



HX-400



HX-500



EPY



EQY



CY5



Marlin 4



Marlin 5



CX-400



CX-500



CX-600



CX-700



CX-800



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**ISO 9001:2000
Certified**



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CUSTOMER ANALYSIS INFORMATION SHEET

Date: _____

Name: _____ Company: _____ Project: _____

Address: _____ City/State/Zip: _____

Phone: _____ Fax: _____ E-mail: _____

Boat Information

Manufacturer: _____ Model: _____ New Model Existing Model Alternative Power Configuration

Overall Length (LOA): _____ Waterline Length (LWL): _____ Displacement: _____ Pockets: _____

Beam (B): _____ Draft: _____ LCG from Stern: _____

Deadrise Angle at Stern: _____ Running Trim Angle: _____ Shaft Inclination Angle: _____ Tunnels: _____

Distance: Shaft Centerline @ Propeller to Bottom: _____ Maximum Desired Propeller Diameter: _____ Blade #: _____

Distance: Shaft Centerline @ Propeller to Waterline: _____ Desired Vessel Speed: _____ Other: _____

Engine Information

Single: Twin: Triple Other

Manufacturer: _____ Model: _____ Year: _____ Diesel: Gas:

Horsepower RPM Horsepower RPM

Engine Rating: Shaft: _____ Continuous: _____ **Desired Engine RPM:** _____

Brake: _____ Intermittent: _____ Gear Reduction Ratio: _____

Information for Existing Propulsion System

Engine Information Single: Twin: Triple Other

Manufacturer: _____ Model: _____ Year: _____ Diesel: Gas:

Horsepower RPM Horsepower RPM

Engine Rating: Shaft: _____ Continuous: _____ Gear Reduction Ratio: _____

Brake: _____ Intermittent: _____

Propeller Information

Single: Twin: Triple Other

Manufacturer: _____ Model: _____ Diameter: _____ Pitch: _____ # Blades: _____

Material: Bronze Nickel Aluminum Bronze Stainless Steel Other TE Cup No TE Cup

RPM Speed

Performance: Full Throttle: _____ Vessel Displacement during performance run: _____

Cruise: _____

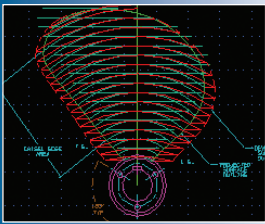
Shaft - Other Information

Shaft-Bore Diameter: _____ Full Taper Hub Requested

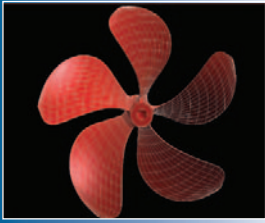
Wake fraction (Wf): _____

Notes:

