

## WATER PROPERTIES IN EXCEL

Excel spreadsheet functions were created by Glen R. M<sup>c</sup>Gee using Visual Basic for Applications (VBA) to calculate water properties. This is recommended to anyone using Excel to analyse thermalhydraulic data.

The functions use correlations developed by Bill Garland, M<sup>c</sup>Master University. Separate functions are provided for subcooled, saturated, and superheated properties. Additional 'general' functions are provided that call the appropriate state-specific routine (based on the input  $T_{in}$  and  $P_{in}$ ), but the user must supply a quality ( $X_{in}$ ) if the fluid is saturated. The function names, required input and output values, and ranges of validity are listed in the attached table.

To use the functions in an Excel workbook, follow the examples below. Alt-F11 gets you to the functions, listed under Module 1. The routines all contain internal checking logic to screen for invalid inputs. If possible, the invalid input value is reset to the nearest limit (i.e.,  $HGSUP(2.0, 600.0) = HGSUP(2.0, 450.0) = 3363.6$ ). Otherwise, a message is generated (i.e.,  $HGSUP(2.0, 20.0) = \#NUM!$ ). General property functions can be forced to return saturation values by setting either  $P_{in}$  or  $T_{in}$  to 0.

**FUNCTION ROUTINES IN EXCEL TEMPLATE MACH20.XLT**

<b>Property</b>	<b>Units</b>	<b>Subcooled Liquid</b>	<b>Saturated</b>	<b>Superheated Vapour</b>	<b>General</b>
<b>Specific Volume</b>	m <sup>3</sup> /kg	VFSUB(P <sub>in</sub> , T <sub>in</sub> )	VF(P <sub>in</sub> ) VG(P <sub>in</sub> )	VGSUP(P <sub>in</sub> , T <sub>in</sub> )	V(P <sub>in</sub> , T <sub>in</sub> , X <sub>in</sub> )
<b>Enthalpy</b>	kJ/kg	HFSUB(P <sub>in</sub> , T <sub>in</sub> )	HF(P <sub>in</sub> ) HG(P <sub>in</sub> )	HGSUP(P <sub>in</sub> , T <sub>in</sub> )	H(P <sub>in</sub> , T <sub>in</sub> , X <sub>in</sub> )
<b>Specific Heat</b>	kJ/kg	CPFSUB(P <sub>in</sub> , T <sub>in</sub> )	CPF(P <sub>in</sub> ) CPG(P <sub>in</sub> )	CPGSUP(P <sub>in</sub> , T <sub>in</sub> )	CP(P <sub>in</sub> , T <sub>in</sub> , X <sub>in</sub> )
<b>Thermal Conductivity</b>	W/m-C	AKF(P <sub>in</sub> , T <sub>in</sub> )		AKG(P <sub>in</sub> , T <sub>in</sub> )	K(P <sub>in</sub> , T <sub>in</sub> , X <sub>in</sub> )
<b>Saturation Pressure</b>	MPa		PSAT(T <sub>in</sub> )		
<b>Saturation Temperature</b>	°C		TSAT(P <sub>in</sub> )		
<b>Ranges:</b>	P <sub>in</sub>	P <sub>fg</sub> to 18 MPa	0.0006 to 18 MPa	0.002 to 18 MPa	0.002 to 18 MPa
	T <sub>in</sub>	0.1 to 356°C		T <sub>fg</sub> to 450°C	0.1 to 450°C
	X <sub>in</sub>				0 to 1