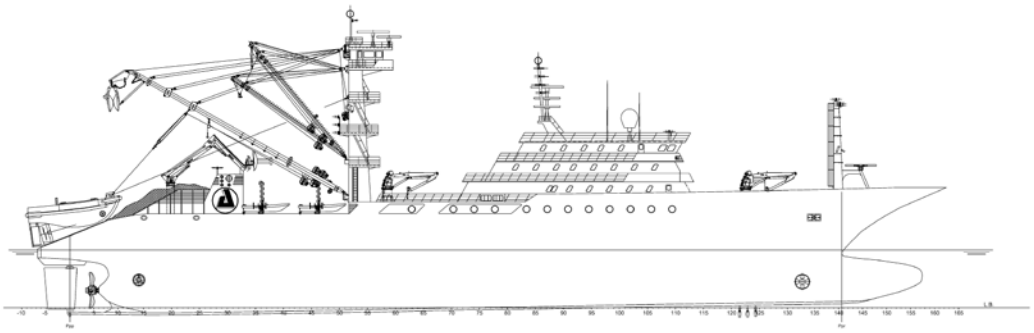
UNIVERSIDADE DA CORUÑA

PROYECTO FIN DE CARRERA

CURSO 2.015-2016

PROYECTO NÚMERO 16-15



Atunero 3300m3

Cuaderno 6

Predicción de potencia y cálculo de propulsor y timón

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Escola Politécnica Superior

UNIVERSIDADE DA CORUÑA

DEPARTAMENTO DE INGENIERÍA NAVAL Y OCEÁNICA

TRABAJO FIN DE GRADO

CURSO 2.015-2016

PROYECTO NÚMERO 16-15

TIPO DE BUQUE : Atunero de 3300 M3

CLASIFICACIÓN , COTA Y REGLAMENTOS DE APLICACIÓN : DNV. TORREMOLINOS MARPOL COLREG ILO 2006

CARACTERÍSTICAS DE LA CARGA: Atún congelado a -55ºC

VELOCIDAD Y AUTONOMÍA : 16,5 nudos en condiciones de servicio al 85% MCR y 15% de MM. 6000 millas de autonomía en estas condiciones

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA : Los habituales en este tipo de buque

PROPULSIÓN : Diesel eléctrica

TRIPULACIÓN Y PASAJE : 30 personas en camarotes individuales y dobles

OTROS EQUIPOS E INSTALACIONES : Hélice transversal en proa y popa. Los habituales en este tipo de buque

Ferrol, Junio 2.016

1-INTRODUCCIÓN

En este cuaderno se va a calcular y desarrollar los siguientes puntos:

- Estimación de la potencia propulsora
- Método y resultados del cálculo del propulsor. Alternativas estudiadas
- Cálculo del timón
- Croquis del perfil del propulsor, codaste y timón

Las características finales del buque, fijadas en cuadernos anteriores son:

DIMENSIONES

Lt(m)	113,60
Lpp(m)	96,50
B(m)	16,70
Dcp(m)	8,00
Dsup(m)	10,70
Tm(m)	7,20
Fn	0,276
Cb	0,570
Cp	0,588
Cm	0,969
Cf	0,753
Δ (Tn)	6781
Pot (kW)*	6743

*La potencia no será definitiva hasta la realización de este cuaderno.

En este cuaderno se va a desarrollar, con más detalle y por varios métodos, los cálculos de la potencia propulsora que es necesaria para el cumplimiento con lo requerido en velocidad de servicio en los RPA para el buque.

Para la predicción de potencia, se empleará el software NavCad, ya que tiene implementado numerosos métodos de predicción de potencia, y una vez definidos los parámetros del proyecto, el programa selecciona de entre todos los métodos los que más se ajustan a las variables propias de cada método.

La mayoría de los valores requeridos por el programa se obtienen de las hidrostáticas al calado de diseño, que se muestran en el ANEXO I.

Primeramente se realizara un estudio de la resistencia al avance, para determinar la potencia necesaria.

Con los valores obtenidos se procede a verificar la elección del motor que se instalará en el buque. A partir de los valores de potencia en el eje y revoluciones se realiza el diseño de la hélice.

De todos los métodos sugeridos por el software, el método ANDERSEN es el que más se ciñe a las características de nuestro buque proyecto. Un método apto para buques de entre 0,55 – 0,85 Cb provistos de bulbo.

Estas son Las características del método:

Andersen

Top Previous Next

Reference	Andersen, P. and Guldhammer, H.E., "A Computer-Oriented Power Prediction Procedure", CADMO, 1986. Guldhammer, H.E. and Harvald, Sv.Aa., "Ship Resistance", Akademisk Forlag, Copenhagen, 1974. Harvald, Sv.Aa., "Resistance and Propulsion of Ships", John Wiley & Sons, New York, 1983.
Vessel type	Single and twin-screw cargo ships
Prediction scope	Resistance: Bare-hull resistance Propulsion: Hull-propulsor interaction coefficients
Parameters	CVOL 4.0..6.0 CB(LWL) 0.55··0.85 LWL/BWL 5.0··8.0 Includes analysis for: Bulbous bow Propellers 1··2
Speed range	FN(LWL) 0.05··0.33
Formula error	Not presented.
Methodology	2-D CR, ITTC-57 CF, random model tests Model scale, open propellers
Remarks	This is a numerical implementation of the well-used graphical procedure of Guldhammer and Harvald [Guldhammer, 1974]. This procedure used a variety of random published model tests to make up the data set. The authors describe the method as general purpose for early design and warn about use of the method in the ballast condition. **[Propulsion]** Authors recommend modifying the wake fraction in the single-screw trial condition to w[ship] = 0.7 w[model], otherwise model values are acceptable. Authors describe the method as general purpose for early design. This is a numerical implementation of the well-used graphical procedure of Harvald.

2-PLANTEAMIENTO DE LA PLANTA PROPULSORA

Al ser la propulsión del buque diésel eléctrica, el motor propulsor será un motor eléctrico, que irá directamente acoplado al eje. Para alimentar este motor eléctrico se dispondrán de dos grupos generadores, que tendrán la potencia necesaria tanto para abastecer al motor eléctrico y la demanda de la planta eléctrica (1.200 kW)

3-CÁLCULO DE LA RESISTENCIA AL AVANCE

El cálculo de la Resistencia al avance lo realiza el programa si le introducimos los siguientes datos:

- Eslora en la flotación:

La sacamos de las hidrostáticas del ANEXO I, obteniendo un valor de: LWL = 100,789 m

- Desplazamiento:

Obtenido de las hidrostáticas: $\Delta = 6811$ Tn

- Número de hélices:

Como la mayoría de los buques de la base de datos pondremos una hélice.

- Rango de velocidades:

Seleccionamos el rango de velocidades para el cual vamos a hacer el estudio, y distinguimos de entre ellas la de servicio.

Speeds		
Speed [01]	10,00	kt
Speed [02]	12,00	kt
Speed [03]	13,00	kt
Speed [04]	14,00	kt
Speed [05]	14,50	kt
Speed [06]	15,00	kt
Speed [07]	15,50	kt
Speed [08]	16,00	kt
Speed [09]	16,50	kt
Speed [10]	17,00	kt
Design condition		
Design speed:	16,50	kt

Ahora seguimos definiendo los parámetros del casco:

- Centros de gravedad:

  Obtenidos de las hidrostáticas: Lcb = 46,963 m y Lcf = 40,896 m

- Área de la maestra:

  Obtenida de las hidrostáticas: Am = 116,855 m2

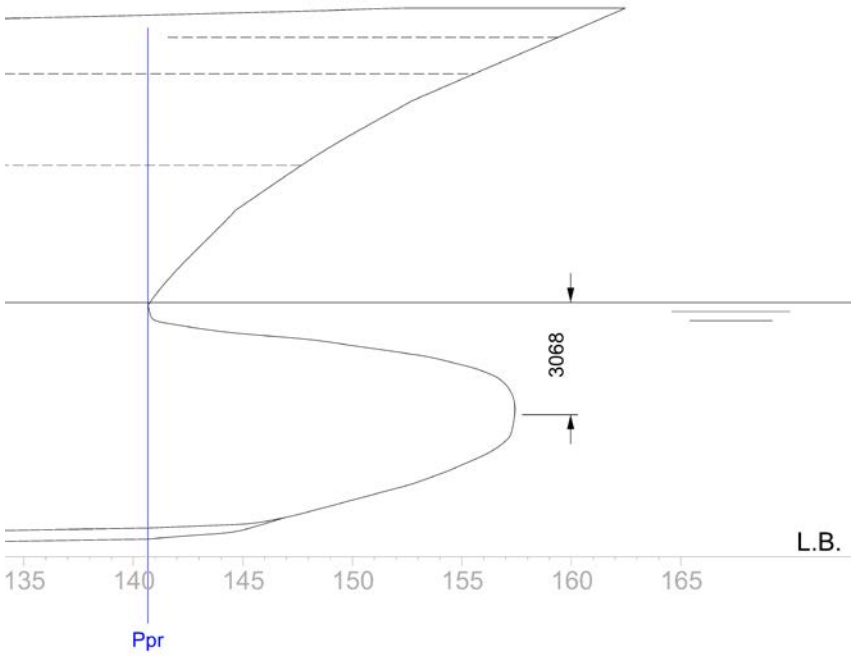
- Área de la flotación:

  Obtenida de las hidrostáticas: Af = 1269,51 m2

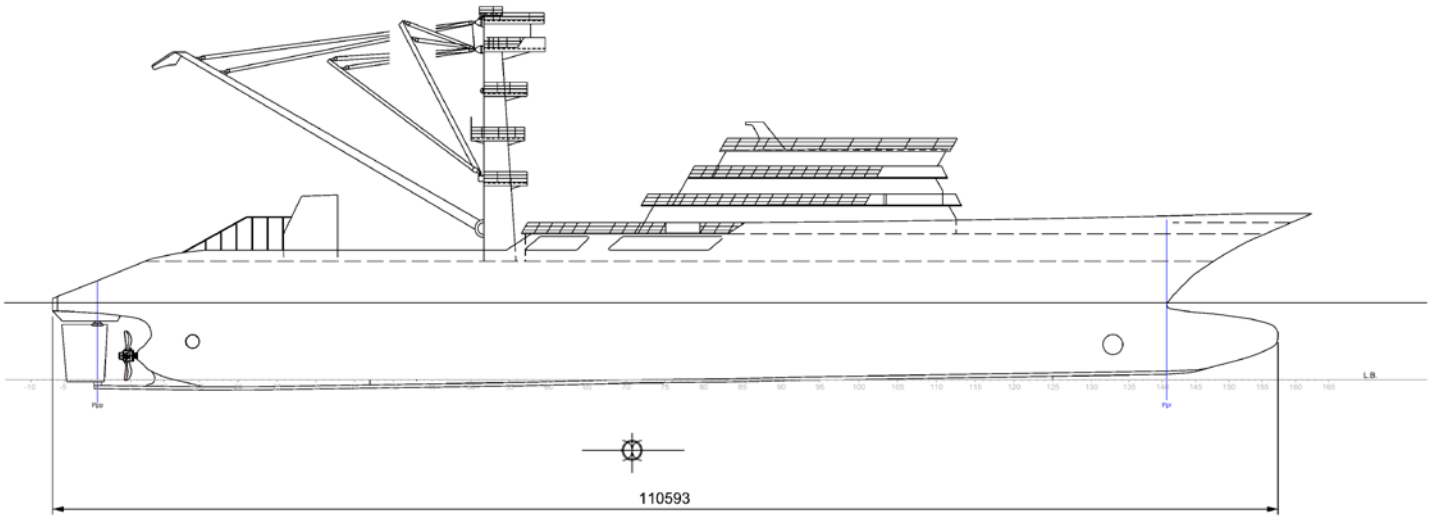
- Sección del bulbo:

  Obtenemos el área de la sección del bulbo con las formas presentadas en el cuaderno 3. Sb = 6,93 m2

- Distancia de la nariz del bulbo a la flotación:



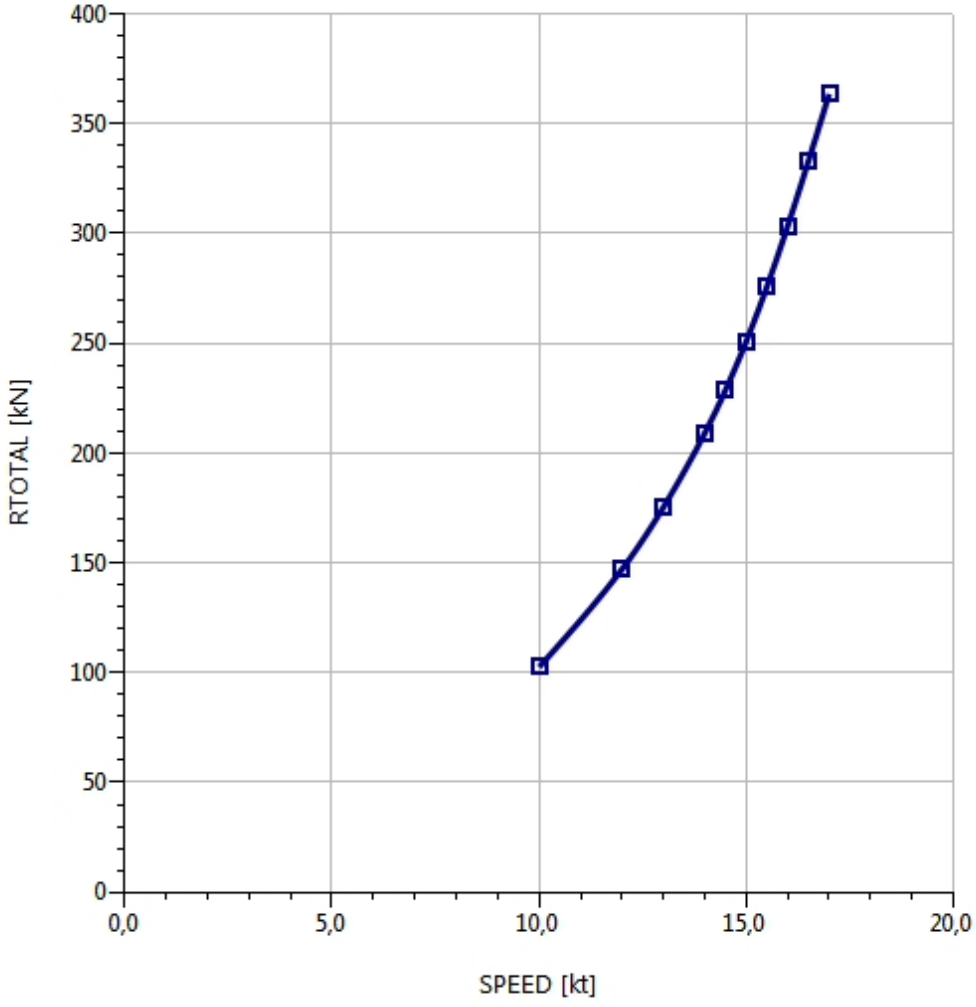
- Distancia de la nariz del bulbo a la popa:



