KCE ThermoFluidProperties

Hochschule Zittau/Görlitz
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Calculation of the Thermodynamic Properties
for Working Fluids in Simulations of Power Engineering Processes
Properties Calculation Libraries

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Steam, Water, and Ice

Library LibIF97
- Industrial Formulation IAPWS-IF97 (Revision 2007)
- Supplementary Standards IAPWS-IF97-S01, -S03ref, -S04, -S05
- IAPWS Revised Advisory Note No. 3 on Thermodynamic Derivatives (2008)

Library LibIF97_META
Industrial Formulation IAPWS-IF97 (Revision 2007) for metastable steam

Library LibICE
- Ice from IAPWS-06
- Melting line and sublimation line from IAPWS-08
- Water from IAPWS-IF97
- Steam from IAPWS-95 and IAPWS-IF97

Humid Combustion Gas Mixtures

Library LibHuGas
Model: Ideal mixture of the real fluids:
CO_2 - Span and Wagner (1994)
O_2 - Schmidt and Wagner (1995)
H_2O - IAPWS-95
Ar - Tegeler et al. (1999)
N_2 - Span et. al. (2000)
and of the ideal gases:
SO_2, CO, Ne (Bücker et al., 2003)
Consideration of:
- Condensation of steam
- Dissociation and Poynting effect

Library LibIdGasMix
Model: Ideal gas mixture of 25 ideal gases from VDI-Guideline 4670 (2003)

Humid Air

Library LibHuAir
Model: Ideal mixture of the real fluids:
- Dry air from Lemmon et al. (2000)
- Steam, water, and ice from IAPWS-IF97 and IAPWS-06

Consideration of:
- Condensation and freezing of steam
- Dissociation from the VDI-Guideline 4670 (2003)
- Poynting effect from ASHRAE RP-1485

Library ASHRAE LibHuAirProp
Model: Virial equation from ASHRAE Report RP-1485 for real mixture of the real fluids dry air and steam.

Extremely Fast Property Calculations Using the Spline-Based Table Look-up Method (SBTL)

Library LibSBTL_IF97
Library LibSBTL_95
Library LibSBTL_HuAir

For steam, water, humid air, carbon dioxide and other fluids and mixtures according IAPWS Guideline 2015 for Computational Fluid Dynamics (CFD), real-time and non-stationary simulations

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Carbon Dioxide Including Dry Ice
Library LibCO2
Formulation of Span and Wagner (1994)

Ammonia/Water - Mixtures
Library LibAmWa
IAPWS Guideline 2001 of Tillner-Roth and Friend (1998)

Water/Lithium Bromide - Mixtures
Library LibWaLi
Formulation of Kim and Infante Ferreira (2004)

Dry Air Including Liquid State
Library LibRealAir
Formulation of Lemmon et al. (2000)

Seawater
Library LibSeaWa
IAPWS Industrial Formulation (2013)

Ammonia
Library LibNH3
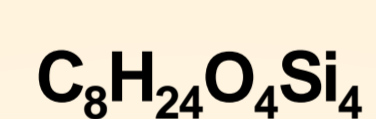Formulation of Tillner-Roth et al. (1993)

Hydrogen
Library LibH2
Formulation of Leachman et al. (2009)

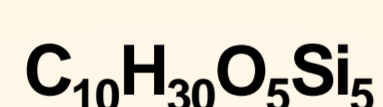## Nitrogen and Oxygen
Libraries LibN2 and LibO2
Formulations of Span et al. (2000) and Schmidt and Wagner (1985)

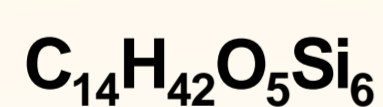
Siloxanes as ORC Working Fluids

$C_8H_{24}O_4Si_4$
Octamethylcyclotetrasiloxane
Library LibD4

$C_{10}H_{30}O_5Si_5$
Decamethylcyclopentasiloxane
Library LibD5

$C_{14}H_{42}O_5Si_6$
Tetradecamethylhexasiloxane
Library LibMD4M
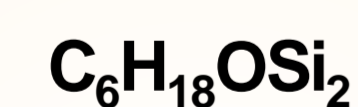
$C_6H_{18}OSi_2$
Hexamethyldisiloxane
Library LibMM

Formulation of Colonna et al. (2006)
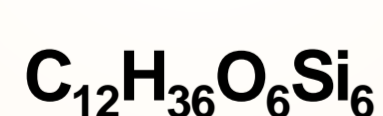
$C_{12}H_{36}O_6Si_6$
Dodecamethylcyclohexasiloxane
Library LibD6
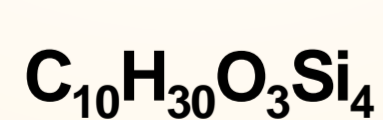
$C_{10}H_{30}O_3Si_4$
Decamethyltetrasiloxane
Library LibMD2M
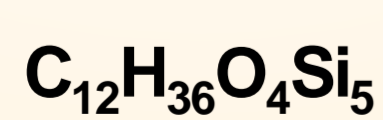
$C_{12}H_{36}O_4Si_5$
Dodecamethylpentasiloxane
Library LibMD3M
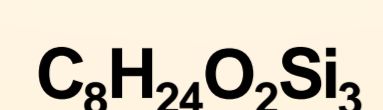
$C_8H_{24}O_2Si_3$
Octamethyltrisiloxane
Library LibMDM

Formulation of Colonna et al. (2008)

R134a
Library LibR134a
Formulation of Tillner-Roth and Baehr (1994)

Iso-Butane
Library LibButane_Iso
Formulation of Bücker and Wagner (2006)

Liquid Coolants
Library LibSecRef
Liquid solutions of water with
$C_2H_6O_2$ — Ethylene glycol
$C_3H_8O_2$ — Propylene glycol
C_2H_5OH — Ethanol
CH_3OH — Methanol
$C_3H_8O_3$ — Glycerol
K_2CO_3 — Potassium carbonate
$CaCl_2$ — Calcium chloride
$MgCl_2$ — Magnesium chloride
NaCl — Sodium chloride
$C_2H_3KO_2$ — Potassium acetate
$CHKO_2$ — Potassium formate
LiCl — Lithium chloride
NH_3 — Ammonia
Formulation of the International Institute of Refrigeration (IIR 2010)

Propane
Library LibPropane
Formulation of Lemmon et al. (2009)

n-Butane
Library LibButane_n
Formulation of Bücker and Wagner (2006)

Ethanol
Library LibC2H5OH
Formulation of Schroeder et al. (2012)

Methanol
Library LibCH3OH
Formulation of de Reuck and Craven (1993)

Helium
Library LibHe
Formulation of Arp et al. (1998)

Hydrocarbons
$C_{10}H_{22}$ Decane
Library LibC10H22
C_5H_{12} Iso-Pentane
Library LibC5H12_ISO
C_5H_{12} Neo-Pentane
Library LibC5H12_NEO
C_5H_{14} Iso-Hexane
Library LibC5H14
C_7H_8 Toluene
Library LibC7H8
Formulation of Lemmon and Span (2006)

Other Fluids
CO Carbon monoxide
Library LibCO
COS Carbonyl sulfide
Library LibCOS
H_2S Hydrogen sulfide
Library LibH2S
N_2O Dinitrogen monoxide
Library LibN2O
SO_2 Sulfur dioxide
Library LibSO2
C_3H_6O Acetone
Library LibC3H6O
Formulation of Lemmon and Span (2006)