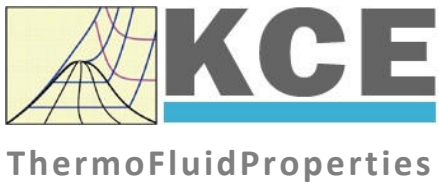

Property Library for Ammonia-Water Mixtures

LibAmWa

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Property Functions

Functional Dependence	Function Name	Call in Fortran	Property or Function	Unit
$a = f(p,t,\xi)$	a_ptxi_AmWa	APTXIAMWA(P,T,XI)	Thermal diffusivity	m^2/s
$a' = f(p,t,\xi')$	al_ptxil_AmWa	ALPTXILAMWA(P,T,XIL)	Thermal diffusivity of saturated liquid	m^2/s
$a' = f(p,t,\xi'')$	al_ptxiv_AmWa	ALPTXIVAMWA(P,T,XIV)	Thermal diffusivity of saturated liquid	m^2/s
$a'' = f(p,t,\xi')$	av_ptxil_AmWa	AVPTXILAMWA(P,T,XIL)	Thermal diffusivity of saturated vapor	m^2/s
$a'' = f(p,t,\xi'')$	av_ptxiv_AmWa	AVPTXIVAMWA(P,T,XIV)	Thermal diffusivity of saturated vapor	m^2/s
$c_p = f(p,t,\xi)$	cp_ptxi_AmWa	CPPTXIAMWA(P,T,XI)	Specific isobaric heat capacity	kJ/(kg K)
$c'_p = f(p,t,\xi')$	cpl_ptxil_AmWa	CPLPTXILAMWA(P,T,XIL)	Specific isobaric heat capacity of saturated liquid	kJ/(kg K)
$c'_p = f(p,t,\xi'')$	cpl_ptxiv_AmWa	CPLPTXIVAMWA(P,T,XIV)	Specific isobaric heat capacity of saturated liquid	kJ/(kg K)
$c''_p = f(p,t,\xi')$	cpv_ptxil_AmWa	CPVPTXILAMWA(P,T,XIL)	Specific isobaric heat capacity of saturated vapor	kJ/(kg K)
$c''_p = f(p,t,\xi'')$	cpv_ptxiv_AmWa	CPVPTXIVAMWA(P,T,XIV)	Specific isobaric heat capacity of saturated vapor	kJ/(kg K)
$c_v = f(p,t,\xi)$	cv_ptxi_AmWa	CVPTXIAMWA(P,T,XI)	Specific isochoric heat capacity	kJ/(kg K)
$c'_v = f(p,t,\xi')$	cvl_ptxil_AmWa	CVLPTXILAMWA(P,T,XIL)	Specific isochoric heat capacity of saturated liquid	kJ/(kg K)
$c'_v = f(p,t,\xi'')$	cvl_ptxiv_AmWa	CVLPTXIVAMWA(P,T,XIV)	Specific isochoric heat capacity of saturated liquid	kJ/(kg K)
$c''_v = f(p,t,\xi')$	cvv_ptxil_AmWa	CVVPTXILAMWA(P,T,XIL)	Specific isochoric heat capacity of saturated vapor	kJ/(kg K)
$c''_v = f(p,t,\xi'')$	cvv_ptxiv_AmWa	CVVPTXIVAMWA(P,T,XIV)	Specific isochoric heat capacity of saturated vapor	kJ/(kg K)
$D_g = f(p,t,\xi_v)$	Dg_ptxiv_AmWa	DGPTXIVAMWA(P,T,XIV)	Diffusion coefficient vapor mixture	m^2/s
$D_l = f(t,\xi_l)$	Dl_txil_AmWa	DLTXILAMWA(P,XIL)	Diffusion coefficient in liquid mixture	m^2/s
$h = f(p,t,\xi)$	h_ptxi_AmWa	HPTXIAMWA(P,T,XI)	Specific enthalpy	kJ/kg
$h' = f(p,t,\xi')$	hl_ptxil_AmWa	HLPTXILAMWA(P,T,XIL)	Specific enthalpy of saturated liquid	kJ/kg