X3.2693 Y-3.0562 Z-1.9022
X4.3099 Y-3.3319 Z-1.7785
X4.8743 Y-3.5222 Z-1.6848
X5.6172 Y-3.7509 Z-1.5638
X6.2813 Y-3.9317 Z-1.4566
X6.9790 Y-4.0939 Z-1.3413
X7.5947 Y-4.2101 Z-1.2347
X8.2515 Y-4.3036 Z-1.1141
X8.6217 Y-4.3417 Z-1.0426
X9.0418 Y-4.3687 Z-0.9574
X9.4296 Y-4.3787 Z-0.8748
X9.9384 Y-4.3751 Z-0.7618
X10.6301 Y-4.3388 Z-0.6100
X10.8427 Y-4.3314 Z-0.5548
X11.0942 Y-4.3318 Z-0.5091
X11.3882 Y-4.3493 Z-0.4686
X11.5180 Y-4.3684 Z-0.4589
X11.6256 Y-4.3956 Z-0.4584
X11.6813 Y-4.4155 Z-0.4617
X11.7627 Y-4.4536 Z-0.4725
X11.8273 Y-4.4947 Z-0.4851
X11.8754 Y-4.5366 Z-0.4977
X11.9121 Y-4.5830 Z-0.5103
X11.9386 Y-4.6344 Z-0.5229
X11.9830 Y-4.7926 Z-0.6000
X12.0297 Y-5.0572 Z-0.7000
X12.0714 Y-5.2200 Z-0.8000
X12.1164 Y-5.3800 Z-0.9000
X12.1421 Y-5.5400 Z-1.0000
X12.1550 Y-5.7000 Z-1.1000
X12.1600 Y-5.8600 Z-1.2000
X12.1650 Y-6.0200 Z-1.3000
X12.1700 Y-6.1800 Z-1.4000
X12.1750 Y-6.3400 Z-1.5000
X12.1800 Y-6.5000 Z-1.6000
X12.1850 Y-6.6600 Z-1.7000
X12.1900 Y-6.8200 Z-1.8000
X12.1950 Y-6.9800 Z-1.9000
X12.2000 Y-7.1400 Z-2.0000
X12.2050 Y-7.3000 Z-2.1000
X12.2100 Y-7.4600 Z-2.2000
X12.2150 Y-7.6200 Z-2.3000
X12.2200 Y-7.7800 Z-2.4000
X12.2250 Y-7.9400 Z-2.5000
X12.2300 Y-8.1000 Z-2.6000
X12.2350 Y-8.2600 Z-2.7000
X12.2400 Y-8.4200 Z-2.8000
X12.2450 Y-8.5800 Z-2.9000
X12.2500 Y-8.7400 Z-3.0000
X12.2550 Y-8.9000 Z-3.1000
X12.2600 Y-9.0600 Z-3.2000
X12.2650 Y-9.2200 Z-3.3000
X12.2700 Y-9.3800 Z-3.4000
X12.2750 Y-9.5400 Z-3.5000
X12.2800 Y-9.7000 Z-3.6000
X12.2850 Y-9.8600 Z-3.7000
X12.2900 Y-10.0200 Z-3.8000
X12.2950 Y-10.1800 Z-3.9000
X12.3000 Y-10.3400 Z-4.0000
X12.3050 Y-10.5000 Z-4.1000
X12.3100 Y-10.6600 Z-4.2000
X12.3150 Y-10.8200 Z-4.3000
X12.3200 Y-10.9800 Z-4.4000
X12.3250 Y-11.1400 Z-4.5000
X12.3300 Y-11.3000 Z-4.6000
X12.3350 Y-11.4600 Z-4.7000
X12.3400 Y-11.6200 Z-4.8000
X12.3450 Y-11.7800 Z-4.9000
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X12.3550 Y-12.1000 Z-5.1000
X12.3600 Y-12.2600 Z-5.2000
X12.3650 Y-12.4200 Z-5.3000
X12.3700 Y-12.5800 Z-5.4000
X12.3750 Y-12.7400 Z-5.5000
X12.3800 Y-12.9000 Z-5.6000
X12.3850 Y-13.0600 Z-5.7000
X12.3900 Y-13.2200 Z-5.8000
X12.3950 Y-13.3800 Z-5.9000
X12.4000 Y-13.5400 Z-6.0000
X12.4050 Y-13.7000 Z-6.1000
X12.4100 Y-13.8600 Z-6.2000
X12.4150 Y-14.0200 Z-6.3000
X12.4200 Y-14.1800 Z-6.4000
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X12.4650 Y-15.6200 Z-7.3000
X12.4700 Y-15.7800 Z-7.4000
X12.4750 Y-15.9400 Z-7.5000
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X12.4850 Y-16.2600 Z-7.7000
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X12.5150 Y-17.2200 Z-8.3000
X12.5200 Y-17.3800 Z-8.4000
