

# Correlating $K_T/K_Q$ for Symmetric-section Propellers

## A HydroComp Technical Report

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### OVERVIEW

Certain "thruster-style" propellers are required to develop equal thrust in both the "ahead" and "astern" direction. These types of propellers do not have conventional blade sections (e.g., foil, ogival). Rather they have sections that are symmetrical in both the chord-wise direction (no skew) and in thickness (equal thickness distribution about the mid-chord with no camber). See the accompanying graphic for an example of this propeller type [Saunders, H.E., *Hydrodynamics in Ship Design*, Vol. 2, SNAME, 1957].

### PROPELLER PERFORMANCE

There is no systematic series available for propellers of this type (that we have found). However, in the reference cited above we have found model test and geometric data for one symmetric-section propeller. The propeller has the following specifications:

Blades	EAR	P/D	BTF	Rake	Skew	Hub/D
3	0.42	0.96	0.045	None	None	0.16

As the typical range of interest for these propellers in the low-speed, high-thrust regime (the so-called "bollard" condition), we limited our investigation to the lowest J-values which were tested (0.20 was the lowest J). This information will allow us to derive correlation multipliers that can be used in either NavCad ( $K_T$  and  $K_Q$  multipliers) or PropExpert (T and P factors).

### CORELATION TO THE B-SERIES

We looked at all of the available open-wheel propeller series and determined that the B-series gave the most consistent correlation. The following table shows the results of this investigation at two J-values:

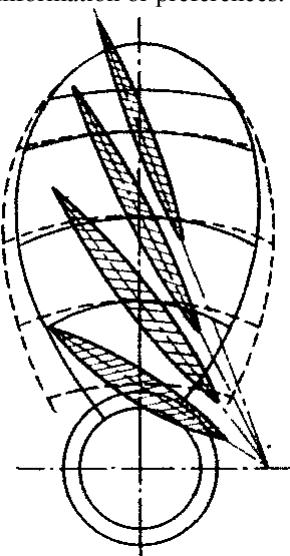
J	Prop $K_T$	B-series $K_T$	$K_T$ ratio	Prop $K_Q$	B-series $K_Q$	$K_Q$ ratio
0.20	0.290	0.321	0.903	0.0429	0.0448	0.958
0.30	0.258	0.292	0.883	0.0390	0.0414	0.942

### SUMMARY

Based on this information, a strategy for modeling symmetric-section propellers at the low-speed, high-thrust condition is:

- B-series propeller
- Thrust correlation factor = 0.90  
NavCad:  $K_T$  multiplier, PropExpert: T factor
- Torque/power correlation factor = 0.96  
NavCad:  $K_Q$  multiplier, PropExpert: P factor

Please remember that this analysis was performed for one propeller of one particular geometry (e.g., 3 blades, 0.42 EAR). Therefore, as with all design data, this information is subject to a designer's own information or preferences.



HydroComp, Inc.  
13 Jenkins Ct, Suite 200  
Durham, NH 03824 USA  
Tel (603)868-3344  
Fax (603)868-3366  
[info@hydrocompinc.com](mailto:info@hydrocompinc.com)  
[www.hydrocompinc.com](http://www.hydrocompinc.com)