HI-TECH
since 1975

HUNG SHEN PROPELLER

FPP · CPP & Shafting

宏昇螺旋槳

International Quality System
Certification ISO 9001:2008

ISO 9001:2008 CERTIFICATED FIRM
DNV CERTIFICATION B.V. THE NETHERLANDS

Classification Society

ABS

BV

CCS

CR

DNV

GL

KR

LR

NK

RINA

RS

CSD

Hung Shen Propeller CO., LTD

Cheng Cheng-I
President

Hung Shen was founded in 1975. Our mission is to earn and maintain our client's continuing confidence by fulfilling their expectation in our products and services. Although we have the best design and manufacturing technology, we strive to maintain our leading position through continuing research and development. We feel it is our job to provide the best propellers to our customers. Hung Shen genuinely cares about our customers. Our customers' happiness has been the motivation behind our company for the past 32 years.

TAIWAN Ping Tung (Headquarter)

China Kun Shan (Main Plant)

For many years, Hung Shen has outstanding references when it comes to the quality of propeller on navy vessels. National Defense praised Hung Shen with a medal of Merits in 1999.
In 2009, Hung Shen wins the 6th Annual Taiwan Yu-Shan Enterprise Award.

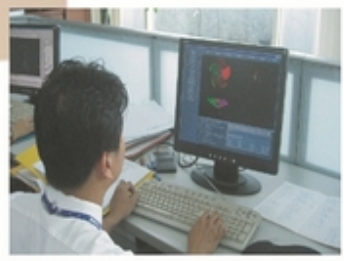
With decades of experiences and high technology design ability, Hung Shen can make the perfect combination and state-of-the-art propeller to meet individual's needs. Hung Shen is also capable of design and manufacture of shafting equipment for small to medium size ships. Our expertise is in engineering the optimum marine propulsion solution for each individual case.

Main Products FPP . CPP . Shafting

Research & Development

With decades of experience, we know how to design and manufacture the best propeller to match your vessel. Using the latest technology, together with our years of design expertise, we can develop the optimum state-of-the-art propeller to meet individual needs.

In order to optimize the performance of luxury yachts, ferries and warships, Hung Shen has developed a NEW Silent Propeller (NSP) series. The use of this 4 or 5 blade advanced propeller will reduce propeller induced vibration and noise levels dramatically. The new foil section, makes the blade sections much less sensitive to cavitation when operating in the non-uniform inflow common to yachts, ferries and warships. The NSP series reduces ship vibration level approximately 50% and cabin noise level approximately 3dB (A) for luxury yachts. At the same time, it increases the propeller efficiency for high-speed craft. The ship speed can be increased by approximately one knot for ships with maximum speed around 30 knots.



3-D CAD /CAM Workstation

To focus on vessel speed over 25 knots, Hung Shen has developed a new propeller series which out-performs pervious propeller series.

We have performed a series of model propeller tests considering different expended area ratios (0.75 & 1.0), number of blades (3, 4 & 5), inclined shaft angles (0, 6, 8 & 10 degrees) and cavitation numbers (atm, 1.0, 0.75, 0.6, 0.5, 0.45, & 0.4), and have formed a complete propeller series.

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Prop. Water Test Tunnel

Hung Shen R&D Team

Mr. Wu
Director of R&D

More than 30 years of experience in Propeller and Shafting Design, Current Vice President

Prof. Kehr
Consulting form NTOU

Dr.-Ing., Tech. University of Berlin, Germany
-Propeller Induced Noise
-Propeller Design

Dr. Kao
Manager of R&D

Ph.D. National Taiwan Ocean University
-Fluid Dynamics
-Propeller Induced Noise and Vibration

Prof. Hsin
Consulting from NTOU

Ph.D. Massachusetts Institute of Tech. (MIT)
-Propeller Theory
-Fluid Dynamics

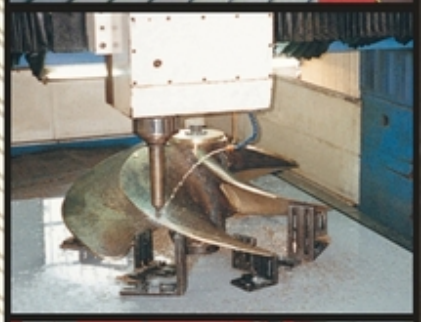
Manufacturing

FPP CNC Blade Milling

In order for a well-designed propeller to perform optimally, it has to be manufactured with high precision. Our propeller blades are manufactured with high precision CNC machines. The CNC manufacturing process fulfills the ISO484/2 Class S standards, and enables the propeller to obtain the best efficiency with minimum vibration and noise.

CPP CNC Blade and Flange Milling

We manufacture different types of Controllable Pitch Propellers(Mn-Bronze, Ni-Al Bronze, and Stainless Steel (CF-3). The processing precision achieves ISO Class S tolerance.

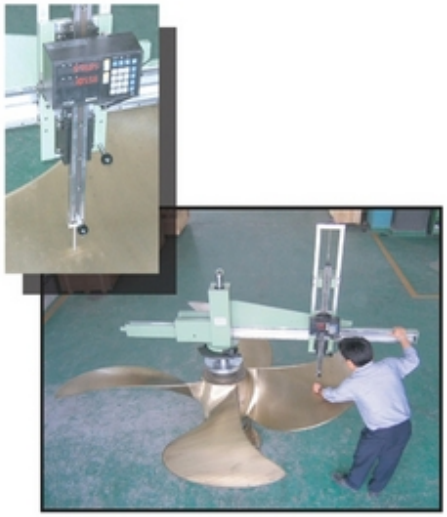


Quality Control

Hung Shen has obtained ISO-9001:2000 quality certification and is approved by ABS, BV, CR, DNV, GL, LR, NK and CSD. All Hung Shen propellers are manufactured under stringent quality control procedures and systems.

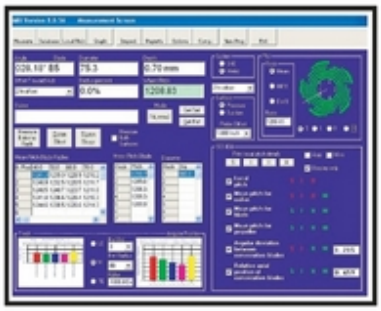
MRI Machine

- To provide the best quality for our all customers.
- To ensure that the manufacturing process is based on the optimal design.
- The report generated by the MRI software is a good reference for future repair of the propeller.
- According to the information measured from the MRI, we can assure our customers that the propeller will attain the design goals of high efficiency, low vibration, and low noise.



Pitch Measurement Instrument
(Prop. Dia. 3600mm)

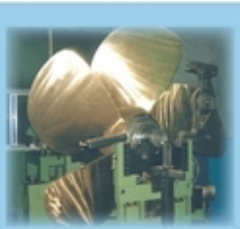
MRI Machine



Spectro-scopic Analyer

Material Test

Dynamic Balancing Test



Dynamic Balancing Test

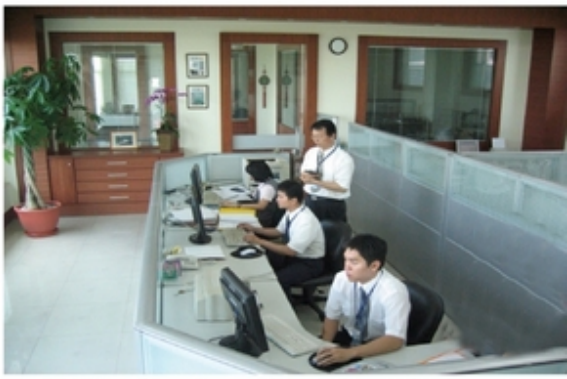
Key Seating Machine

High Performance Pleasure Craft and Yacht
High Efficiency, Maximum Speed, Fast Planing Time and Maximum Comfort

Navy Vessels - Low Vibration, Low Noise and Minimum Cavitation

Fixed Pitch Propellers

Hung Shen has many years of experience in the design of fixed pitch propellers (FPP) . Our propellers provide excellent fuel economy, low vibration/noise level and no harmful cavitation. They are individually designed for the specific vessels to deliver the optimum in propeller efficiency.