X12.5250 Y-17.5400 Z-8.5000
X12.5300 Y-17.7000 Z-8.6000
X12.5350 Y-17.8600 Z-8.7000
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X12.5450 Y-18.1800 Z-8.9000
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X12.5650 Y-18.8200 Z-9.3000
X12.5700 Y-18.9800 Z-9.4000
X12.5750 Y-19.1400 Z-9.5000
X12.5800 Y-19.3000 Z-9.6000
X12.5850 Y-19.4600 Z-9.7000
X12.5900 Y-19.6200 Z-9.8000
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X13.5300 Y-49.7000 Z-28.6000
X13.5350 Y-49.8600 Z-28.7000
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X13.8350 Y-59.4600 Z-34.7000
X13.8400 Y-59.6200 Z-34.8000
X13.8450 Y-59.7800 Z-34.9000
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X13.8650 Y-60.4200 Z-35.3000
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X13.8750 Y-60.7400 Z-35.5000
X13.8800 Y-60.9000 Z-35.6000
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X13.9150 Y-62.0200 Z-36.3000
X13.9200 Y-62.1800 Z-36.4000
X13.9250 Y-62.3400 Z-36.5000
X13.9300 Y-62.5000 Z-36.6000
X13.9350 Y-62.6600 Z-36.7000
X13.9400 Y-62.8200 Z-36.8000
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X13.9550 Y-63.3000 Z-37.1000
X13.9600 Y-63.4600 Z-37.2000
X13.9650 Y-63.6200 Z-37.3000
X13.9700 Y-63.7800 Z-37.4000
X13.9750 Y-63.9400 Z-37.5000
X13.9800 Y-64.1000 Z-37.6000
X13.9850 Y-64.2600 Z-37.7000
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X14.0400 Y-66.0200 Z-38.8000
X14.0450 Y-66.1800 Z-38.9000
X14.0500 Y-66.3400 Z-39.0000
X14.0550 Y-66.5000 Z-39.1000
X14.0600 Y-66.6600 Z-39.2000
X14.0650 Y-66.8200 Z-39.3000
X14.0700 Y-66.9800 Z-39.4000
X14.0750 Y-67.1400 Z-39.5000
X14.0800 Y-67.3000 Z-39.6000
X14.0850 Y-67.4600 Z-39.7000
X14.0900 Y-67.6200 Z-39.8000
X14.0950 Y-67.7800 Z-39.9000
X14.1000 Y-67.9400 Z-40.0000
X14.1050 Y-68.1000 Z-40.1000
X14.1100 Y-68.2600 Z-40.2000
X14.1150 Y-68.4200 Z-40.3000
X14.1200 Y-68.5800 Z-40.4000
X14.1250 Y-68.7400 Z-40.5000
X14.1300 Y-68.9000 Z-40.6000
X14.1350 Y-69.0600 Z-40.7000
X14.1400 Y-69.2200 Z-40.8000
X14.1450 Y-69.3800 Z-40.9000
X14.1500 Y-69.5400 Z-41.0000
X14.1550 Y-69.7000 Z-41.1000
X14.1600 Y-69.8600 Z-41.2000
X14.1650 Y-70.0200 Z-41.3000
X14.1700 Y-70.1800 Z-41.4000
X14.1750 Y-70.3400 Z-41.5000
X14.1800 Y-70.5000 Z-41.6000
X14.1850 Y-70.6600 Z-41.7000
X14.1900 Y-70.8200 Z-41.8000
X14.1950 Y-70.9800 Z-41.9000
X14.2000 Y-71.1400 Z-42.0000
X14.2050 Y-71.3000 Z-42.1000
X14.2100 Y-71.4600 Z-42.2000
X14.2150 Y-71.6200 Z-42.3000
X14.2200 Y-71.7800 Z-42.4000
X14.2250 Y-71.9400 Z-42.5000
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X14.2400 Y-72.4200 Z-42.8000
X14.2450 Y-72.5800 Z-42.9000



