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Ships and marine technology — Propulsion plants for ships —

Part 1: Vocabulary for geometry of propellers

Navires et technologie maritime — Installations de propulsion des navires —

Partie 1: Termes et définitions relatifs à la géométrie de l'hélice

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 3715 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 3715-1 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

ISO 3715 consists of the following parts, under the general title *Ships and marine technology — Propulsion plants for ships*:

— *Part 1: Vocabulary for geometry of propellers*

— *Part 2: Vocabulary for controllable-pitch propeller plants*

Ships and marine technology — Propulsion plants for ships —

Part 1: Vocabulary for geometry of propellers

Scope

This part of ISO 3715 gives terms and definitions for screw propellers used in the propulsion plants of ships and other vessels (such as mobile offshore drilling units) that are self-propelled or propulsion-assisted.

The definitions are valid only for the hydrodynamically effective part of the propeller. No definitions are given for the mechanical construction of the hub.

Vocabulary for hydraulically operated controllable-pitch propeller plants is given in ISO 3715-2.

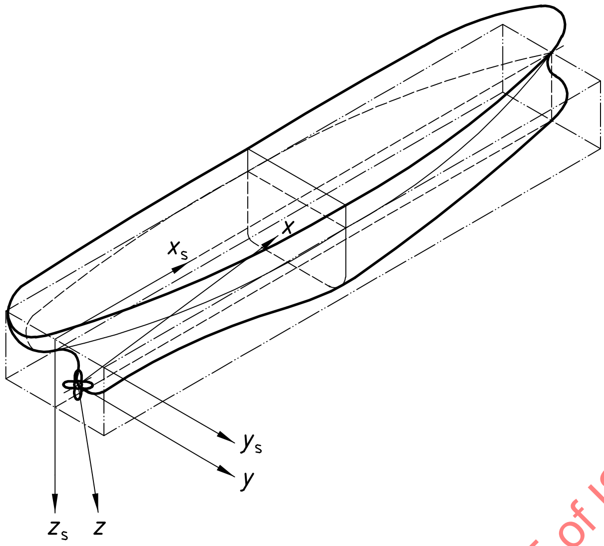
Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 3715. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 3715 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3715-2, *Ships and marine technology — Propulsion plants for ships — Part 2: Vocabulary for controllable-pitch propeller plants*

Systems of coordinates

System of rectangular coordinates for definition of propeller position at hull (see Figure 1).

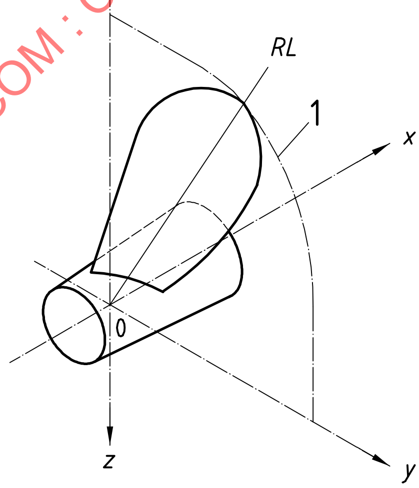


NOTE Coordinates of the ship given in this figure are marked with subscript s [deviating from the International Towing Tank Conference (ITTC), agreement].

Figure 1 — Rectangular coordinates for definition of propeller position at hull

System of rectangular coordinates for definition of propeller geometry (see Figure 2).

This system of coordinates is not in agreement with that of the ship in general.