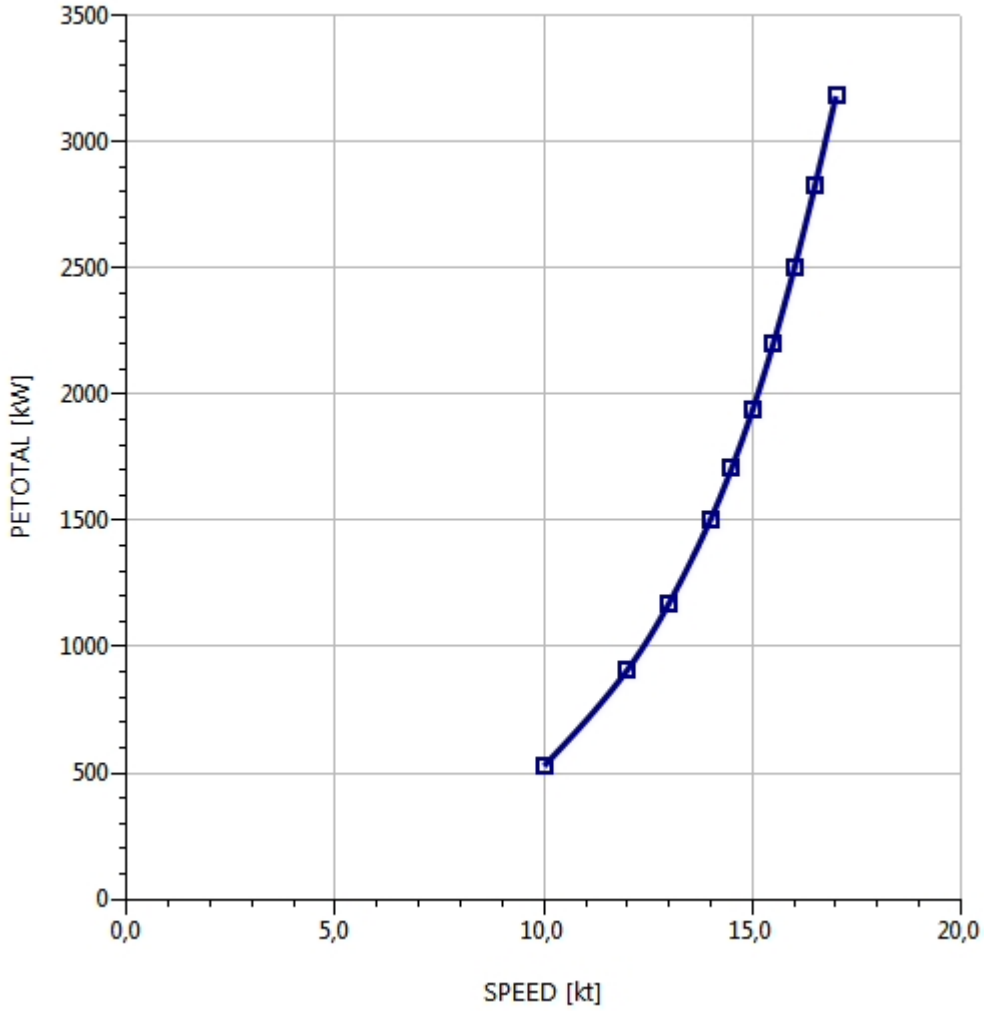
El resto de valores introducidos serán:

Angulo de entrada	18°
Formas popa	U
Formas proa	V
Resistencia por apéndices	5%
Margen de mar	15%

- Resistencia al avance: 333,05 kN



- Potencia efectiva: 2827,0 kW



La potencia efectiva es la potencia que debe entregarse al propulsor para superar la resistencia al avance, pero no es la misma que la potencia que tiene el conjunto de diésel generadores, ya que se deben tener en cuenta distintos rendimientos.

La potencia del motor será

Los resultados del análisis se encuentran en el ANEXO II.

4-ESTIMACIÓN DE POTENCIA PRELIMINAR

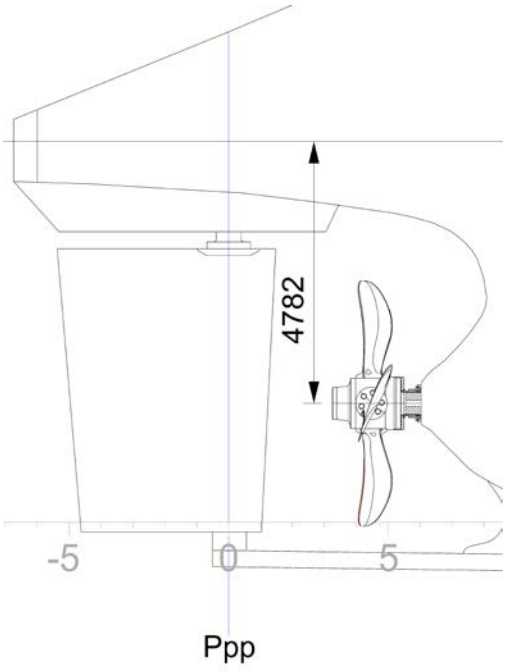
Para la predicción de la potencia propulsora, el estudio se realiza basándose en la estimación de la potencia que es necesario proporcionar al buque para conseguir la velocidad de servicio que en este caso es de 16,5 nudos. Se va a dimensionar el propulsor mediante empuje, es decir, a partir de la resistencia al avance obtenida en el apartado anterior para la misma velocidad.

Realizaremos la elección de la hélice para este caso, aunque no será definitiva ya que estudiaremos hélices con diferente número de palas, con el fin de buscar el más óptimo.

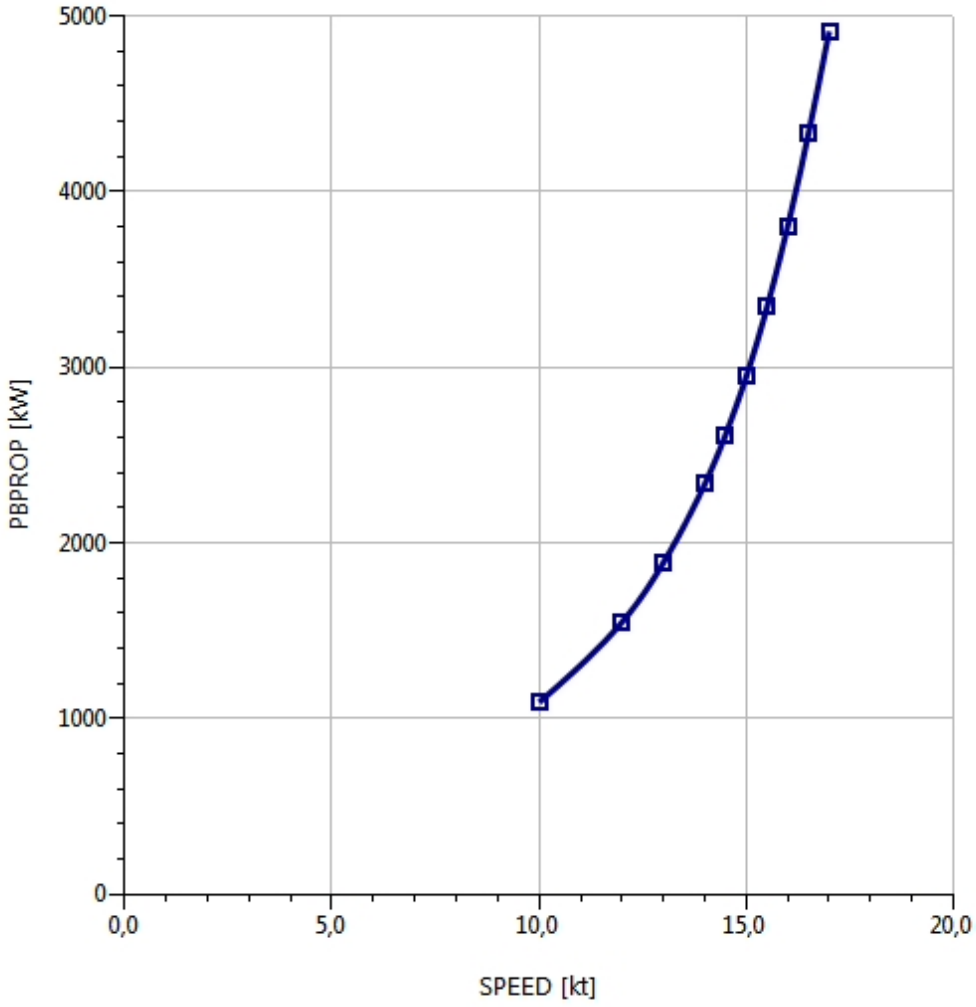
Tomaremos una hélice de paso variable, y para este estudio se le asignarán 4 palas, aunque más adelante se realizará el estudio para 5 y 6 palas. El diámetro máximo de la hélice será de 4,5 m para asegurar su buena inmersión en todas las condiciones de carga y respetar los huelgos definidos por la sociedad de clasificación. El análisis se realizará para 110 rpm, que son las revoluciones a las que suelen ir este tipo de buques.

Introduciremos los siguientes datos en el programa:

- Inmersión del eje:



Una vez realizado el análisis, se comprueba que la potencia necesaria para propulsar el buque a la velocidad deseada es de 4329,7 kW. El resto de los resultados del estudio se encuentran en el ANEXO II.



5-SELECCIÓN DEL MOTOR

Para la potencia obtenida en el apartado anterior se ha seleccionado un motor eléctrico de inducción de alta tensión de la marca ABB modelo AMI 560L4A B de 4 polos, que desarrolla una potencia de 4750 kW.

Para alimentar este motor eléctrico se han dispuesto dos grupos generadores Wartsila 6L34 con las siguientes características:

Marca	WÄRTSILÄ
Modelo	6L34
Potencia Motor	3000 kW
Potencia generador	3600 kVA
Velocidad nominal	750 rpm
Número de cilindros	6 en línea
Ciclo	4 tiempos
Cilindrada	36,3 L

Estos grupos generadores abastecen tanto la demanda de potencia del motor eléctrico principal como la demanda de la planta eléctrica del buque (1.200 kW), que se ha obtenido del buque base.

Las características de estos motores están dispuestas en el ANEXO III.

6-SELECCIÓN DE LA HÉLICE DEFINITIVA

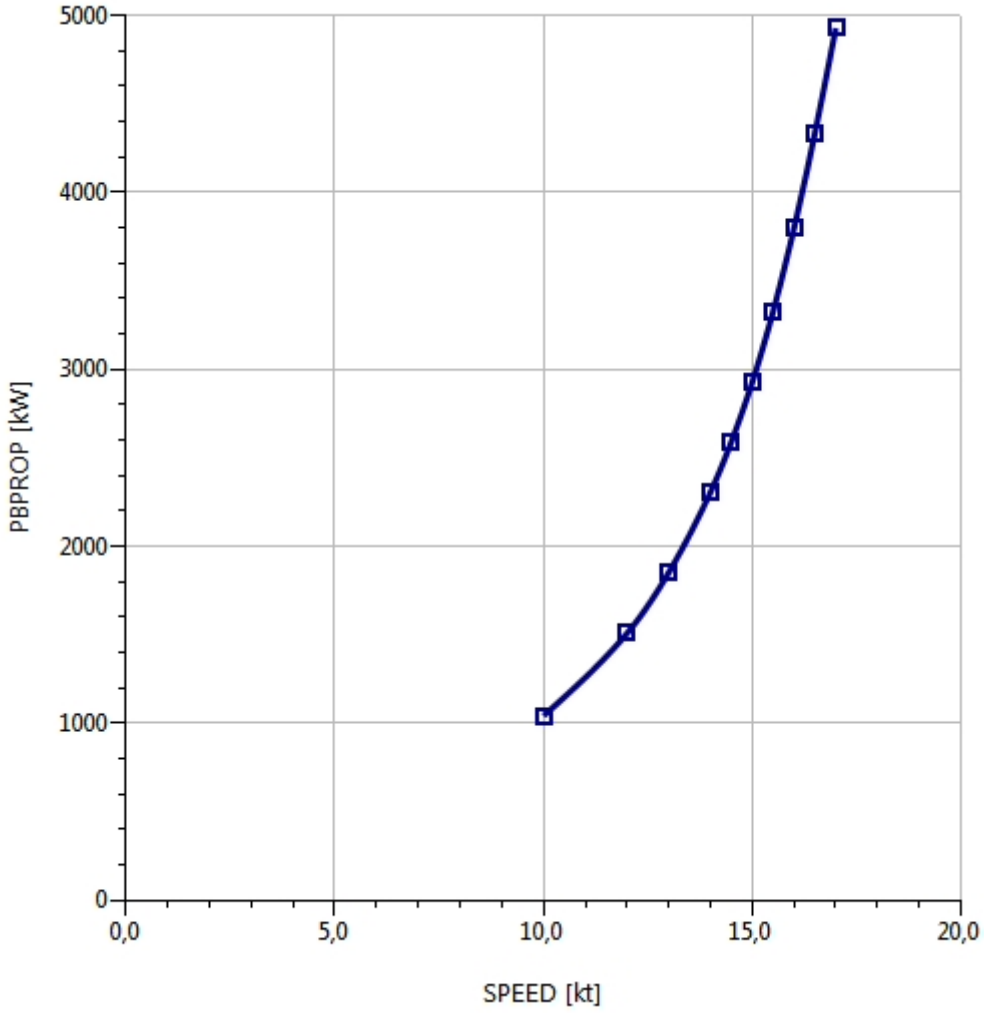
Para la selección definitiva de la hélice seguiremos utilizando el navcad, solo que ahora los cálculos se realizarán *by power* ya que ahora conocemos la potencia con la que contamos.

Vamos a realizar el estudio para distinto número de palas con el fin de seleccionar el modelo óptimo para el correcto funcionamiento del propulsor. Lo haremos con 4, 5 y 6 palas.

-4 palas

Para una configuración de 4 palas se han obtenido los siguientes resultados:

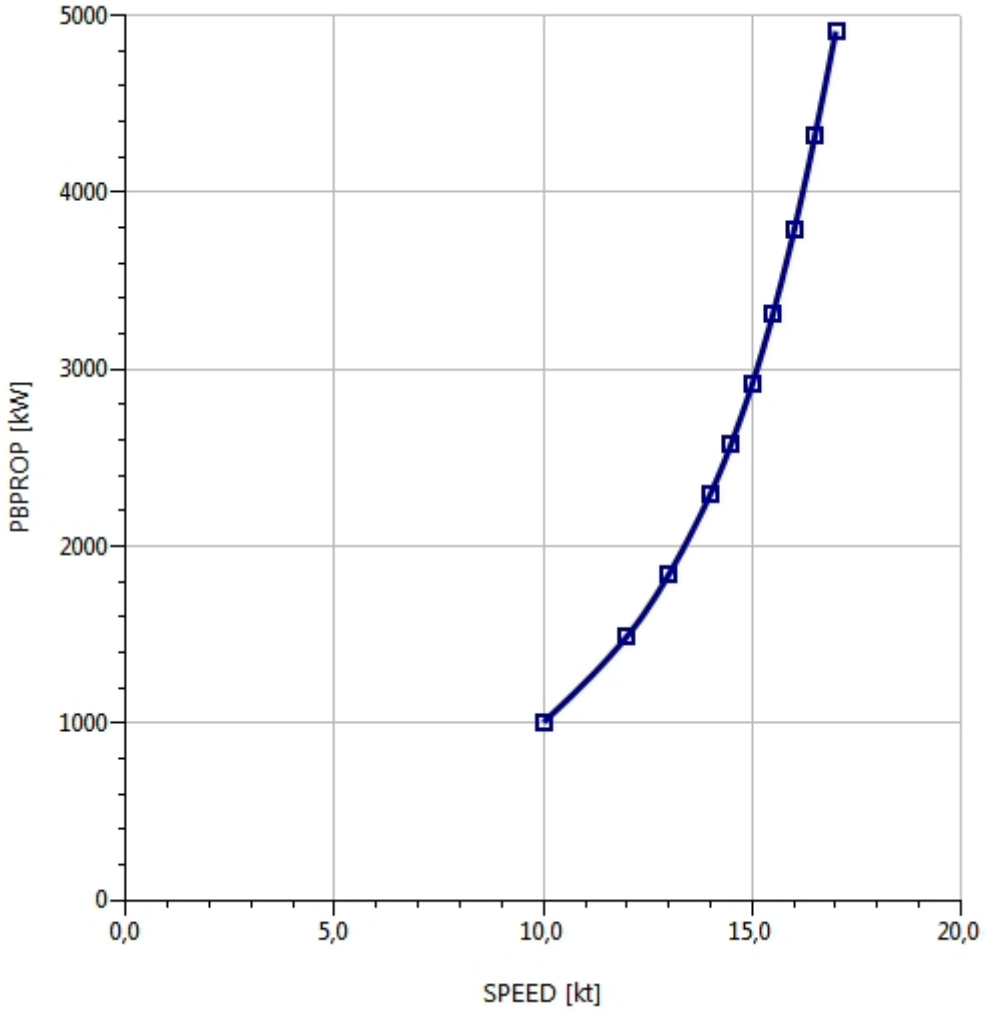
Potencia	4333,8 kW
EFFOA	0,6523
Diámetro	4,5 m