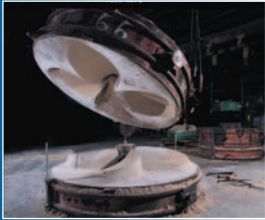
Computer Aided Design (CAD)



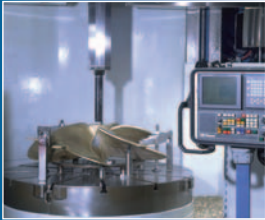
Final Design Model



All patterns are machined cut on computer driven CNC cutting mills. This assures that the design criteria will carry through to the propeller castings.



The use of "no bake" sand in molding Federal Propeller patterns result in extremely accurate castings.



State-of-the-art machining centers provide utmost accuracy in bore specifications - SAE or metric.



Computer driven CNC machine mill certain FEDERAL custom propellers exactly and consistently.



Sophisticated measurement recording instruments (Halé MRI) facilitate full documentation and perpetual record.

Michigan Wheel Corporation (MWC) is a propeller supplier to custom yacht manufacturers, production boat builders, and commercial shipyards around the world. For those that seek to optimize performance and efficiency, MWC is challenged with expanding propeller design and analysis capabilities. Optimized propeller fit does result in increased speeds, improved cruising range, and exceptional passenger comfort levels.

MWC's objective in appreciating and effecting "state of the art" propeller design and manufacture is to provide vessel owners with propellers that meet or exceed the design objectives of the designer and builder. With the "state of the art" objective, MWC offers the FEDERAL propeller series. The FEDERAL series is manufactured with particular emphasis on tolerance specifications. Each FEDERAL meets exacting tolerances, and is provided with complete inspection documentation.

Designers and builders have a variety of FEDERAL propeller options to choose from. These options range from traditional design standard series propellers manufactured to close tolerance, Equi-Poise/Equi-Quad; to custom adaptation of traditional design, EPX, EQX and HX series; to complete custom design EPY, EQY, CY5, CX, and MARLIN series propellers.

ENGINEERING

The FEDERAL propeller line concentrates on the application specific custom design and manufacturing efforts. A builder or designer will accept propeller suggestion based on the function/value ratio of component parts in attaining specific design criteria. The entire hull-propulsion system must be integrated. The Federal design team exists to work with designers and builders in the process of providing propellers that will meet expected criteria.

MANUFACTURING

Engineered manufacturing processes are employed in manufacturing FEDERAL product line to specific tolerances. Each segment of manufacture has strict control and documentation. This control assures that the end product will result in close interpretation of design. The specific design and tolerance level created for propellers on a particular application is determined by design expectations and analytical modeling of those expectations.

FEDERAL manufactures propellers to close tolerance. Aspects of the manufacture meet the recognizable standard of ISO 484/2, Class 1 and Class S. The intent of establishing tolerance on the FEDERAL line is to address the features most critical to end performance. 100% compliance with ISO standards, including development of specific thickness and edge gages, is exceptional. The control level of FEDERAL manufacture, particularly in the NC machine finished propeller product, calls into question the use of gages to verify aspects that are programmed into the manufacture. Michigan Wheel Corporation is ISO 9001:2000 Certified.

