Sorption Properties Library (SorpPropLib)

Manual

Summary

Sorption equilibrium data are fundamental to design and develop sorption systems. Currently, some databases exist which contain experimental equilibrium data, e.g., Springer Materials, NIST, Dortmund Data Bank. However, no open-source database exists containing both experimental sorption equilibrium data as well as generalized equilibrium models and the associated coefficients of sorption working pairs.

Here, the sorption property library – SorpPropLib – comes in. SorpPropLib contains generalized equilibrium models, associated coefficients of adsorption and absorption working pairs, and experimentally measured equilibrium data. The working principle of SorpPropLib is explained below.

Working principle of SorpPropLib

The equilibrium models are implemented in *C*, and the coefficients and experimental data are stored text-based in a *JSON database*. First, a sorption work pair object is initialized by specifying a sorption work pair, including the equilibrium and refrigerant model. Then, the user can calculate various sorption equilibrium data using the sorption working pair object. The schematic of the working principle is shown below.

Integration of SorpPropLib into other programming environments

SorpPropLib can currently be used from 6 programming environments besides the programming language *C*: *C++*, *Python*, *Matlab*, *Modelica*, *LabVIEW*, and *Excel*. For this purpose, SorpPropLib is compiled as a dynamic link library (DLL) and integrated into the programming environments via wrapper functions. In addition, some of the programming environments (e.g., *Python*) contain functions for visualizing equilibrium data and creating or reading out the *JSON database*. The scheme of integrating SorpPropLib into other programming environments is shown below.

Citing SorpPropLib

The SorpPropLib shall be cited via the following journal article:

Yang, Zhiyao; Gluesenkamp, Kyle R.; Frazzica, Andrea (2021): Equilibrium vapor pressure properties for absorbent and adsorbent materials. In: *International Journal of Refrigeration* 124, pp. 134-166. DOI: 10.1016/j.ijrefrig.2020.12.013.

Furthermore, the following conference paper shall be cited when using the *JSON database*, *C* code, or an interface to the programming environments mentioned before:

Engelpracht, M.; Yang, Z.; Gluesenkamp, K. R.; Turnaoglu, T.; Seiler, J.; Bardow, A. (2020): SorpPropLib: An Open-Source Database for Sorption Equilibrium Properties. In: *ISHPC 2021 proceedings - online pre-conference 2020*, pp. 33-36. International Sorption Heat Pump Conference. Berlin, Germany.

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1 Usage of SorpPropLib

SorpPropLib is currently applicable in 6 programming environments: *C/C++*, *Python*, *Matlab*, *Modelica*, *LabVIEW*, and *Excel*. The application of SorpPropLib in the programming environments is briefly explained below.

1.1 *C/C++* and compiling DLL

The *C* code is in the folder "SorpPropLib\c_code\". Examples of using the *C* code are in the folder "SorpPropLib\c_code\src\", with file names beginning with "test_".

Since the equilibrium models are implemented in *C*, either the *C* code (see examples) or a pre-compiled DLL (see example "test_workingPair_DLL.c") can be used directly. The pre-compiled DLLs are in the folder "SorpPropLib\c_code\lib\". Currently, DLLs are pre-compiled for the following systems/architectures: Windows 32bit, Windows 64bit, and Linux Centos 64bit. If the pre-compiled DLLs are not sufficient, makefiles are available for (1) the *C* compiler from Microsoft Visual Studios and (2) the *C* compiler from MinGW or GNU to compile user-specific DLLs. The makefiles are to be used as follows:

1. <u>Makefile for Microsoft Visual Studios:</u>
   a) Replace the contents of the file "makefile" in the folder "SorpPropLib\c_code\" with the contents of the file "makefile_MSVS"
   b) Make sure that the variable "BUILD_RELEASE" in the "makefile" file is set to "YES"
   c) Open the developer prompt for Microsoft Visual Studios
   d) Set the correct architecture (32bit or 64bit) by running the appropriate bat file (see the comment at the beginning of the makefile)
   e) Navigate to the folder "SorpPropLib\c_code\"
   f) Compile the DLL by executing the command "NMAKE all /C" (if all files are to be rebuilt, use the command "NMAKE all /A /C")
   g) The DLL is saved in the folder "SorpPropLib\c_code\lib\"
2. <u>Makefile for MinGW / GNU:</u>
   a) Replace the content of the file "makefile" in the folder "SorpPropLib\c_code\" with the content of the file "makefile_MINGW"

b) Make sure that the variable "BUILD_RELEASE" is set to "YES" and the variable "TYPE_SYSTEM" is set according to the system

c) Open the command prompt under Windows or the console under Linux

d) Navigate to the folder "SorpPropLib\c_code\"

e) Copy the path to the file "mingw32-make.exe", which corresponds to the required architecture (32bit or 64bit):

   i. Example for 32bit: "C:\MinGW32bit\bin\mingw32-make.exe"

   ii. Example for 64bit: "C:\MinGW64bit\bin\mingw32-make.exe"

f) Compile the DLL by executing the command"'path to correct make.exe' all" (if all files are to be rebuilt, use the command"'path to correct make.exe' all -B")

g) The DLL is saved in the folder "SorpPropLib\c_code\lib\"

1.2 *Python*

The *Python* interface is in the folder "SorpPropLib\textbackslash python_wrapper\". The required (pre)compiled DLL is to be stored in "SorpPropLib\python_wrapper\sorpproplib\data". Examples for using the *Python* interface are in the folder "SorpPropLib\python_wrapper\", with file names starting with "example_":

- example_generate_json_file: Generates the JSON database from CSV files in UTF8 format (see chapter Extension)
- example_generate_content_list: Generates Excel files in the folder "SorpPropLib" containing all implemented equilibrium approaches for absorption and adsorption work pairs as well as all implemented refrigerant functions
- example_generate_manual: Automatically generates LaTeX files in the folder "SorpPropLib\python_wrapper\sorpproplib\doc\" to compile the manual
- example_calling_DLL: Demonstrates all wrapper functions available in *Python*
- example_generate_plots: Demonstrates all implemented functions for visualizing equilibrium data

The example files can be executed directly with *Python* because the paths to the DLL and the JSON database are stored as relative paths in the example files.

1.3 *Matlab*

The *Matlab* interface is in the folder "SorpPropLib\matlab_wrapper\". The required (pre)compiled DLL and the JSON database are to be stored in "SorpPropLib\matlab_wrapper\data". Examples for using the *Matlab* interface are in the folder "SorpPropLib\matlab_wrapper\", where the file names start with "minimal_example_":

- minimal_example_absorption_activity: Demonstrates all available equilibrium functions of absorption work pairs based on activity coefficients (e.g., Wilson)
- minimal_example_absorption_conventional: Demonstrates all available equilibrium functions of absorption work pairs based on conventional approaches (e.g., Antoine or Duehring)
- minimum_example_absorption_mixing: Demonstrates all available equilibrium functions of absorption work pairs based on mixing rules of cubic equations of state
- minimum_example_adsorption_surface: Demonstrates all available equilibrium functions of adsorption work pairs based on the surface approach (e.g., Toth)
- minimal_example_adsorption_surface_vapor: Demonstrates all available equilibrium functions of adsorption working pairs based on the surface approach and using the vapor pressure as an additional function argument (e.g., Freundlich)
- minimal_example_adsorption_volumetric: Demonstrates all available equilibrium functions of adsorption working pairs based on the volumetric approach and using the vapor pressure and density of the adsorpt as additional function arguments (e.g., Dubinin-Astakhov)

The example files can be executed directly with *Matlab* since the paths to the DLL and the JSON database are stored as relative paths in the example files.