Key

1 Limit of propeller disc area

0 Origin of coordinates

x Direction of shaft centre

y Direction to starboard

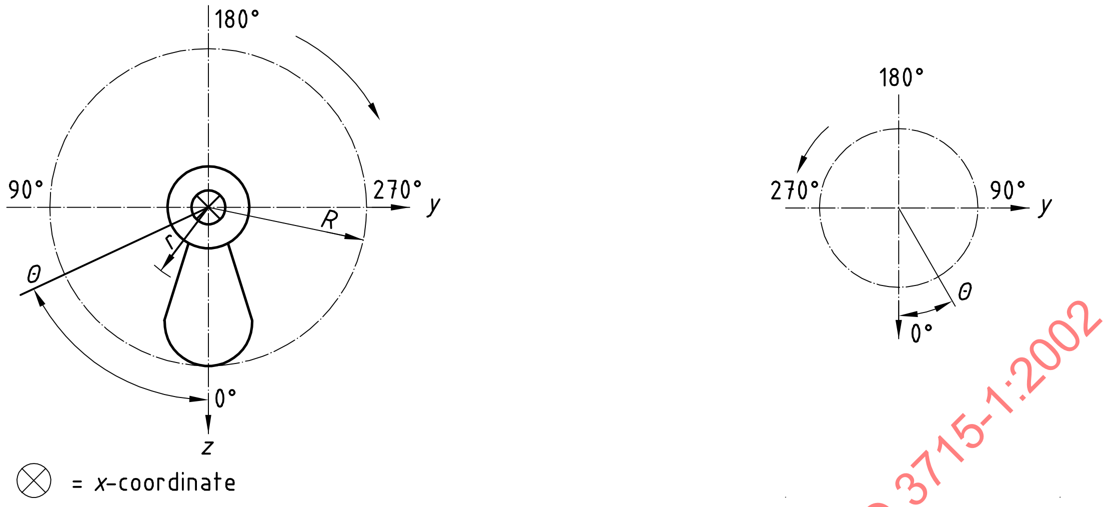
z Direction perpendicular to *x*- and *y*-coordinates

RL Reference line (see 6.4)

NOTE This system of coordinates is valid independently of the direction of rotation of the propeller.

Figure 2 — Rectangular coordinates for definition of propeller geometry

System of cylindrical coordinates for definition of propeller geometry (see Figure 3)



a) **Going ahead with a right-handed propeller**

b) **Going ahead with a left-handed propeller**

Key

Θ Angular coordinate of the system of cylindrical coordinates

r Radial coordinate of the system of cylindrical coordinates

x Coordinate perpendicular to the r-plane and identical to the x-coordinate as defined in Figure 2

R Radius of propeller

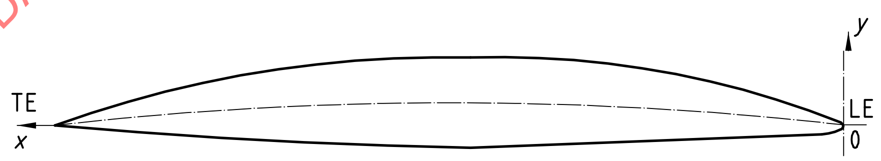
NOTE This system of coordinates is used, for example, to define the geometry of propeller blades.

Left-handed propellers are drawn in general as being right-handed.

$\bar{r} = \frac{r}{R} =$ dimensionless radius.

Figure 3 — Cylindrical coordinates for definition of propeller geometry

System of rectangular coordinates for definition of cylindrical blade sections (see Figure 4 and 6)



Key

TE Trailing edge

LE Leading edge

Figure 4 — Rectangular coordinates for definition of cylindrical blade section

Terms and definitions

1
screw propeller

1.1
propeller radius
R [General]
RP [Computer]
largest vertical distance of the extreme point of a blade (i.e. blade tip) related to the x-coordinate of the system according to Figure 2

NOTE For propellers with mounted blades and controllable-pitch propellers, this definition is valid for design pitch.

1.2
propeller diameter
D [General]
DP [Computer]
diameter of the circle passed by the extreme point of a blade whilst turning around the x-coordinate

$D = 2R$

NOTE For propellers with mounted blades and controllable-pitch propellers, this definition is valid for design pitch.

1.3
number of blades
Z [General]
Z [Computer]
number of blades fitted around the x-coordinate or on the hub

1.4
disc area
A_O [General]
AO [Computer]
disc area calculated by means of the propeller diameter

$$A_O = D^2 \frac{\pi}{4}$$

NOTE See Figure 3.