-5 palas

Para una configuración de 5 palas se han obtenido los siguientes resultados:

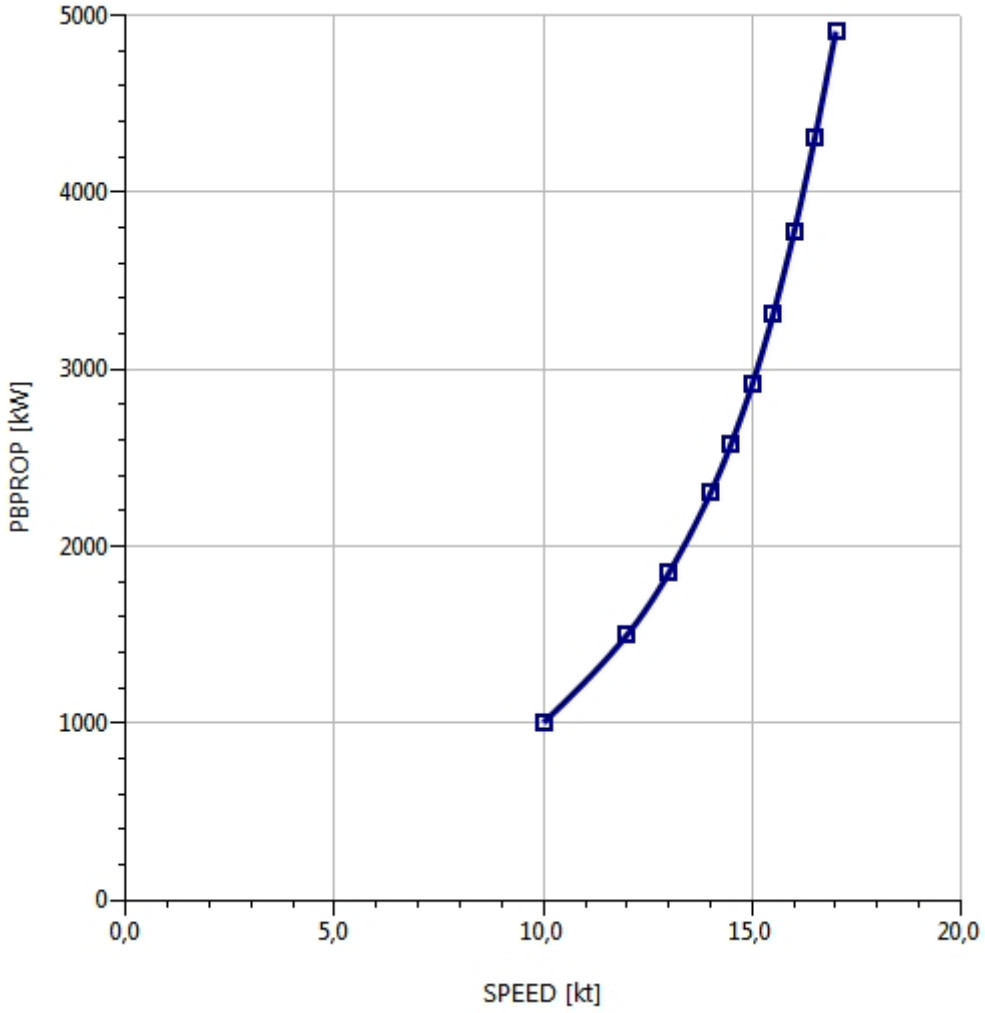
Potencia	4317,5 kW
EFFOA	0,6548
Diámetro	4,5 m



-6 palas

Para una configuración de 6 palas se han obtenido los siguientes resultados:

Potencia	4309,0 kW
EFFOA	0,6561
Diámetro	4,5 m



-Conclusión

Comparamos los resultados con las diferentes configuraciones de palas:

	4 palas	5 palas	6 palas
Potencia	4333,8 kW	4317,5 kW	4309,0 kW
EFFOA	0,6523	0,6548	0,6561
Diámetro	4,5 m	4,5 m	4,5 m

Vemos que la configuración de 6 palas necesita suministrar menos potencia para alcanzar la velocidad de servicio, y tiene un mayor rendimiento, por lo que será la configuración escogida. Los resultados del análisis se encuentran en el ANEXO II

-Datos geométricos del propulsor

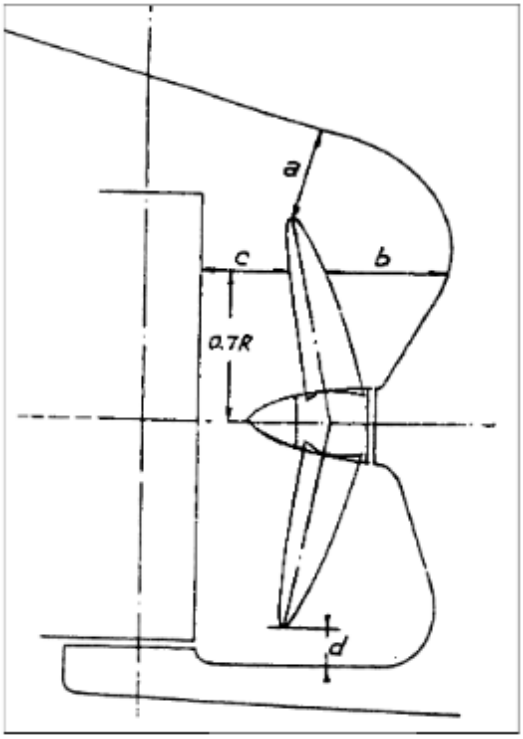
- Relación área desarrollada/área disco AD/A0 = 0,5985
- Diámetro = 4,5 m
- Relación paso diámetro, H/D = 1,13

El propulsor cavitará un 6,3 % a la velocidad de servicio 16,5 nudos en navegación libre.

7-VANOS DEL CODASTE

El perfil de popa debe cumplir con las claras de codaste exigidas por la sociedad de clasificación. En el caso del buque proyecto, se van tener en cuenta los valores exigidos por el DNV, ya que es la Sociedad de Clasificación impuesta en el RPA.

Dónde los valores mínimos son:



a = (0,24 – 0,01Z) x D = 0,81 m

b = (0,35 – 0.02Z) x D = 1,215 m

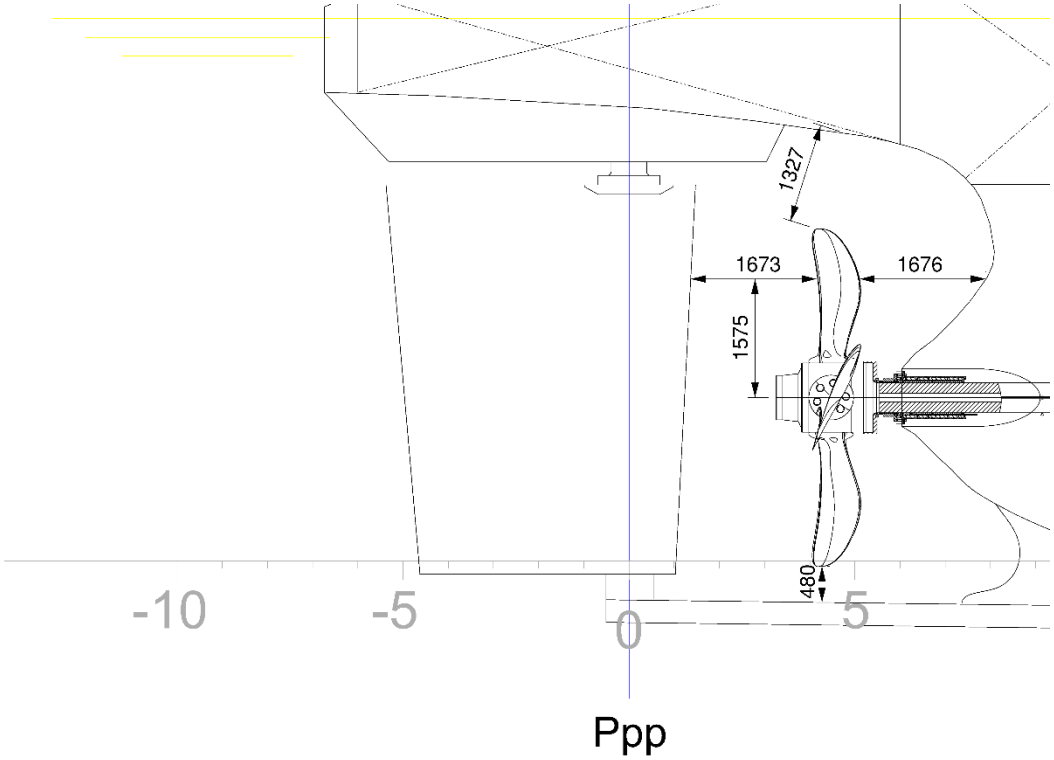
c = 0,1D = 0,45 m

d = 0,035D = 0,158 m

Z es el número de palas, Z = 6

D es el diámetro de la hélice, D = 4,5 m.

A continuación se muestra el diseño del codaste del buque proyecto:



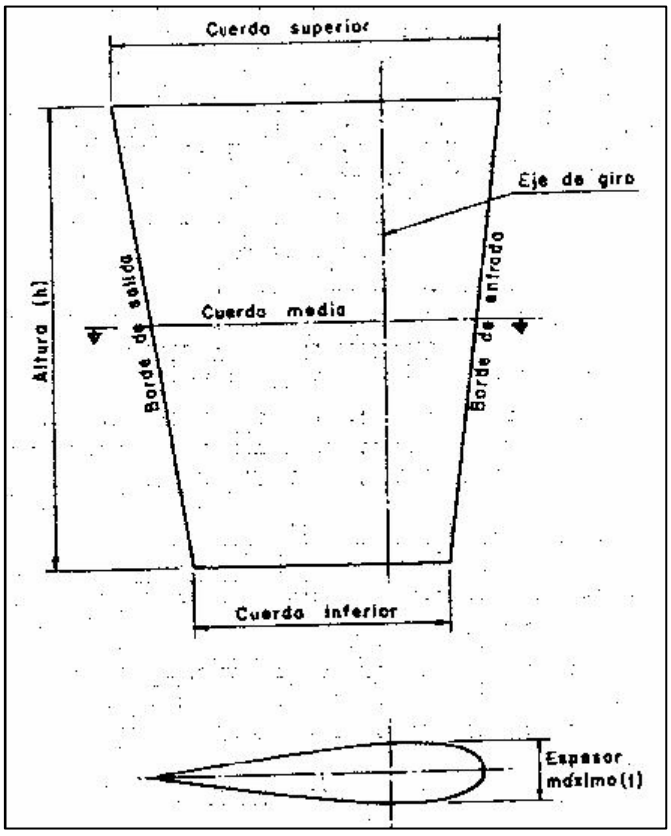
En la siguiente tabla se presentan los datos obtenidos, comprobándose que cumplen los mínimos requeridos por el DNV:

	Buque proyecto	DNV	Cumple
a (m)	1,327	0,810	SI
b (m)	1,676	1,215	SI
c (m)	1,673	0,450	SI
d (m)	0,480	0,158	SI

8-DISEÑO DEL TIMÓN

Antes de comenzar a calcular todos los parámetros geométricos de timón, se definen aquellos que tienen una mayor importancia:

- Altura (h): dimensión normal al flujo.
- Cuerda (c): dimensión paralela al flujo.
- Espesor (t): dimensión perpendicular al plano de crujía.
- Relación de espesor (t/c)**:** Relación entre el máximo espesor del perfil y la cuerda.
- Alargamiento (λ=h/c): Es la relación entre la altura del timón y la cuerda media
- Área del timón: Área total del timón
- Tipo de perfil: Distribución de espesores a lo largo de la cuerda. Para timones marinos, el tipo de perfil más empleado son las secciones NACA00ab, donde ab es la relación de espesor.



-Tipo de timón:

Acorde con el buque base, se ha escogido un timón de tipo suspendido, soportado por la mecha.

En la parte inferior del timón, la quilla tiene una continuidad hasta su mecha. Esto es una medida de seguridad para que las redes no se enreden entre el timón y la hélice durante las tareas de pesca. No se trata de un pinzote, es decir, no ayuda al soportado del timón.

-Superficie del timón:

D. Antonio Baquero propone para el área del timón que se sitúe entre el 1,1 y el 2,9% del área de deriva. Según estudios realizados en canales de experiencias con atuneros, el área óptima se encuentra entorno al 2,2% del área de deriva.

El área de deriva para el calado de diseño consigue un valor del área proyectada lateral de 715,34 m2, obtenida del maxsurf.

Con estos datos, el área del timón es:

$$At = \%\ rel \times Aderiva$$

$$At = 0{,}022 \times 715{,}34 = 15{,}73\ m2$$

-Contorno del timón:

El contorno es de forma trapezoidal, lo normal en estos buques, ya que al ser de tipo suspendido, esta forma permite subir el centro de gravedad de la superficie de la pala con lo que se reducen los esfuerzos a que se encuentra sometida la mecha en la bocina de la limera. A continuación se calculan las distintas dimensiones de la pala.

-Altura (h):

La altura del timón está condicionada por la disposición del codaste y por la instalación de una aleta fija en su parte superior que permite una mejor maniobrabilidad al impedir la formación de torbellinos en la estela a la salida de la hélice. El espacio disponible permite una altura de 6,01 m.

Aplicando el reglamento del Lloyd´s se observa que la altura del timón debe ser del orden del 115% del diámetro de la hélice. Teniendo en cuenta que el diámetro de la hélice es de 4,5 m., se obtiene una altura de timón:

$$h = 1{,}15 \times 4{,}5 = 5{,}17 \text{ m.}$$

-Cuerda (c):

Con el valor de la altura y el área de la pala se obtiene la cuerda que ha de tener el perfil:

$$c = At/h = 3{,}00 \text{ m}$$

-Relación de compensación:

La relación de compensación es el área de la pala a popa de la mecha en relación al área a proa de la mecha. Según DNV, no debe superar el 33 %. Para buques de un coeficiente de bloque de 0,6 es del orden de 0,250-0,255. En el caso del buque proyecto se va a tomar el menor valor del intervalo, ya que en este caso se está hablando de un coeficiente de bloque de 0,57:

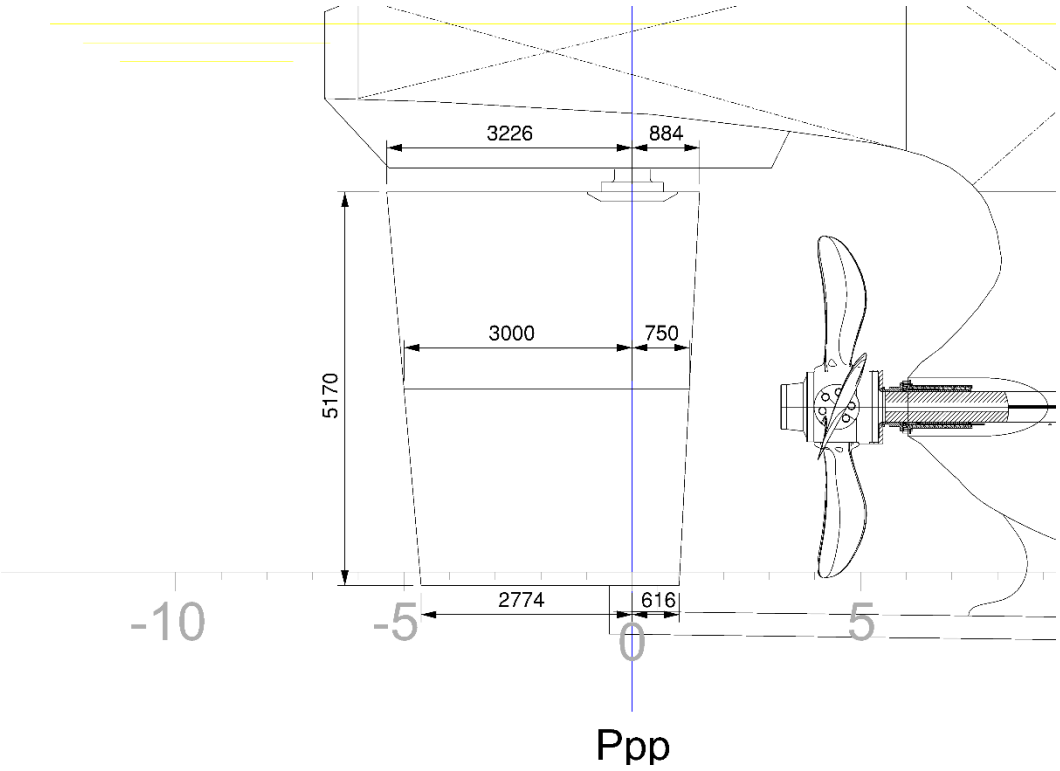
$$\text{Compensación} = Apr/At$$

$$Apr = \text{Compensación} \times At = 3{,}93 \text{ m2}$$

Teniendo en cuenta la forma trapezoidal, la altura total del timón y el área de compensación se obtiene el siguiente una longitud media de compensación por proa de la mecha:

$$lcomp.= Apr/h = 0{,}75 \text{ m.}$$

El contorno del timón queda finalmente:



-Definición del perfil:

El perfil empleado debe tener una geometría que conduzca a un reparto de presiones de tal forma que el centro de las mismas no se mueva excesivamente con el aumento del ángulo del timón.