1.4 *Modelica*

The *Modelica* interface is in the folder "SorpProp-Lib\modelica_wrapper\SorpPropLib\". The required (pre)compiled DLL and the JSON database are to be stored under "SorpPropLib\modelica_wrapper\SorpPropLib\Resoureces\Library" and "SorpPropLib\modelica_wrapper\SorpPropLib\Resoureces\Data" respectively. Examples for using the *Modelica* interface can be found in the *Modelica* library in the packages "SorpPropLib.DirectFunctionCals.Tester" or "SorpPropLib.WorkingPair.Tester":

- Test_WPair_refrigerant: Demonstrates all available refrigerant functions
- Test_WPair_absorption_activity: Demonstrates all available equilibrium functions of absorption working pairs based on activity coefficients (e.g., Wilson)
- Test_WPair_absorption_conventional: Demonstrates all available equilibrium functions of absorption work pairs based on conventional approaches (e.g., Antoine or Duehring)
- Test_WPair_absorption_mixing: Demonstrates all available equilibrium functions of absorption working pairs based on mixing rules of cubic equations of state

- Test_WPair_adsorption_surface: Demonstrates all available equilibrium functions of adsorption work pairs starting based on the surface approach (e.g., Toth)
- Test_WPair_adsorption_surface_vapor: Demonstrates all available equilibrium functions of adsorption working pairs based on the surface approach and using the vapor pressure as an additional function argument (e.g., Freundlich)
- Test_WPair_adsorption_volumetric: Demonstrates all available equilibrium functions of adsorption working pairs based on the volumetric approach and using the vapor pressure and density of the adsorpt as additional function arguments (e.g., Dubinin-Astakhov)

The example files cannot be executed directly in *Modelica* because the path to the JSON database is not specified as a relative path. Therefore, the variable "path_db" must be adjusted to execute the sample files.

1.5 *LabVIEW*

The *LabVIEW* interface is in the folder "SorpPropLib\labview_wrapper\". The required (pre)compiled DLL and the JSON database are to be saved under "SorpPropLib\labview_wrapper\data". Examples for using the *LabVIEW* interface can be found in the *LabVIEW* project under "SorpPropLib.Examples" or under "SorpPropLib.Sub-libraries.direct_call.Examples" and "SorpPropLib.Sub-libraries.struct_call.Examples":

- plot_isosteric_chart: Demonstrates how to plot equilibrium data in an isosteric chart.
- Test_abs_activity: Demonstrates all available equilibrium functions of absorption work pairs based on activity coefficients (e.g., Wilson)
- Test_abs_conventional: Demonstrates all available equilibrium functions of absorption work pairs based on conventional approaches (e.g., Antoine or Duehring)
- Test_abs_mixing: Demonstrates all available equilibrium functions of absorption working pairs based on mixing rules of cubic equations of state
- Test_ads_surface: Demonstrates all available equilibrium functions of adsorption work pairs starting based on the surface approach (e.g., Toth)
- Test_ads_surface_vapor: Demonstrates all available equilibrium functions of adsorption working pairs based on the surface approach and using the vapor pressure as an additional function argument (e.g., Freundlich)
- Test_ads_volumetric: Demonstrates all available equilibrium functions of adsorption working pairs based on the volumetric approach and using the vapor pressure and density of the adsorpt as additional function arguments (e.g., Dubinin-Astakhov)

The example files cannot be executed directly in *LabVIEW* because the path to the JSON database is not specified as a relative path. Therefore, the variable "path_db" must be adjusted to execute the example files.

1.6 *Excel*

The *Excel* interface is in the folder "SorpPropLib\excel_wrapper\". The required (pre)compiled DLL and the JSON database are to be stored under "SorpPropLib\excel_wrapper\data". Examples for using the *Excel* interface can be found in the folder "SorpPropLib\excel_wrapper\", where the file names start with "minimal_example_":

- minimal_example_dll_functions: Demonstrates all wrapper functions that are available in *Excel*
- minimal_example_isosteric_chart_adsorption: Demonstrates how to visualize adsorption equilibrium data in an isosteric chart

The sample files cannot be executed directly in *Excel* because the path to the DLL cannot be specified as a relative path but must be hardcoded. Therefore, the path to the DLL must be corrected before executing the *Excel* files:

