

**Property Library for
Seawater
Calculated from the
IAPWS Industrial Formulation
2013**

LibSeaWa

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Property Functions

Functional Dependence	Function Name in Excel®	Call as Fortran Program	Property or Function	Unit of the Result	Reference	Page
$a = f(p, t, \xi)$	a_ptXI_SeaWa	= A_PT XI_SEAWA(P,T,XI)	Thermal diffusivity	m ² /s	[1], [2], [16]	3/2
$a_l = f(t, \xi)$	al_tXI_SeaWa	= AL_T XI_SEAWA(T,XI)	Thermal diffusivity of subcooled liquid	m ² /s	[1], [2], [16]	3/3
$a_{sl} = f(p_s, t_s, \xi_{sl})$	asl_pstsXisl_SeaWa	= ASL_PST SXISL_SEAWA(PS,TS,XISL)	Thermal diffusivity of saturated liquid	m ² /s	[1], [2], [16]	3/4
$a_{sv} = f(p_s, t_s, \xi_{sv})$	asv_pstsXisl_SeaWa	= ASV_PST SXISL_SEAWA(PS,TS,XISL)	Thermal diffusivity of saturated vapor	m ² /s	[1], [2], [16]	3/5
$\alpha_l = f(p, t, \xi)$	alphan_ptXi_SeaWa	= ALPHAL_PT XI_SEAWA(P,T,XI)	Thermal expansion coefficient of subcooled liquid	1/K	[1], [16]	3/6
$\alpha_{sl} = f(p_s, t_s, \xi_{sl})$	alphasl_pstsXisl_SeaWa	= ALPHASL_PST SXISL_SEAWA(PS,TS,XISL)	Thermal expansion coefficient of saturated liquid	1/K	[1], [16]	3/7
$\beta_l = f(p, t, \xi)$	betal_ptXi_SeaWa	= BETAL_PT XI_SEAWA(P,T,XI)	Haline contraction coefficient of subcooled liquid	kg/kg	[1], [16]	3/8
$\beta_{sl} = f(p, t, \xi_{sl})$	betasl_pstsXisl_SeaWa	= BETASL_PST SXISL_SEAWA(PS,TS,XISL)	Haline contraction coefficient of saturated liquid	kg/kg	[1], [16]	3/9
$\beta_{lsl} = f(p, t, \xi)$	betalsl_ptXi_SeaWa	= BETAISL_PT XI_SEAWA(P,T,XI)	Isentropic temperature-pressure coefficient of subcooled liquid	K/kPa	[1], [16]	3/10
$\beta_{lssl} = f(p, t, \xi_{sl})$	betalssl_pstsXisl_SeaWa	= BETAISL_PST SXISL_SEAWA(PS,TS,XISL)	Isentropic temperature-pressure coefficient of saturated liquid	K/kPa	[1], [16]	3/11
$c_p = f(p, t, \xi)$	cp_ptXI_SeaWa	= CP_PT XI_SEAWA(P,T,XI)	Specific isobaric heat capacity	kJ/(kg·K)	[1], [2], [16]	3/12
$c_{p_l} = f(p, t, \xi)$	cpl_ptXI_SeaWa	= CPL_PT XI_SEAWA(P,T,XI)	Specific isobaric heat capacity of subcooled liquid	kJ/(kg·K)	[1], [2], [16]	3/13