1.5
area ratio

1.5.1
developed area ratio
A_D/A_O [General]
ADR [Computer]
developed area of all blades related to the propeller disc area

1.5.2
expanded area ratio
A_E/A_O [General]
AER [Computer]
expanded area of all blades related to the propeller disc area

NOTE For blade areas see 6.1.

1.6
centre of gravity of propeller
defined by a measure in x-direction; the mass of propeller cap is not considered for monoblock propellers

NOTE See Figure 5.

1.7
propeller plane
plane of a propeller realized by y- and z-coordinates

NOTE For y-z plane, see Figure 2.

1.8
direction of rotation, right-handed
⟨according to a right-hand thread⟩ when going ahead the propeller moves in the upper point from left to right (seen from aft)

1.9
direction of rotation, left-handed
⟨according to a left-hand thread⟩ when going ahead the propeller moves in the upper part from right to left (seen from aft)

2
hub
part of the propeller the blades are fitted to (fixed or removable), also forming the connection to the propellers shaft and, in the case of controllable pitch propellers, the housing of the mechanism to adjust the blades

NOTE The propeller cap is normally not part of the hub.

2.1
hub diameter
d_h [General]
DH [Computer]
diameter of the hub in the propeller plane

NOTE See Figure 5.

2.2
fore diameter of hub
d_{hf} [General]
DHF [Computer]
fore diameter of the hub, not considering any shoulder

NOTE See Figure 5.

2.3
after diameter of hub
d_{ha} [General]
DHA [Computer]
after diameter of the hub, not considering any shoulder

NOTE See Figure 5.

2.4
hub length
l_h [General]
LH [Computer]
length of the hub, any shoulder aft and fore included

NOTE See Figure 5.

2.5
after length of hub
l_{ha} [General]
LHA [Computer]
length of the hub taken from propeller plane to aft end of the hub including aft shoulder

NOTE See Figure 5.

2.6
fore length of hub
l_{hf} [General]
LHF [Computer]
length of the hub taken from propeller plane to fore end of the hub including fore shoulder

2.7
hub diameter ratio
d_h/D [General]
DHR [Computer]
relation of hub diameter to propeller diameter

3
blade
part of a propeller beginning at the contour of the hub and ending at the blade tip

NOTE In the case of controllable-pitch propellers and propellers with mounted blades, all parts for bearing and fitting the blades to the hub and being fixed to the blade belong to the blades.

3.1
blade tip
utmost part of a blade, positioned at the propeller radius R

NOTE In special cases, the blade tip is represented by a cylindrical section at the propeller radius R.

3.2
blade root
zone of transition of blade to hub

3.3
leading edge
LE [General and computer]
blade edge directed to the inflow under normal operating conditions starting from the blade root and ending at the blade tip

3.4
trailing edge
TE [General and computer]
blade edge opposite to the inflow under normal operating conditions starting from the blade root and ending at the blade tip

3.5
shape of edges
shape of the fore and aft part of a cylindrical section e.g. rounded, sharpened

NOTE Examples of shapes: anti-singing edge, edge with rounded nose.

3.6
suction side
back
SS [General and computer]
blade side, directed to the inflow whilst ship is going ahead

NOTE It is the upper side of a cylindrical profile section (see Figure 6).

3.7
pressure side
face
PS [General and computer]
blade side opposite the suction side (see Figure 6)

3.8
blade outline
shape of blade

3.9
centre of gravity of blade
mass centre of blade

NOTE It is defined by its coordinate values in the coordinate system according to Figure 2 (see also Figure 8 for information).

4
cylindrical blade section
developed penetration area of a cylinder coaxial related to the x-coordinate of a propeller with a propeller blade

NOTE See Figure 6.

4.1
mean line of blade section
ML [General]
connecting line of the centre of contact circles within a cylindrical profile section between suction and pressure side

NOTE See Figure 6.

4.2
camber
f [General]
F [Computer]
maximum value of the y-coordinate or f is equal to maximum y-value of the mean line

NOTE See Figure 6.

