the aft terminal of L to the aftmost point on the compartment being considered, in metres;

X_f = the longitudinal distance from the aft terminal of L to the foremost point on the compartment being considered, in metres;

Z_l = the vertical distance from the moulded baseline to the lowest point on the compartment being considered, in metres;

Z_u = the vertical distance from the moulded baseline to the highest point on the compartment being considered, in metres. Z_u is not to be taken greater than D_s; and

y = the minimum horizontal distance measured at right angles to the centreline between the compartment under consideration and the side shell, in metres;

3.

$\frac{X_a}{L}$	P_{Sa}
0.00	0.000
0.05	0.023
0.10	0.068
0.15	0.117
0.20	0.167
0.25	0.217
0.30	0.267
0.35	0.317
0.40	0.367
0.45	0.417
0.50	0.467

$\frac{X_f}{L}$	P_{Sf}
0.00	0.967
0.05	0.917
0.10	0.867
0.15	0.817
0.20	0.767
0.25	0.717
0.30	0.667
0.35	0.617
0.40	0.567
0.45	0.517
0.50	0.467

$\frac{Z_l}{D_s}$	P_{Sl}
0.00	0.000
0.05	0.000
0.10	0.001
0.15	0.003
0.20	0.007
0.25	0.013
0.30	0.021
0.35	0.034
0.40	0.055
0.45	0.085
0.50	0.123

$\frac{Z_u}{D_s}$	P_{Su}
0.00	0.968
0.05	0.952
0.10	0.931
0.15	0.905
0.20	0.873
0.25	0.836
0.30	0.789
0.35	0.733
0.40	0.670
0.45	0.599
0.50	0.525

0.55	0.517	0.55	0.417	0.55	0.172	0.55	0.452
0.60	0.567	0.60	0.367	0.60	0.226	0.60	0.383
0.65	0.617	0.65	0.317	0.65	0.285	0.65	0.317
0.70	0.667	0.70	0.267	0.70	0.347	0.70	0.255
0.75	0.717	0.75	0.217	0.75	0.413	0.75	0.197
0.80	0.767	0.80	0.167	0.80	0.482	0.80	0.143
0.85	0.817	0.85	0.117	0.85	0.553	0.85	0.092
0.90	0.867	0.90	0.068	0.90	0.626	0.90	0.046
0.95	0.917	0.95	0.023	0.95	0.700	0.95	0.013
1.00	0.967	1.00	0.000	1.00	0.775	1.00	0.000

9. The probability P_B of breaching a compartment from bottom damage shall be calculated as follows:

   1. $P_B = P_{BL}P_{BT}P_{BV}$

   Where

   P_{BL} = 1 - P_{Bf} - P_{Ba} = probability the damage will extend into the longitudinal zone bounded by X_a and X_f;

   P_{BT} = 1 - P_{Bp} - P_{Bs} = probability the damage will extend into the transverse zone bounded by Y_p and Y_s; and

   P_{BV} = 1 - P_{Bz} = probability the damage will extend vertically above the boundary defined by z.

   2. P_{Ba}, P_{Bf}, P_{Bp}, P_{Bs}, and P_{Bz} shall be determined by linear interpolation from the tables of probabilities for bottom damage provided in paragraph 9.3 of this regulation, where:

   P_{Ba} = the probability the damage will lie entirely aft of location $\frac{X_a}{L}$,

   P_{Bf} = the probability the damage will lie entirely forward of location X_f/L;

   P_{Bp} = the probability the damage will lie entirely to port of the tank;

   P_{Bs} = the probability the damage will lie entirely to starboard of the tank; and

   P_{Bz} = the probability the damage will lie entirely below the tank.

Compartment boundaries X_a, X_f, Y_p, Y_s, and z shall be developed as follows:

X_a and X_f are as defined in paragraph 8.2 of this regulation;

Y_p = the transverse distance from the port-most point on the compartment located at or below the waterline d_B, to a vertical plane located $B_B/2$ to starboard of the ship's centreline, in metres;

Y_s = the transverse distance from the starboard-most point on the compartment located at or below the waterline d_B, to a vertical plane located $B_B/2$ to starboard of the ship's centreline, in metres; and

z = the minimum value of z over the length of the compartment, where, at any given longitudinal location, z is the vertical distance from the lower point of the bottom shell at that longitudinal location to the lower point of the compartment at that longitudinal location, in metres.

3. Tables of probabilities for bottom damage

$\frac{X_a}{L}$	P_{Ba}
0.00	0.000
0.05	0.002
0.10	0.008
0.15	0.017
0.20	0.029
0.25	0.042
0.30	0.058
0.35	0.076
0.40	0.096
0.45	0.119
0.50	0.143
0.55	0.171
0.60	0.203
0.65	0.242
0.70	0.289
0.75	0.344
0.80	0.409
0.85	0.482
0.90	0.565
0.95	0.658
1.00	0.761

$\frac{X_f}{L}$	P_{Bf}
0.00	0.969
0.05	0.953
0.10	0.936
0.15	0.916
0.20	0.894
0.25	0.870
0.30	0.842
0.35	0.810
0.40	0.775
0.45	0.734
0.50	0.687
0.55	0.630
0.60	0.563
0.65	0.489
0.70	0.413
0.75	0.333
0.80	0.252
0.85	0.170
0.90	0.089
0.95	0.026
1.00	0.000

$\frac{Y_p}{B_B}$	P_{Bp}
0.00	0.844
0.05	0.794
0.10	0.744
0.15	0.694
0.20	0.644
0.25	0.594
0.30	0.544
0.35	0.494
0.40	0.444
0.45	0.394
0.50	0.344
0.55	0.297
0.60	0.253
0.65	0.211
0.70	0.171
0.75	0.133
0.80	0.097
0.85	0.063
0.90	0.032
0.95	0.009
1.00	0.000

$\frac{Y_s}{B_B}$	P_{Bs}
0.00	0.000
0.05	0.009
0.10	0.032
0.15	0.063
0.20	0.097
0.25	0.133
0.30	0.171
0.35	0.211
0.40	0.253
0.45	0.297
0.50	0.344
0.55	0.394
0.60	0.444
0.65	0.494
0.70	0.544
0.75	0.594
0.80	0.644
0.85	0.694
0.90	0.744
0.95	0.794
1.00	0.844