Workboats and Fishboats - High Power & Energy Saving

Stainless Steel- High Precision

Controllable Pitch Propellers

Controllable pitch propellers (CPP) are the ideal choice for commercial vessels with large gear ratios. CP propellers provide excellent maneuverability, thus saving ship time and tug costs. Our CP propellers guarantee superior propeller efficiency, reliability and minimum noise and vibration level. We have the capability to produce controllable pitch propellers up to 5.5 meters in diameter.

CPP CNC Blade and Flange Milling

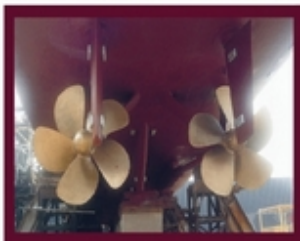
We manufacture different types of CPP(Mn-Bronze, Ni-Al Bronze, and Stainless Steel (CF-3). The processing precision achieves ISO Class S tolerance.

Shafting

Hung Shen is capable of the design and manufacture of shafting equipment for all boats and small to medium size ships. Our expertise is in engineering the optimum marine propulsion solution for each individual case.

Shafting CNC Milling

Custom Propellers



27 knots

Navy Warship

The silent propellers designed and manufactured by Hung Shen have been installed on eleven Navy warships.The propellers were manufactured to ISO 484/2 Class "S" standards. The performance of the propellers has been verified as superior by the customer.

35 knots

Navy Patrol Vessel

The Navy triple-screw guided missle fast patrol boat has been equipped with propellers and shafting systems designed and delivered by Hung Shen. The propeller induced vibration and noise level have been found to be very low even at the maximum ship speed of 35knots.

①

②

③

Offshore Patrol Vessels

Twin screw offshore patrol vessels, owned by the Navy, have been equipped with propellers designed and delivered by Hung Shen. The sea trial speed of the vessels was determined to be higher than the required specification. By using the new-foil section, the cavitation extension and its associated vibration and noise have been controlled very well. The performance of these propellers has gained the affirmation of the ship owners, ship builders, and ship designers.

① 720 Tons Coast Guard Vessel, 31Knots
② 600 Tons Custom Prevention Ship, 31 Knots
③ 720 Tons Coast Guard Vessel, 31Knots

①

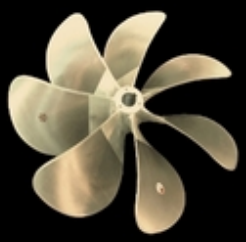
②

③

Fishboat & Workboat

The silent propellers were installed on the Tuna Purse Seiner constructed by Ching-Fu Shipbuilding Company. The advanced propellers enable the ship to achieve a low underwater acoustic level while underway. Thus, the propellers not only increase the fish catch, but also reduce the noise and vibration level in the cabin.

Custom Propellers-Yachts



What is Custom Propellers?

Custom propellers are designed for specific vessels and engine combinations. They enable vessels to achieve their optimum performance. Both the lifting line theory and the lifting surface theory are used to design propellers with higher performance requirements.

For vessels with maximum speed over 25 knots, the custom propeller designs provides significant benefits in many areas such as efficiency, vibration / noise, and cavitation erosion. Custom propellers are designed first by using the propeller lifting line theory to optimize performance in accordance with custom's requirements: including the vessel speed, engine braked horsepower, effective horsepower curve, propeller diameter, number of blades, etc.

This lifting line theory is also used to develop the optimum expanded area ratio and chord length distribution to meet the cavitation requirements. Finally, a lifting surface theory is used to obtain camber and pitch distribution skew and blade thickness are optimized in the design for maximum performance.

This design process is carried out using a specialized computer program which can simulate the vessel's performance using different reduction gear ratios and sized propellers..

Custom Surface Piercing Propellers

Standard Propellers for Medium Speed Vessels

EP-3B

EP-4B

EP-5B

Efficiency Propeller EP-3B

The EP-3B series is designed for optimum efficiency, particularly for craft with operating speed less than 25 knots. This type of propeller has high damage resistance due to the relatively thick leading edge. They are widely used by pilot boats, general pleasure crafts, police launches, patrol boats and similar vessels.

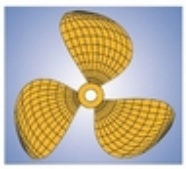
Efficiency Propeller EP-4B

The EP-4B series has similar characteristics with the EP-3B series, except that EP-4B provides lower vibration levels than EP-3B due to the increased blade area and number of blades. Thus, it is suitable for higher performance pleasure craft.

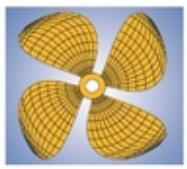
Efficiency Propeller EP-5B

The EP-5B series has larger expanded area ratio than that of the EP-4B and EP-3B series. This type of propeller is suitable for high power vessels and for vessels in which the noise and vibration in the cabin are critical.

Stainless Steel



EP-3B
Dia 10″ ~ 50″
E.A.R. 0.55
Up to 28 Knots



EP-4B
Dia 17″ ~ 50″
E.A.R. 0.68
Up to 28 Knots

EP-5B
Dia 17″ ~ 50″
E. A. R. 0.85
Up to 32 Knots

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades EAR: 0.55 Lbs	4 blades EAR: 0.68 Lbs	5 blades EAR: 0.85 Lbs
inches	mm	aft end	forward end	length	max bore	pilot bore			
10	254	1-1/2	1-5/8	2-1/4	1	3/4	3.1		
11	279	1-1/2	1-5/8	2-1/4	1	3/4	4.2		
12	305	1-5/8	1-3/4	2-3/8	1-1/8	7/8	5.1		
13	330	1-5/8	1-13/16	2-3/4	1-1/4	1	7		
14	356	1-7/8	2	2-3/4	1-1/4	1	9		
15	381	1-7/8	2	2-3/4	1-1/4	1	10		
16	406	2-1/8	2-3/8	3-1/4	1-3/8	1-1/8	12		
17	432	2-1/8	2-3/8	3-1/4	1-3/8	1-1/4	14	15	18
18	457	2-3/8	2-5/8	3-1/4	1-1/2	1-1/4	16	18	22
19	483	2-3/8	2-5/8	3-3/4	1-1/2	1-1/4	19	21	25
20	508	2-3/8	2-5/8	3-3/4	1-1/2	1-1/4	21	25	30
21	533	2-3/4	3	4-1/8	1-3/4	1-3/8	27	30	37
22	559	2-3/4	3	4-1/8	1-3/4	1-3/8	30	32	39
23	584	3	3-1/4	4-1/2	2	1-1/2	35	38	45
24	610	3	3-1/4	4-1/2	2	1-1/2	38	42	55
25	635	3-3/8	3-3/4	4-7/8	2-1/4	1-3/4	42	47	59
26	660	3-3/8	3-3/4	4-7/8	2-1/4	1-3/4	48	54	64
28	711	3-3/4	4-1/8	5-3/4	2-1/2	2	60	68	81
30	762	4-1/4	4-5/8	6	3	2	78	87	102
32	813	4-1/4	4-5/8	6	3	2	88	98	118
34	864	4-1/4	4-5/8	6-1/2	3	2-1/4	104	115	138
36	914	4-5/8	5-1/8	8	3-1/2	2-3/4	127	140	169
38	965	4-5/8	5-1/8	8	3-1/2	2-3/4	142	159	190
40	1016	5	5-1/2	9	3-3/4	3	170	189	225
42	1067	5-3/8	6	10-7/16	4	3	208	230	270
44	1118	5-7/16	6-3/16	11	4	3	236	262	308
46	1168	5-5/8	6-1/4	11-7/8	4	3	270	298	350
48	1219	6	6-7/8	12-1/2	4-1/2	3-1/2	294	330	394
50	1270	6	6-7/8	12-1/2	4-1/2	3-1/2	365	391	447

Standard KCA Propellers for High Speed Vessels

KCA-3B

KCA Series Propeller KCA-3B

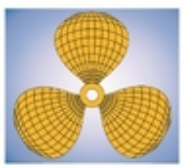
The KCA-3B series is a conventional propeller that has relatively good efficiency for operating speeds lower than 25 knots. However, the vibration and noise induced by this type of propeller for medium and high shaft inclinations is marginal.