4.3
chord length
c [General]
C [Computer]
developed length of a cylindrical profile section from the leading edge to the trailing edge

NOTE See Figure 6.

4.4
leading part of chord length
c_{LE} [General]
CLE [Computer]
developed length of a cylindrical profile section taken from the leading edge to the reference line related to the x-coordinate of the cylindrical section

NOTE See system of coordinates in Figure 4; see also Figure 8 for information.

4.5
trailing part of chord length
c_{TE} [General]
CTE [Computer]
developed length of a cylindrical section taken from the trailing edge to the reference line, related to the x-coordinate of a cylindrical section

NOTE See system of coordinate in Figure 4; see also Figure 8 for information.

4.6
thickness of blade section

4.6.1
maximum thickness of blade section
maximum thickness of the blade section at the radial coordinate r
t [General]
T [Computer]

NOTE See Figure 8.

4.6.2
local thickness of blade section
blade thickness at any location along the x-coordinate axis
t_x [General]
TX [Computer]

NOTE See system of coordinates in Figure 4; see also Figure 6 for information.

5
pitch
P [General]
P [Computer]
covered distance of a point in x-direction after one revolution ($\Theta = 2\pi$) moving on a screw line

NOTE 1 See system of coordinates in Figure 3.

NOTE 2 The pitch is unambigeously defined only for a helix of a constant lead.

The area of a propeller blade is in general not an ideal helicoidal surface, but an area similar to a helicoidal surface. Therefore only area elements have defined pitch values.

The pitch values of area elements are in general different in both directions, radial and, with cambered profile sections, peripheral as well.

5.1
pitch angle
ϕ [General]
PHI [Computer]
angle between the helix of constant lead and the propeller plane, taken on the cylindrical surface

$$\arctan \frac{P}{2\pi r}$$

5.2
pitch of pressure side
P_{PS} [General]
PPS [Computer]
pitch of the line between the first and the last measuring point of the pressure side of a cylindrical section (taken in the development of the cylinder)

NOTE See Figure 6.

5.3
pitch of mean line
P_{ML} [General]
PML [Computer]
pitch of the chord between leading edge and trailing edge point of the mean line (taken in the development of the cylinder)

5.4
local pitch
P_x [General]
PX [Computer]
pitch of the tangent of a curved line, e.g. pressure side of a cylindrical section, at a certain point

NOTE 1 Approximately, the pitch of the line between two adjacent points of a curved line is named local pitch.

NOTE 2 These measures will be used for examination purpose of the manufactured propeller.

5.5
pitch of mean line at leading point of blade section
P_{LE} [General]
PLE [Computer]
pitch of the tangent of the mean line at the leading edge point

5.6
pitch of mean line at trailing point of blade section
P_{TE} [General]
PTE [Computer]
pitch of the tangent of the mean line at the trailing edge point

5.7
mean pitch of blade
P_{MB} [General]
PMB [Computer]
nominal mean pitch of the blade calculated by means of a defined formular using the pitch of the individual cylindrical sections and the corresponding chord lengths

5.8
mean pitch of propeller
P_m [General]
PM [Computer]
arithmetical mean, calculated from the mean pitch of the individual blades

NOTE This value is used, for example to calculate the true slip and the apparent slip value as well.

It is used with restrictions for comparison purpose of the propulsion quality of different propellers.

5.9
pitch at a certain radius
P [General]
pitch at a certain radius $\bar{r}$

EXAMPLE For $\bar{r} = 0,7$, the pitch is $P_{0,7}$.

5.10
pitch ratio
P/D [General]
PDR [Computer]
quotient of a pitch and the propeller diameter

6
description of propeller (see Figure 8)

6.1
blade areas

6.1.1
projected blade area
A_P [General]
AP [Computer]
projection of the blade area in the direction of the x-coordinate

NOTE See Figure 8.

