ITTC 표준기호(2)

(ITTC Standard Symbols)

수조시험연구회(KTTC)

국제수조회의(International Towing Tank Conference)에서는 오래전부터 기호 및 용어위원회(Symbols & Terminology Group)를 구성하여 ITTC 표준기호를 작성해 왔다.

19차 ITTC('90.9. 스페인)에서 채택된 "ITTC 표준기호"는 3가지 주제－General Mechanics, Ships in General, Special Craft－로 분류되어 왔다. 본 내용에서는 이러한 표준기호를 나누어 소개하고자 한다(참고문헌 : "Standard Symbols and Terminology", 19TH ITTC, Sept. 1990, Madrid, Spain).

SECTION 1 GENERAL MECHANICS

1.2 FLUID MECHANICS

1.2.1 Flow Parameters

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
κ	CAP	Coefficient of kinematic capillarity	$\frac{\sigma}{\rho}$	m^3/s^2
μ	MU	Coefficient of dynamic viscosity	Shear stress per unit velocity gradient	kg/ms
ν	NU	Coefficient of kinematic viscosity	$\frac{\mu}{\rho}$	m^2/s
σ	CAPC	Capillarity constant	Surface tension per unit length	kg/s^2

1.2.2 Flow Fields

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
G	CCIR	Non－dimensional circulation	$\frac{\Gamma}{\pi DV}$ (π is usually omitted)	1

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
h	H	Static pressure head, in general		m
H	HT	Total head, Bermoulli	$h + \frac{p}{w} + \frac{q}{w}$	m
I	CIND	Induction factor	Ratio between velocities induced by helicoidal and by straight line vortices	1
p	PR	Pressure		Pa
P_u	PRU	Ambient pressure in undisturbed flow		Pa
q	PRD	Dynamic pressure	Density of kinematic energy $\frac{\rho U^2}{2}$	Pa
Q	QF	Rate of flow	Volume passing across a control surface in time unit	m^3/s
u, u_x, u_1	VX	Velocity component in direction of x, y, z axes		m/s
v, u_y, u_2	VY			
w, u_z, u_3	VZ			
V	V	Velocity	$V = (u^2 + v^2 + w^2)^{\frac{1}{2}}$	m/s
U_U	UU	Velocity of undisturbed flow		m/s
V_R	VRES	Resultant velocity of flow approaching a hydrofoil	Taking vortex induced velocities into account	m/s
α	ALFA	Angle of attack or incidence	Angle between the direction of undisturbed relative flow and the surface of line referred to	1
α_E	ALFE	Effective angle of attack or incidence	The angle of attack relative to the chord line including the effect of induced velocities	1
α_G	ALFG	Geomertric angle of attack or incidence	The angle of attack relative to the chord line neglecting the effect of induced velocities	1
α_i	ALFI	Hydrodynamic angle of attack	In relation to the position at zero lift	1
α_S	ALFS	Ideal angle of attack	For thin airfoil or hydrofoil, angle of attack for which the streamlines are tangent to the mean line at the leading edge. This condition is usually referred to as "shock-free" entry or "smooth"	1

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
α_0	ALFO	Angle of zero lift	Angle of attack or incidence at zero lift	1
γ	GAM	Vortex density	Strength per length or per area of vortex distribution	m/s
Γ	CIR	Circulation	$\oint$Vds along a closed line	m^2/s
ϕ	POTF	Potential function, such as velocity function		m^2/s
Ψ	STRF	Stream function	Ψ = const is the equation of a stream surface	m^3/s
ζ_x	ZETAX	Streamwise vorticity	$\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}$	1/s

1.2.3 Lifting Surfaces

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
A	A	Aspect ratio of the lifting surface	$\frac{b^2}{S}$	1
b	B	Wing span		m
C_{av}	CMEAN	Mean chord length		m
C_d	CD	Section drag coefficient		1
C_L	CL	Section lift coefficient		1
C_m	CM	Section moment coefficient		1
C_t	CT	Tip chord length		m
C_r	CR	Root chord length		m
C_ϵ	CDI	Induced drag coefficient		1
l_e	LE	Leading edge		
M_{ac}	MAC	Moment about aerodynamic center		Nm
M_{cp}	MCP	Moment about center of pressure		Nm
S	S	Platform area	$b \cdot C_{av}$	m^2
t_e	TE	Trailing edge		
W	W	Induced velocity		m/s
δ_f	DELFL	Flap deflection angle		deg
δ_s	DELSL	Slat deflection angle		deg
Λ	LAMBDA	Sweep angle		deg
λ	TR	Taper ratio	C_t/C_r	1