Functional Dependence	Function Name	Call in Fortran	Property or Function	Unit
$h' = f(p,t,\xi'')$	hl_ptxiv_AmWa	HLPTXIVAMWA(P,T,XIV)	Specific enthalpy of saturated liquid	kJ/kg
$h'' = f(p,t,\xi')$	hv_ptxil_AmWa	HVPTXILAMWA(P,T,XIL)	Specific enthalpy of saturated vapor	kJ/kg
$h'' = f(p,t,\xi'')$	hv_ptxiv_AmWa	HVPTXIVAMWA(P,T,XIV)	Specific enthalpy of saturated vapor	kJ/kg
$p = f(h,s,\xi)$	p_hsxi_AmWa	PHSXIAMWA(H,S,XI)	Backward function: Pressure from enthalpy, entropy, and NH_3 mass fraction	kg/kg
$p = f(t,\xi,x_\delta)$	p_txixd_AmWa	PTXIXDAMWA(T,XI,XD)	Pressure from temperature, NH_3 mass fraction, and vapor fraction	bar
$p_s = f(t,\xi')$	ps_txil_AmWa	PSTXILAMWA(T,XIL)	Vapor pressure	bar
$p_s = f(t,\xi'')$	ps_txiv_AmWa	PSTXIVAMWA(T,XIV)	Vapor pressure	bar
$Pr = f(p,t,\xi)$	Pr_ptxi_AmWa	PRPTXIAMWA(P,T,XI)	Prandtl-Number	-
$Pr' = f(p,t,\xi')$	Prl_ptxil_AmWa	PRLPTXILAMWA(P,T,XIL)	Prandtl-Number of saturated liquid	-
$Pr' = f(p,t,\xi'')$	Prl_ptxiv_AmWa	PRLPTXIVAMWA(P,T,XIV)	Prandtl-Number of saturated liquid	-
$Pr'' = f(p,t,\xi')$	Prv_ptxil_AmWa	PRVPTXILAMWA(P,T,XIL)	Prandtl-Number of saturated vapor	-
$Pr'' = f(p,t,\xi'')$	Prv_ptxiv_AmWa	PRVPTXIAMWA(P,T,XIV)	Prandtl-Number of saturated vapor	-
$region = f(p,h,\xi)$	region_phxi_AmWa	REGPHXIAMWA(P,H,XI)	Phase region from pressure, enthalpy, and NH_3 mass fraction	-
$region = f(p,s,\xi)$	region_psxi_AmWa	REGPSXIAMWA(P,S,XI)	Phase region from pressure, entropy, and NH_3 mass fraction	-
$region = f(p,t,\xi)$	region_ptxi_AmWa	REGPTXIAMWA(P,T,XI)	Phase region from pressure, temperature, and NH_3 mass fraction	-
$region = f(h,s,\xi)$	region_hsxi_AmWa	REGHSXIAMWA(H,S,XI)	Phase region from enthalpy, entropy, and NH_3 mass fraction	-
$s = f(p,t,\xi)$	s_ptxi_AmWa	SPTXIAMWA(P,T,XI)	Specific entropy	kJ/(kg K)
$s' = f(p,t,\xi')$	sl_ptxil_AmWa	SLPTXILAMWA(P,T,XIL)	Specific entropy of saturated liquid	kJ/(kg K)
$s' = f(p,t,\xi'')$	sl_ptxiv_AmWa	SLPTXIVAMWA(P,T,XIV)	Specific entropy of saturated liquid	kJ/(kg K)
$s'' = f(p,t,\xi')$	sv_ptxil_AmWa	SVPTXILAMWA(P,T,XIL)	Specific entropy of saturated vapor	kJ/(kg K)
$s'' = f(p,t,\xi'')$	sv_ptxiv_AmWa	SVPTXIVAMWA(P,T,XIV)	Specific entropy of saturated vapor	kJ/(kg K)
$\sigma_l = f(t,\xi')$	sigmal_txil_AmWa	SIGMALTXILAMWA(T,XIL)	Surface tension of saturated liquid	mN/m