KCA-4B

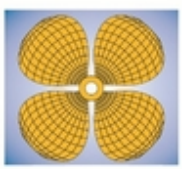
KCA Series Propeller KCA-4B & KCA-5B

The KCA-4B & 5B series are designed with wider blades to control cavitation on the blade surface, and have good efficiency for operating speed lower than 30 knots. The vibration level induced by this series is lower than that of the KCA-3B series.

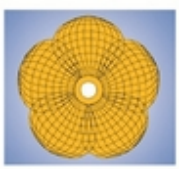
KCA-5B



KCA-3B
Dia 20″~50″
E. A. R. 0.55 ~ 0.80
Up to 32 Knots



KCA-4B
Dia 20″~50″
E. A. R. 0.65 ~ 1.0
Up to 32 Knots



KCA-5B
Dia 20″~50″
E. A. R. 0.80 ~ 1.0
Up to 34 Knots

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades	4 & 5 blades
inches	mm	aft end	forward end	length	max bore	pilot bore	EAR: 0.65 Lbs	EAR: 0.85 Lbs
20	508	2-1/2	2-3/4	4-1/2	1-1/2	1-1/4	32	39
21	533	2-3/4	3	5-1/4	1-3/4	1-3/8	37	44
22	559	2-3/4	3	5-1/4	1-3/4	1-3/8	39	46
23	584	3	3-3/8	6	2	1-1/2	45	55
24	610	3	3-3/8	6	2	1-1/2	49	64
25	635	3-3/8	3-7/8	6-3/4	2-1/4	1-3/4	54	69
26	660	3-3/8	3-7/8	6-3/4	2-1/4	1-3/4	61	75
28	711	3-3/4	4-1/4	7-1/2	2-1/2	2	74	92
30	762	4-1/4	4-7/8	9	3	2-1/4	95	116
32	813	4-1/4	4-7/8	9	3	2-1/4	107	136
34	864	4-5/8	5-3/8	10-1/2	3-1/2	2-1/2	133	165
36	914	4-5/8	5-3/8	10-1/2	3-1/2	2-1/2	152	190
38	965	4-7/8	5-5/8	11-1/4	3-3/4	2-3/4	177	222
40	1016	5-1/8	5-7/8	12	4	3	205	258
42	1067	5-1/8	5-7/8	12	4	3	231	293
44	1118	5-1/8	5-7/8	12	4	3	264	332
46	1168	5-1/8	5-7/8	12	4	3	294	375
48	1219	6	6-7/8	11-1/4	4-1/2	3-1/2	345	438
50	1270	6	6-7/8	11-1/4	4-1/2	3-1/2	378	489

KCA propellers are manufactured by CNC

Standard Propellers for □□□□□ High Speed Vessels

NEW R&D Low Vibration & Low Noise

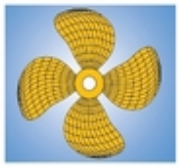
New Vanguard Propeller NVP-4B & NVP-5B

The NVP series is a high performance propeller using new-foil section, which is less sensitive to the change of angle of attack due to the propeller operating at inclined shaft condition. Thus, this type of propeller can control cavitation extension on the blade surface very well and avoid the phenomena of serious thrust breakdown. As a result, it can significantly reduce the vibration and noise induced by propeller cavitation.

The NVP series is suitable for use on planning craft, including high performance yachts, patrol boats and high speed passenger vessels. The NVP series has better acceleration performance and exceptional water gripping capability; the boat will hold its planning speed better in extreme maneuvering and during sharp turns.

NVP-4B

NVP-5B



NVP-4B
Dia. 17″~50″
E.A.R. 0.69 0.85
Up to 34 Knots

NVP-5B
Dia. 22″~50″
E.A.R. 0.86 1.06
Up to 36 Knots

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		4 blades		5 blades	
inches	mm	aft end	forward end	length	max bore	pilot bore	DAR: 0.69 Lbs	DAR: 0.85 Lbs	DAR: 0.86 Lbs	DAR: 1.06 Lbs
17	432	2-1/4	2-1/2	4-1/8	1-3/8	1-1/4	27	33		
18	457	2-1/2	2-3/4	4-1/2	1-1/2	1-1/4	30	37		
19	483	2-1/2	2-3/4	4-1/2	1-1/2	1-1/4	34	41		
20	508	2-1/2	2-3/4	4-1/2	1-1/2	1-1/4	37	44		
21	533	2-3/4	3	5-1/4	1-3/4	1-3/8	42	50		
22	559	2-3/4	3	5-1/4	1-3/4	1-3/8	43	52	53	64
23	584	3	3-3/8	6	2	1-1/2	52	62	63	76
24	610	3	3-3/8	6	2	1-1/2	60	73	74	89
25	635	3-3/8	3-7/8	6-3/4	2-1/4	1-3/4	65	79	79	95
26	660	3-3/8	3-7/8	6-3/4	2-1/4	1-3/4	71	85	87	104
28	711	3-3/4	4-1/4	7-1/2	2-1/2	2	87	104	106	127
30	762	4-1/4	4-7/8	9	3	2-1/4	110	131	134	161
32	813	4-1/4	4-7/8	9	3	2-1/4	129	155	157	188
34	864	4-5/8	5-3/8	10-1/2	3-1/2	2-1/2	156	187	190	227
36	914	4-5/8	5-3/8	10-1/2	3-1/2	2-1/2	180	215	219	262
38	965	4-7/8	5-5/8	11-1/4	3-3/4	2-3/4	210	252	256	307
40	1016	5-1/8	5-7/8	12	4	3	244	292	298	357
42	1067	5-1/8	5-7/8	12	4	3	277	332	338	405
44	1118	5-1/8	5-7/8	12	4	3	314	376	383	459
46	1168	5-1/8	5-7/8	12	4	3	354	425	433	519
48	1219	6	6-7/8	11-1/4	4-1/2	3-1/2	414	496	505	604
50	1270	6	6-7/8	11-1/4	4-1/2	3-1/2	462	554	564	676

NVP propellers are manufactured by CNC

Custom Propellers for □ □ □ □ □ High Speed Vessels

NEW R&D Low Vibration & Low Noise

NSP-4B

NSP-5B

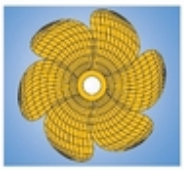
New Silent Propeller NSP- 4B, 5B, 6B & 7B

□In order to optimize the performance of luxury yachts and patrol boats, Hung Shen Propeller has developed NEW SILENT PROPELLER Series, based on results of a 10-year propeller research project for high-speed crafts using new-foil blade section. This makes the blade section much less sensitive to cavitation when operating at inclined shaft conditions common to yachts. The NSP Series incorporates the following product features:

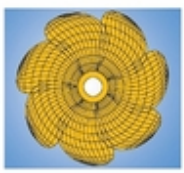
-4B, 5B, 6B and 7B.
-0.7 ~1.2 blade area ratio. (approx)
-Optimized variable pitch distribution.
-Non-linear blade skew of 18 ~ 36 degrees.
-Advanced new-foil section
-Average for the high-speed craft (over 25 knots), NSP increases the speed more than 1 knot when compared to KCA. □

NSP-4B
Dia. 20″~ 50″
E.A.R. 0.7~1.1
Up to 36 Knots

NSP-5B
Dia. 24″~ 50″
E.A.R. 0.7~1.1
Up to 38 Knots

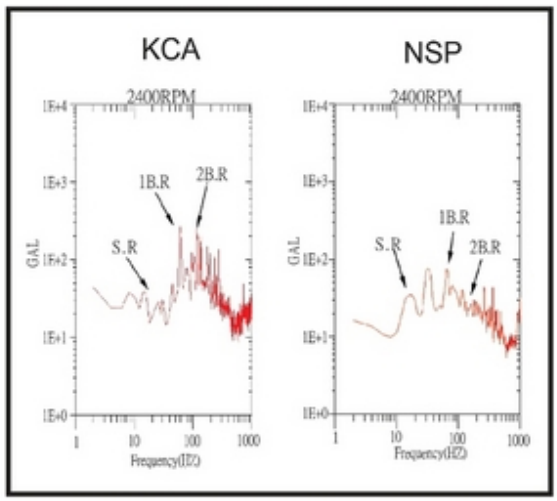


NSP-6B
Dia. 24″~ 50″
E.A.R. 0.7~1.2
Up to 40 Knots

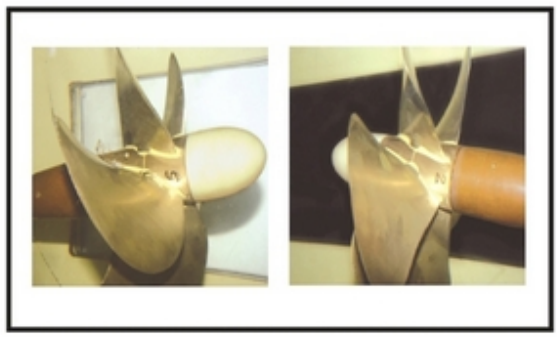


NSP-7B
Dia. 24″~ 50″
E.A.R. 0.7~1.2
Up to 42 Knots

This figure compares the performance between KCA and NSP at 2400 rpm engine revolution. From these results, it can be seen very clearly that the vibration levels of the first blade rate (1BR) and second blade rate (2BR) induced by standard KCA series propellers are about three times as high as that of NSP series propellers. This research project was performed by the National Taiwan Ocean University (NTOU).



The cavitation characteristics on the blade back at position 90 degrees and on the blade face at position 270 degrees, for a 5 bladed NSP propeller operating at its design condition (cavitation number 0.75, 8 degrees shaft angle) is demonstrated in the cavitation tunnel.



NSP propellers are manufactured by CNC

Custom Super Series Propellers for Super High Speed Vessels

NEW R&D

Super Series Propeller SSP-3B, SSP-4B & SSP-5B

The SSP series is designed for use on high speed planning craft. By using new foil sections, the pressure distribution on the blade is not sensitive to the change of the angle of attack. Both the efficiency and the cavitation characteristics of the SSP series are better than Newton-Rader sections operating on an inclined shaft. In addition, the new foil sections help to eliminate erosion due to root cavitation.

The following parameters were evaluated as part of the model testing:

-3, 4 and 5 blades
-1.0, 1.2, 1.4, 1.6 and 1.8 pitch/diameter ratios
-atm, 1.5, 1.0, 0.75, 0.6, 0.5, 0.45 and 0.4 cavitation numbers
-0 and 24 degree skew angles
-0.75 and 1.00 EAR (Expanded Area Ratio)
-0, 6, 8, and 10 degree shaft angles

In addition to the shaft thrust and torque, the normal forces at the inclined shaft conditions were also measured. The actual efficiency of the propellers for inclined shaft conditions were thus measured.

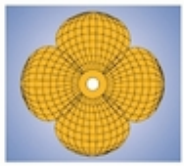
The SSP series has better acceleration performance, and has an exceptional water gripping capability; the boat will hold its planning speed in extreme maneuvering and during sharp turns. SSP series propellers have been installed on many high speed craft since 1998 and have been operating very successfully in 30 to 45 knot applications.

SSP-3B

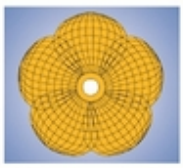
SSP-4B

SSP-5B

SSP-3B
Dia. 22″~50″
E.A.R. 0.7~1.0
Up to 45 Knots

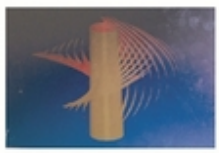


SSP-4B
Dia. 22″~50″
E.A.R. 0.7~1.2
Up to 45 Knots



SSP-5B
Dia. 24″~50″
E.A.R. 0.7~1.2
Up to 45 Knots

CAD/CAM Workstation



Twin Screw

120 Tons Triple Screw Passenger Boat, Custom Super Series Propellers, 40 Knots

120 Tons Custom Super Series Propellers34.5 Knots

SSP propellers are manufactured by CNC

Custom Surface Piercing Propellers

Excellent Speed Propeller **ESP- 4B**
Accelerating Smooth Propeller **ASP- 5B & 6B**

ESP-4B

Both the ESP and ASP series were designed for use on very high speed craft, when both propeller revolutions and advance speed are high. Both the ASP-5B and ASP-6B series provide high efficiency and smooth operation. In addition, the ASP-6B series also provides excellent acceleration performance for overcoming hump resistance.

Speed 50 Knots

ASP-5B

ESP-4B
Dia. 18″~50″
E.A.R. 0.7~0.85
Up to 50 Knots

ASP-5B
Dia. 18″~50″
E.A.R. 0.9~1.0
Up to 50 Knots

ASP-6B
Dia. 18″~50″
E.A.R. 1.0~1.15
Up to 50 Knots

Stainless Steel ASP-6B

ASP-6B

ESP & ASP propellers are manufactured by CNC

Standard Propellers for Ski Boats

ISP-3B

Inboard Ski Propeller ISP-3B and ISP-4B

Ski propellers are designed to be used for high horsepower and very high shaft rotation conditions. The ISP-3B and 4B propellers provide low vibration and high performance. All Ski propellers are cast in Ni-Al Bronze, with propellers diameter from 12 to 15 inches.

ISP-4B

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades	4 blades
inches	mm	aft end	forward end	length	max bore	pilot bore	EAR: 0.55 Lbs	EAR: 0.62 Lbs
12	305	1-9/16	1-3/4	2-3/8	1-1/8	7/8	5.1	6.1
13	330	1-9/16	1-3/4	2-3/4	1-1/8	1	7	8.2
14	356	1-3/4	2	2-3/4	1-1/8	1	9	9.8
15	381	1-3/4	2	2-3/4	1-1/8	1	10	11

Standard Propellers for Medium & High Speed Vessels


NEP-3B

NEO Efficiency Propeller NEP-3B

The Neo-EP series was specially designed for the Japanese market. The Neo-EP propellers are used on Japanese vessels where the highest propulsive efficiency is desired. Due to the high efficiency, the Neo-EP series is very popular in the Japanese market.


NEPC-3B

NEO Efficiency Propeller Camber NEPC-3B

This propeller is similar to the NEP series except that the blade sections are slightly curved which effectively increases the blade camber. This design provides all the advantages of our standard series, plus the additional camber provides an increase in performance.