1. 2. 4 Boundary Layers

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
C_f	CF	Skin friction coefficient	$\frac{\tau}{\frac{1}{2}\rho U_e^2}$	1
F	CQF	Entrainment factor	$\frac{1}{U_e}\cdot\frac{dQ}{dX}$	1
H	HBL	Boundary layer shape parameter	$\frac{\delta^*}{\theta}$	1
H_E	HQF	Entrainment shape parameter	$\frac{(\delta-\delta^*)}{\theta}$	1
p	PS	Static pressure		Pa
P	PT	Total pressure		Pa
Q	QF	Entrainment	$\int_a^b U dy$	m^2/s
R_{δ^*}	RDELS	Reynolds number based on displacement thickness	$\frac{U_\infty\delta^*}{\nu}$ or $\frac{U_e\delta^*}{\nu}$	1
R_θ	RTHETA	Reynolds number based on momentum thickness	$\frac{U_\infty\theta}{\nu}$ or $\frac{U_e\theta}{\nu}$	1
u	UFL	Velocity fluctuations in boundary layer		m/s
u^s	UFLS	Root mean square value of velocity fluctuations	$u'^2=\frac{1}{T}\int_0^T u^2dt$	m/s
u^+	UPLUS		$\frac{U}{u_\tau}$	1
U	UM	Time mean of the velocity boundary layer		
$\triangle U$	UDEF	Velocity defect in boundary layer	$\frac{U_e-U}{u_\tau}$	1
y^+	YPLUS		$\frac{yu_\tau}{\nu}$	1
β	BETA	Equilibrium parameter	$\frac{\delta^*}{\tau_\omega\frac{dp}{dx}}$	1
δ_{995}	DEL	Thickness of a boundary layer at $U=0.995U_e$		m
δ^*, δ_1	DELS	Displacement thickness of boundary layer	$\int_0^\delta(\frac{U_e-U}{u_e})dy$	m
$\triangle$	CD	Clauser thickness	$\int_0^\delta(\frac{U_e-U}{u_\tau})dy$	m
K	K	Von Karman constant(0.41)		1
Λ	LAMBDA	Pressure gradient parameter	$\delta_{999}/(\nu\frac{dU_e}{dx})$	1

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
θ^*, δ^{**}	ENTH	Energy thickness	$\int_0^{\delta}(\frac{U}{U_e})\ (1-\frac{U^2}{U_e^2})dy$	m
θ	THETA	Momentum thickness	$\int_0^{\delta}(\frac{U}{U_e})\ (1-\frac{U}{U_e})dy$	m
τ_w	TAUW	Shear stress at a wall	$\mu(\frac{\partial U}{\partial y})\ y=0$	Pa

1. 2. 5 Cavitation

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
α_S	GASR	Gas content ratio	$\frac{\alpha}{\alpha_S}$	1
D_C	CD	Cavity drag		N
H	HTN	Net useful head turboengines	Total head produced or absorbed by impeller or rotating machines	m
H_U	HTU	Total head upstream	Total head upstream of the impeller or rotating machinery	m
L_C	LC	Cavity length	The streamwise dimension of a fully-developed cavitating region	m
P	PR	Absolute ambient pressure		Pa
P_C	PRC	Cavity pressure	Actual pressure within a steady (quasi steady) cavity	Pa
P_{CB}	PRCB	Collapse presure	The pressure produced in the field of a collapsing cavitating bubble	Pa
P_I	PRI	Critical pressure	The absolute ambient pressure at which cavitation inception takes place	Pa
P_V	PRV	Vapor pressure of water		Pa
T_n	TN	Thoma number	$H_u-(\frac{p_v}{w})/H$	1
U_I	UI	Critical velocity	Free stream velocity at which cavitation inception takes place	m/s
V_L	VOLL	Volume loss	$\frac{w_L}{w}$	m^3
W_L	WTL	Weight loss	Weight of material actually eroded from a specimen during a specified time	kg/s
α	GAS	Gas content	The amount of solved and undissolved gas in a liquid	ppm or %

Standard Symbol	Computer Symbol	Name of Concept	Definition or Explanation	SI Unit
δ_C	DLTC	Cavity thickness	Maximum dimension of a fully-developed cavity normal to the length dimension	m
σ	CAVC	Cavitation number	$\frac{p-p_C}{q}$	1
α_S	GASS	Gas content of the saturated liquid		ppm or %
σ_V	CAVV	Vapor cavitation number	$\frac{p-p_V}{q}$	1