1. Open the file "DirectFunctionCalls.bas" in the folder "SorpPropLib\excel_wrapper\vba\", for example, with Notepad
2. Search and replace all "lib 'Path to DLL'" with "lib 'Corrected path to DLL'"
3. Open an *Excel* example and allow macros
4. If developer tools are not yet activated in *Excel*, activate them under File -> Options -> Customize ribbon -> Check developer tools
5. Open the application "Visual Basic" under Developer tools
6. Delete module "DirectFunctionCalls" and add adapted module "DirectFunctionCalls", which contains the correct path to DLL
7. Recalculate a formula in *Excel* so that all functions are updated

1.7 Known problems

The following problems are currently known:

1. *Excel* wrapper is currently just working with *Excel 2016* and not with *Excel 365*
2. When running wrapper functions that rely on the approach 'direct function calls' (e.g., all wrapper functions in *Excel*), RAM is only freed when the programming environment is closed and not when the calculation is finished. However, the error does not occur in the testers of the *C* code. In addition, the error does

not occur when wrapper functions based on the approach ‘working pair struct’ (i.e., mainly used in all examples) are executed.

3. Some implemented fits represent the experimental data very poorly:
   a) This happens mainly for absorption work pairs based on activity coefficients.
   b) Since all implemented equations have been checked several times and for each equilibrium approach there are fits for work pairs that reproduce experimental data very well, the error is suspected to be in the parameterization
   c) Tip: Check the quality of the equilibrium approach before use, e.g., with this manual

2 Extension of SorpPropLib

Three cases can be distinguished to extend SorpPropLib with new (equilibrium) data:

1. (Equilibrium) model is already implemented in SorpPropLib.
2. (Equilibrium) model is not yet implemented in SorpPropLib, but the type of the equilibrium model (e.g., adsorption→equilibrium approach based on the volumetric approach, or absorption→equilibrium approach based on activity coefficients) is implemented in SorpPropLib.
3. (Equilibrium) model and type of equilibrium model are not yet implemented in SorpPropLib.

The necessary procedure for the three cases is explained below.

2.1 Case 1 – (Equilibrium) model implemented in SorpPropLib

If the (equilibrium) model already exists in SorpPropLib, the following steps are necessary to add (equilibrium) data:

1. Add the coefficients of the (equilibrium) model and all other necessary data to the correct *Excel* file in the folder "SorpPropLib\python_wrapper\sorpproplib\data\JSON\equation_coefficients\xlsx\":
   a) Colour code: Black - check OK; Red - No experimental data available to check; Orange - Fit does not match experimental data well
   b) Save the *Excel* file as a CSV file in UTF8 format under "SorpPropLib\python_wrapper\sorpproplib\data\JSON\equation_coefficients\"
2. If available, add experimental data points and other necessary data to the correct *Excel* files under "SorpPropLib\python_wrapper\sorpproplib\data\JSON\experimental_data\abs\xlsx\" or "SorpPropLib\python_wrapper\sorpproplib\data\JSON\experimental_data\abs\xlsx\" and also save it as a CSV file in UTF8 format under "SorpPropLib\python_wrapper\sorpproplib\data\JSON\experimental_data\abs\" or "SorpPropLib\python_wrapper\sorpproplib\data\JSON\experimental_data\abs\" respectively
3. Execute the Python files "example_generate_json_file", "example_generate_content_list", and "example_generate_manual" to update the JSON database and the content lists
4. Update the manual by compiling the LaTeX file "manual.tex" in the folder "SorpPropLob\python_wrapper\sorpproplib\doc"

2.2 Case 2 - Type of (equilibrium) model implemented in SorpPropLib

If the type of (equilibrium) model already exists in SorpPropLib, but not the required (equilibrium) model, the following steps are necessary to add (equilibrium) data:

1. Implement the (equilibrium) model and all associated inverses / partial derivatives in C (compare equilibrium models of the same type for further information):
   a) Insert the header file, including documentation, in the folder "SorpPropLib\c_code\incl\"
   b) Insert the source file, including documentation, in the folder "SorpPropLib\c_code\src",
   c) Insert the source file, including the tester documentation used to test and verify all implementations, in the folder "SorpPropLib\c_code\src\"
2. Add the new (equilibrium) model (i.e., all inverses, partial derivatives, ...) to the initialization functions of the refrigerant, adsorption, or absorption struct:
   a) Refrigerant: The initialization has to be adapted via the function "newRefrigerant" in the file "SorpPropLib\c_code\src\refrigerant.c"
   b) Adsorption: The initialization has to be adapted via the function "newAdsorption" in the file "SorpPropLib\c_code\src\sorption.c"
   c) Absorption: The initialization has to be adapted via the function "newAbsorption" in the file "SorpPropLib\c_code\src\absorption.c"
3. Extend the test models of the refrigerant-, adsorption- or absorption-struct as well as the workingPair-structs with the new (equilibrium) model
   a) Refrigerant: The file "SorpPropLib\c_code\src\test_refrigerant.c" has to be extended by the new model
   b) Adsorption: The file "SorpPropLib\c_code\src\test_adsorption.c" has to be extended by the new model
   c) Absorption: The file "SorpPropLib\c_code\src\test_absorption.c" shall be extended by the new model
   d) Working pair: The files "test_workingPair.c", "test_workingPair_staticLibrary.c", and "test_workingPair_DLL.c" in the folder "SorpPropLib\c_code\src\" have to be extended with the new model
4. Adapt the makefiles to execute the C-code:
   a) Add the path to the source file of the new (equilibrium) model to the variable "SOURCE_LIB".
   b) Add the test file of the new (equilibrium) model to the recipes "test_refrigerants", "test_adsorption", or "test_absorption".

   c) Add a recipe for the test file

5. Execute steps 1)-2) of case 1
6. Add the LaTeX code of the new (equilibrium) model to the Python file "SorpPropLib\python_wrapper\sorpproplib\doc\equation.py" and to the LaTeX file "SorpPropLib\python_wrapper\sorpproplib\doc\chapter\approaches.tex
7. Execute steps 3)-4) of case 1

2.3 Case 3 - Type of (equilibrium) model not implemented in SorpPropLib

If neither the (equilibrium) model nor the type of (equilibrium) model exists in SorpPropLib, the following steps are necessary to add (equilibrium) data:

1. Execute step 1) of case 2
2. Execute step 2) of case 2:
   a) If necessary, new function prototypes for the general functions of adsorption working pairs have to be added to the file “SorpPropLib\c_code\src\structDefinitions.c”
   b) Add new low-level functions to directly execute the new equilibrium functions in the file "SorpPropLib\c_code\src\workingPair.c" and all wrappers
3. Execute steps 3) - 7) of case 2

3 Approaches implemented into SorpPropLib

Currently, various generalized equilibrium approaches have been implemented for absorption and adsorption working pairs as well as for the vapor pressure and saturated liquid density of refrigerants. Details of the implemented functions are presented below.

3.1 Refrigerants - Vapour Pressure

Currently, 5 approaches are implemented in SorpPropLib to calculate vapor pressure p_{sat} in Pa as a function of temperature T in K. In addition, the partial derivatives according to the temperature as well as the inverses of the approaches are implemented in SorpPropLib. Details of the approaches are presented below.