Functional Dependence	Function Name	Call in Fortran	Property or Function	Unit
$t = \mathrm{f}(p,h,\xi)$	t_phxi_AmWa	TPHXIAMWA(P,H,XI)	Backward function: Temperature from pressure, enthalpy, and NH_3 mass fraction	°C
$t = \mathrm{f}(p,s,\xi)$	t_psxi_AmWa	TPSXIAMWA(P,S,XI)	Backward function: Temperature from pressure, entropy, and NH_3 mass fraction	°C
$t = \mathrm{f}(p,\xi,x_\delta)$	t_pxixd_AmWa	TPXIXDAMWA(P,XI,XD)	Temperature from pressure, NH_3 mass fraction, and vapor fraction	°C
$t_s = \mathrm{f}(p,\xi')$	ts_pxil_AmWa	TSPXILAMWA(P,XIL)	Saturation temperature	°C
$t_s = \mathrm{f}(p,\xi'')$	ts_pxiv_AmWa	TSPXIVAMWA(P,XIV)	Saturation temperature	°C
$v = \mathrm{f}(p,t,\xi)$	v_ptxi_AmWa	VPTXIAMWA(P,T,XI)	Specific volume	m^3/kg
$v' = \mathrm{f}(p,t,\xi')$	vl_ptxil_AmWa	VLPTXILAMWA(P,T,XIL)	Specific volume of saturated liquid	m^3/kg
$v' = \mathrm{f}(p,t,\xi'')$	vl_ptxiv_AmWa	VLPTXIVAMWA(P,T,XIV)	Specific volume of saturated liquid	m^3/kg
$v'' = \mathrm{f}(p,t,\xi')$	vv_ptxil_AmWa	VVPTXILAMWA(P,T,XIL)	Specific volume of saturated vapor	m^3/kg
$v'' = \mathrm{f}(p,t,\xi'')$	vv_ptxiv_AmWa	VVPTXIVAMWA(P,T,XIV)	Specific volume of saturated vapor	m^3/kg
$w = \mathrm{f}(p,t,\xi)$	w_ptxi_AmWa	WPTXIAMWA(P,T,XI)	Speed of sound	m/s
$w' = \mathrm{f}(p,t,\xi')$	wl_ptxil_AmWa	WLPTXILAMWA(P,T,XIL)	Speed of sound of saturated liquid	m/s
$w' = \mathrm{f}(p,t,\xi'')$	wl_ptxiv_AmWa	WLPTXIVAMWA(P,T,XIV)	Speed of sound of saturated liquid	m/s
$w'' = \mathrm{f}(p,t,\xi')$	wv_ptxil_AmWa	WVPTXILAMWA(P,T,XIL)	Speed of sound of saturated vapor	m/s
$w'' = \mathrm{f}(p,t,\xi'')$	wv_ptxiv_AmWa	WVPTXIVAMWA(P,T,XIV)	Speed of sound of saturated vapor	m/s
$\eta = \mathrm{f}(p,t,\xi)$	eta_ptxi_AmWa	ETAPTXIAMWA(P,T,XI)	Dynamic viscosity	Pa s
$\eta' = \mathrm{f}(p,t,\xi')$	etal_ptxil_AmWa	ETALPTXILAMWA(P,T,XIL)	Dynamic viscosity of saturated liquid	Pa s
$\eta' = \mathrm{f}(p,t,\xi'')$	etal_ptxiv_AmWa	ETALPTXIVAMWA(P,T,XIV)	Dynamic viscosity of saturated liquid	Pa s
$\eta'' = \mathrm{f}(p,t,\xi')$	etav_ptxil_AmWa	ETAVPTXILAMWA(P,T,XIL)	Dynamic viscosity of saturated vapor	Pa s
$\eta'' = \mathrm{f}(p,t,\xi'')$	etav_ptxiv_AmWa	ETAVPTXIVAMWA(P,T,XIV)	Dynamic viscosity of saturated vapor	Pa s
$\lambda = \mathrm{f}(p,t,\xi)$	lambda_ptxi_AmWa	LAMBDAPTXIAMWA(P,T,XI)	Therm. conductivity	W/(m K)