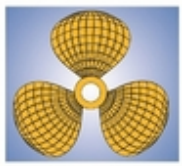

SSP-3B

Super Series Propeller SSP-3B (with small E.A.R.)

The SSP series is designed for use on high speed craft. By using new foil-sections, the pressure distribution on the blade is not sensitive to the change of the angle of attack. Propellers from this series have been installed on many high speed crafts and have operated at 30 to 45 knots very successfully under inclined shaft conditions.


NEP-3B
Dia. 600mm~1200mm
E.A.R. 0.40 0.45 0.50
Up to 30 Knots


NEPC-3B
Dia. 600mm~1200mm
E.A.R. 0.40 0.45 0.50
Up to 32 Knots


SSP-3B
Dia. 600mm~1200mm
E.A.R. 0.50~1.0
Up to 45 Knots

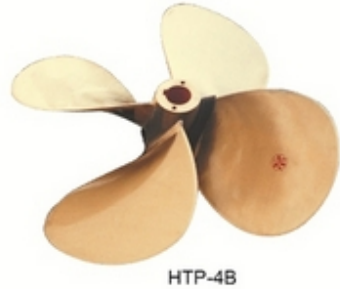
Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades		
mm	inches	aft end	forward end	length	max bore	pilot bore	EAR: 0.40 Lbs	EAR: 0.45 Lbs	EAR: 0.50 Lbs
600	23.62	65	80	110	50	35	26	29	32
620	24.41	65	80	110	50	35	28	31	34
640	25.20	75	90	120	55	45	32	36	39
660	25.98	75	90	120	55	45	34	38	42
680	26.77	75	90	120	55	45	37	41	46
700	27.56	85	100	130	60	45	43	48	53
720	28.35	85	100	130	60	45	46	52	57
740	29.13	85	100	130	60	45	49	55	60
760	29.92	85	100	130	60	45	52	58	64
780	30.71	95	110	140	65	50	59	66	73
800	31.50	95	110	140	65	50	62	69	76
820	32.28	95	110	140	65	50	66	74	81
840	33.07	95	110	140	65	50	70	78	86
860	33.86	95	110	150	70	50	74	83	91
880	34.65	95	110	150	70	50	79	89	97
900	35.43	95	110	150	70	50	83	93	102
920	36.22	95	110	150	70	50	88	99	108
940	37.01	110	130	160	75	55	101	113	124
960	37.80	110	130	160	75	55	106	119	130
980	38.58	110	130	160	75	55	111	124	137
1000	39.37	110	130	160	75	55	117	131	144
1020	40.16	110	130	170	80	55	123	138	151
1040	40.94	110	130	170	80	55	129	145	159
1060	41.73	110	130	170	80	55	135	151	166
1080	42.52	110	130	170	80	55	142	159	175
1100	43.31	130	150	185	85	60	162	181	199
1120	44.09	130	150	185	85	60	169	189	208
1140	44.88	130	150	185	85	60	176	197	217
1160	45.67	130	150	185	85	60	184	206	226
1180	46.46	130	150	200	90	65	192	215	236
1200	47.24	130	150	200	90	65	200	224	246

* size up to 1500 mm

NEP, NEPC and SSP propellers are manufactured by CNC

Standard Propellers for Displacement Vessels

HTP-3B

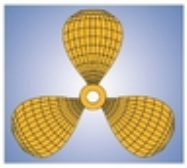


HTP-4B

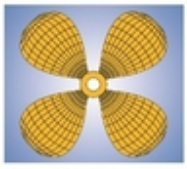
Heavy Thrust Propeller HTP-3B, HTP-4B & HTP-5B

The Heavy Thrust HTP-3B series are designed for displacement vessels, such as general fishing vessels and workboats. This series have a semi-elliptical blade outline, constant pitch and standard ogival blade sections. This series is designed without any skew for maximum reverse performance.

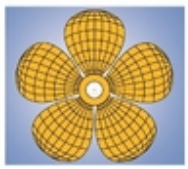
The HTP-4B series has a larger blade area ratio than the HTP-3B series. Thus, it is more suitable for high power applications, such as tug boats and push boats. These propellers are available in Mn-Bronze or Ni-Al Bronze from 20 inches to 120 inches diameters.



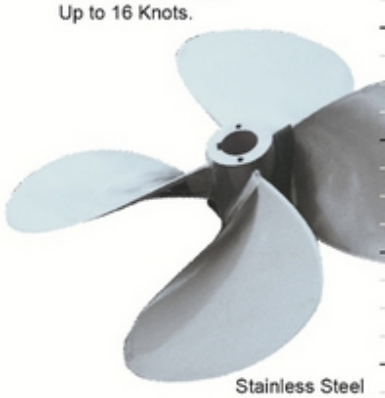
HTP-3B
Dia 20″ ~ 60″
E.A.R. 0.50
Dia 62″ ~96″
E.A.R. 0.46
Up to 16 Knots.



HTP-4B
Dia 20″ ~ 60″
E.A.R. 0.70 ~ 0.90
Dia 62″ ~120″
E.A.R. 0.62 ~ 0.90
Up to 16 Knots.



HTP-5B
Dia 50″ ~ 120″
E.A.R. 0.70 ~ 0.90
Up to 16 Knots.



Stainless Steel

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades dia. to 60" EAR: 0.50 dia. 62"-96" EAR: 0.46 Lbs	4 blades dia. to 60" EAR: 0.70 dia. 62"-96"EAR: 0.62 Lbs
inches	mm	aft end	forward end	length	max bore	pilot bore		
20	508	2-1/8	2-7/16	3-3/4	1-3/8	1-1/4	20	24
21	533	2-7/16	2-13/16	4-1/8	1-1/2	1-3/8	23	30
22	559	2-7/16	2-13/16	4-1/8	1-1/2	1-3/8	26	34
23	584	2-13/16	2-3/16	4-1/2	1-3/4	1-1/2	32	40
24	610	2-13/16	2-3/16	4-1/2	1-3/4	1-1/2	35	43
25	635	3-3/16	3-5/8	5-1/4	2	1-3/4	40	50
26	660	3-3/16	3-5/8	5-1/4	2	1-3/4	46	56
28	711	3-1/2	4	5-1/4	2-1/4	1-3/4	57	70
30	762	3-13/16	4-3/8	6	2-1/2	2	72	89
32	813	4-1/4	4-13/16	6	3	2	100	123
34	864	4-7/16	5-1/16	6-3/4	3-1/4	2-1/4	116	145
36	914	4-3/4	5-1/2	7	3-1/2	2-1/2	138	172
38	965	5-1/16	5-13/16	4-1/4	3-3/4	2-1/2	162	200
40	1016	5-1/16	5-13/16	7-3/4	3-3/4	2-3/4	180	228
42	1067	5-1/4	6	8	3-3/4	2-3/4	213	275
44	1118	5-1/4	6	8	3-3/4	2-3/4	235	302
46	1168	6	6-3/4	10	4	3	288	361
48	1219	6	6-3/4	10	4	3	312	395
50	1.27	6-9/16	7-3/8	10-3/4	4-1/2	3	366	450
52	1.32	6-9/16	7-3/8	10-3/4	4-1/2	3	393	491
54	1.37	6-9/16	7-3/8	10-3/4	4-1/2	3	425	531
56	1.42	7-5/8	8-3/8	11-1/2	5	3-1/4	492	621
58	1.47	7-5/8	8-3/8	11-1/2	5	3-1/4	537	665
60	1.52	7-5/8	8-3/8	12	5	3-1/2	582	715
62	1.57	9	10	13-1/4	6	4	742	918
64	1.63	9	10	13-1/4	6	4	786	970
66	1.68	9	10	13-1/4	6	4	835	1030
68	1.73	10-1/2	11-3/4	14-1/2	7	5	994	1210
70	1.78	10-1/2	11-3/4	14-1/2	7	5	1045	1275
72	1.83	10-1/2	11-3/4	14-1/2	7	5	1100	1352
74	1.88	10-1/2	11-3/4	14-1/2	7	6	1165	1445
76	1.93	10-1/2	11-3/4	14-1/2	7	6	1235	1532
78	1.98	10-1/2	11-3/4	14-1/2	7	6	1309	1638
80	2.03	11-1/8	12-1/2	17	7-1/2	6	1503	1846
82	2.08	11-1/8	12-1/2	17	7-1/2	6	1586	1957
84	2.13	11-1/8	12-1/2	17	7-1/2	6	1663	2071
86	2.18	11-1/8	12-1/2	17	7-1/2	6	1758	2185
88	2.23	11-1/8	12-1/2	17	7-1/2	6	1853	2318
90	2.28	11-7/8	13-1/4	18-1/4	8	6	2059	2563
92	2.33	11-7/8	13-1/4	18-1/4	8	6	2153	2690
94	2.38	11-7/8	13-1/4	18-1/4	8	6	2264	2835
96	2.43	11-7/8	13-1/4	18-1/4	8	6	2278	2879