Además debe tener una buena resistencia al desprendimiento del flujo, así como una buena respuesta en cuanto a coeficiente de sustentación.

En este caso se usará un perfil tipo NACA 0023 donde la relación t/c = 0,23. Este tipo de perfil se caracteriza por tener el máximo espesor al 70 % de la cuerda tomando como origen el borde de salida.

9-CÁLCULO DEL PAR TORSOR Y FUERZA SOBRE LA PALA

Teniendo determinada las características geométricas, se procede al cálculo de las fuerzas y momentos que actúan sobre la pala del timón y de la mecha por la acción del agua sobre él cuando se mete el timón a una banda.

Las fuerzas y momentos determinados, son importantes a la hora de realizar el cálculo del escantillonado de la estructura del timón, mechas y apoyos, así como de la elección del accionamiento.

La distancia desde el borde de ataque al centro de presión se estima mediante la siguiente expresión, realizando el cálculo a 35º, según lo indicado por el SOLAS:

$$D = (0{,}2 + 0{,}3 \times \text{sen}\alpha) \times l$$

Donde l es la longitud del timón em m.

$$D = 1{,}313 \text{ m}$$

Distancia del centro de presiones al eje:

$$d_{avante} = 1{,}313 - 0{,}75 = 0{,}563 \text{ m}$$

$$d_{ciando} = (3{,}75 - 1{,}313) - 0{,}75 = 1{,}687 \text{m}$$

La fuerza sobre el timón se calcula aplicando la fórmula de Joëssel. Para la velocidad de ciado se toman 2/3 de la velocidad de servicio.

$$F_{avante} = \frac{41{,}35 \times A_t \times V^2 \times \text{sen}\alpha}{0{,}2 + 0{,}3 \times \text{sen}\alpha} = 72{,}23 \text{ Tn}$$

$$F_{ciando} = \frac{41{,}35 \times A_t \times \frac{2}{3}V^2 \times \text{sen}\alpha}{0{,}2 + 0{,}3 \times \text{sen}\alpha} = 32{,}10 \text{ Tn}$$

Par torsor:

$$P_{avante} = 72{,}23 \times 0{,}536 = 38{,}71 \, Tn \cdot m$$

$$P_{ciando} = 32{,}10 \times 1{,}687 = 54{,}15 \, Tn \cdot m$$

El par torsor para el diseño del servo se multiplica el mayor par torsor obtenido del cálculo anterior por un factor de seguridad de 1,3:

$$Q_{torsor} = 54{,}15 \cdot 1{,}3 = 70{,}40 \, Tn \cdot m$$

ANEXO I

HIDROSTÁTICAS AL CALADO DE DISEÑO

	Draft Amidships m	7,200
1	Displacement t	6811
2	Heel deg	0,0
3	Draft at FP m	7,200
4	Draft at AP m	7,200
5	Draft at LCF m	7,200
6	Trim (+ve by stern) m	0,000
7	WL Length m	100,835
8	Beam max extents on WL m	16,724
9	Max sect. area m^2	116,855
10	Wetted Area m^2	2289,42
11	Waterpl. Area m^2	1269,51
12	Prismatic coeff. (Cp)	0,564
13	Block coeff. (Cb)	0,503
14	Max Sect. area coeff. (Cm)	0,952
15	Waterpl. area coeff. (Cwp)	0,753
16	LCB from zero pt. (+ve fwd) m	46,963
17	LCF from zero pt. (+ve fwd) m	40,896
18	KB m	4,007
19	KG m	7,200
20	BMt m	3,395
21	BML m	111,967
22	GMt m	0,202
23	GML m	108,774
24	KMt m	7,402
25	KML m	115,974
26	Immersion (TPc) tonne/cm	13,013
27	KN m	-0,001
28	Trim angle (+ve by stern) deg	0,0000
29	Lat.proj. Underwater area m^2	715,339

ANEXO II

REPORTS

RESISTENCIA

Resistance

5 sep 2016 04:20
HydroComp NavCad 2014

Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3 By thrust.hcnc**

Analysis parameters

Vessel drag		Added drag	
Technique:	[Calc] Prediction	Appendage:	[Calc] Percentage
Prediction:	Holtrop	Wind:	[Off]
Reference ship:		Seas:	[Off]
Model LWL:		Shallow/channel:	[Off]
Expansion:	Custom	Towed:	[Off]
Friction line:	ITTC-57	Margin:	[Calc] Hull drag only [15%]
Hull form factor:	[On] 1,198	**Water properties**	
Speed corr:	[Off]	Water type:	Salt
Spray drag corr:	[Off]	Density:	1026,00 kg/m3
Corr allowance:	0,000338	Viscosity:	1,18920e-6 m2/s
Roughness [mm]:	[On] 0,15		

Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T	Lambda
Value	0,27	0,56	6,04	2,32	0,63
Range	0,06··0,62	0,55··0,85	3,90··14,90	2,10··4,00	0,01··1,00

Prediction results

	SPEED COEFS		ITTC-78 COEFS						
SPEED [kt]	FN	FV	RN	CF	[CTLT/CF]	CR	dCF	CA	CT
10,00	0,164	0,379	4,36e8	0,001701	1,198	0,000363	0,000000	0,000338	0,002739
12,00	0,196	0,455	5,23e8	0,001661	1,198	0,000401	0,000000	0,000338	0,002729
13,00	0,213	0,493	5,67e8	0,001644	1,198	0,000463	0,000000	0,000338	0,002771
14,00	0,229	0,531	6,10e8	0,001629	1,198	0,000560	0,000000	0,000338	0,002850
14,50	0,237	0,550	6,32e8	0,001622	1,198	0,000626	0,000000	0,000338	0,002906
15,00	0,245	0,569	6,54e8	0,001615	1,198	0,000707	0,000000	0,000338	0,002979
15,50	0,254	0,588	6,76e8	0,001608	1,198	0,000803	0,000000	0,000338	0,003067
16,00	0,262	0,607	6,98e8	0,001601	1,198	0,000910	0,000000	0,000338	0,003166
+ 16,50 +	0,270	0,626	7,19e8	0,001595	1,198	0,001018	0,000000	0,000338	0,003267
17,00	0,278	0,645	7,41e8	0,001589	1,198	0,001118	0,000000	0,000338	0,003360

	RESISTANCE							
SPEED [kt]	RBARE [kN]	RAPP [kN]	RWIND [kN]	RSEAS [kN]	RCHAN [kN]	RTOWED [kN]	RMARGIN [kN]	RTOTAL [kN]
10,00	85,48	4,27	0,00	0,00	0,00	12,82	12,82	102,58
12,00	122,64	6,13	0,00	0,00	0,00	18,40	18,40	147,17
13,00	146,17	7,31	0,00	0,00	0,00	21,93	21,93	175,41
14,00	174,30	8,71	0,00	0,00	0,00	26,14	26,14	209,16
14,50	190,69	9,53	0,00	0,00	0,00	28,60	28,60	228,83
15,00	209,17	10,46	0,00	0,00	0,00	31,37	31,37	251,00
15,50	229,97	11,50	0,00	0,00	0,00	34,49	34,49	275,96
16,00	252,95	12,65	0,00	0,00	0,00	37,94	37,94	303,54
+ 16,50 +	277,54	13,88	0,00	0,00	0,00	41,63	41,63	333,05
17,00	303,00	15,15	0,00	0,00	0,00	45,45	45,45	363,60

	EFFECTIVE POWER		OTHER		
SPEED [kt]	PEBARE [kW]	PETOTAL [kW]	CTLR	CTLT	RBARE/W
10,00	439,8	527,7	0,00636	0,04801	0,00129
12,00	757,1	908,5	0,00702	0,04783	0,00184
13,00	977,6	1173,1	0,00812	0,04858	0,00220
14,00	1255,3	1506,4	0,00982	0,04994	0,00262
14,50	1422,5	1707,0	0,01097	0,05094	0,00287
15,00	1614,1	1936,9	0,01238	0,05221	0,00315
15,50	1833,7	2200,5	0,01407	0,05376	0,00346
16,00	2082,0	2498,4	0,01594	0,05549	0,00380
+ 16,50 +	2355,8	2827,0	0,01784	0,05725	0,00417
17,00	2649,9	3179,9	0,01959	0,05888	0,00456

Resistance

5 sep 2016 04:20

HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3 By thrust.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**100,789 m**
Max beam on WL:	[LWL/BWL 6,035]	**16,700 m**
Max molded draft:	[BWL/T 2,319]	**7,200 m**
Displacement:	[CB 0,545]	**6781,00 t**
Wetted surface:	[CS 2,816]	**2298,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,506]	**50,954 m**
LCF fwd TR:	[XCF/LWL 0,444]	**44,722 m**
Max section area:	[CX 0,969]	**116,5 m2**
Waterplane area:	[CWP 0,757]	**1274,2 m2**
Bulb section area:		**6,9 m2**
Bulb ctr below WL:		**3,320 m**
Bulb nose fwd TR:		**110,593 m**
Imm transom area:	[ATR/AX 0,061]	**7,1 m2**
Transom beam WL:	[BTR/BWL 0,637]	**10,643 m**
Transom immersion:	[TTR/T 0,136]	**0,980 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[BTK flow]	**-1,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,0 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***4500,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Resistance

5 sep 2016 04:20
HydroComp NavCad 2014

Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3 By thrust.hcnc**

Appendage data

General	
Definition:	**Percentage**
Percent of hull drag:	**5,00 %**
Planing influence	
LCE fwd TR:	**0,000 m**
VCE below WL:	**0,000 m**
Shafting	
Count:	**1**
Max prop diameter:	**4500,0 mm**
Shaft angle to WL:	**0,00 deg**
Exposed shaft length:	**0,000 m**
Shaft diameter:	**0,000 m**
Wetted surface:	**0,0 m2**
Strut bossing length:	**0,000 m**
Bossing diameter:	**0,000 m**
Wetted surface:	**0,0 m2**
Hull bossing length:	**0,000 m**
Bossing diameter:	**0,000 m**
Wetted surface:	**0,0 m2**
Strut (per shaft line)	
Count:	**0**
Root chord:	**0,000 m**
Tip chord:	**0,000 mm**
Span:	**0,000 m**
T/C ratio:	**0,000**
Projected area:	**0,0 m2**
Wetted surface:	**0,0 m2**
Exposed palm depth:	**0,000 m**
Exposed palm width:	**0,000 m**
Rudder	
Count:	**0**
Rudder location:	**Behind propeller**
Type:	**Balanced foil**
Root chord:	**0,000 m**
Tip chord:	**0,000 m**
Span:	**0,000 m**
T/C ratio:	**0,000**
LE sweep:	**0,00 deg**
Projected area:	**0,0 m2**
Wetted surface:	**0,0 m2**

Skeg/Keel	
Count:	**0**
Type:	**Skeg**
Mean length:	**0,000 m**
Mean width:	**0,000 m**
Height aft:	**0,000 m**
Height mid:	**0,000 m**
Height fwd:	**0,000 m**
Projected area:	**0,0 m2**
Wetted surface:	**0,0 m2**
Stabilizer	
Count:	**0**
Root chord:	**0,000 m**
Tip chord:	**0,000 m**
Span:	**0,000 m**
T/C ratio:	**0,000**
LE sweep:	**0,00 deg**
Wetted surface:	**0,0 m2**
Projected area:	**0,0 m2**
Dynamic multiplier:	**1,00**
Bilge keel	
Count:	**0**
Mean length:	**0,000 m**
Mean base width:	**0,000 m**
Mean projection:	**0,000 m**
Wetted surface:	**0,0 m2**
Tunnel thruster	
Count:	**0**
Diameter:	**0,000 m**
Sonar dome	
Count:	**0**
Wetted surface:	**0,0 m2**
Miscellaneous	
Count:	**0**
Drag area:	**0,0 m2**
Drag coef:	**0,00**

Environment data

Wind	
Wind speed:	**0,00 kt**
Angle off bow:	**0,00 deg**
Gradient correction:	**Off**
Exposed hull	
Transverse area:	**0,0 m2**
VCE above WL:	**0,000 m**
Profile area:	**0,0 m2**
Superstructure	
Superstructure shape:	**Cargo ship**
Transverse area:	**0,0 m2**
VCE above WL:	**0,000 m**
Profile area:	**0,0 m2**

Seas	
Significant wave ht:	**0,000 m**
Modal wave period:	**0,0 sec**
Shallow/channel	
Water depth:	**0,000 m**
Type:	**Shallow water**
Channel width:	**0,000 m**
Channel side slope:	**0,00 deg**
Hull girth:	**0,000 m**

Resistance

5 sep 2016 04:20

HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3 By thrust.hcnc**

Symbols and values

SPEED =	Vessel speed
FN =	Froude number [LWL]
FV =	Froude number [VOL]
RN =	Reynolds number [LWL]
CF =	Frictional resistance coefficient
CV/CF =	Viscous/frictional resistance coefficient ratio [dynamic form factor]
CR =	Residuary resistance coefficient
dCF =	Added frictional resistance coefficient for roughness
CA =	Correlation allowance [dynamic]
CT =	Total bare-hull resistance coefficient
RBARE =	Bare-hull resistance
RAPP =	Additional appendage resistance
RWIND =	Additional wind resistance
RSEAS =	Additional sea-state resistance
RCHAN =	Additional shallow/channel resistance
RTOWED =	Additional towed object resistance
RMARGIN =	Resistance margin
RTOTAL =	Total vessel resistance
PEBARE =	Bare-hull effective power
PETOTAL =	Total effective power
CTLR =	Telfer residuary resistance coefficient
CTLT =	Telfer total bare-hull resistance coefficient
RBARE/W =	Bare-hull resistance to weight ratio
+ =	Design speed indicator
* =	Exceeds parameter limit

ANÁLISIS PRELIMINAR

Propulsion

5 sep 2016 04:28
HydroComp NavCad 2014

Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3 By thrust.hcnc**

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	**Fixed RPM**
Max prop diam:	**4500,0 mm**	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	**[On] Custom**	RPM constraint:	
Rudder location:	**Behind propeller**	Limit [RPM/s]:	
Friction line:	**ITTC-57**	**Water properties**	
Hull form factor:	**1,198**	Water type:	**Salt**
Corr allowance:	**0,000338**	Density:	**1026,00 kg/m3**
Roughness [mm]:	**[On] 0,15**	Viscosity:	**1,18920e-6 m2/s**
Ducted prop corr:	**[Off]**		
Tunnel stern corr:	**[Off]**		
Effective diam:			
Recess depth:			