$c_{p_sl} = f(p_s, t_s, \zeta_{sl})$	cpsl_pstsXisl_SeaWa	= CPSL_PSTSXISL_SEAWA(PS,TS,XISL)	Specific isobaric heat capacity of saturated liquid	kJ/(kg·K)	[1], [2], [16]	3/14
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Functional Dependence	Function Name in Excel®	Call as Fortran Program	Property or Function	Unit of the Result	Reference	Page
$c_{p_{sv}} = f(p_s, t_s, \xi_{sl})$	cpsv_pstsXisl_SeaWa	= CPSV_PSTSXISL_SEAWA(PS,TS,XISL)	Specific isobaric heat capacity of saturated vapor	kJ/(kg·K)	[1], [2], [16]	3/15
$\eta = f(p, t, \xi)$	eta_ptXI_SeaWa	= ETA_PTXI_SEAWA(P,T,XI)	Dynamic viscosity	Pa·s	[1], [2], [16]	3/16
$\eta_l = f(t, \xi)$	etal_tXI_SeaWa	= ETAL_TXI_SEAWA(T,XI)	Dynamic viscosity of subcooled liquid	Pa·s	[1], [2], [16]	3/17
$\eta_{sl} = f(p_s, t_s, \xi_{sl})$	etasl_pstsXisl_SeaWa	= ETASL_PSTSXISL_SEAWA(PS,TS,XISL)	Dynamic viscosity of saturated liquid	Pa·s	[1], [2], [16]	3/18
$\eta_{sv} = f(p_s, t_s, \xi_{sl})$	etasv_pstsXisl_SeaWa	= ETASV_PSTSXISL_SEAWA(PS,TS,XISL)	Dynamic viscosity of saturated vapor	Pa·s	[1], [2], [16]	3/19
$f_l = f(p, t, \xi)$	fl_ptXI_SeaWa	= FL_PTXI_SEAWA(P,T,XI)	Specific Helmholtz energy of subcooled liquid	kJ/kg	[1], [16]	3/20
$f_{sl} = f(p_s, t_s, \xi_{sl})$	fsl_pstsXisl_SeaWa	= FSL_PSTSXISL_SEAWA(PS,TS,XISL)	Specific Helmholtz energy of saturated liquid	kJ/kg	[1], [16]	3/21
$\phi = f(p, t, \xi)$	phil_ptXI_SeaWa	= PHIL_PTXI_SEAWA(P,T,XI)	Osmotic coefficient of subcooled liquid	[-]	[1], [16]	3/22
$\phi_{sl} = f(p_s, t_s, \xi_{sl})$	phisl_pstsXisl_SeaWa	= PHISL_PSTSXISL_SEAWA(PS,TS,XISL)	Osmotic coefficient of saturated liquid	[-]	[1], [16]	3/23
$h = f(p, t, \xi)$	h_ptXI_SeaWa	= H_PTXI_SEAWA(P,T,XI)	Specific enthalpy	kJ/kg	[1], [2], [16]	3/24
$h_l = f(p, t, \xi)$	hl_ptXI_SeaWa	= HL_PTXI_SEAWA(P,T,XI)	Specific enthalpy of subcooled liquid	kJ/kg	[1], [2], [16]	3/25
$h_{sl} = f(p_s, t_s, \xi_{sl})$	hsl_pstsXisl_SeaWa	= HSL_PSTSXISL_SEAWA(PS,TS,XISL)	Specific enthalpy of saturated liquid	kJ/kg	[1], [2], [16]	3/26
$h_{sv} = f(p_s, t_s, \xi_{sl})$	hsv_pstsXisl_SeaWa	= HSV_PSTSXISL_SEAWA(PS,TS,XISL)	Specific enthalpy of saturated steam	kJ/kg	[1], [2], [16]	3/27
$\kappa = f(p, t, \xi)$	kappa_ptXI_SeaWa	= KAPPA_PTXI_SEAWA(P,T,XI)	Isentropic exponent	[-]	[1], [16]	3/28

