HOW TO CHOOSE THE CORRECT BOW THRUSTER

THE INFLUENCE OF THE WIND
The force applied to the boat by the wind is determined by wind speed and direction, and the lateral wind draft area of the boat. When the wind speed rises, the wind pressure increases exponentially. The shape and the dimensions of the boat profile about the waterline (the topsides and superstructure) determine the lateral wind draft area. A streamlined hull and superstructure offer less resistance to the wind and a streamlining reduction factor of 0.75 is applied, when calculating the wind pressure.

<table>
<thead>
<tr>
<th>Wind speed knots</th>
<th>Description</th>
<th>Wind speed ft/s</th>
<th>Wind pressure lbf/sq.ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 - 16</td>
<td>moderate breeze</td>
<td>17 - 27</td>
<td>0.40 - 1</td>
</tr>
<tr>
<td>16 - 22</td>
<td>fresh breeze</td>
<td>27 - 37</td>
<td>1 - 1.9</td>
</tr>
<tr>
<td>22 - 28</td>
<td>strong breeze</td>
<td>37 - 47</td>
<td>1.9 - 3.1</td>
</tr>
<tr>
<td>28 - 34</td>
<td>near gale</td>
<td>47 - 57</td>
<td>3.1 - 4.6</td>
</tr>
<tr>
<td>34 - 40</td>
<td>gale</td>
<td>57 - 67</td>
<td>4.6 - 6.3</td>
</tr>
</tbody>
</table>

THE WIND TORQUE
The torque is determined by multiplying the wind force by the distance (A) between the centre of effort of the wind and the centre of rotation of the boat. For the vast majority of power boats and full keel sailboats, an approximate torque is calculated by multiplying the wind force by half of the boat’s length.

THE THRUST FORCE
It is the thrust force which determines the effectiveness of a bow thruster and not the output of the electric or hydraulic motor in kW or HP. The nominal thrust force is the result of the power of the motor, the shape of the propeller and the drag inside the tunnel. For direct current electric thrusters, battery size and condition, and cables length and gauge, will also affect the performance of the bow thruster. VETUS electrical bow thrusters have a very high thrust of between 28 and 38 lbf/ft. The required thrust force to counter the turning effect of the wind is calculated by dividing the the wind torque in foot pounds by the distance (B) between the centre of the bow thruster tunnel and pivot point of the boat in feet.

Calculation example
The boat has an overall length of 36 ft and the lateral wind draft measures 190 sq.ft. It is required that the bow can still be controlled easily when a wind force of 20 knots applies. At a wind force of 20 knots, the wind pressure is:

\[ p = 1.0 \text{ to } 1.9 \text{ lbf/sq.ft} \text{ i.e.p. (average) } 1.45 \text{ lbf/sq.ft}. \]

The required torque reads:

\[ T = \text{wind pressure} \times \text{wind draft} \times \text{reduction factor} \times \text{distance center of effort to pivot point}, (= \text{appr. half the ship’s length}) \]

\[ T = 1.45 \text{ lbf/sq.ft} \times 190 \text{ sq.ft} \times 0.75 \times 36 \text{ ft} = 3719 \text{ ft.lbs.} \]

The required thrust force is calculated as follows:

\[ F = \frac{\text{torque}}{\text{distance between center of bow thruster and the pivot point of the boat.} \ (\text{with the transom as pivot of the boat})} \]

\[ F = \frac{3719 \text{ ft.lbs.}}{34.5 \text{ ft.}} = 107.8 \text{ lbf} \]

The VETUS bow thruster which is most suitable for this particular vessel is the 121 lbf model (Beaufort 5), 55 lbf in case of Beaufort 4 and 165 lbf in case of Beaufort 6. Always bear in mind that the effective performance of a bow thruster will vary with each particular boat, as the displacement, the shape of the underwater section and the positioning of the bow thruster will always be variable factors. As a rule of thumb it can be assumed that the stern thruster may be “one model smaller” than the bow thruster model, as it has been calculated. Therefore, in this case a stern thruster type 77 lbf will be the correct model.

The effective voltage at the electric motor is dependent among other things, on the battery capacity, the internal resistance of the battery cables, battery switch and fuse, the ambient temperature, etc. The specified thrust force produced by VETUS electric bow thrusters is measured at an effective voltage of 10.5 or 21 Volts at the electric motor, for 12 or 24 Volt installations respectively.

Practical tests demonstrate that acoustic material type ARM can help to reduce bow thruster noise. A coat of ARM compound, or a layer of sheet material around the tunnel can reduce the sound level by about 3 dB(A). Two layers can create a reduction of up to 7 dB(A).