6.1.2
developed blade area
A_D [General]
AD [Computer]
area enclosed by the connection line between the end points of the cylindrical profile sections turned in the propeller plane

NOTE See Figure 8.

6.1.3
expanded blade area
A_E [General]
AE [Computer]
area enclosed by the connection line between the end points of the developed and additionally straightened sections

NOTE See Figure 8.

6.2
rake and skew of blade sections (see Figures 7 and 8)

6.2.1
rake of blade sections
$\mathrm{R}k$ [General]
RK [Computer]
stagger of cylindrical profile sections in direction of the x-coordinate (positive values opposite to the x-direction

NOTE 1 See Figure 7.

NOTE 2 For numerical description of the rake, for instance, the position of the blade tip or of the centre of the chord of a profile section is used in relation to the propeller plane opposite to the direction of ahead run.

6.2.1.1
rake at tip of blade
Rk_t [General]
RKT [Computer]
distance of the blade tip from the propeller plane

NOTE See Figure 8.

6.2.2
skew of blade sections
Sk [General]
SK [Computer]
stagger of the cylindrical profile sections related to the propeller plane (positive values opposite to ahead rotation

NOTE 1 See Figure 7.

NOTE 2 For a numerical description of the skew of the profile section, for example, the position of the blade tip or of the centre of the chord of a profile section is used in relation to the reference line opposite to the ahead rotation direction.

6.2.2.1
skew angle at tip of blade
Θ_s [General]
TETS [Computer]
angle between the straight lines which enclose the $c/2$ line and start from the propeller centre

NOTE See Figure 8.

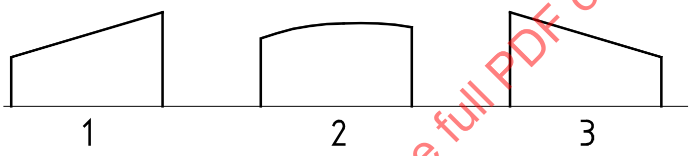
6.3
clearance curve
C_c [General]
curve describing the overall dimensions of a blade passing the x-z-plane

NOTE 1 See Figure 8.

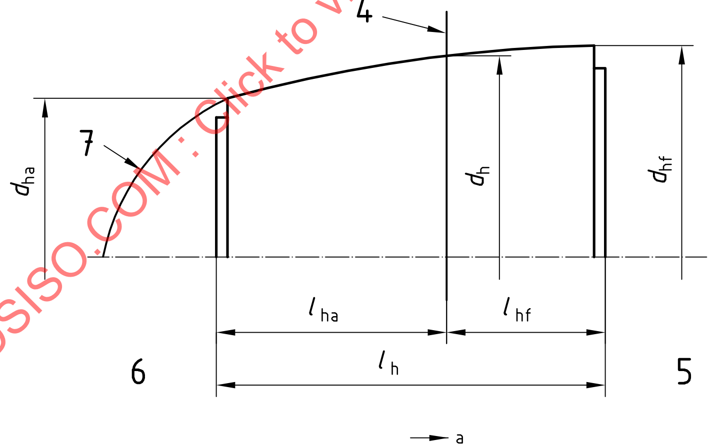
NOTE 2 When changing the pitch, the clearance curve will change too.

6.4
reference line
RL [General]
straight line, originated at the origin of the system of coordinates, which all individual points of a blade are related to

NOTE See Figure 8.