$\kappa_l = f(p, t, \xi)$	kappal_ptXI_SeaWa	= KAPPAL_PT XI_SEAWA(P,T,XI)	Isentropic exponent of subcooled liquid	[-]	[1], [16]	3/29
Functional Dependence	Function Name in Excel®	Call as Fortran Program	Property or Function	Unit of the Result	Reference	Page
$\kappa_{sl} = f(p_s, t_s, \xi_{sl})$	kappasl_pstsXisl_SeaWa	= KAPPASL_PST SXISL_SEAWA(PS,TS,XISL)	Isentropic exponent of saturated liquid	[-]	[1], [16]	3/30
$\kappa_{sv} = f(p_s, t_s, \xi_{sv})$	kappasv_pstsXisl_SeaWa	= KAPPASV_PST SXISL_SEAWA(PS,TS,XISL)	Isentropic exponent of saturated vapor	[-]	[1], [16]	3/31
$\kappa_{T_l} = f(p, t, \xi)$	kappaTl_ptXI_SeaWa	= KAPPATL_PT XI_SEAWA(P,T,XI)	Isothermal compressibility of subcooled liquid	1/kPa	[1], [16]	3/32
$\kappa_{T_{sl}} = f(p_s, t_s, \xi_{sl})$	kappaTsl_pstsXisl_SeaWa	= KAPPATSL_PST SXISL_SEAWA(PS,TS,XISL)	Isothermal compressibility of saturated liquid	1/kPa	[1], [16]	3/33
$\kappa_{Is_l} = f(p, t, \xi)$	kappalsl_ptXI_SeaWa	= KAPPAISL_PT XI_SEAWA(P,T ,XI)	Isentropic compressibility of subcooled liquid	1/kPa	[1], [16]	3/34
$\kappa_{Is_{sl}} = f(p_s, t_s, \xi_{sl})$	kappalsl_pstsXisl_SeaWa	= KAPPAISL_PST SXISL_SEAWA(PS,TS,XISL)	Isentropic compressibility of saturated liquid	1/kPa	[1], [16]	3/35
$\lambda = f(p, t, \xi)$	lambda_ptXI_SeaWa	= LAMBDA_PT XI_SEAWA(P,T,XI)	Thermal conductivity	W/(m·K)	[3], [4], [15]	3/36
$\lambda_l = f(t, \xi)$	lambdal_tXI_SeaWa	= LAMBDA_L_T XI_SEAWA(T,XI)	Thermal conductivity of subcooled liquid	W/(m·K)	[3], [4], [15]	3/37
$\lambda_{sl} = f(p_s, t_s, \xi_{sl})$	lambdasl_pstsXisl_SeaWa	= LAMBDA_SL_PST SXISL_SEAWA(PS,TS,XISL)	Thermal conductivity of saturated liquid	W/(m·K)	[3], [4], [15]	3/38
$\lambda_{sv} = f(p_s, t_s, \xi_{sv})$	lambdasv_pstsXisl_SeaWa	= LAMBDA_SV_PST SXISL_SEAWA(PS,TS,XISL)	Thermal conductivity of saturated vapor	W/(m·K)	[3], [4], [15]	3/39
$\mu_l = f(p, t, \xi)$	myl_ptXI_SeaWa	= MYL_PT XI_SEAWA(P,T,XI)	Relative chem. potential of subcooled liquid	kJ/kg	[1], [16]	3/40
$\mu_{sl} = f(p_s, t_s, \xi_{sl})$	mysl_pstsXisl_SeaWa	= MYSL_PST SXISL_SEAWA(PS,TS,XISL)	Relative chem. potential of saturated liquid	kJ/kg	[1], [16]	3/41
$\mu_{W_l} = f(p, t, \xi)$	mywl_ptXI_SeaWa	= MYWL_PT XI_SEAWA(P,T,XI)	Relative chem. potential of	kJ/kg	[1], [16]	3/42

			H ₂ O of subcooled liquid			
$\mu_{W_sl} = f(p_s, t_s, \xi_{sl})$	mywsl_pstsXisl_SeaWa	= MYWSL_PSTSXISL_SEAWA(P,S,TS,XISL)	Relative chem. potential of H ₂ O of saturated liquid	kJ/kg	[1], [16]	3/43
Functional Dependence	Function Name in Excel®	Call as Fortran Program	Property or Function	Unit of the Result	Reference	Page
$\mu_{Salt_l} = f(p, t, \xi)$	mySaltl_ptXI_SeaWa	= MYSALTPTXI_SEAWA(P,T,XI)	Relative chem. potential of sea salt of subcooled liquid	kJ/kg	[1], [16]	3/44
$\mu_{Salt_sl} = f(p_s, t_s, \xi_{sl})$	mySaltsl_pstsXisl_SeaWa	= MYSALTSLPSTSXISL_SEAWA(P,S,TS,XISL)	Relative chem. potential of sea salt of saturated liquid	kJ/kg	[1], [16]	3/45
$\nu = f(p, t, \xi)$	ny_ptXI_SeaWa	= NYPTXI_SEAWA(P,T,XI)	Kinematic viscosity	m ² /s	[1], [2], [16]	3/46
$\nu_l = f(t, \xi)$	nyl_tXI_SeaWa	= NYLTXI_SEAWA(T,XI)	Kinematic viscosity of subcooled liquid	m ² /s	[1], [2], [16]	3/47
$\nu_{sl} = f(p_s, t_s, \xi_{sl})$	nysl_pstsXisl_SeaWa	= NYSLPSTSXISL_SEAWA(P,S,TS,XISL)	Kinematic viscosity of saturated liquid	m ² /s	[1], [2], [16]	3/48
$\nu_{sv} = f(p_s, t_s, \xi_{sl})$	nysv_pstsXisl_SeaWa	= NYSV_PSTSXISL_SEAWA(P,S,TS,XISL)	Kinematic viscosity of saturated vapor	m ² /s	[1], [2], [16]	3/49
$\rho_s = f(t_s, \xi_{sl})$	ps_tsXisl_SeaWa	= PSTSXISL_SEAWA(TS,XISL)	Boiling pressure	bar	[1], [2], [4], [16]	3/50
$\rho_{mel} = f(t, \xi)$	pmel_tXI_SeaWa	= PMELTXI_SEAWA(T,XI)	Freezing pressure	bar	[1], [4], [5], [16]	3/51
$\rho_{tr} = f(\xi)$	ptr_Xi_SeaWa	= PTRXI_SEAWA(T,XI)	Triple point pressure	bar	[1], [4], [5], [16]	3/52
$Pr = f(p, t, \xi)$	Pr_ptXI_SeaWa	= PRPTXI_SEAWA(P,T,XI)	Prandtl Number	[-]	[1], [2], [3], [16]	3/53
$Pr_l = f(t, \xi)$	Pr_l_tXI_SeaWa	= PRLTXI_SEAWA(T,XI)	Prandtl Number of subcooled liquid	[-]	[1], [2], [3], [16]	3/54
$Pr_{sl} = f(p_s, t_s, \xi_{sl})$	Prsl_pstsXisl_SeaWa	= PRSLPSTSXISL_SEAWA(P,S,TS,XISL)	Prandtl Number of saturated liquid	[-]	[1], [2], [3], [16]	3/55