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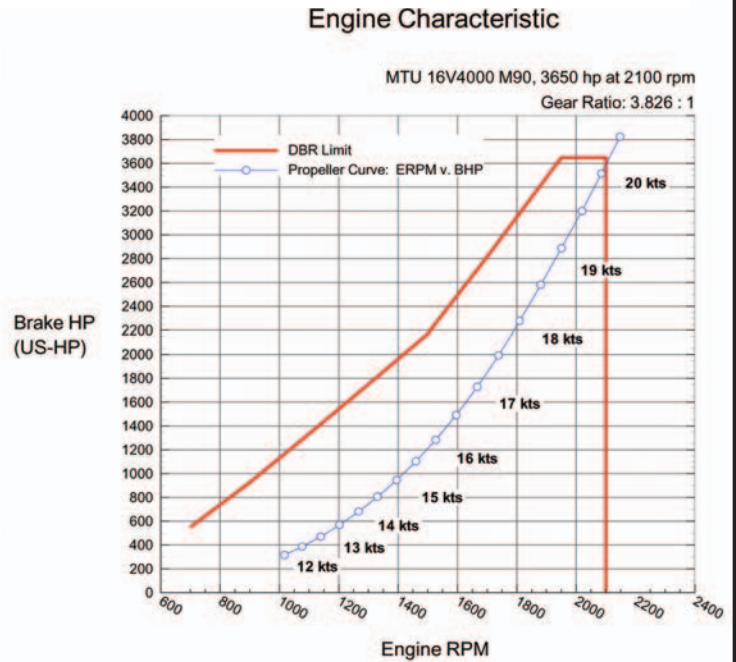
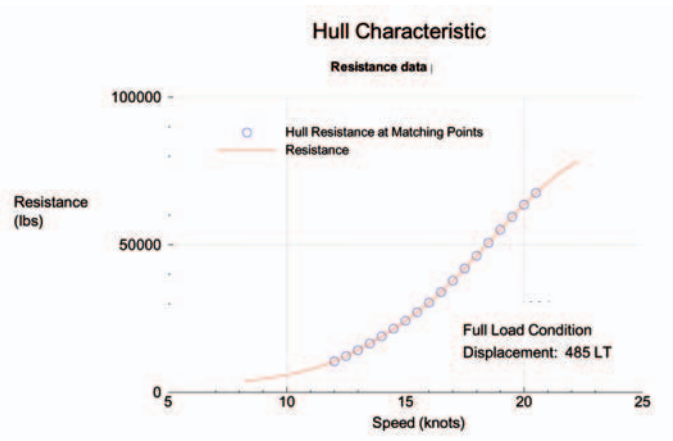
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MARLIN SERIES (MARLIN 4, MARLIN 5)	3
CX SERIES (CX-400, CX-500, CX-600, CX-700, CX-800)	4
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Federal Propeller

Design Considerations

In working with builders, the Federal design team utilizes a number of tools and programs to optimize suggested propeller design.

Hull and Engine characteristics are plotted against data provided by the Builder/boat designer and the engine companies:



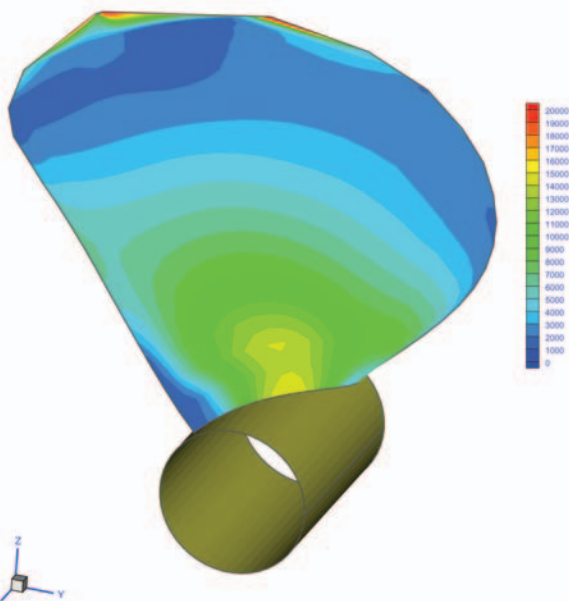
Consideration is given to the stresses on the propeller, in design:

68.0 x 62.0 CX-500, EAR = 1.00

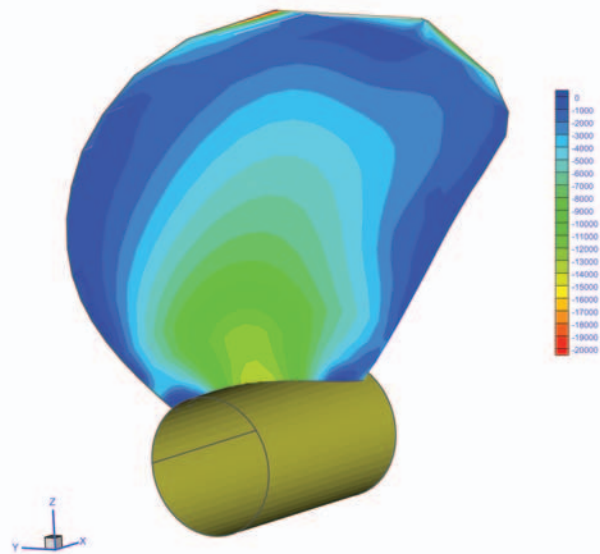


Structural Analysis (FEA)

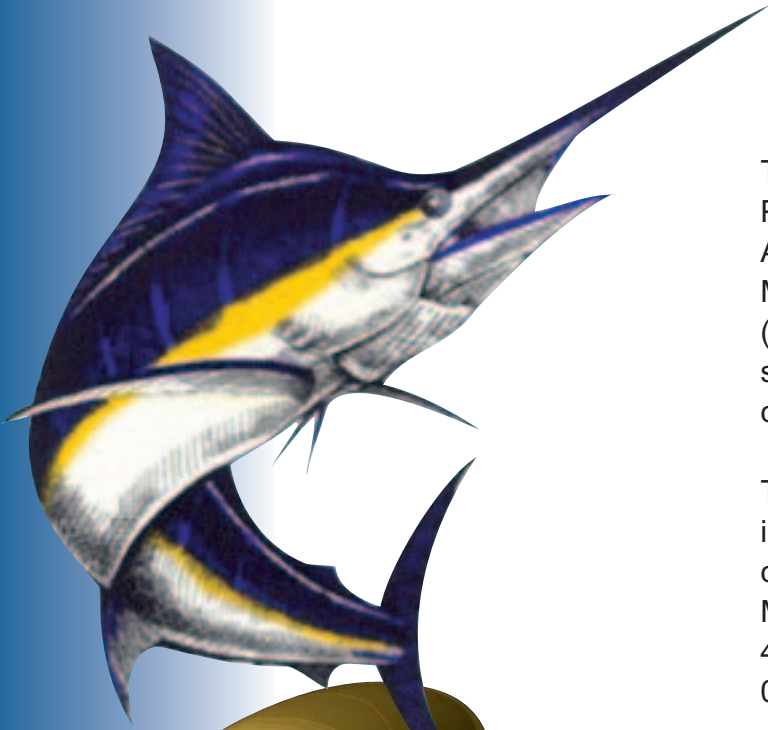
Face Tensile Stresses (psi)



Back Compressive Stresses (psi)



“MARLIN” SERIES



The MARLIN series is the result of a major R & D Program undertaken with Maritime Research Associates LLC (MRA), MTU Detroit Diesel, and the Maritime Research Institute of the Netherlands (MARIN). The applications are for high power/high speed Sportfish and Sportcruiser models that are capable of speeds into the high 40 knot range.

This series is primarily for NEW construction, involving Michigan Wheel at design, where consideration can be given to best appreciate of MARLIN configuration. The MARLIN propellers in 4-blade will range from 0.825 to 0.90 E.A.R., and 0.90 to 1.05 E.A.R. in 5-blade.

The MARLIN series design features variable pitch, camber, skew, and a degree of rake. All MARLIN are fully CNC machine finished to high tolerance. The purpose of the series, beyond optimizing performance, is to MANAGE cavitation.