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,27**	**5,37**	**0,55**	**6,04**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE				
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]	
10,00	**527,7**	**0,2368**	**0,1919**	**1,0200**	**1500**	**1092,3**	**---**	**0,0**	
12,00	**908,5**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1549,0**	**---**	**0,0**	
13,00	**1173,1**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1888,1**	**---**	**0,0**	
14,00	**1506,4**	**0,2369**	**0,1919**	**1,0200**	**1500**	**2336,0**	**---**	**0,0**	
14,50	**1707,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2616,5**	**---**	**0,0**	
15,00	**1936,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2948,3**	**---**	**0,0**	
15,50	**2200,5**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3342,1**	**---**	**0,0**	
16,00	**2498,4**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3803,4**	**---**	**0,0**	
+ 16,50 +	**2827,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4329,7**	**---**	**0,0**	
17,00	**3179,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4912,7**	**---**	**0,0**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
10,00	**134**	**76,76**	**6,88**	**1059,5**	**1092,3**	**1092,3**	**1092,3**	**313,2**	**2097,0**
12,00	**134**	**108,85**	**9,76**	**1502,6**	**1549,0**	**1549,0**	**1549,0**	**265,0**	**2663,5**
13,00	**134**	**132,68**	**11,89**	**1831,5**	**1888,1**	**1888,1**	**1888,1**	**235,5**	**2976,3**
14,00	**134**	**164,16**	**14,71**	**2266,0**	**2336,0**	**2336,0**	**2336,0**	**205,0**	**3318,2**
14,50	**134**	**183,87**	**16,48**	**2538,0**	**2616,5**	**2616,5**	**2616,5**	**189,6**	**3504,4**
15,00	**134**	**207,19**	**18,57**	**2859,8**	**2948,3**	**2948,3**	**2948,3**	**174,0**	**3704,5**
15,50	**134**	**234,86**	**21,05**	**3241,8**	**3342,1**	**3342,1**	**3342,1**	**158,7**	**3920,5**
16,00	**134**	**267,27**	**23,96**	**3689,3**	**3803,4**	**3803,4**	**3803,4**	**143,9**	**4151,9**
+ 16,50 +	**134**	**304,26**	**27,27**	**4199,8**	**4329,7**	**4329,7**	**4329,7**	**130,4**	**4395,7**
17,00	**134**	**345,23**	**30,94**	**4765,3**	**4912,7**	**4912,7**	**4912,7**	**118,4**	**4647,5**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
10,00	**0,4611**	**1,0000**	**0,4831**	**0,32759**	**126,94**	**102,58**	
12,00	**0,5598**	**1,0000**	**0,5865**	**0,39696**	**182,11**	**147,17**	
13,00	**0,5929**	**1,0000**	**0,6213**	**0,42375**	**217,05**	**175,41**	
14,00	**0,6154**	**1,0000**	**0,6449**	**0,44597**	**258,82**	**209,16**	
14,50	**0,6226**	**1,0000**	**0,6524**	**0,45565**	**283,16**	**228,83**	
15,00	**0,6269**	**1,0000**	**0,6569**	**0,46453**	**310,59**	**251,00**	
15,50	**0,6283**	**1,0000**	**0,6584**	**0,47242**	**341,48**	**275,96**	
16,00	**0,6269**	**1,0000**	**0,6569**	**0,47888**	**375,60**	**303,54**	
+ 16,50 +	**0,6231**	**1,0000**	**0,6529**	**0,48348**	**412,12**	**333,05**	
17,00	**0,6177**	**1,0000**	**0,6473**	**0,48606**	**449,93**	**363,60**	

Propulsion

5 sep 2016 04:28

HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3 By thrust.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
10,00	**0,3893**	**0,0601**	**0,00807**	**0,39637**	**0,1368**	**1,0093**	**2,1459**	**2,67e7**	
12,00	**0,4672**	**0,0862**	**0,01145**	**0,39497**	**0,1123**	**1,0058**	**1,7615**	**2,69e7**	
13,00	**0,5061**	**0,1027**	**0,01396**	**0,40114**	**0,10767**	**1,0215**	**1,689**	**2,70e7**	
14,00	**0,5450**	**0,1225**	**0,01727**	**0,41246**	**0,10667**	**1,0503**	**1,6732**	**2,70e7**	
14,50	**0,5645**	**0,1340**	**0,01934**	**0,42068**	**0,10754**	**1,0713**	**1,6869**	**2,71e7**	
15,00	**0,5839**	**0,1470**	**0,02179**	**0,4312**	**0,10947**	**1,098**	**1,7171**	**2,71e7**	
15,50	**0,6034**	**0,1616**	**0,02471**	**0,444**	**0,11247**	**1,1306**	**1,7642**	**2,72e7**	
16,00	**0,6228**	**0,1778**	**0,02811**	**0,45834**	**0,11637**	**1,1671**	**1,8253**	**2,73e7**	
+ 16,50 +	**0,6423**	**0,1951**	**0,03201**	**0,47289**	**0,12079**	**1,2042**	**1,8948**	**2,73e7**	
17,00	**0,6617**	**0,2130**	**0,03632**	**0,48636**	**0,12532**	**1,2385**	**1,9658**	**2,74e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
10,00	**19,00**	**2,88**	**0,58**	**31,68**	**0,304**	**14,71**	**2,0**	**2,0**	**2117,8**
12,00	**13,20**	**2,88**	**0,57**	**31,68**	**0,350**	**21,10**	**2,0**	**2,0**	**2539,9**
13,00	**11,25**	**2,88**	**0,57**	**31,68**	**0,378**	**25,14**	**2,0**	**2,0**	**2757,7**
14,00	**9,70**	**2,88**	**0,56**	**31,68**	**0,413**	**29,98**	**2,0**	**2,0**	**2982,2**
14,50	**9,04**	**2,88**	**0,56**	**31,68**	**0,433**	**32,80**	**2,0**	**2,0**	**3097,9**
15,00	**8,45**	**2,88**	**0,56**	**31,68**	**0,455**	**35,98**	**2,0**	**2,0**	**3216,8**
15,50	**7,91**	**2,88**	**0,55**	**31,68**	**0,481**	**39,56**	**2,4**	**2,4**	**3339,2**
16,00	**7,43**	**2,88**	**0,55**	**31,68**	**0,509**	**43,51**	**3,3**	**3,3**	**3464,4**
+ 16,50 +	**6,98**	**2,88**	**0,55**	**31,68**	**0,539**	**47,74**	**4,6**	**4,6**	**3590,7**
17,00	**6,58**	**2,88**	**0,55**	**31,68**	**0,570**	**52,12**	**6,2**	**6,2**	**3716,6**

Propulsion

5 sep 2016 04:28

HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3 By thrust.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**100,789 m**
Max beam on WL:	[LWL/BWL 6,035]	**16,700 m**
Max molded draft:	[BWL/T 2,319]	**7,200 m**
Displacement:	[CB 0,545]	**6781,00 t**
Wetted surface:	[CS 2,816]	**2298,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,506]	**50,954 m**
LCF fwd TR:	[XCF/LWL 0,444]	**44,722 m**
Max section area:	[CX 0,969]	**116,5 m2**
Waterplane area:	[CWP 0,757]	**1274,2 m2**
Bulb section area:		**6,9 m2**
Bulb ctr below WL:		**3,320 m**
Bulb nose fwd TR:		**110,593 m**
Imm transom area:	[ATR/AX 0,061]	**7,1 m2**
Transom beam WL:	[BTR/BWL 0,637]	**10,643 m**
Transom immersion:	[TTR/T 0,136]	**0,980 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[BTK flow]	**-1,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,0 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***4500,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Propulsor data

Propulsor			
Count:		**1**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By thrust**	
Reference prop:			
Blade count:		**4**	
Expanded area ratio:		**0,5427**	**[Size]**
Propeller diameter:		**4500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,9409]	**4233,9 mm**	**[Size]**
Hub immersion:		**5032,0 mm**	

Engine/gear			
Engine data:			
Rated RPM:		**0 RPM**	
Rated power:		**0,0 kW**	
Gear efficiency:		**1,000**	
Load correction:		**Off**	
Gear ratio:		**11,157**	**[Size]**
Shaft efficiency:		**0,970**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**Off**

Design condition	
Max prop diam:	**4500,0 mm**
Design speed:	**16,50 kt**
Reference power:	**4500,0 kW**
Design point:	**0,850**
Reference RPM:	**1500,0**
Design point:	**1,030**

Propulsion

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Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3 By thrust.hcnc**

Symbols and values

SPEED =	Vessel speed
PETOTAL =	Total vessel effective power
WFT =	Taylor wake fraction coefficient
THD =	Thrust deduction coefficient
EFFR =	Relative-rotative efficiency
RPMENG =	Engine RPM
PBPROP =	Brake power per propulsor
FUEL =	Fuel rate per engine
LOADENG =	Percentage of engine max available power at given RPM
RPMPROP =	Propulsor RPM
QPROP =	Propulsor open water torque
QENG =	Engine torque
PDPROP =	Delivered power per propulsor
PSPROP =	Shaft power per propulsor
PSTOTAL =	Total vessel shaft power
PBTOTAL =	Total vessel brake power
TRANSP =	Transport factor
EFFO =	Propulsor open-water efficiency
EFFG =	Gear efficiency (load corrected)
EFFOA =	Overall propulsion efficiency [=PETOTAL/PSTOTAL]
MERIT =	Propulsor merit coefficient
THRPROP =	Open-water thrust per propulsor
DELTHR =	Total vessel delivered thrust
J =	Propulsor advance coefficient
KT =	Propulsor thrust coefficient [horizontal, if in oblique flow]
KQ =	Propulsor torque coefficient
KTJ2 =	Propulsor thrust loading ratio
KQJ3 =	Propulsor torque loading ratio
CTH =	Horizontal component of bare-hull resistance coefficient
CP =	Propulsor thrust loading coefficient
RNPROP =	Propeller Reynolds number at 0.7R
SIGMAV =	Cavitation number of propeller by vessel speed
SIGMAN =	Cavitation number of propeller by RPM
SIGMA07R =	Cavitation number of blade section at 0.7R
TIPSPEED =	Propeller circumferential tip speed
MINBAR =	Minimum expanded blade area ratio recommended by selected cavitation criteria
PRESS =	Average propeller loading pressure
CAVAVG =	Average predicted back cavitation percentage
CAVMAX =	Peak predicted back cavitation percentage [if in oblique flow]
PITCHFC =	Minimum recommended pitch to avoid face cavitation
+ =	Design speed indicator
* =	Exceeds recommended parameter limit
! =	Exceeds recommended cavitation criteria [warning]
!! =	Substantially exceeds recommended cavitation criteria [critical]
!!! =	Thrust breakdown is indicated [severe]
--- =	Insignificant or not applicable

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Propulsion

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Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	**Fixed RPM**
Max prop diam:	**4500,0 mm**	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	**[On] Custom**	RPM constraint:	
Rudder location:	**Behind propeller**	Limit [RPM/s]:	
Friction line:	**ITTC-57**	**Water properties**	
Hull form factor:	**1,198**	Water type:	**Salt**
Corr allowance:	**0,000338**	Density:	**1026,00 kg/m3**
Roughness [mm]:	**[On] 0,15**	Viscosity:	**1,18920e-6 m2/s**
Ducted prop corr:	**[Off]**		
Tunnel stern corr:	**[Off]**		
Effective diam:			
Recess depth:			

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,27**	**5,37**	**0,55**	**6,04**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE				
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]	
10,00	**527,7**	**0,2368**	**0,1919**	**1,0200**	**1500**	**1042,6**	**---**	**0,0**	
12,00	**908,5**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1508,7**	**---**	**0,0**	
13,00	**1173,1**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1852,8**	**---**	**0,0**	
14,00	**1506,4**	**0,2369**	**0,1919**	**1,0200**	**1500**	**2306,9**	**---**	**0,0**	
14,50	**1707,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2591,3**	**---**	**0,0**	
15,00	**1936,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2928,2**	**---**	**0,0**	
15,50	**2200,5**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3328,5**	**---**	**0,0**	
16,00	**2498,4**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3797,8**	**---**	**0,0**	
+ 16,50 +	**2827,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4333,8**	**---**	**0,0**	
17,00	**3179,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4927,8**	**---**	**0,0**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
10,00	**130**	**75,72**	**6,57**	**1011,3**	**1042,6**	**1042,6**	**1042,6**	**328,1**	**2177,3**
12,00	**130**	**109,58**	**9,50**	**1463,5**	**1508,7**	**1508,7**	**1508,7**	**272,1**	**2772,0**
13,00	**130**	**134,56**	**11,67**	**1797,2**	**1852,8**	**1852,8**	**1852,8**	**240,0**	**3101,6**
14,00	**130**	**167,55**	**14,53**	**2237,7**	**2306,9**	**2306,9**	**2306,9**	**207,6**	**3463,0**
14,50	**130**	**188,21**	**16,32**	**2513,6**	**2591,3**	**2591,3**	**2591,3**	**191,4**	**3660,4**
15,00	**130**	**212,67**	**18,44**	**2840,4**	**2928,2**	**2928,2**	**2928,2**	**175,2**	**3873,1**
15,50	**130**	**241,74**	**20,97**	**3228,6**	**3328,5**	**3328,5**	**3328,5**	**159,3**	**4103,3**
16,00	**130**	**275,83**	**23,92**	**3683,9**	**3797,8**	**3797,8**	**3797,8**	**144,1**	**4350,8**
+ 16,50 +	**130**	**314,76**	**27,30**	**4203,8**	**4333,8**	**4333,8**	**4333,8**	**130,2**	**4612,3**
17,00	**130**	**357,90**	**31,04**	**4780,0**	**4927,8**	**4927,8**	**4927,8**	**118,0**	**4883,2**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
10,00	**0,4831**	**1,0000**	**0,5061**	**0,3432**	**126,94**	**102,58**	
12,00	**0,5747**	**1,0000**	**0,6022**	**0,40756**	**182,11**	**147,17**	
13,00	**0,6043**	**1,0000**	**0,6331**	**0,43184**	**217,05**	**175,41**	
14,00	**0,6232**	**1,0000**	**0,6530**	**0,45161**	**258,82**	**209,16**	
14,50	**0,6286**	**1,0000**	**0,6587**	**0,46007**	**283,16**	**228,83**	
15,00	**0,6312**	**1,0000**	**0,6614**	**0,46771**	**310,59**	**251,00**	
15,50	**0,6309**	**1,0000**	**0,6611**	**0,47435**	**341,48**	**275,96**	
16,00	**0,6278**	**1,0000**	**0,6579**	**0,47958**	**375,60**	**303,54**	
+ 16,50 +	**0,6225**	**1,0000**	**0,6523**	**0,48302**	**412,12**	**333,05**	
17,00	**0,6158**	**1,0000**	**0,6453**	**0,48457**	**449,93**	**363,60**	

Propulsion

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HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
10,00	**0,4024**	**0,0642**	**0,00851**	**0,39637**	**0,13058**	**1,0093**	**2,0483**	**2,48e7**	
12,00	**0,4828**	**0,0921**	**0,01231**	**0,39497**	**0,10938**	**1,0058**	**1,7157**	**2,49e7**	
13,00	**0,5231**	**0,1097**	**0,01512**	**0,40114**	**0,10566**	**1,0215**	**1,6574**	**2,50e7**	
14,00	**0,5633**	**0,1309**	**0,01883**	**0,41246**	**0,10534**	**1,0503**	**1,6524**	**2,51e7**	
14,50	**0,5834**	**0,1432**	**0,02115**	**0,42068**	**0,10651**	**1,0713**	**1,6707**	**2,52e7**	
15,00	**0,6035**	**0,1570**	**0,02390**	**0,4312**	**0,10872**	**1,098**	**1,7054**	**2,52e7**	
15,50	**0,6236**	**0,1727**	**0,02716**	**0,444**	**0,11201**	**1,1306**	**1,757**	**2,53e7**	
16,00	**0,6437**	**0,1899**	**0,03099**	**0,45833**	**0,1162**	**1,1671**	**1,8227**	**2,53e7**	
+ 16,50 +	**0,6638**	**0,2084**	**0,03537**	**0,47289**	**0,12091**	**1,2042**	**1,8966**	**2,54e7**	
17,00	**0,6839**	**0,2275**	**0,04021**	**0,48636**	**0,12571**	**1,2385**	**1,9719**	**2,54e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
10,00	**19,00**	**3,08**	**0,62**	**30,65**	**0,304**	**15,36**	**2,0**	**2,0**	**2188,8**
12,00	**13,20**	**3,08**	**0,61**	**30,65**	**0,350**	**22,03**	**2,0**	**2,0**	**2625,0**
13,00	**11,25**	**3,08**	**0,60**	**30,65**	**0,378**	**26,26**	**2,0**	**2,0**	**2850,2**
14,00	**9,70**	**3,08**	**0,60**	**30,65**	**0,413**	**31,31**	**2,0**	**2,0**	**3082,1**
14,50	**9,04**	**3,08**	**0,59**	**30,65**	**0,433**	**34,26**	**2,0**	**2,0**	**3201,7**
15,00	**8,45**	**3,08**	**0,59**	**30,65**	**0,455**	**37,57**	**2,3**	**2,3**	**3324,7**
15,50	**7,91**	**3,08**	**0,59**	**30,65**	**0,481**	**41,31**	**3,1**	**3,1**	**3451,2**
16,00	**7,43**	**3,08**	**0,59**	**30,65**	**0,509**	**45,44**	**4,3**	**4,3**	**3580,5**
+ 16,50 +	**6,98**	**3,08**	**0,58**	**30,65**	**0,539**	**49,86**	**5,9**	**5,9**	**3711,1**
17,00	**6,58**	**3,08**	**0,58**	**30,65**	**0,570**	**54,43**	**7,9**	**7,9**	**3841,2**