* size up to 120 inches

Standard Propellers for Medium Speed Vessels

HSP-3B

Highly Skewed Propeller HSP-3B

The HSP-3B series is designed for achieving low vibration and low noise. This Highly Skewed propeller can reduce stern vibration by 40% and reduce the noise in the cabin, thus improving the living quality of crews onboard. The HSP series is usually supplied in Ni- Al Bronze.

HSP-4B

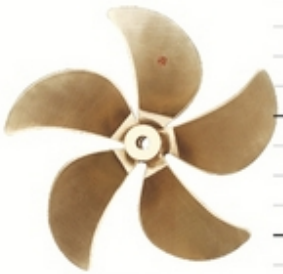
Highly Skewed Propeller HSP-4B & HSP-5B

The HSP-4B and HSP-5B series have similar characteristic as the HSP-3B series. These propellers are designed for those customers who prefer to have very low vibration and noise in the cabin. The HSP-5B series have a larger blade area than either the HSP-3B or HSP-4B series. Thus, the HSP-5B series are more suitable for high power applications. These propellers are available in Ni- Al Bronze. from 30 inches to 120 inches diameters.

HSP-3B
Dia 20″~80″
E.A.R. 0.45
Up to 18 Knots

HSP-4B
Dia 20″~120″
E.A.R. 0.60
Up to 18 Knots

HSP-5B
Dia 30″~120″
E.A.R. 0.75
Up to 18 Knots



HSP-5B

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades	4 blades	5 blades
inches	mm	aft end	forward end	length	max bore	pilot bore	EAR: 0.45 Lbs	EAR: 0.60 Lbs	EAR: 0.75 Lbs
20	508	55	65	100	35	20	17	22	
21	533	65	75	110	40	25	20	26	
22	559	65	75	110	40	25	23	30	
23	584	70	80	120	50	35	27	35	
24	610	70	80	120	50	35	32	42	
25	635	85	95	120	55	40	39	51	
26	660	85	95	120	60	45	41	54	
27	686	90	105	140	65	45	49	64	
28	711	90	105	140	65	45	52	69	
30	762	100	120	150	70	55	66	87	106
32	813	100	120	150	75	55	78	102	124
34	864	115	130	160	85	55	94	124	151
36	914	120	140	160	95	65	109	143	174
38	965	130	150	180	95	65	132	174	212
40	1016	130	150	180	95	65	150	198	242
42	1067	140	160	180	95	65	176	231	282
44	1118	140	160	180	95	65	197	259	316
46	1168	155	175	185	100	70	230	302	368
48	1219	155	175	205	100	70	260	342	417
50	1270	170	190	230	115	80	301	396	483
52	1321	170	190	240	115	80	334	439	536
54	1372	170	190	250	115	90	366	482	588
56	1422	200	215	260	125	90	431	567	692
58	1473	200	215	275	125	100	471	620	756
60	1524	200	215	295	125	100	518	682	832
62	1575	230	255	295	150	100	604	795	970
64	1626	230	255	305	150	110	651	856	1044
66	1676	230	255	305	150	110	698	919	1121
68	1727	270	300	345	180	120	836	1100	1342
70	1778	270	300	345	180	120	891	1172	1430
72	1829	270	300	365	180	130	957	1259	1536
74	1880	270	300	365	180	150	1005	1323	1614
76	1930	270	300	365	180	150	1069	1407	1717
78	1980	270	300	365	180	150	1137	1496	1825
80	2030	285	320	430	190	150	1290	1697	2070

* size up to 120 inches

Standard Propellers for Displacement Vessels

NAP-3B

Neo-Ability Propeller NAP-3B

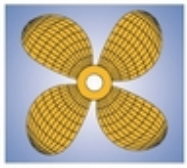
The NAP-3B series is designed to give high performance and optimum maneuverability on all types of displacement vessels. The blade's thick foil sections and generous hub dimensions provide special strength and damage resistance. The NAP series incorporates 10 degrees of rake and a small amount of skew.

Neo-Ability Propeller NAP-4B & NAP-5B

The NAP-4B & NAP-5B series are designed for fishing boats and workboats. This series provides minimum fuel consumption and great efficiency. Due to the increased blade area and number of blades the NAP-5B provides the lowest vibration and noise levels.

NAP-4B

NAP-3B
Dia. 20″~80″
E.A.R. 0.45
Up to 18 Knots



NAP-4B
Dia. 20″~120″
E.A.R. 0.50 0.60
Up to 18 Knots

NAP-5B
Dia. 30″~120″
E.A.R. 0.75
Up to 18 Knots

NAP-5B

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		3 blades	4 blades		5 blades
inches	mm	aft end	forward end	length	max bore	pilot bore	EAR: 0.45 Lbs	EAR: 0.50 Lbs	EAR: 0.60 Lbs	EAR: 0.75 Lbs
20	508	55	65	100	35	20	17	18	22	
21	533	65	75	110	40	25	20	22	26	
22	559	65	75	110	40	25	23	25	30	
23	584	70	80	120	50	35	27	29	35	
24	610	70	80	120	50	35	32	35	42	
25	635	85	95	120	55	40	39	42	51	
26	660	85	95	120	60	45	41	45	54	
27	686	90	105	140	65	45	49	53	64	
28	711	90	105	140	65	45	52	57	69	
30	762	100	120	150	70	55	66	72	87	106
32	813	100	120	150	75	55	78	85	102	124
34	864	115	130	160	85	55	94	103	124	151
36	914	120	140	160	95	65	109	119	143	174
38	965	130	150	180	95	65	132	145	174	212
40	1016	130	150	180	95	65	150	165	198	242
42	1067	140	160	180	95	65	176	192	231	282
44	1118	140	160	180	95	65	197	216	259	316
46	1168	155	175	185	100	70	230	252	302	368
48	1219	155	175	205	100	70	260	285	342	417
50	1270	170	190	230	115	80	301	330	396	483
52	1321	170	190	240	115	80	334	366	439	536
54	1372	170	190	250	115	90	366	402	482	588
56	1422	200	215	260	125	90	431	472	567	692
58	1473	200	215	275	125	100	471	516	620	756
60	1524	200	215	295	125	100	518	568	682	832
62	1575	230	255	295	150	100	604	662	795	970
64	1626	230	255	305	150	110	651	713	856	1044
66	1676	230	255	305	150	110	698	766	919	1121
68	1727	270	300	345	180	120	836	916	1100	1342
70	1778	270	300	345	180	120	891	976	1172	1430
72	1829	270	300	365	180	130	957	1049	1259	1536
74	1880	270	300	365	180	150	1005	1102	1323	1614
76	1930	270	300	365	180	150	1069	1172	1407	1717
78	1980	270	300	365	180	150	1137	1246	1496	1825
80	2030	285	320	430	190	150	1290	1414	1697	2070

* size up to 120 inches

Standard Propellers for Medium Speed Vessels

TAP-4B

NEW R&D

Thrust-Ability Propeller TAP-4B

The TAP-4B series is designed to give high efficiency, low vibration and better maneuverability on all types of displacement vessels, such as high performance fishing vessels and workboats. The TAP-4B series incorporates NACA blade sections, variable pitch distribution, 10 degrees of rake and little skew. The foil sections and generous hub dimensions provide good strength and damage resistance.