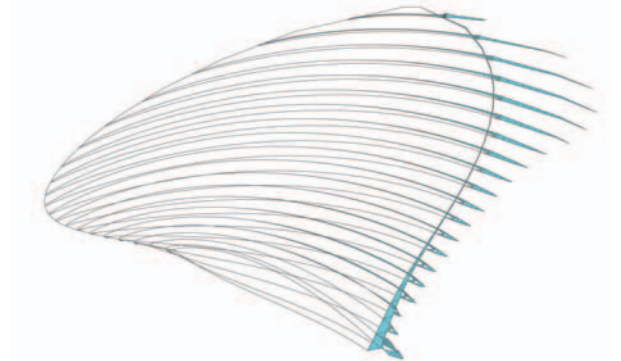
MARLIN 4



MARLIN 5

Design Cavitation Pattern

(Looking Spanwise: Hub to Tip)



JARRETT BAY 70
Photos courtesy of Robin Forti
Anderson

“CX” SERIES

The FEDERAL CX series propellers are the BEST possible choice for propeller performance. Federal naval architects can design a custom propeller for your specific application. Using vessel data and performance targets provided by the customer, a propeller with the optimum combination of diameter, pitch, blade count, blade area, and camber is designed to maximize the performance of each yacht that is evaluated. Maximum performance is not just better top speed; it is a better cruise speed, better acceleration, improved fuel economy, and smoother, quieter operation. All CX series propellers are completely CNC machined to exacting specifications.

The use of the latest CNC machining and inspection technology ensures that every CX propeller is manufactured as designed. This process results in consistent and repeatable propeller manufacture, so replacement sets or spares will match the originals.

The Federal design and sales team works closely with designers, yacht builders, propeller shops and owners to qualify optimal propellers for any given application. Federal engineers use the latest in propeller design technology to design each propeller, including custom propeller geometry design code and sophisticated hydrodynamic analysis software. This allows the designer to maximize propeller efficiency while minimizing the performance robbing effects of cavitation. This is particularly important as engine horsepower and boat speeds continue to increase.

Every new CX series propeller is given a 5-digit serial number, which gives customer service and repair agents a detailed history for a particular propeller. Field service requires sophisticated computerized propeller measurement equipment, ie: Hale MRI, which can appreciate the original design and apply to any rework necessary. Federal representatives work with repair facilities providing the necessary assistance to resolve propeller related issues.

CX series propellers are available in 3, 4, 5, 6, 7, and 8-blade configurations. Blade area ratios are determined by the special application.



CX-400



CX-500



CX-600



CX-700



CX-800



HATTERAS 80' MOTOR YACHT SL
Photo courtesy of Hatteras Yachts



118' BURGER
Photo courtesy of Forest Johnson



WESTPORT
Photo courtesy of Apogee
Photography



KVICHAK 80' LOGISTICS
SUPPORT CRAFT
Photo courtesy of Kvichak Marine



TRIBUTE PERFORMANCE
Photo by Tribute Performance
Boats



MERRITT
Photo courtesy of Merritt's Boats



HATTERAS 77'
Photo courtesy of Hatteras Yachts

FEDERAL PROPELLERS

“Y” SERIES

The new Federal “Y” series propeller is a semi-custom series that offers many features and benefits of a full-custom propeller with the economies of series manufacture. The “Y” is evolved from years of custom propeller design experience. All “Y” propellers are CNC machine finished.

The chosen combination of blade area and skew in this series, along with variable pitch and camber, make for a close efficiency match throughout the entire engine power curves. Years of propeller design experience have allowed Federal naval architects to optimize the “Y” design to maximize the performance of virtually all planing hulls. Increasingly, boat builders are choosing to install the new “Y” series as standard equipment after appreciating the difference in sea-trials compared to less sophisticated product.

Each EPY, EQY, and CY5 propeller are manufactured to exacting specifications, and inspected using the latest digital technology. Each propeller is given a serial number, permitting design and inspection data to be retrieved and reviewed for field service.



EPY
0.66 E.A.R.



EQY
0.835 E.A.R.



CY5
0.935 E.A.R.