3.1.1 VaporPressure_EoS1

The vapor pressure p_{sat} is calculted by:

$$
\begin{aligned}
p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\
\xi &= 1 - \theta && \text{, and} \\
\theta &= {}^{T}/_{T_{\text{crit}}} && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
T_{crit}	K	p_{ref}	Pa	a_1	-	b_1	-
a_2	-	b_2	-	a_3	-	b_3	-
a_4	-	b_4	-	a_5	-	b_5	-
a_6	-	b_6	-	a_7	-	b_7	-

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$T(p_{\text{sat}})$	K	Uses Newton-Raphson method (start: 253.15 K)

Function	Unit	Implementation
$\frac{\partial p_{\mathrm{sat}}(T)}{\partial T}$	$\mathrm{Pa\,K^{-1}}$	Analytical function

3.1.2 VaporPressure_EoS2

The vapor pressure p_{sat} is calculted by:

$$\begin{aligned} p_{\mathrm{sat}} &= p_{\mathrm{ref}} \exp\left({}^{a_0}/_{\theta} + \sum_{i=1}^{4} a_i \theta^{b_i} + a_5 \xi^{b_5} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\mathrm{crit}}} && . \end{aligned}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
T_{crit}	K	p_{ref}	Pa	a_0	-	a_1	-
b_1	-	a_2	-	b_2	-	a_3	-
b_3	-	a_4	-	b_4	-	a_5	-
b_5	-						

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$T(p_{\mathrm{sat}})$	K	Uses Newton-Raphson method (start: 313.15 K)
$\frac{\partial p_{\mathrm{sat}}(T)}{\partial T}$	$\mathrm{Pa\,K^{-1}}$	Analytical function

3.1.3 VaporPressure_EoS3

The vapor pressure p_{sat} is calculted by:

$$\begin{aligned} p_{\mathrm{sat}} &= p_{\mathrm{ref}} \exp\left({}^{a_0}/_{T} + \sum_{i=1}^{2} a_i T^{b_i} + a_3 \xi^{b_3} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\mathrm{crit}}} && . \end{aligned}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
T_{crit}	K	p_{ref}	Pa	a_0	-	a_1	-
b_1	-	a_2	-	b_2	-	a_3	-
b_3	-						

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$T(p_{\text{sat}})$	K	Uses Newton-Raphson method (start: 253.15 K)
$\frac{\partial p_{\text{sat}}(T)}{\partial T}$	$\text{Pa}\,\text{K}^{-1}$	Analytical function

3.1.4 VaporPressure_Antoine

The vapor pressure p_{sat} is calculted by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value
a	-	b	K	c	K

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$T(p_{\text{sat}})$	K	Analytical function
$\frac{\partial p_{\text{sat}}(T)}{\partial T}$	$\text{Pa}\,\text{K}^{-1}$	Analytical function

3.1.5 VaporPressure_EoSCubic

When using the Soave-Redlich-Kwong equation of state with custom equation for α (EoS = -10), the vapor pressure p_{sat} is calculted by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \beta_0 + \sum_{i=1}^{3}\beta_i\theta^i && \text{, and} \\
\theta &= {}^{T_{\text{crit}}}/_{T} - {}^{T}/_{T_{\text{crit}}} && .
\end{aligned}
$$

When using the Soave-Redlich-Kwong equation of state (EoS = -5), the vapor pressure p_{sat} is calculted by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{({}^{T}/_{T_{\text{crit}}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

When using the Peng-Robinson equation of state with custom equation for α (EoS = 5), the vapor pressure p_{sat} is calculted by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)+b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \beta_0 + \sum_{i=1}^{3}\beta_i\theta^i && \text{, and} \\
\theta &= {}^{T_{\text{crit}}}/_{T} - {}^{T}/_{T_{\text{crit}}} && .
\end{aligned}
$$

When using the Peng-Robinson equation of state (EoS = 10), the vapor pressure p_{sat} is calculted by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

When using the Peng-Robinson-Stryjek-Vera equation of state (EoS = 20), the vapor pressure p_{sat} is calculted by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= \kappa_0 + \kappa_1\left(1 + \sqrt{(T/T_{\text{crit}})}\right)(0.7 - T/T_{\text{crit}}) && \text{, and} \\
\kappa_0 &= 0.378893 + 1.4897153\omega - 0.17131848\omega^2 + 0.0196554\omega^3 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	**Unit**	**Par.**	**Unit.**	**Par.**	**Value**	**Par.**	**Value**
EoS	-	T_{crit}	K	p_{crit}	Pa	ω	-
κ_1	-	β_0	-	β_1	-	β_2	-
β_3	-						

