

**ECTP 2023**

\_\_\_\_ Venice ITALY

\_\_\_\_\_ 10-13 September 2023

**22<sup>nd</sup> EUROPEAN CONFERENCE  
ON THERMOPHYSICAL PROPERTIES**

**Book of Abstracts**

# CONTENTS

*About the Conference* pp. 4 – 5

*Committees* p. 6

*Conference Information* p. 7

*Guidelines for oral lectures and poster contributions* p. 8

*Plenary lecturers* pp. 9 – 11

*Oral contributions* pp. 12 – 179

OS1 - 1 - L1A/ L1B /L1C /L1D /L1E pp. 12 - 16

OS1 - 1 - L2A/ L2B/ L2C/ L2D/ L2E pp. 17 - 21

OS1 - 1 - L3A/L3B/ L3C/ L4D/ L4E pp. 22 - 26

OS1 - 1 - L4A/L4B/ L4D/ L4E pp. 27 - 30

OS1 - 2 - K1A/ K1B /K1C /K1D /K1E pp. 31 - 35

OS1 - 2 - L1A/ L1B/ L1C/ L1D/ L1E pp. 36 - 40

OS1 - 2 - L2A/L2B/ L2C/ L2D/ L2E pp. 41 - 45

OS1 - 2 - L3A/L3B/ L3C/ L3E pp. 46 - 49

OS1 - 3 - L1A/ L1B /L1C /L1D /L1E pp. 50 - 53

OS1 - 3 - L2A/ L2B/ L2C/ L2D/ L2E pp. 54 - 57

OS1 - 3 - L3A/L3B/ L3C/ L4D/ L4E pp. 58 - 61

OS1 - 3 - L4A/L4B/ L4D/ L4E pp. 62 - 64

OS2 - 1 - L1A/ L1B /L1C /L1D /L1E pp. 65 - 69

OS2 - 1 - L2A/ L2B/ L2C/ L2D/ L2E pp. 70 - 74

OS2 - 1 - L3A/L3B/ L3C/ L4D/ L4E pp. 75 - 79

OS2 - 1 - L4A/L4B/ L4C/ L4D/ L4E pp. 80 - 84

OS2 - 2 - L1A/ L1C /L1D /L1E pp. 85 - 88

OS2 - 2 - L2A/ L2C/ L2D/ L2E pp. 89 - 92

OS2 - 2 - L3A/ L3C/ L4D/ L4E pp. 93 - 96

OS2 - 2 - L4A/ L4C/ L4D/ L4E pp. 97 - 100

OS2 - 3 - L1A/ L1B /L1C /L1D /L1E pp. 101 - 105  
OS2 - 3 - L2A/ L2B/ L2C/ L2D/ L2E pp. 106 - 110  
OS2 - 3 - L3A/L3B/ L3C/ L4D/ L4E pp. 111 - 115  
OS2 - 3 - L4A/L4B/ L4C/ L4D/ L4E pp. 116 - 120  
OS2 - 3 - L5A/L5B/ L5C/ L5D/ L5E pp. 121 - 125  
OS3 - 1 - L1A/ L1B /L1C /L1D /L1E pp. 126 - 129  
OS3 - 1 - L2A/ L2B/ L2C/ L2D/ L2E pp. 130 - 133  
OS3 - 1 - L3A/L3B/ L3C/ L4D/ L4E pp. 134 - 137  
OS3 - 1 - L4A/L4B/ L4C/ L4D/ L4E pp. 138 - 141  
OS3 - 2 - L1B/ L1C /L1D /L1E pp. 142 - 145  
OS3 - 2 - L2B/ L2C/ L2D/ L2E pp. 146 - 149  
OS3 - 2 - L3B/L3C/ L4D/ L4E pp. 150 - 153  
OS3 - 2 - L4B/ L4C/ L4D/ L4E pp. 154 - 157  
OS3 - 3 - K2A/ K2B /K2C /K2D /K2E pp. 158 - 162  
OS3 - 3 - L1A/ L1B/ L1C/ L1D/ L1E pp. 163 - 167  
OS3 - 3 - L2A/L2B/ L2C/ L2D/ L2E pp. 168 - 172  
OS3 - 3 - L3B/ L3C/ L3D/ L3E pp. 173 - 176  
OS3 - 3 - L4C/ L4D / L4E pp. 177 - 179

*Poster Contributions* pp. 180 – 271

PS1 pp. 180 – 211

PS2 pp. 212 – 245

PS3 pp. 246 – 267

*Authors' naming list* pp. 268 - 274

# Property Calculation Libraries and Software for Working Fluids in Energy Conversion Processes

H.-J. Kretzschmar<sup>1\*</sup>, Matthias Kunick<sup>2</sup>, Sebastian Herrmann<sup>2</sup>, Martin Suender<sup>2</sup>

<sup>1</sup> KCE-ThermoFluidProperties, Amberg, (Germany)

<sup>2</sup> Faculty of Mechanical Engineering, Zittau/Goerlitz University of Applied Sciences, Zittau (Germany)

<sup>3</sup> \*Corresponding Author: kretzschmar@thermofluidprop.com

The program libraries for calculating thermophysical properties of water and steam, mixtures with water and steam, and other working fluids are designed for practical use by engineers calculating heat cycles, steam or gas turbines, boilers, heat pumps, refrigerators and other energy conversion processes. Thermodynamic properties, transport properties, thermodynamic derivatives and inverse functions can be calculated.

The following property libraries are presented:

*LibIF97* for water and steam, *LibIF97-META* for metastable steam, *LibICE* for ice, *LibSeaWa* for seawater, *LibHuGas* for humid combustion-gas mixtures also at high pressures, *LibHuAir* for humid air also at high pressures and with high water content, *LibAmWa* for ammonia/water mixtures in absorption processes, *LibWaLi* for water/lithium bromide mixtures in absorption processes, *LibIdGasMix* for 25 ideal gases and their mixtures, *LibRealAir* for real dry air, *LibCO2* for carbon dioxide including dry ice, *LibNH3* for ammonia, *LibPropane* for propane, *LibButane\_Iso* and *LibButane\_n* for iso-butane and n-butane, *LibD4*, *LibD5*, *LibD6*, *LibMDM*, *LibMD2M*, *LibMD3M*, *LibMD4M*, and *LibMM* for siloxanes used in ORC processes, *LibCH3OH* for methanol, *LibC2H5OH* for ethanol, *LibH2* for hydrogen, *LibN2* for nitrogen, *LibHe* for helium, and *LibSecRef* for liquid coolants.

In addition, property libraries for a number of refrigerants and hydrocarbons are available.

These libraries contain accurate and fast algorithms currently available for calculating thermodynamic and transport properties.

For extremely fast property computations in CFD or simulations of transient processes, property libraries that use the Spline-Based Table Look-up method (SBTL) are available.

The property libraries can be used in user-specific programs written in Fortran, C/C++, C#, Java, Python, Visual Basic or other programming languages on Windows, Linux or Mac OS.

In addition, add-ons for the use of these property libraries in Excel, MATLAB and Simulink, Mathcad, Engineering Equation Solver (EES), Dymola and SimulationX (Modelica), and LabVIEW are available.