BERTRAM 450
Photo courtesy of Bertram Yachts



TIARA SOVRAN 4700
Photo courtesy of Tiara Yachts



CRUISERS 497 SPORT SEDAN
Photo courtesy of Cruisers Yachts



46' CARVER
Photo courtesy of Carver Yachts



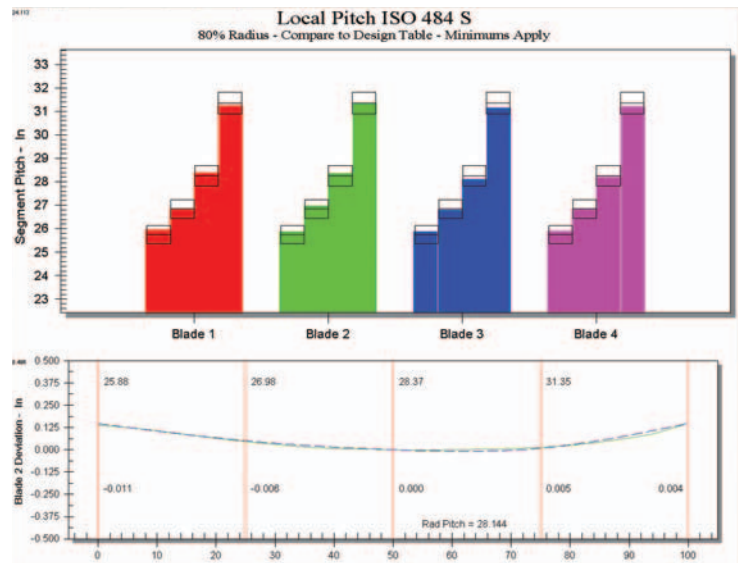
RAMPAGE 41' EXPRESS
Photo courtesy of Rampage Yachts



CABO 47' FLYBRIDGE
Photo courtesy of Cabo Yachts



62' NEPTUNUS
Photo courtesy of Neptunus



Typical Pitch Progression

“HX” SERIES

The Federal HX series offers high tolerance hand finished propeller manufacture in a variety of design configurations. This series is primarily constant pitch, with expanded area ratios. High horsepower pleasure and commercial applications require specific propellers to achieve maximum thrust, speed, and smoothness. The proven pitch geometry yields exceptional performance without the additional cost associated with custom, CNC machined propellers. The HX series is often the solution, as the next step from traditional series toward custom fit.

HX are available in 3, 4, and 5-blade configurations. Blade area ratios are determined by the specific application.

“X” SERIES

“EPX” and “EQX” are an evolution of the tried and true Equi-Poise and Equi-Quad series propellers. The designs have been modified to be better suited to highly loaded, limited tip clearance applications. New manufacturing technologies, such as machine finishing, are utilized in manufacture to facilitate accurate and repeatable product. The availability of this series will be progressive, with additional sizes being added regularly. Availability will be size specific, in a range of bores, without or with all degrees of cup.

EQUI-POISE & EQUI-QUAD

The Federal Equi-Poise three blade and Equi-Quad four blade propeller series are for applications that benefit from traditional propeller geometry held to a close tolerance. The proven performance of these designs is enhanced through strict manufacturing controls. Those controls result in closely matched sets that are a step above standard line series propellers. By utilizing a traditional design, Federal can supply a vast range of sizes, at good value, with a minimal lead time.



HX-400



HX-500



EPX



EQX



Equi-Quad



Equi-Poise



*SEA FORCE IX
Photo courtesy of Sea Force IX, Inc.*



*DONZI R-73
Photo courtesy of Roscioli Yachting*



*PACIFIC MARINER 65" DIAMOND
Photo courtesy of Pacific MarineR*



*TIARA SOVRAN 3600
Photo courtesy of Tiara Yachts*



*SILVERTON 360 EXPRESS
Photo courtesy of Silverton Marine*