TAP-4B
Dia. 40"~120"
E.A.R. 0.60
Up to 18 Knots

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		4 blades EAR: 0.60 Lbs
inches	mm	aft end	forward end	length	max bore	pilot bore	
40	1016	130	150	180	95	65	198
42	1067	140	160	180	95	65	231
44	1118	140	160	180	95	65	259
46	1168	155	175	185	100	70	302
48	1219	155	175	205	100	70	342
50	1270	170	190	230	115	80	396
52	1321	170	190	240	115	80	439
54	1372	170	190	250	115	90	482
56	1422	200	215	260	125	90	567
58	1473	200	215	275	125	100	620
60	1524	200	215	295	125	100	682
62	1575	230	255	295	150	100	795
64	1626	230	255	305	150	110	856
66	1676	230	255	305	150	110	919
68	1727	270	300	345	180	120	1100
70	1778	270	300	345	180	120	1172
72	1829	270	300	365	180	130	1259
74	1880	270	300	365	180	150	1323
76	1930	270	300	365	180	150	1407
78	1980	270	300	365	180	150	1496
80	2030	285	320	430	190	150	1697

* size up to 120 inches

Sail Boat Propellers

Thrust Propeller TP- 2B
Skewed Sail Boat Propeller SSBP-2B
Sail Boat Propeller SBP-2B
NEO Efficiency Propeller NEP-3B (see page 15)

NEP-3B

TP-2B

SSBP-2B

SBP-2B

Diameter		Hub Dimensions (Inches)			Standard Taper Bore (Inches)		2 blades EAR: 0.30 Lbs	3 blades EAR: 0.45 Lbs
inches	mm	aft end	forward end	length	max bore	pilot bore		
10	254	1-7/16	1-5/8	2-1/4	7/8	3/4	2	2.2
11	279	1-7/16	1-5/8	2-1/4	7/8	3/4	2.4	2.64
12	305	1-9/16	1-3/4	2-3/8	1-1/8	7/8	3.1	3.3
13	330	1-9/16	1-3/4	2-3/4	1-1/8	1	3.5	3.96
14	356	1-3/4	2	2-3/4	1-1/8	1	4.8	5.06
15	381	1-3/4	2	2-3/4	1-1/8	1	5.5	5.94
16	406	1-15/16	2-3/16	3-1/4	1-1/4	1-1/8	6.8	7.48
17	432	2	2-5/16	3-1/4	1-3/8	1-1/8	8.1	8.58
18	457	2	2-5/16	3-1/4	1-3/8	1-1/8	9.2	9.68
20	508	2-1/8	2-7/16	3-3/4	1-3/8	1-1/4	11.9	12.76

Standard and Custom Propellers for Displacement Vessels

Custom SKP-5B

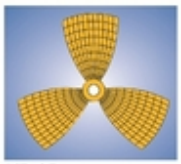
Kaplan Propeller KP-3B & KP-4B

The KP-3B and KP-4B series are specially designed with large tip chord lengths for operation in a duct. In this application it can develop substantially higher thrust than a conventional propeller.

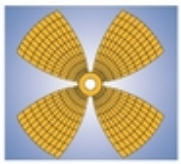
Custom Skewed Kaplan Propeller SKP-4B & SKP-5B

The SKP-4B and SKP-5B series have a skewed Kaplan blade to reduce vibration and provide all the advantages of our standard KP series. This propeller is typically manufactured in manganese bronze. It can also be supplied in Ni-Al Bronze, in applications where fatigue strength and erosion are a concern.

Custom Stainless Steel Propellers
(Dia 3000 mm, 3200 Kgs)



KP-3B
Dia 10″-95″
E.A.R. 0.55
Up to 15 Knots



KP-4B
Dia 16″-120″
E.A.R. 0.55 0.70
Up to 15 Knots

Custom SKP-4B
Dia 40″-120″
E.A.R. 0.55 0.70
Up to 17 Knots

Custom SKP-4B
(Variable pitch distribution)

NEW R&D

Advantage Propeller AD-3B, AD-4B & AD-5B

ADVANTAGE series propellers outperform conventional three and four blade propellers providing good fuel economy, low vibration and no harmful cavitation in both design and off design conditions.

ADVANTAGE propellers available in manganese bronze, nickel-aluminum bronze and stainless steel (CF-3) are a product of state of the art engineering incorporating

- Five blades
- Optimized pitch distribution
- Non-linear blade skew
- Advanced technology blade sections
- Low Vibration and low noise

ADVANTAGE series propellers are custom engineered for specific vessels to deliver the optimum in propeller efficiency. ADVANTAGE propellers produce substantial reductions in noise level, and propeller induced vibration level both thru the hull (Surface force induced) and up the shaft line (Bearing force induced). .

Hub Bore Dimension

Propeller Hub Taper 1:16

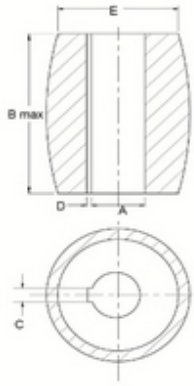
(unit: in)

Standard Taper	Dia. Small End(A)		Hub Length(B)	Moninal Keyway(D)	
				Width(C)	Depth(D)
3/4"	0.608	0.610	2-1/4"	3/16"	3-32"
7/8"	0.710	0.712	2-5/8"	1/4"	1/8"
1"	0.811	0.813	3"	1/4"	1/8"
1-1/8"	0.913	0.915	3-3/8"	1/4"	1/8"
1-1/4"	1.015	1.017	3-3/4"	5/16"	5/32"
1-3/8"	1.116	1.118	4-1/8"	5/16"	5/32"
1-1/2"	1.218	1.220	4-1/2"	3/8"	3/16"
1-3/4"	1.421	1.423	5-1/4"	7/16"	7/32"
2"	1.624	1.626	6"	1/2"	1/4"
2-1/4"	1.827	1.829	6-3/4"	9/16"	9/32"
2-1/2"	2.030	2.032	7-1/2"	5/8"	5/16"
2-3/4"	2.233	2.235	8-1/4"	5/8"	5/16"
3"	2.437	2.439	9"	3/4"	5/16"
3-1/4"	2.640	2.642	9-3/4"	3/4"	5/16"
3-1/2"	2.843	2.845	10-1/2"	7/8"	5/16"
3-3/4"	3.046	3.048	11-1/4"	7/8"	5/16"
4"	3.249	3.251	12"	1"	5/16"
4-1/2"	3.796	3.798	11-1/4"	1-1/8"	3/8"
5"	4.218	4.220	12-1/2"	1-1/4"	7/16"
5-1/2"	4.640	4.642	13-3/4"	1-1/4"	7/16"
6"	4.749	4.751	15"	1-3/8"	1/2"
6-1/2"	5.145	5.147	16-1/4"	1-3/8"	1/2"
7"	5.541	5.543	17-1/2"	1-1/2"	9/16"
7-1/2"	5.937	5.939	18-3/4"	1-1/2"	9/16"
8"	6.332	6.334	20"	1-3/4"	9/16"

SAE Standard Tapers

NOTES:

1. Shafts and bores to 6" and diameter have taper of 3/4" /ft. on the diameter 1/16"/inch. 1 degree 47'23" angel with centerline.
2. Shafts and bores 6" and larger have taper of 1"/ft. on diameter.
3. For intermediate size, refer to SEA Handbook or contact us.
4. Propeller hub length generally is less than maximum "B".
5. Oversea specification on request.

