Aquafax

Inboard

How to Calculate the Rudder Torque of your Boat

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When the torque necessary to manoeuvre a boat is not specified by a naval architect nor by the shipbuilders yard, it can be calculated as follows:

It must be known that the torque necessary to manoeuvre the boat depends on:

- The speed of the water flowing on the surface of the rudder at a certain angle
- The rudder size
- The total sweep of the rudder (& part of the boat when the rudder shaft is not perpendicular)
- The compensating service

ULTRAFLEX METHOD

The torque calculation for a maximum speed of about 25 knotts:

$$T = S \times [(0.4a)-b] \times V^2 \times k$$

T = Torque in kgm
S = Total surface area of the rudder in M^2 (h x a)
h = Height of the rudder in M
a = Width of the rudder in M
b = The value of the compensation in M
V = Speed of the boat in knots

k = Coefficient according to the total angle of the rudder

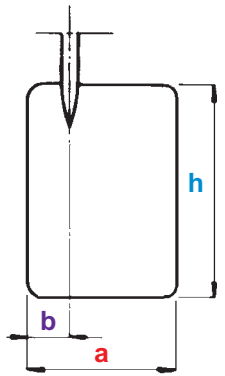
Port to Starboard 50°	k = 10.84
Port to Starboard 60°	k = 13.01
Port to Starboard 70°	**k = 15.89**
Port to Starboard 80°	k = 17.80
Port to Starboard 90°	k = 19.52

Straightening according to type of boat:

- For boats equipped with jet engines	T x 1.3
- For power boats with two engines and one rudder	T x 0.5
- For sailboats	T x 0.5
- For twin rudders	**T x 2**

Ultraflex Calculation Example

Assume a rudder with:
Height of **0.5m (h)**
Overall width of **0.35m (a)**
Balance of **0.10m (b)**
Maximum boat speed = **22 knots**
port to Starboard = **70°**



The maximum torque on the rudder blade is given by:
$T = S \times [(0.4a)-b] \times V^2 \times k$
$T = S \times (0.4a-b) \times V^2 \times 15.89$
$T = (0.5 \times 0.35) \times [(0.4 \times 0.35) - 0.10] \times 22^2 \times 15.89$
$T = 0.175 \times 0.04 \times 484 \times 15.89$
T = 53.9kgm

Assuming twin rudders
Maximum steering torque = (53.9 x 2) = 107.8kgm
Therefore the appropriate cylinder = 4-48034 (max torque rating of 111kgm)

BCS METHOD

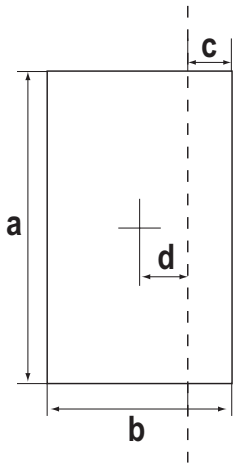
a = Height of Rudder
b = Width of Rudder
c = Balance of Rudder
d = Centre of Pressure
S = Force
V = Speed of Boat
A = Surface area of Rudder

$d = (0.372 \times b) - c$
$S = 8.16 \times V^2 \times A$

MT = Torque per rudder in kgm = S x d

BCS Calculation Example

Assume a rudder with:
Height of **1.10m (a)**
Overall width of **0.65m (b)**
Balance of **0.21m (c)**
Maximum boat speed = **18 knots**



The maximum torque on the rudder blade is given by:
d = (0.372 x 0.65) - 0.21 = 0.03
A = 1.10 x 0.65 = 0.71m
S = 8.16 x 324 x 0.71 = 1877.12

MT = 1877.12 x 0.03 = **56.31kgm**

Assuming twin rudders
MT = 2 x 56.31 = **112.62kgm**

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