$Pr_{sv} = f(p_s, t_s, \xi_{sl})$	Prsv_pstsXisl_SeaWa	= PRSV_PSTSXISL_SEAWA(PS,TS,XISL)	Prandtl Number of saturated vapor	[-]	[1], [2], [3], [16]	3/56
$\rho = f(p, t, \xi)$	rho_ptXI_SeaWa	= RHO_PTXI_SEAWA(P,T,XI)	Density	kg/m ³	[1], [2], [16]	3/57
$\rho_l = f(p, t, \xi)$	rho_l_ptXI_SeaWa	= RHOL_PTXI_SEAWA(P,T,XI)	Density of subcooled liquid	kg/m ³	[1], [2], [16]	3/58
Functional Dependence	Function Name in Excel®	Call as Fortran Program	Property or Function	Unit of the Result	Reference	Page
$\rho_{sl} = f(p_s, t_s, \xi_{sl})$	rhosl_pstsXisl_SeaWa	= RHOSL_PSTSXISL_SEAWA(PS,TS,XISL)	Density of saturated liquid	kg/m ³	[1], [2], [16]	3/59
$\rho_{sv} = f(p_s, t_s, \xi_{sl})$	rhosv_pstsXisl_SeaWa	= RHOSV_PSTSXISL_SEAWA(PS,TS,XISL)	Density of saturated vapor	kg/m ³	[1], [2], [16]	3/60
$s = f(p, t, \xi)$	s_ptXI_SeaWa	= S_PTXI_SEAWA(P,T,XI)	Specific entropy	kJ/(kg·K)	[1], [2], [16]	3/61
$s_l = f(p, t, \xi)$	sl_ptXI_SeaWa	= SL_PTXI_SEAWA(P,T,XI)	Specific entropy of subcooled liquid	kJ/(kg·K)	[1], [2], [16]	3/62
$s_{sl} = f(p_s, t_s, \xi_{sl})$	ssl_pstsXisl_SeaWa	= SSL_PSTSXISL_SEAWA(PS,TS,XISL)	Specific entropy of saturated liquid	kJ/(kg·K)	[1], [2], [16]	3/63
$s_{sv} = f(p_s, t_s, \xi_{sl})$	ssv_pstsXisl_SeaWa	= SSV_PSTSXISL_SEAWA(PS,TS,XISL)	Specific entropy of saturated vapor	kJ/(kg·K)	[1], [2], [16]	3/64
$t_s = f(p_s, \xi_{sl})$	ts_psXisl_SeaWa	= TS_PSXISL_SEAWA(PS,XISL)	Boiling temperature	°C	[1], [2], [4], [16]	3/65
$t_{mel} = f(p, \xi)$	tmel_pXi_SeaWa	= TMEL_PXI_SEAWA(P,XI)	Freezing temperature	°C	[1], [4], [5], [16]	3/66
$t_{tr} = f(\xi)$	ttr_Xi_SeaWa	= TTR_XI_SEAWA(T,XI)	Triple point temperature	°C	[1], [4], [5], [16]	3/67
Region = $f(p, t, \xi)$	Region_ptXI_SeaWa	= REGION_PTXI_SEAWA(P,T,XI)	Region	[-]	[1], [2], [4], [16]	3/68
Region = $f(p, h, \xi)$	Region_phXI_SeaWa	= REGION_PHXI_SEAWA(P,H,XI)	Region	[-]	[1], [2], [4], [16]	3/69
Region = $f(p, s, \xi)$	Region_psXI_SeaWa	= REGION_P SXI_SEAWA(P,S,XI)	Region	[-]	[1], [2], [4], [16]	3/70

