



Marine Safety Center Technical Note

MTN 01-01
16717/46 CFR 173
September 17, 2001

Subj: Towline Pull Criteria for Vessels Equipped with Z-Drives

Ref: (a) 46 CFR 173.095 (*Conventional Propellers and Kort Nozzles*)
(b) Marine Safety Manual, Vol. IV, Chap. 6, Section 6.E.2 (*Voith-Schneider Propellers*)

1. Purpose: This Technical Note provides clarification of the towline pull criterion requirements specified in 46 CFR 173.095.

2. Discussion:

a. The towline pull formulas listed in reference (a) were developed for vessels with conventional rudders and propellers. Because different propeller arrangements have been developed resulting in an increase in bollard pull, a need arose to modify the towline pull formulas to accurately reflect these changes. Reference (b) modified the formulas for Voith-Schneider type propulsion units and made the determination that reference (a) could be used for a vessel fitted with "Kort nozzles."

b. So called Z-Drive configurations, with fully directional propellers, eliminated rudders altogether. This made it difficult to use reference (a) since there was no way to calculate the 's' factor. Reference (b) was used until a more accurate method was developed. In 1996 a method was developed to more accurately reflect the bollard pull produced by the Z-Drive configuration. Until now, this method has not been clearly delineated to the public.

3. Applicability: The guidelines provided in this Technical Note apply to all U.S. flag towing vessels that are equipped with Z-Drive propulsion units.

4. Action: For vessels equipped with the Z-Drive configuration, the formulas outlined in reference (a) will be used with a modification to the 's' factor. The 's' factor will be calculated as follows:

$$s = 1 + \cos(\theta) / 2$$

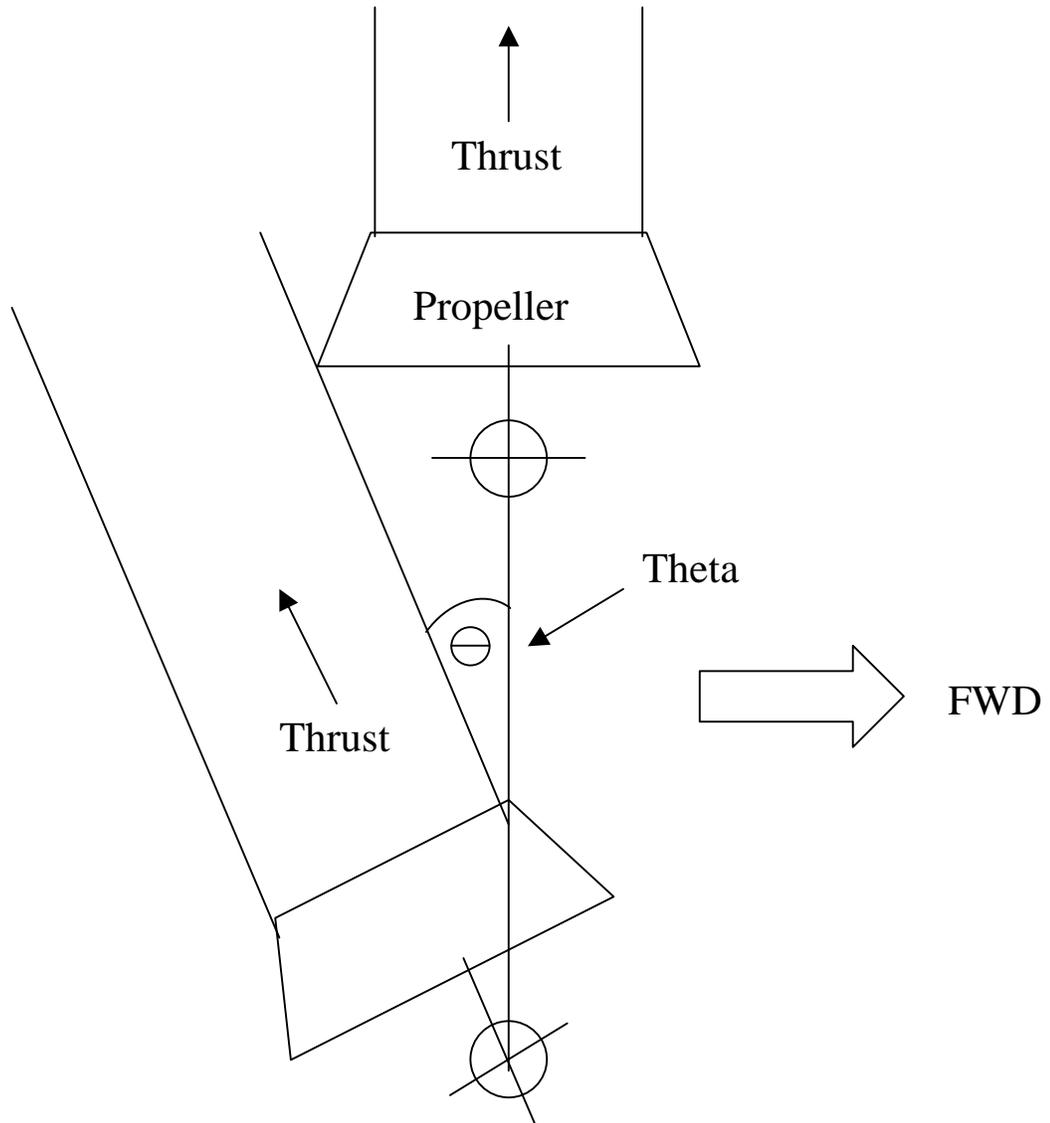
Theta is the offset angle between Z-Drive units that occurs when one unit is thrusting directly transverse and the other is directed so that its thrust flow tangentially intersects the nozzle of the first Z-Drive. (See Enclosure (1))

A. L. PEEK

Encl: (1) Z-Drive configuration

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$$S = \frac{1 + \cos \theta}{2}$$

Z-Drive Configuration

Enclosure (1)