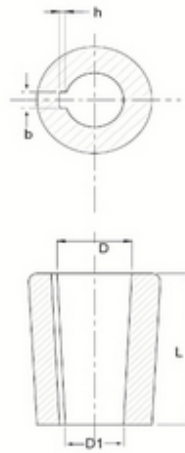


Taper 1:16

Propeller Hub Taper 1 : 10 ISO 4566:1992(E)

(unit: mm)

Shaft Dia.	Big Dia. D	Small Dia. D1	Length L	Keyway	
				b	h
20	20	15	50	6	3
25	25	19	60	6	3
30	30	22	80	8	4
35	35	26	90	10	4
40	40	30	100	12	4
45	45	34	110	14	5.5
50	50	38	120	14	5.5
55	55	42	130	16	5.5
60	60	46	140	16	5.5
65	65	50	150	18	5.5
70	70	54	160	18	5.5
75	74.5	57.5	170	20	6
80	79.5	61.5	180	20	6
85	84.5	65.5	190	22	7
90	89.5	69.5	200	22	7
95	94.5	73.5	210	25	7
100	99	77	220	25	7
110	109	85	240	28	7.5
120	119	93	260	32	8.5
130	129	101	280	36	9.5
140	139	109	300	36	9.5
150	149	117	320	36	9.5
160	159	125	340	40	10.5



Taper 1:10

PROPELLER ORDER SHEET

CLIENT DATA

Client :		
Phone :	Fax :	E-mail :
Date :		

VESSEL DATA

Hull Number :	
Hull Type :	☐ planing ☐ semi-planing ☐ semi-displacement ☐ displacement
Hull Condition :	☐ New Hull ☐ Old Hull
Bottom Design :	☐ Open ☐ Tunnel
Hull Material :	☐ Steel ☐ Aluminium ☐ Wood ☐ Fiberglass
Overall Length (LOA) :	
Loaded Waterline Length (LWL) :	
Beam :	
Maximum Chine Breadth :	
Draft :	
Light Loaded Displacement :	
Full Loaded Displacement :	
Deadrise Angle At Midship :	
LCG Distance From Stern :	
Deep From Waterline To Shaft Center :	
Shaft Angle :	
Maximum Propeller Diameter :	, Tip clearance _____.
Stabilizing Fin :	☐ With ☐ Without

MAIN ENGINE DATA

Manufacturer :	
Model :	
Brake Horsepower :	☐ _____HP ☐ _____PS ☐ _____KW
Engine RPM at BHP Output :	
Gear Reduction Ratio :	
Number of Engines :	☐ Single ☐ Twin ☐ Triple ☐ Quadruple
Expected Speed :	knots. (at _____Tons Displacement)
Expected Speed is Obtained by :	☐ Sea Trial ☐ Calculating ☐ Others _____

PROPELLER DATA

Diameter :	inches (mm)
Pitch :	inches (mm)
Expanded Area Ratio :	
Number of Blade :	☐ 2-Blade ☐ 3-Blade ☐ 4-Blade ☐ 5-Blade ☐ 6-Blade ☐ 7-Blade
Direction of Rotation :	☐ RH ☐ LH
Propeller Series :	☐ EP ☐ KCA ☐ NVP ☐ NSP ☐ SSP ☐ ESP ☐ ASP ☐ Other _____
Material :	☐ Mn-Bronze ☐ Ni-Al Bronze ☐ Stainless Steel

Comments :

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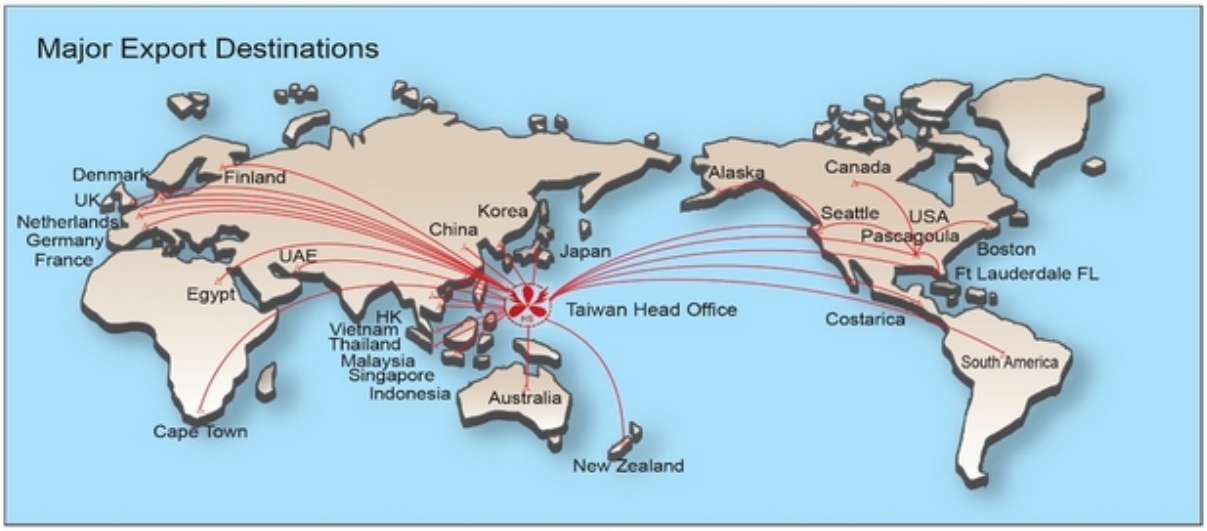
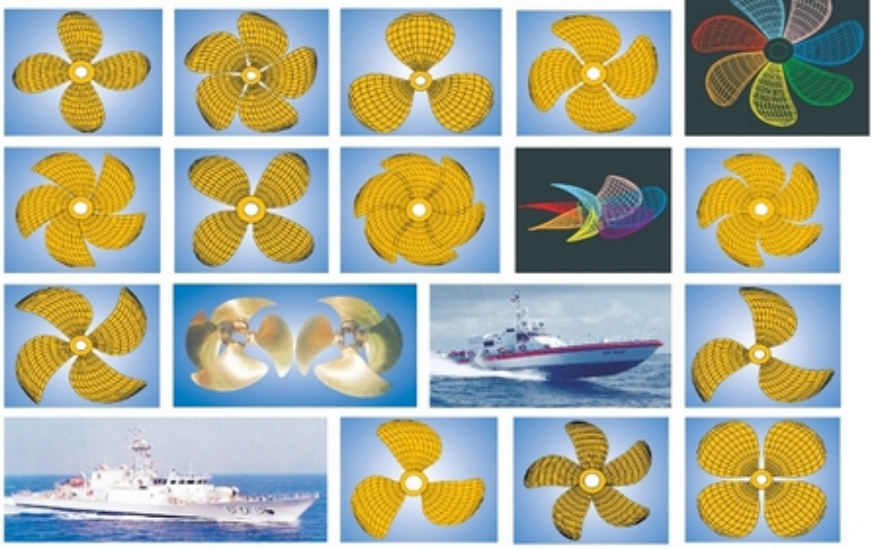
Sale Market





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