Propulsion

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Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**100,789 m**
Max beam on WL:	[LWL/BWL 6,035]	**16,700 m**
Max molded draft:	[BWL/T 2,319]	**7,200 m**
Displacement:	[CB 0,545]	**6781,00 t**
Wetted surface:	[CS 2,816]	**2298,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,506]	**50,954 m**
LCF fwd TR:	[XCF/LWL 0,444]	**44,722 m**
Max section area:	[CX 0,969]	**116,5 m2**
Waterplane area:	[CWP 0,757]	**1274,2 m2**
Bulb section area:		**6,9 m2**
Bulb ctr below WL:		**3,320 m**
Bulb nose fwd TR:		**110,593 m**
Imm transom area:	[ATR/AX 0,061]	**7,1 m2**
Transom beam WL:	[BTR/BWL 0,637]	**10,643 m**
Transom immersion:	[TTR/T 0,136]	**0,980 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[BTK flow]	**-1,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,0 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***4500,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Propulsor data

Propulsor			
Count:		**1**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By power**	
Reference prop:			
Blade count:		**4**	
Expanded area ratio:		**0,5197**	**[Size]**
Propeller diameter:		**4500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,9581]	**4311,3 mm**	**[Size]**
Hub immersion:		**5032,0 mm**	

Engine/gear			
Engine data:			
Rated RPM:		**0 RPM**	
Rated power:		**0,0 kW**	
Gear efficiency:		**1,000**	
Load correction:		**Off**	
Gear ratio:		**11,531**	**[Size]**
Shaft efficiency:		**0,970**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**Off**

Design condition	
Max prop diam:	**4500,0 mm**
Design speed:	**16,50 kt**
Reference power:	**4750,0 kW**
Design point:	**0,850**
Reference RPM:	**1500,0**
Design point:	**1,030**

Propulsion

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Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Symbols and values

SPEED =	Vessel speed
PETOTAL =	Total vessel effective power
WFT =	Taylor wake fraction coefficient
THD =	Thrust deduction coefficient
EFFR =	Relative-rotative efficiency
RPMENG =	Engine RPM
PBPROP =	Brake power per propulsor
FUEL =	Fuel rate per engine
LOADENG =	Percentage of engine max available power at given RPM
RPMPROP =	Propulsor RPM
QPROP =	Propulsor open water torque
QENG =	Engine torque
PDPROP =	Delivered power per propulsor
PSPROP =	Shaft power per propulsor
PSTOTAL =	Total vessel shaft power
PBTOTAL =	Total vessel brake power
TRANSP =	Transport factor
EFFO =	Propulsor open-water efficiency
EFFG =	Gear efficiency (load corrected)
EFFOA =	Overall propulsion efficiency [=PETOTAL/PSTOTAL]
MERIT =	Propulsor merit coefficient
THRPROP =	Open-water thrust per propulsor
DELTHR =	Total vessel delivered thrust
J =	Propulsor advance coefficient
KT =	Propulsor thrust coefficient [horizontal, if in oblique flow]
KQ =	Propulsor torque coefficient
KTJ2 =	Propulsor thrust loading ratio
KQJ3 =	Propulsor torque loading ratio
CTH =	Horizontal component of bare-hull resistance coefficient
CP =	Propulsor thrust loading coefficient
RNPROP =	Propeller Reynolds number at 0.7R
SIGMAV =	Cavitation number of propeller by vessel speed
SIGMAN =	Cavitation number of propeller by RPM
SIGMA07R =	Cavitation number of blade section at 0.7R
TIPSPEED =	Propeller circumferential tip speed
MINBAR =	Minimum expanded blade area ratio recommended by selected cavitation criteria
PRESS =	Average propeller loading pressure
CAVAVG =	Average predicted back cavitation percentage
CAVMAX =	Peak predicted back cavitation percentage [if in oblique flow]
PITCHFC =	Minimum recommended pitch to avoid face cavitation
+ =	Design speed indicator
* =	Exceeds recommended parameter limit
! =	Exceeds recommended cavitation criteria [warning]
!! =	Substantially exceeds recommended cavitation criteria [critical]
!!! =	Thrust breakdown is indicated [severe]
--- =	Insignificant or not applicable

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Propulsion

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HydroComp NavCad 2014

Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	**Fixed RPM**
Max prop diam:	**4500,0 mm**	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	**[On] Custom**	RPM constraint:	
Rudder location:	**Behind propeller**	Limit [RPM/s]:	
Friction line:	**ITTC-57**	**Water properties**	
Hull form factor:	**1,198**	Water type:	**Salt**
Corr allowance:	**0,000338**	Density:	**1026,00 kg/m3**
Roughness [mm]:	**[On] 0,15**	Viscosity:	**1,18920e-6 m2/s**
Ducted prop corr:	**[Off]**		
Tunnel stern corr:	**[Off]**		
Effective diam:			
Recess depth:			

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,27**	**5,37**	**0,55**	**6,04**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE				
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]	
10,00	**527,7**	**0,2368**	**0,1919**	**1,0200**	**1500**	**1006,0**	**---**	**0,0**	
12,00	**908,5**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1491,4**	**---**	**0,0**	
13,00	**1173,1**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1840,8**	**---**	**0,0**	
14,00	**1506,4**	**0,2369**	**0,1919**	**1,0200**	**1500**	**2297,2**	**---**	**0,0**	
14,50	**1707,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2581,5**	**---**	**0,0**	
15,00	**1936,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2917,5**	**---**	**0,0**	
15,50	**2200,5**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3316,2**	**---**	**0,0**	
16,00	**2498,4**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3783,4**	**---**	**0,0**	
+ 16,50 +	**2827,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4317,5**	**---**	**0,0**	
17,00	**3179,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4910,2**	**---**	**0,0**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
10,00	**119**	**79,58**	**6,34**	**975,8**	**1006,0**	**1006,0**	**1006,0**	**340,1**	**2417,1**
12,00	**119**	**117,97**	**9,39**	**1446,7**	**1491,4**	**1491,4**	**1491,4**	**275,3**	**3064,2**
13,00	**119**	**145,61**	**11,59**	**1785,6**	**1840,8**	**1840,8**	**1840,8**	**241,6**	**3423,5**
14,00	**119**	**181,71**	**14,47**	**2228,2**	**2297,2**	**2297,2**	**2297,2**	**208,5**	**3818,2**
14,50	**119**	**204,20**	**16,26**	**2504,1**	**2581,5**	**2581,5**	**2581,5**	**192,2**	**4034,2**
15,00	**119**	**230,78**	**18,38**	**2830,0**	**2917,5**	**2917,5**	**2917,5**	**175,9**	**4267,3**
15,50	**119**	**262,31**	**20,89**	**3216,7**	**3316,2**	**3316,2**	**3316,2**	**159,9**	**4520,4**
16,00	**119**	**299,27**	**23,83**	**3669,9**	**3783,4**	**3783,4**	**3783,4**	**144,7**	**4793,4**
+ 16,50 +	**119**	**341,52**	**27,19**	**4187,9**	**4317,5**	**4317,5**	**4317,5**	**130,7**	**5083,1**
17,00	**119**	**388,40**	**30,93**	**4762,9**	**4910,2**	**4910,2**	**4910,2**	**118,4**	**5385,0**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
10,00	**0,5007**	**1,0000**	**0,5246**	**0,35569**	**126,94**	**102,58**	
12,00	**0,5814**	**1,0000**	**0,6092**	**0,41229**	**182,11**	**147,17**	
13,00	**0,6082**	**1,0000**	**0,6373**	**0,43465**	**217,05**	**175,41**	
14,00	**0,6258**	**1,0000**	**0,6558**	**0,45352**	**258,82**	**209,16**	
14,50	**0,6310**	**1,0000**	**0,6612**	**0,46182**	**283,16**	**228,83**	
15,00	**0,6335**	**1,0000**	**0,6639**	**0,46943**	**310,59**	**251,00**	
15,50	**0,6332**	**1,0000**	**0,6636**	**0,47611**	**341,48**	**275,96**	
16,00	**0,6302**	**1,0000**	**0,6604**	**0,4814**	**375,60**	**303,54**	
+ 16,50 +	**0,6248**	**1,0000**	**0,6548**	**0,48485**	**412,12**	**333,05**	
17,00	**0,6180**	**1,0000**	**0,6476**	**0,4863**	**449,92**	**363,60**	

Propulsion

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HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
10,00	**0,4383**	**0,0761**	**0,01061**	**0,39637**	**0,12599**	**1,0093**	**1,9764**	**1,96e7**	
12,00	**0,5259**	**0,1092**	**0,01572**	**0,39497**	**0,10812**	**1,0058**	**1,696**	**1,98e7**	
13,00	**0,5697**	**0,1302**	**0,01941**	**0,40114**	**0,10497**	**1,0215**	**1,6466**	**1,99e7**	
14,00	**0,6135**	**0,1552**	**0,02422**	**0,41246**	**0,10489**	**1,0503**	**1,6454**	**1,99e7**	
14,50	**0,6354**	**0,1698**	**0,02722**	**0,42068**	**0,1061**	**1,0713**	**1,6644**	**2,00e7**	
15,00	**0,6573**	**0,1863**	**0,03076**	**0,4312**	**0,10832**	**1,098**	**1,6992**	**2,00e7**	
15,50	**0,6792**	**0,2048**	**0,03496**	**0,444**	**0,11159**	**1,1306**	**1,7505**	**2,01e7**	
16,00	**0,7011**	**0,2253**	**0,03989**	**0,45834**	**0,11576**	**1,1671**	**1,8158**	**2,01e7**	
+ 16,50 +	**0,7230**	**0,2472**	**0,04552**	**0,47289**	**0,12045**	**1,2042**	**1,8894**	**2,02e7**	
17,00	**0,7449**	**0,2699**	**0,05177**	**0,48636**	**0,12526**	**1,2385**	**1,9648**	**2,02e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
10,00	**19,00**	**3,65**	**0,73**	**28,14**	**0,317**	**14,27**	**2,0**	**2,0**	**2383,9**
12,00	**13,20**	**3,65**	**0,71**	**28,14**	**0,368**	**20,47**	**2,0**	**2,0**	**2858,9**
13,00	**11,25**	**3,65**	**0,71**	**28,14**	**0,400**	**24,40**	**2,0**	**2,0**	**3104,2**
14,00	**9,70**	**3,65**	**0,70**	**28,14**	**0,438**	**29,10**	**2,0**	**2,0**	**3356,8**
14,50	**9,04**	**3,65**	**0,70**	**28,14**	**0,461**	**31,84**	**2,0**	**2,0**	**3487,1**
15,00	**8,45**	**3,65**	**0,69**	**28,14**	**0,486**	**34,92**	**2,3**	**2,3**	**3621,0**
15,50	**7,91**	**3,65**	**0,69**	**28,14**	**0,514**	**38,39**	**3,2**	**3,2**	**3758,7**
16,00	**7,43**	**3,65**	**0,69**	**28,14**	**0,546**	**42,23**	**4,5**	**4,5**	**3899,6**
+ 16,50 +	**6,98**	**3,65**	**0,68**	**28,14**	**0,579**	**46,33**	**6,2**	**6,2**	**4041,8**
17,00	**6,58**	**3,65**	**0,68**	**28,14**	**0,614**	**50,58**	**8,4**	**8,4**	**4183,5**

Propulsion

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Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**100,789 m**
Max beam on WL:	[LWL/BWL 6,035]	**16,700 m**
Max molded draft:	[BWL/T 2,319]	**7,200 m**
Displacement:	[CB 0,545]	**6781,00 t**
Wetted surface:	[CS 2,816]	**2298,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,506]	**50,954 m**
LCF fwd TR:	[XCF/LWL 0,444]	**44,722 m**
Max section area:	[CX 0,969]	**116,5 m2**
Waterplane area:	[CWP 0,757]	**1274,2 m2**
Bulb section area:		**6,9 m2**
Bulb ctr below WL:		**3,320 m**
Bulb nose fwd TR:		**110,593 m**
Imm transom area:	[ATR/AX 0,061]	**7,1 m2**
Transom beam WL:	[BTR/BWL 0,637]	**10,643 m**
Transom immersion:	[TTR/T 0,136]	**0,980 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[BTK flow]	**-1,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,0 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***4500,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Propulsor data

Propulsor			
Count:		**1**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By power**	
Reference prop:			
Blade count:		**5**	
Expanded area ratio:		**0,5592**	**[Size]**
Propeller diameter:		**4500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 1,0568]	**4755,7 mm**	**[Size]**
Hub immersion:		**5032,0 mm**	

Engine/gear			
Engine data:			
Rated RPM:		**0 RPM**	
Rated power:		**0,0 kW**	
Gear efficiency:		**1,000**	
Load correction:		**Off**	
Gear ratio:		**12,558**	**[Size]**
Shaft efficiency:		**0,970**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**Off**

Design condition	
Max prop diam:	**4500,0 mm**
Design speed:	**16,50 kt**
Reference power:	**4750,0 kW**
Design point:	**0,850**
Reference RPM:	**1500,0**
Design point:	**1,030**

Propulsion

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Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Symbols and values

SPEED =	Vessel speed
PETOTAL =	Total vessel effective power
WFT =	Taylor wake fraction coefficient
THD =	Thrust deduction coefficient
EFFR =	Relative-rotative efficiency
RPMENG =	Engine RPM
PBPROP =	Brake power per propulsor
FUEL =	Fuel rate per engine
LOADENG =	Percentage of engine max available power at given RPM
RPMPROP =	Propulsor RPM
QPROP =	Propulsor open water torque
QENG =	Engine torque
PDPROP =	Delivered power per propulsor
PSPROP =	Shaft power per propulsor
PSTOTAL =	Total vessel shaft power
PBTOTAL =	Total vessel brake power
TRANSP =	Transport factor
EFFO =	Propulsor open-water efficiency
EFFG =	Gear efficiency (load corrected)
EFFOA =	Overall propulsion efficiency [=PETOTAL/PSTOTAL]
MERIT =	Propulsor merit coefficient
THRPROP =	Open-water thrust per propulsor
DELTHR =	Total vessel delivered thrust
J =	Propulsor advance coefficient
KT =	Propulsor thrust coefficient [horizontal, if in oblique flow]
KQ =	Propulsor torque coefficient
KTJ2 =	Propulsor thrust loading ratio
KQJ3 =	Propulsor torque loading ratio
CTH =	Horizontal component of bare-hull resistance coefficient
CP =	Propulsor thrust loading coefficient
RNPROP =	Propeller Reynolds number at 0.7R
SIGMAV =	Cavitation number of propeller by vessel speed
SIGMAN =	Cavitation number of propeller by RPM
SIGMA07R =	Cavitation number of blade section at 0.7R
TIPSPEED =	Propeller circumferential tip speed
MINBAR =	Minimum expanded blade area ratio recommended by selected cavitation criteria
PRESS =	Average propeller loading pressure
CAVAVG =	Average predicted back cavitation percentage
CAVMAX =	Peak predicted back cavitation percentage [if in oblique flow]
PITCHFC =	Minimum recommended pitch to avoid face cavitation
+ =	Design speed indicator
* =	Exceeds recommended parameter limit
! =	Exceeds recommended cavitation criteria [warning]
!! =	Substantially exceeds recommended cavitation criteria [critical]
!!! =	Thrust breakdown is indicated [severe]
--- =	Insignificant or not applicable