$t = f(p, h, \xi)$	t_phXI_SeaWa	= T_PHXI_SEAWA(P,H,XI)	Backward function: Temperature from pressure and specific enthalpy	°C	[1], [2], [4], [16]	3/71
$t = f(p, s, \xi)$	t_psXI_SeaWa	= T_PSI_SAWA(P,S,XI)	Backward function: Temperature from pressure and specific entropy	°C	[1], [2], [4], [16]	3/72
Functional Dependence	Function Name in Excel®	Call as Fortran Program	Property or Function	Unit of the Result	Reference	Page
$u = f(p, t, \xi)$	u_ptXI_SeaWa	= U_PTXI_SEAWA(P,T,XI)	Specific internal energy	kJ/kg	[1], [2], [16]	3/73
$u_l = f(p, t, \xi)$	ul_ptXI_SeaWa	= UL_PTXI_SEAWA(P,T,XI)	Specific internal energy of subcooled liquid	kJ/kg	[1], [2], [16]	3/74
$u_{sl} = f(p_s, t_s, \xi_{sl})$	usl_pstsXisl_SeaWa	= USL_PSTSI_SAWA(PS,TS,XISL)	Specific internal energy of saturated liquid	kJ/kg	[1], [2], [16]	3/75
$u_{sv} = f(p_s, t_s, \xi_{sv})$	usv_pstsXisl_SeaWa	= USV_PSTSI_SAWA(PS,TS,XISL)	Specific internal energy of saturated vapor	kJ/kg	[1], [2], [16]	3/76
$v = f(p, t, \xi)$	v_ptXI_SeaWa	= V_PTXI_SEAWA(P,T,XI)	Specific volume	m³/kg	[1], [2], [16]	3/77
$v_l = f(p, t, \xi)$	vl_ptXI_SeaWa	= VL_PTXI_SEAWA(P,T,XI)	Specific internal energy of subcooled liquid	m³/kg	[1], [2], [16]	3/78
$v_{sl} = f(p_s, t_s, \xi_{sl})$	vsl_pstsXisl_SeaWa	= VSL_PSTSI_SAWA(PS,TS,XISL)	Specific volume of saturated liquid	m³/kg	[1], [2], [16]	3/79
$v_{sv} = f(p_s, t_s, \xi_{sv})$	vsv_pstsXisl_SeaWa	= VSV_PSTSI_SAWA(PS,TS,XISL)	Specific volume of saturated vapor	m³/kg	[1], [2], [16]	3/80
$w = f(p, t, \xi)$	w_ptXI_SeaWa	= W_PTXI_SEAWA(P,T,XI)	Speed of sound	m/s	[1], [16]	3/81
$w_l = f(p, t, \xi)$	wl_ptXI_SeaWa	= WL_PTXI_SEAWA(P,T,XI)	Speed of sound of liquid	m/s	[1], [16]	3/82
$w_{sl} = f(p_s, t_s, \xi_{sl})$	wsl_pstsXisl_SeaWa	= WSL_PSTSI_SAWA(PS,TS,XISL)	Speed of sound of saturated liquid	m/s	[1], [16]	3/83
$w_{sv} = f(p_s, t_s, \xi_{sv})$	wsv_pstsXisl_SeaWa	= WSV_PSTSI_SAWA(PS,TS,XISL)	Speed of sound of saturated vapor	m/s	[1], [16]	3/84

$x = f(p, t, \xi)$	x_ptXI_SeaWa	= X_PTXI_SEAWA(P,T,XI)	Vapor fraction	kg/kg	[1], [16]	3/85
$\xi_{sl} = f(p_s, t_s)$	Xisl_psts_SeaWa	= XISL_PSTS_SEAWA(PS,TS)	Mass fraction of sea salt in saturated liquid	kg/kg	[1], [16]	3/86
$\xi_{sv} = f(p_s, t_s)$	Xisv_psts_SeaWa	= XISV_PSTS_SEAWA(PS,TS)	Mass fraction of sea salt in saturated vapor	kg/kg	[1], [16]	3/87

Range of Validity

Pressure:	0.002 093	\leq	p	\leq	1000	bar
Temperature:	-12.15	\leq	t	\leq	220	°C
Salinity:	0	\leq	ξ	\leq	0.2	kg _{salt} /kg _{mixture}

Reference State

Property	SeaWater
Pressure	1.01325 bar
Temperature	0 °C
Salinity	0.003516504 kg/kg
Enthalpy	0 kJ/kg
Entropy	0 kJ/(kg·K)

Variable Types for Function Call

All functions and variables:	REAL*8
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Property functions with deviation to the range of validity (cp. Chapter 3)