Functional Dependence	Function Name	Call in Fortran	Property or Function	Unit
$\lambda' = f(p,t,\xi')$	lambdal_ptxil_AmWa	LAMBDALPTXILAMWA(P,T,XIL)	Therm. conductivity of saturated liquid	W/(m K)
$\lambda' = f(p,t,\xi'')$	lambdal_ptxiv_AmWa	LAMBDALPTXIVAMWA(P,T,XIV)	Therm. conductivity of saturated liquid	W/(m K)
$\lambda'' = f(p,t,\xi')$	lambdav_ptxil_AmWa	LAMBDAVPTXILAMWA(P,T,XIL)	Therm. conductivity of saturated vapor	W/(m K)
$\lambda'' = f(p,t,\xi'')$	lambdav_ptxiv_AmWa	LAMBDAVPTXIVAMWA(P,T,XIV)	Therm. conductivity of saturated vapor	W/(m K)
$\nu = f(p,t,\xi)$	nue_ptxi_AmWa	NUEPTXIAMWA(P,T,XI)	Kinematic viscosity	m^2/s
$\nu' = f(p,t,\xi')$	nuel_ptxil_AmWa	NUELPTXILAMWA(P,T,XIL)	Kinematic viscosity of saturated liquid	m^2/s
$\nu' = f(p,t,\xi'')$	nuel_ptxiv_AmWa	NUELPTXIVAMWA(P,T,XIV)	Kinematic viscosity of saturated liquid	m^2/s
$\nu'' = f(p,t,\xi')$	nuev_ptxil_AmWa	NUEVPTXILAMWA(P,T,XIL)	Kinematic viscosity of saturated vapor	m^2/s
$\nu'' = f(p,t,\xi'')$	nuev_ptxiv_AmWa	NUEVPTXIVAMWA(P,T,XIV)	Kinematic viscosity of saturated vapor	m^2/s
$x_\delta = f(p,t,\xi)$	xd_ptxi_AmWa	XDPTXIAMWA(P,T,XI)	Vapor fraction from pressure, temperature and NH_3mass fraction	kg/kg
$x_\delta = f(h,s,\xi)$	xd_hsxi_AmWa	XDHSXIAMWA(H,S,XI)	Backward function: Vapor fraction from enthalpy, entropy, and NH_3 mass fraction	kg/kg
$\xi' = f(p,t,\xi'')$	xil_ptxiv_AmWa	XILPTXIVAMWA(P,T,XIV)	NH_3 mass fraction of saturated liquid	kg/kg
$\xi'' = f(p,t,\xi')$	xiv_ptxil_AmWa	XIVPTXILAMWA(P,T,XIL)	NH_3 mass fraction of saturated vapor	kg/kg

Units:

t in °C

p in bar

ξ in (kg NH_3)/(kg mixture)

Details on the calculation of wet steam

The wet steam region is calculated automatically by the subprograms which are valid in the entire range of validity.

For the functions of saturated liquid (…$'$) and saturated vapor (…$''$) it is adequate to enter two parameters:

- either p and t ,
- or t and ξ' resp. t and ξ'' ,
- or p and ξ' resp. p and ξ'' .

Enter -1000 for the value which is not given. If p, t, and ξ' or p, t, and ξ'' are entered the program considers the parameters to match, i.e., to represent the p-t saturation curve. If this is not true the function value to be calculated results in -1000.

Range of validity

Temperature ranges	from $t_{tr}(\xi)$ up to $2 \cdot t_c\ (\xi)$,
	with: t_{tr,NH_3} = -77.655 °C, t_{tr,H_2O} = 0.01 °C
Pressure ranges	from 0.1 bar up to 400 bar
Composition ranges	from 0.0 up to 1.0 (kg NH_3)/(kg mixture)

Reference state

Water:	triple point for saturated liquid
	h_{H2O} = 0.000611783 kJ/kg and
	s_{H2O} = 0.0 kJ/(kg K)
	at p_{tr} = 0.00611657 bar and t_{tr} = 0.01 °C
Ammonia:	triple point for saturated liquid
	h_{NH3} = 2.333 kJ/kg and
	s_{NH3} = 0.0 kJ/(kg K)
	at p_{tr} = 0.060912 bar and t_{tr} = -77.655 °C

Note:

If the calculated function results in -1000, the values entered represent a state point beyond the range of validity of LibAmWa. For further information on each function and its range of validity see Chapter 3. The same information may also be accessed via the online help pages.