ANÁLISIS 6 PALAS

Propulsion

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Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	**Fixed RPM**
Max prop diam:	**4500,0 mm**	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	**[On] Custom**	RPM constraint:	
Rudder location:	**Behind propeller**	Limit [RPM/s]:	
Friction line:	**ITTC-57**	**Water properties**	
Hull form factor:	**1,198**	Water type:	**Salt**
Corr allowance:	**0,000338**	Density:	**1026,00 kg/m3**
Roughness [mm]:	**[On] 0,15**	Viscosity:	**1,18920e-6 m2/s**
Ducted prop corr:	**[Off]**		
Tunnel stern corr:	**[Off]**		
Effective diam:			
Recess depth:			

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,27**	**5,37**	**0,55**	**6,04**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE				
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]	
10,00	**527,7**	**0,2368**	**0,1919**	**1,0200**	**1500**	**1003,9**	**---**	**0,0**	
12,00	**908,5**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1499,4**	**---**	**0,0**	
13,00	**1173,1**	**0,2369**	**0,1919**	**1,0200**	**1500**	**1848,6**	**---**	**0,0**	
14,00	**1506,4**	**0,2369**	**0,1919**	**1,0200**	**1500**	**2301,3**	**---**	**0,0**	
14,50	**1707,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2582,6**	**---**	**0,0**	
15,00	**1936,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**2914,9**	**---**	**0,0**	
15,50	**2200,5**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3309,7**	**---**	**0,0**	
16,00	**2498,4**	**0,2370**	**0,1919**	**1,0200**	**1500**	**3774,3**	**---**	**0,0**	
+ 16,50 +	**2827,0**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4309,0**	**---**	**0,0**	
17,00	**3179,9**	**0,2370**	**0,1919**	**1,0200**	**1500**	**4909,2**	**---**	**0,0**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
10,00	**112**	**84,50**	**6,32**	**973,8**	**1003,9**	**1003,9**	**1003,9**	**340,8**	**2625,0**
12,00	**112**	**126,21**	**9,44**	**1454,4**	**1499,4**	**1499,4**	**1499,4**	**273,8**	**3309,0**
13,00	**112**	**155,61**	**11,64**	**1793,2**	**1848,6**	**1848,6**	**1848,6**	**240,6**	**3688,4**
14,00	**112**	**193,71**	**14,50**	**2232,3**	**2301,3**	**2301,3**	**2301,3**	**208,1**	**4105,1**
14,50	**112**	**217,39**	**16,27**	**2505,1**	**2582,6**	**2582,6**	**2582,6**	**192,1**	**4333,2**
15,00	**112**	**245,36**	**18,36**	**2827,4**	**2914,9**	**2914,9**	**2914,9**	**176,0**	**4579,8**
15,50	**112**	**278,59**	**20,85**	**3210,4**	**3309,7**	**3309,7**	**3309,7**	**160,2**	**4848,0**
16,00	**112**	**317,70**	**23,77**	**3661,1**	**3774,3**	**3774,3**	**3774,3**	**145,0**	**5138,4**
+ 16,50 +	**112**	**362,71**	**27,14**	**4179,7**	**4309,0**	**4309,0**	**4309,0**	**131,0**	**5448,7**
17,00	**112**	**413,23**	**30,92**	**4761,9**	**4909,2**	**4909,2**	**4909,2**	**118,5**	**5775,1**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
10,00	**0,5017**	**1,0000**	**0,5257**	**0,35643**	**126,94**	**102,58**	
12,00	**0,5783**	**1,0000**	**0,6059**	**0,41011**	**182,11**	**147,17**	
13,00	**0,6056**	**1,0000**	**0,6346**	**0,4328**	**217,05**	**175,41**	
14,00	**0,6247**	**1,0000**	**0,6546**	**0,45271**	**258,82**	**209,16**	
14,50	**0,6308**	**1,0000**	**0,6610**	**0,46163**	**283,16**	**228,83**	
15,00	**0,6341**	**1,0000**	**0,6645**	**0,46986**	**310,59**	**251,00**	
15,50	**0,6345**	**1,0000**	**0,6649**	**0,47704**	**341,48**	**275,96**	
16,00	**0,6317**	**1,0000**	**0,6620**	**0,48257**	**375,60**	**303,54**	
+ 16,50 +	**0,6261**	**1,0000**	**0,6561**	**0,4858**	**412,12**	**333,05**	
17,00	**0,6181**	**1,0000**	**0,6477**	**0,4864**	**449,93**	**363,60**	

Propulsion

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HydroComp NavCad 2014

Project ID **Atunero 3300 m3**

Description

File name **ATUNERO 3300m3.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
10,00	**0,4664**	**0,0862**	**0,01275**	**0,39637**	**0,12573**	**1,0093**	**1,9723**	**1,65e7**	
12,00	**0,5596**	**0,1237**	**0,01905**	**0,39497**	**0,1087**	**1,0058**	**1,705**	**1,66e7**	
13,00	**0,6062**	**0,1474**	**0,02349**	**0,40114**	**0,10542**	**1,0215**	**1,6536**	**1,67e7**	
14,00	**0,6528**	**0,1758**	**0,02924**	**0,41246**	**0,10508**	**1,0503**	**1,6483**	**1,68e7**	
14,50	**0,6761**	**0,1923**	**0,03281**	**0,42068**	**0,10615**	**1,0713**	**1,6651**	**1,68e7**	
15,00	**0,6994**	**0,2109**	**0,03703**	**0,4312**	**0,10822**	**1,098**	**1,6976**	**1,69e7**	
15,50	**0,7227**	**0,2319**	**0,04205**	**0,444**	**0,11138**	**1,1306**	**1,7471**	**1,69e7**	
16,00	**0,7460**	**0,2551**	**0,04795**	**0,45833**	**0,11548**	**1,1671**	**1,8114**	**1,70e7**	
+ 16,50 +	**0,7693**	**0,2799**	**0,05474**	**0,47289**	**0,12021**	**1,2042**	**1,8857**	**1,70e7**	
17,00	**0,7926**	**0,3056**	**0,06237**	**0,48636**	**0,12523**	**1,2385**	**1,9644**	**1,71e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
10,00	**19,00**	**4,13**	**0,82**	**26,45**	**0,329**	**13,33**	**2,0**	**2,0**	**2536,8**
12,00	**13,20**	**4,13**	**0,80**	**26,45**	**0,386**	**19,13**	**2,0**	**2,0**	**3042,3**
13,00	**11,25**	**4,13**	**0,79**	**26,45**	**0,421**	**22,80**	**2,0**	**2,0**	**3303,3**
14,00	**9,70**	**4,13**	**0,79**	**26,45**	**0,464**	**27,19**	**2,0**	**2,0**	**3572,1**
14,50	**9,04**	**4,13**	**0,78**	**26,45**	**0,488**	**29,75**	**2,0**	**2,0**	**3710,7**
15,00	**8,45**	**4,13**	**0,78**	**26,45**	**0,516**	**32,63**	**2,4**	**2,4**	**3853,2**
15,50	**7,91**	**4,13**	**0,77**	**26,45**	**0,548**	**35,87**	**3,2**	**3,2**	**3999,8**
16,00	**7,43**	**4,13**	**0,77**	**26,45**	**0,583**	**39,46**	**4,5**	**4,5**	**4149,7**
+ 16,50 +	**6,98**	**4,13**	**0,76**	**26,45**	**0,620**	**43,29**	**6,3**	**6,3**	**4301,0**
17,00	**6,58**	**4,13**	**0,76**	**26,45**	**0,658**	**47,27**	**8,5**	**8,5**	**4451,8**

Propulsion

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HydroComp NavCad 2014

Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**100,789 m**
Max beam on WL:	[LWL/BWL 6,035]	**16,700 m**
Max molded draft:	[BWL/T 2,319]	**7,200 m**
Displacement:	[CB 0,545]	**6781,00 t**
Wetted surface:	[CS 2,816]	**2298,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,506]	**50,954 m**
LCF fwd TR:	[XCF/LWL 0,444]	**44,722 m**
Max section area:	[CX 0,969]	**116,5 m2**
Waterplane area:	[CWP 0,757]	**1274,2 m2**
Bulb section area:		**6,9 m2**
Bulb ctr below WL:		**3,320 m**
Bulb nose fwd TR:		**110,593 m**
Imm transom area:	[ATR/AX 0,061]	**7,1 m2**
Transom beam WL:	[BTR/BWL 0,637]	**10,643 m**
Transom immersion:	[TTR/T 0,136]	**0,980 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[BTK flow]	**-1,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,0 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***4500,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Propulsor data

Propulsor			
Count:		**1**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By power**	
Reference prop:			
Blade count:		**6**	
Expanded area ratio:		**0,5985**	**[Size]**
Propeller diameter:		**4500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 1,1339]	**5102,5 mm**	**[Size]**
Hub immersion:		**5032,0 mm**	

Engine/gear			
Engine data:			
Rated RPM:		**0 RPM**	
Rated power:		**0,0 kW**	
Gear efficiency:		**1,000**	
Load correction:		**Off**	
Gear ratio:		**13,364**	**[Size]**
Shaft efficiency:		**0,970**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**Off**

Design condition	
Max prop diam:	**4500,0 mm**
Design speed:	**16,50 kt**
Reference power:	**4750,0 kW**
Design point:	**0,850**
Reference RPM:	**1500,0**
Design point:	**1,030**

Propulsion

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HydroComp NavCad 2014

Project ID **Atunero 3300 m3**
Description
File name **ATUNERO 3300m3.hcnc**

Symbols and values

SPEED =	Vessel speed
PETOTAL =	Total vessel effective power
WFT =	Taylor wake fraction coefficient
THD =	Thrust deduction coefficient
EFFR =	Relative-rotative efficiency
RPMENG =	Engine RPM
PBPROP =	Brake power per propulsor
FUEL =	Fuel rate per engine
LOADENG =	Percentage of engine max available power at given RPM
RPMPROP =	Propulsor RPM
QPROP =	Propulsor open water torque
QENG =	Engine torque
PDPROP =	Delivered power per propulsor
PSPROP =	Shaft power per propulsor
PSTOTAL =	Total vessel shaft power
PBTOTAL =	Total vessel brake power
TRANSP =	Transport factor
EFFO =	Propulsor open-water efficiency
EFFG =	Gear efficiency (load corrected)
EFFOA =	Overall propulsion efficiency [=PETOTAL/PSTOTAL]
MERIT =	Propulsor merit coefficient
THRPROP =	Open-water thrust per propulsor
DELTHR =	Total vessel delivered thrust
J =	Propulsor advance coefficient
KT =	Propulsor thrust coefficient [horizontal, if in oblique flow]
KQ =	Propulsor torque coefficient
KTJ2 =	Propulsor thrust loading ratio
KQJ3 =	Propulsor torque loading ratio
CTH =	Horizontal component of bare-hull resistance coefficient
CP =	Propulsor thrust loading coefficient
RNPROP =	Propeller Reynolds number at 0.7R
SIGMAV =	Cavitation number of propeller by vessel speed
SIGMAN =	Cavitation number of propeller by RPM
SIGMA07R =	Cavitation number of blade section at 0.7R
TIPSPEED =	Propeller circumferential tip speed
MINBAR =	Minimum expanded blade area ratio recommended by selected cavitation criteria
PRESS =	Average propeller loading pressure
CAVAVG =	Average predicted back cavitation percentage
CAVMAX =	Peak predicted back cavitation percentage [if in oblique flow]
PITCHFC =	Minimum recommended pitch to avoid face cavitation
+ =	Design speed indicator
* =	Exceeds recommended parameter limit
! =	Exceeds recommended cavitation criteria [warning]
!! =	Substantially exceeds recommended cavitation criteria [critical]
!!! =	Thrust breakdown is indicated [severe]
--- =	Insignificant or not applicable

