Propeller Design

WOLFSON UNIT SOFTWARE©

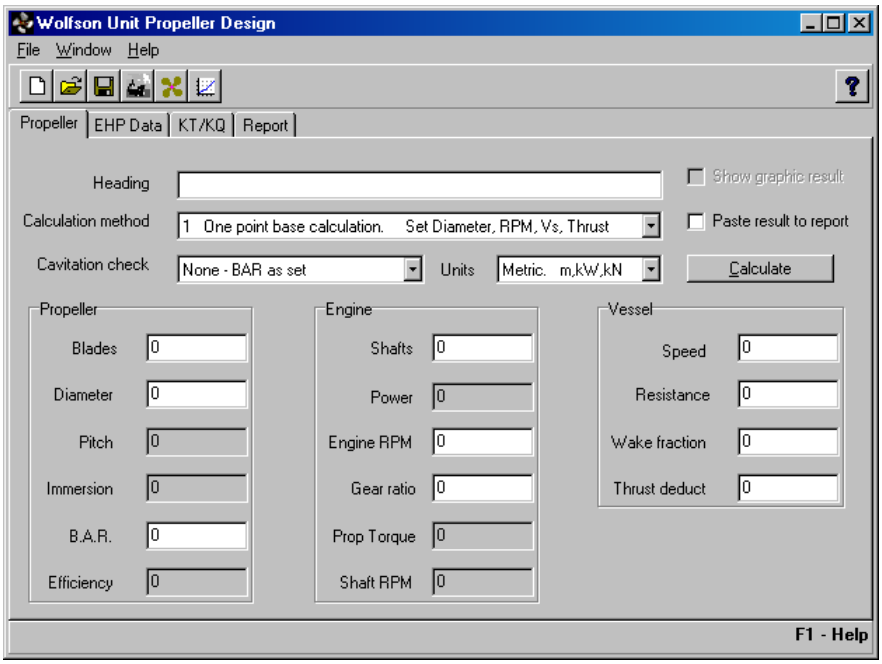
PROPELLER DESIGN PROGRAM

The Propeller Design Program computes propeller performance, using various design and off-design methods, from standard Gawn and Wageningen B-series propeller charts or propeller data input by the user. Data for Kaplan propellers operating in nozzles are also provided. The program provides a rapid means of designing a propeller or investigating the influence on performance and efficiency of various design parameters.

For each propeller, data are held as a series of KT and KQ versus J curves, one curve for each Pitch/Diameter ratio. The program's method of calculation is based upon locating data points within the KT-KQ-J curves. At the core of the process is a cubic spine fitting and interpolation routine, which allows cross-plotting from a known J and KT to determine the P/D ratio and KQ value. Various analysis methods can be used, depending on the propulsion data available and the propeller characteristics required. Resistance and propulsion data can be transferred from the Power Prediction Program or pasted from spreadsheets or other documents.

The screen is divided into four main areas, a menu, a toolbar, a tabbed notebook and a status line:-

Data entry and editing, occurs in the **Tabbed Notebook** area, which is split into four pages:



Propeller. Contains the main data for the propeller, engine installation, and speed and resistance at the design point.

EHP Data. Allows for entry of resistance characteristics over a range of speeds.

KT/KQ. Allows access to the KT/KQ/J data upon which the calculations are based. Data can be viewed graphically.

Report page. The results of calculations may be copied to the report page, which can then be edited and printed.

Figure 1 – Propeller page

The program's method of calculation is based on locating data points within the KT-KQ-J curves. By operating this procedure in ordered sequences, the program can provide a number of different approaches to the problems of design and off-design propeller calculations. The user is able to examine the application of various standard series propellers provided with the program which can be loaded into the computer and examined in the light of the required input. Output data can then be viewed on the screen or printer.

Depending on the specific requirements, the user, having loaded propeller data, can choose one of the design methods and carry out the calculations. In each case the program accepts input parameters, determines the position within the series data, and outputs the variables that were unknown.

If one of the cavitation checks is specified the program carries out an approximate cavitation check using a Burrill cavitation limit line, in order to determine the minimum blade area to avoid cavitation. The primary object of the cavitation check is to ensure that the correct propeller chart data are used in the design calculations. For example, an initial design estimate, using an assumed BAR, will provide the input information necessary to carry out a preliminary cavitation/BAR check and thus choose the most suitable design charts for further calculations.

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FOR MARINE TECHNOLOGY & INDUSTRIAL AERODYNAMICS

ANALYSIS METHODS

	Input Parameters	Principal Outputs
Design Methods		
1	Diameter, RPM, Speed of Advance, Thrust	Pitch, Power, Efficiency
2	Diameter, RPM, Speed of Advance, Power	Pitch, Thrust, Efficiency
3	Diameter, Speed of Advance, Power	Pitch, Power, Optimum RPM, Efficiency
4	Diameter, Speed of Advance, Power	Pitch, Power, Optimum Gear Ratio, Efficiency
5	RPM, Speed of Advance, Thrust	Pitch, Power, Optimum Diameter, Efficiency
6	Diameter, RPM, Power, Thrust-Speed curve	Pitch, Speed of Advance, Efficiency
7	Diameter, Power, Thrust-Speed curve	Pitch, Speed of Advance, Optimum RPM, Efficiency
8	Diameter, Power, Thrust-Speed curve	Pitch, Speed of Advance, Optimum Gear Ratio, Efficiency
9	RPM, Power, Thrust-Speed curve	Pitch, Speed of Advance, Optimum Diameter, Efficiency
Off-Design Methods		
10	Diameter, Pitch, Speed of Advance, Thrust	RPM, Power, Efficiency
11	Diameter, Pitch, Power, Thrust-Speed curve	RPM, Speed of Advance, Efficiency
12	Diameter, Pitch, RPM, Thrust-Speed curve	Power, Speed of Advance, Efficiency
13	Diameter, Pitch, Torque, Thrust-Speed curve	RPM, Power, Speed of Advance, Efficiency

A propeller series can be defined by the user by specifying the values in a series of K_T and K_Q versus J charts, one chart for each value of Pitch/Diameter ratio.

REFERENCES

1. L. Troost, 'Open Water Tests with Modern Propeller Forms', *Transactions of the North East Coast Institute of Engineering and Shipbuilding*, Vol.67, 1950/1
2. R. Gawn, 'Effect of Pitch and Blade Width on Propeller Performance', *Transactions of the Royal Institution of Naval Architects*, Vol.95, 1953
3. R. Gawn and L. Burrill, 'Effect of Cavitation on the Performance of a Series of 16 Propellers', *Transactions of the Royal Institution of Naval Architects*, Vol.99, 1957

PRICE INFORMATION

Windows XP/Vista/7 32-bit and 64-bit: please see www.wolfsonunit.com/pricelist.html
Second copies available at 65%, subsequent copies at 50% of price. Educational discount of 33% on total price. Price includes full technical support from WUMTIA engineers.

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