a) Examples of hub shapes



b) Hub dimensions

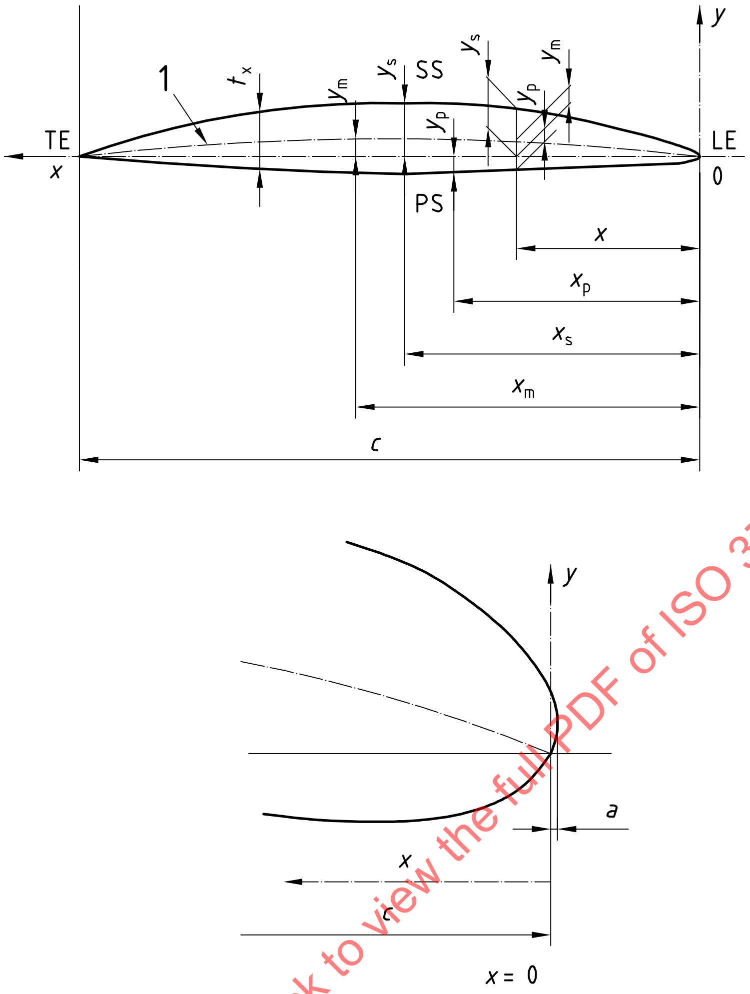
Key

1 Convergent
2 Drum-shaped
3 Divergent
4 Propeller plane
5 Fore
6 Aft
7 Cap

NOTE For hub shapes, see also Figure 9.

[a] Direction of the x-coordinate for above examples

Figure 5 — Hub shapes and dimensions



Key

1 Mean line

LE Leading edge

TE Trailing edge

SS Suction side

PS Pressure side

c Chord length of a cylindrical profile section

t_x Local thickness

x, *y* Coordinates according to Figure 4

Subscripts

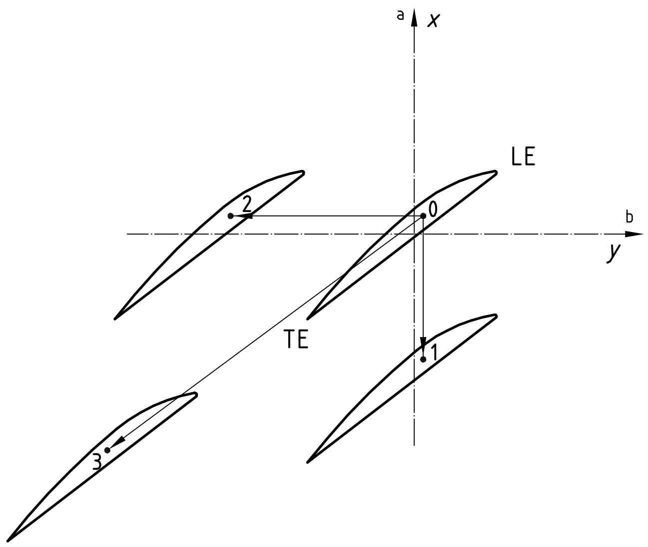
a Overhang of the leading edge contour

m Mean line

s Suction side

p Pressure side

Figure 6 — Cylindrical blade section



Key

LE Leading edge

TE Trailing edge

Stagger

from		to
0	→	1 = Rake
0	→	2 = Skew
0	→	3 = Rake and skew

(0 = Origin, the choice is open)

a Ahead motion

b Direction of rotation for foreword motion

Figure 7 — Rake and skew of blade sections