ANEXO III

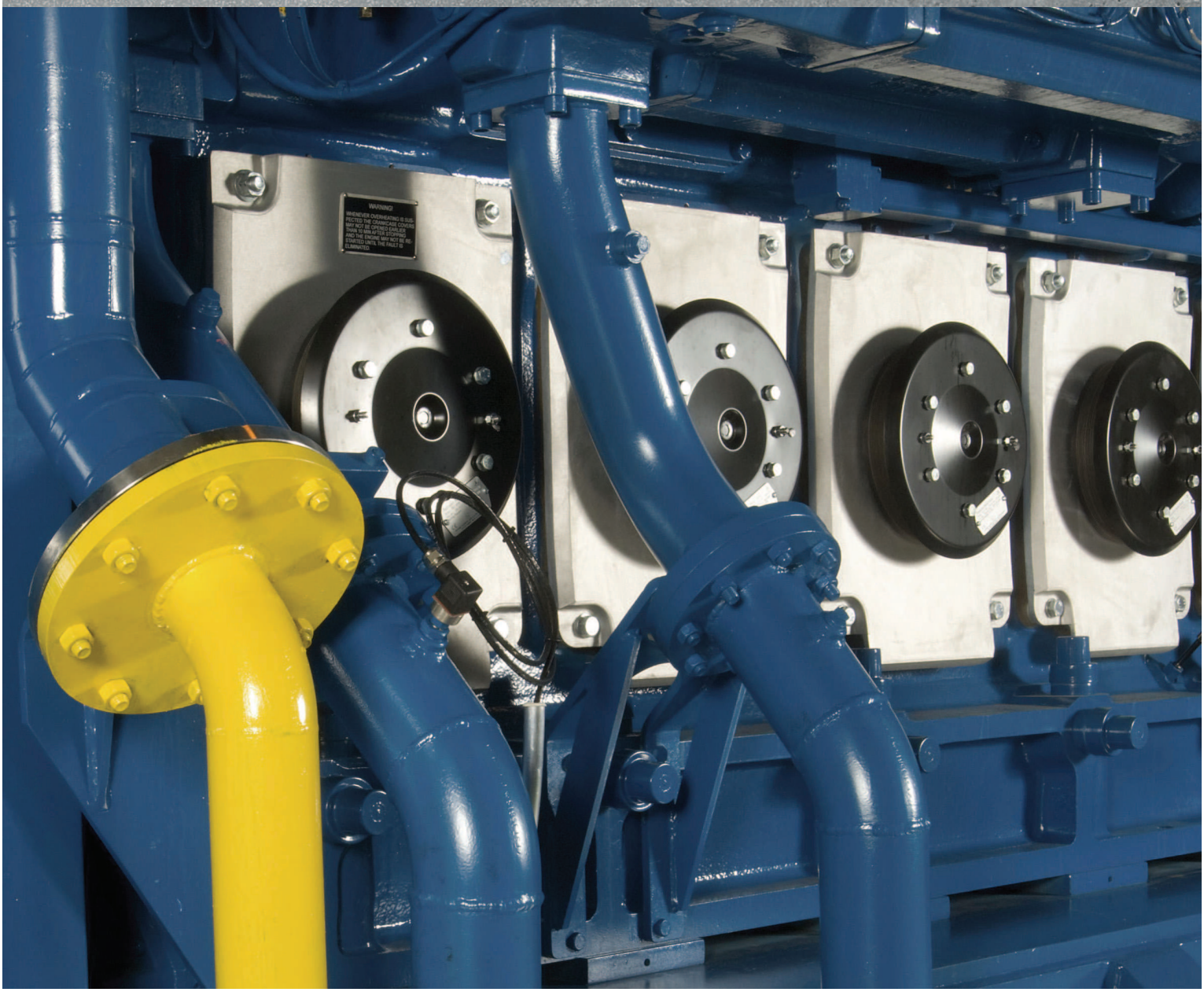
DATOS DE LOS MOTORES

DIÉSEL GENERADORES

WÄRTSILÄ

WÄRTSILÄ Engines

WÄRTSILÄ 34DF PRODUCT GUIDE



3.2 Wärtsilä 6L34DF with 480/500 kW / cylinder

Wärtsilä 6L34DF		AUX		AUX		DE		DE		ME		ME	
		Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode
Cylinder output	**kW**	**480**		**500**		**480**		**500**		**500**		**500**	
Engine speed	rpm	720		750		720		750		750		750	
Engine output	kW	2880		3000		2880		3000		3000		3000	
Mean effective pressure	MPa	2.2		2.2		2.2		2.2		2.2		2.2	
Speed mode		Constant		Constant		Constant		Constant		Constant		Variable	
IMO compliance		Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2
Combustion air system (Note 1)													
Flow at 100% load	kg/s	4.2	5.4	4.5	5.4	4.2	5.4	4.5	5.4	4.5	5.4	4.5	5.5
Temperature at turbocharger intake, max.	°C	45		45		45		45		45		45	
Temperature after air cooler (TE 601), load > 70%	°C	45	-	45	-	45	-	45	-	45	-	45	-
Temperature after air cooler (TE 601), load 30...70%	°C	55	-	55	-	55	-	55	-	55	-	55	-
Temperature after air cooler (TE 601)	°C	-	50	-	50	-	50	-	50	-	50	-	50
Exhaust gas system (Note 2)													
Flow at 100% load	kg/s	4.3	5.5	4.6	5.5	4.3	5.5	4.6	5.5	4.6	5.5	4.6	5.7
Flow at 75% load	kg/s	3.6	4.4	3.8	4.4	3.6	4.4	3.8	4.4	3.8	4.4	3.7	4.3
Flow at 50% load	kg/s	2.9	3.1	3.1	3.1	2.9	3.1	3.1	3.1	3.1	3.1	3.0	3.1
Temperature after turbocharger at 100% load (TE 517)	°C	381	355	381	381	381	346	381	370	381	370	381	361
Temperature after turbocharger at 75% load (TE 517)	°C	402	327	401	349	402	318	401	340	401	340	386	348
Temperature after turbocharger at 50% load (TE 517)	°C	406	350	402	371	406	346	402	366	402	366	340	333
Backpressure, max.	kPa	4		4		4		4		4		4	
Calculated exhaust diameter for 35 m/s	mm	537	595	555	608	537	591	555	603	555	603	554	606
Heat balance at 100% load (Note 3)													
Jacket water, HT-circuit	kW	357	410	372	430	357	406	372	425	372	425	372	443
Charge air, HT-circuit	kW	705	933	601	933	705	933	601	933	601	933	601	966
Charge air, LT-circuit	kW	161	179	171	179	161	179	171	179	171	179	171	184
Lubricating oil, LT-circuit	kW	250	252	260	264	250	250	260	261	260	261	260	281
Radiation	kW	115	117	120	123	115	116	120	121	120	121	120	123
Fuel consumption (Note 4)													
Total energy consumption at 100% load	kJ/kWh	7400	-	7400	-	7400	-	7400	-	7400	-	7400	-
Total energy consumption at 75% load	kJ/kWh	7790	-	7790	-	7790	-	7790	-	7790	-	7520	-
Total energy consumption at 50% load	kJ/kWh	8510	-	8510	-	8510	-	8510	-	8510	-	7700	-
Fuel gas consumption at 100% load	kJ/kWh	7323	-	7323	-	7323	-	7323	-	7323	-	7323	-
Fuel gas consumption at 75% load	kJ/kWh	7671	-	7671	-	7671	-	7671	-	7671	-	7413	-

Wärtsilä 6L34DF		AUX		AUX		DE		DE		ME		ME	
		Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode
Cylinder output	**kW**	**480**		**500**		**480**		**500**		**500**		**500**	
Fuel gas consumption at 50% load	kJ/kWh	8350	-	8350	-	8350	-	8350	-	8350	-	7554	-
Fuel oil consumption at 100% load	g/kWh	1.9	188	1.9	189	1.9	186	1.9	187	1.9	187	1.9	189
Fuel oil consumption at 75% load	g/kWh	2.6	186	2.6	187	2.6	184	2.6	185	2.6	185	2.4	182
Fuel oil consumption 50% load	g/kWh	3.8	193	3.8	194	3.8	192	3.8	193	3.8	193	3.5	181
Fuel gas system (Note 5)													
Gas pressure at engine inlet, min (PT901)	kPa (a)	535	-	535	-	535	-	535	-	535	-	535	-
Gas pressure to Gas Valve Unit, min	kPa (a)	655	-	655	-	655	-	655	-	655	-	655	-
Gas temperature before Gas Valve Unit	°C	0...60	-	0...60	-	0...60	-	0...60	-	0...60	-	0...60	-
Fuel oil system													
Pressure before injection pumps (PT 101)	kPa	700±50		700±50		700±50		700±50		700±50		700±50	
Fuel oil flow to engine, approx	m³/h	3.1		3.2		3.0		3.2		3.2		3.2	
HFO viscosity before the engine	cSt	-	16...24	-	16...24	-	16...24	-	16...24	-	16...24	-	16...24
Max. HFO temperature before engine (TE 101)	°C	-	140	-	140	-	140	-	140	-	140	-	140
MDF viscosity, min.	cSt	2.0		2.0		2.0		2.0		2.0		2.0	
Max. MDF temperature before engine (TE 101)	°C	45		45		45		45		45		45	
Leak fuel quantity (MDF), clean fuel at 100% load	kg/h	5.6	11.1	5.8	11.6	5.6	11.1	5.8	11.6	5.8	11.6	5.9	11.8
Pilot fuel (MDF) viscosity before the engine	cSt	2...11		2...11		2...11		2...11		2...11		2...11	
Pilot fuel pressure at engine inlet (PT 112)	kPa (a)	550...750		550...750		550...750		550...750		550...750		550...750	
Pilot fuel pressure drop after engine, max	kPa	150		150		150		150		150		150	
Pilot fuel return flow at 100% load	kg/h	590		590		590		590		590		590	
Lubricating oil system													
Pressure before bearings, nom. (PT 201)	kPa	500		500		500		500		500		500	
Suction ability, including pipe loss, max.	kPa	30		30		30		30		30		30	
Priming pressure, nom. (PT 201)	kPa	50		50		50		50		50		50	
Suction ability priming pump, including pipe loss, max.	kPa	30		30		30		30		30		30	
Temperature before bearings, nom. (TE 201)	°C	63		63		63		63		63		63	
Temperature after engine, approx.	°C	78		78		78		78		78		78	
Pump capacity (main), engine driven	m³/h	78		81		78		81		81		81	
Pump capacity (main), electrically driven	m³/h	67		70		67		70		70		70	
Priming pump capacity (50/60Hz)	m³/h	15.0 / 18.0		15.0 / 18.0		15.0 / 18.0		15.0 / 18.0		15.0 / 18.0		15.0 / 18.0	
Oil volume, wet sump, nom.	m³	1.6		1.6		1.6		1.6		1.6		1.6	
Oil volume in separate system oil tank	m³	3		3		3		3		3		3	

Wärtsilä 6L34DF		AUX		AUX		DE		DE		ME		ME	
		Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode
Cylinder output	**kW**	**480**		**500**		**480**		**500**		**500**		**500**	
Oil consumption at 100% load, approx.	g/kWh	0.4		0.4		0.4		0.4		0.4		0.4	
Crankcase ventilation flow rate at full load	l/min	840		840		840		840		840		840	
Crankcase ventilation backpressure, max.	kPa	0.3		0.3		0.3		0.3		0.3		0.3	
Oil volume in turning device	l	...		...		...		...		...		...	
Oil volume in speed governor	l	1.4...2.2		1.4...2.2		1.4...2.2		1.4...2.2		1.4...2.2		1.4...2.2	
HT cooling water system													
Pressure at engine, after pump, nom. (PT 401)	kPa	250 + static		250 + static		250 + static		250 + static		250 + static		250 + static	
Pressure at engine, after pump, max. (PT 401)	kPa	530		530		530		530		530		530	
Temperature before cylinders, approx. (TE 401)	°C	85		85		85		85		85		85	
Temperature after engine, nom.	°C	96		96		96		96		96		96	
Capacity of engine driven pump, nom.	m^3/h	60		60		60		60		60		60	
Pressure drop over engine, total	kPa	100		100		100		100		100		100	
Pressure drop in external system, max.	kPa	100		100		100		100		100		100	
Pressure from expansion tank	kPa	70...150		70...150		70...150		70...150		70...150		70...150	
Water volume in engine	m^3	0.41		0.41		0.41		0.41		0.41		0.41	
Delivery head of stand-by pump	kPa	250		250		250		250		250		250	
LT cooling water system													
Pressure at engine, after pump, nom. (PT 471)	kPa	250+ static		250+ static		250+ static		250+ static		250+ static		250+ static	
Pressure at engine, after pump, max. (PT 471)	kPa	530		530		530		530		530		530	
Temperature before engine, max. (TE 471)	°C	38		38		38		38		38		38	
Temperature before engine, min. (TE 471)	°C	25		25		25		25		25		25	
Capacity of engine driven pump, nom.	m^3/h	60		60		60		60		60		60	
Pressure drop over charge air cooler	kPa	35		35		35		35		35		35	
Pressure drop in external system, max.	kPa	100		100		100		100		100		100	
Pressure from expansion tank	kPa	70...150		70...150		70...150		70...150		70...150		70...150	
Delivery head of stand-by pump	kPa	250		250		250		250		250		250	
Starting air system													
Pressure, nom.	kPa	3000		3000		3000		3000		3000		3000	
Pressure, max.	kPa	3000		3000		3000		3000		3000		3000	
Pressure at engine during start, min. (alarm) (20°C)	kPa	1500		1500		1500		1500		1500		1500	
Low pressure limit in starting air receiver	kPa	1600		1600		1600		1600		1600		1600	
Starting air consumption, start (successful)	Nm^3	4.7		4.7		4.7		4.7		4.7		4.7	

Wärtsilä 6L34DF		AUX		AUX		DE		DE		ME		ME	
		Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode	Gas mode	Diesel mode
Cylinder output	**kW**	**480**		**500**		**480**		**500**		**500**		**500**	
Consumption per start (with slowturn)	Nm^3	6.1		6.1		6.1		6.1		6.1		6.1	

Notes:

Note 1 At ISO 15550 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Tolerance 5%.

Note 2 At ISO 15550 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Flow tolerance 5% and temperature tolerance 10°C in gas mode operation. Flow tolerance 8% and temperature tolerance 15°C in diesel mode operation.

Note 3 At 100% output and nominal speed. The figures are valid for ambient conditions according to ISO 15550 except for LT-water temperature, which is corresponding to charge air receiver temperature 45ºC in gas operation. With engine driven water and lubricating oil pumps. Tolerance for cooling water heat 10%, tolerance for radiation heat 30%. Fouling factors and a margin to be taken into account when dimensioning heat exchangers.

Note 4 At ambient conditions according to ISO 15550 and receiver temperature 45 °C. Lower calorific value 42 700 kJ/kg for pilot fuel and 49 620 kJ/kg for gas fuel. With engine driven pumps (two cooling water pumps, one lubricating oil pump and pilot fuel pump). Tolerance 5%.

Note 5 Fuel gas pressure given at LHV $\geq$ 36MJ/m^3N. Required fuel gas pressure depends on fuel gas LHV and need to be increased for lower LHV's. Pressure drop in external fuel gas system to be considered. See chapter Fuel system for further information.

ME = Engine driving propeller, variable speed

AE = Auxiliary engine driving generator

DE = Diesel-Electric engine driving generator

Subject to revision without notice.

MOTOR ELÉCTRICO

Engineered motors
Squirrel cage three phase high voltage motors, Up to 8000 kW

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HV Modular induction motors 3000 V - 50 Hz

Technical data for totally enclosed squirrel cage three phase motors

IP55 - IC 611 - Insulation class F, temperature rise class B

Output kW	Motor type	Product ID	Speed r/min	Efficiency Full load 100 %	Efficiency 3/4 load 75 %	Power factor Full load 100 %	Power factor 3/4 load 75 %	Current I_N A	Current $\frac{I_S}{I_N}$	Current I_0 A	Torque T_N Nm	Torque $\frac{T_S}{T_N}$	Torque $\frac{T_{max}}{T_N}$	Rotor inertia kgm²	Motor weight kg	Sound pressure level L_P dB(A)
1500 r/min = 4 poles				3000 V 50 Hz												
630	**AMI 400L4A**	10024	1482	94.6	94.8	0.87	0.86	146	4.3	38	4058	0.5	1.8	14.6	2930	79
710	**AMI 400L4A**	10025	1484	95.0	95.2	0.87	0.86	165	4.8	46	4569	0.6	2.0	15.6	3030	79
800	**AMI 400L4A**	10026	1486	95.2	95.3	0.86	0.83	188	5.4	62	5142	0.7	2.2	16.6	3110	79
900	**AMI 400L4A**	10027	1486	95.4	95.5	0.86	0.84	210	5.4	66	5785	0.7	2.2	17.6	3210	79
1000	**AMI 400L4A**	10028	1486	95.6	95.7	0.86	0.83	234	5.5	76	6426	0.7	2.2	18.6	3320	79
1120	**AMI 400L4A**	10029	1486	95.8	96.0	0.88	0.86	256	5.5	73	7198	0.8	2.2	20.6	3520	79
1250	**AMI 450L4A**	10030	1486	95.6	95.7	0.88	0.87	286	5.3	77	8033	0.7	2.1	30.9	4190	81
1400	**AMI 450L4A**	10031	1487	95.8	95.9	0.87	0.85	323	5.7	97	8992	0.7	2.3	32.6	4310	81
1600	**AMI 450L4A**	10032	1487	96.0	96.1	0.87	0.85	367	5.9	108	10274	0.8	2.4	36.1	4540	81
1750	**AMI 450L4A**	10033	1489	96.2	96.2	0.87	0.85	403	5.8	124	11224	0.7	2.4	38.3	4680	81
1800	**AMI 500L4A**	10034	1489	95.8	95.9	0.88	0.87	411	4.8	102	11545	0.5	1.9	50.0	5220	82
2000	**AMI 500L4A**	10035	1490	96.1	96.2	0.89	0.87	452	5.4	116	12817	0.6	2.1	56.1	5540	82
2240	**AMI 500L4A**	10036	1490	96.3	96.4	0.88	0.87	507	5.5	131	14354	0.7	2.1	59.1	5710	82
2500	**AMI 500L4A**	10037	1490	96.4	96.5	0.90	0.89	558	5.5	131	16020	0.7	2.1	65.1	6020	82
2750	**AMI 500L4A**	10038	1491	96.6	96.7	0.90	0.89	609	5.8	141	17618	0.7	2.2	71.1	6360	82
3250	**AMI 560L4A B**	10039	1490	96.3	96.4	0.87	0.87	742	4.8	163	20833	0.5	2.1	104.3	8090	86
3750	**AMI 560L4A B**	10040	1490	96.5	96.7	0.89	0.90	836	4.9	154	24037	0.5	2.1	118.4	8660	86
4250	**AMI 560L4A B**	10041	1491	96.7	96.9	0.89	0.88	954	5.5	207	27222	0.6	2.4	127.8	9070	86
4750	**AMI 560L4A B**	10042	1491	96.9	97.0	0.88	0.86	1077	5.8	263	30422	0.7	2.6	140.2	9670	86
5000	**AMI 630L4A B**	10043	1489	96.7	96.8	0.89	0.89	1121	4.8	216	32055	0.5	2.1	183.2	11360	87
5600	**AMI 630L4A B**	10044	1491	97.0	97.1	0.89	0.89	1244	5.4	259	35855	0.6	2.4	206.7	12180	87
6100	**AMI 630L4A B**	10045	1491	97.0	97.2	0.90	0.90	1348	4.9	222	39067	0.5	2.1	222.6	12660	87
7100	**AMI 630L4A B**	10046	1492	97.2	97.3	0.88	0.87	1591	5.6	363	45428	0.6	2.5	243.8	13390	87

Data presented in rating lists are typical values. Guaranteed values on request.
All engineered motors are optimized for the specified application.
Accurate motor data will be given on request at quotation phase.
Legally binding performance and specification data is given to the end user once each order is confirmed.