Implemented inverse functions and partial derivatives are:

Function	**Unit**	**Implementation**
$T(p_{\text{sat}})$	K	Uses Newton-Raphson method (start value calculated)
$\frac{\partial p_{\text{sat}}(T)}{\partial T}$	$\text{Pa}\,\text{K}^{-1}$	Uses two-point numerical differentiation

3.2 Refrigerants - Saturated liquid density

Currently, 1 approach is implemented in SorpPropLib to calculate saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ as a function of temperature T in K. In addition, the partial derivatives according to the temperature is implemented in SorpPropLib. Details of the approach are presented below.

3.2.1 SaturatedLiquidDensity_EoS1

The saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ is calculated by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
flag	-	T_{crit}	K	ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	a_1	-
b_1	-	a_2	-	b_2	-	a_3	-
b_3	-	a_4	-	b_4	-	a_5	-
b_5	-	a_6	-	b_6	-	a_7	-
b_7	-	a_8	-	b_8	-		-

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$\frac{\partial \rho_{\text{sat}}^{\text{liq}}(T)}{\partial T}$	$\text{kg}\,\text{m}^{-3}\,\text{K}^{-1}$	Analytical function

3.3 Absorption - Conventional

Currently, 2 approaches are implemented in SorpPropLib for conventional absorption working pairs to calculate equilibrium pressure p in Pa as a function of temperature T in K and concentration X in $\text{kg}\,\text{kg}^{-1}$. In addition, partial derivatives according

to the temperature and concentration as well as the inverses of the approaches are implemented in SorpPropLib. Details of the approaches are presented below.

3.3.1 Antoine

The equilibrium pressure p is calculated by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
c	K	d	Pa	A_0	-	B_0	K
A_1	-	A_2	-	A_3	-	A_4	-
B_1	K	B_2	K	B_3	K	B_4	K

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$X(p,T)$	$\mathrm{kg\,kg^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{kg\,kg^{-1}}$)
$T(p,X)$	K	Uses Newton-Raphson method (start: 353.15 K)
$\frac{\partial p(X,T)}{\partial T}$	$\mathrm{Pa\,K^{-1}}$	Analytical function
$\frac{\partial p(X,T)}{\partial X}$	$\mathrm{Pa\,kg\,K^{-1}\,kg^{-1}}$	Analytical function
$\frac{\partial X(p,T)}{\partial p}$	$\mathrm{kg\,Pa^{-1}\,kg^{-1}}$	Uses two-point numerical differentiation
$\frac{\partial X(p,T)}{\partial T}$	$\mathrm{kg\,K^{-1}\,kg^{-1}}$	Uses two-point numerical differentiation

3.3.2 Dühring

The equilibrium pressure p is calculated by:

$$\begin{aligned}
p &= {}^{1}/_{r} 10^{C + \frac{D}{T_{\mathrm{ref}}} + \frac{E}{T_{\mathrm{ref}}^2}} && \text{, and} \\
T_{\mathrm{ref}} &= q + \frac{(nT + m - B)}{A} && \text{, and} \\
A &= \sum_{i=0}^{3} a_0 X_{\mathrm{cor}}^i && \text{, and} \\
B &= \sum_{i=0}^{3} b_0 X_{\mathrm{cor}}^i && \text{, and} \\
X_{\mathrm{cor}} &= 100X && .
\end{aligned}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
a_0	-	a_1	-	a_2	-	a_3	-
b_0	-	b_1	-	b_2	-	b_3	-
C	-	m	-	n	-	r	Pa^{-1}
D	K	E	K^2	q	-		

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$X(p,T)$	$\mathrm{kg\,kg^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{kg\,kg^{-1}}$)
$T(p,X)$	K	Analytical function
$\frac{\partial p(X,T)}{\partial T}$	$\mathrm{Pa\,K^{-1}}$	Analytical function
$\frac{\partial p(X,T)}{\partial X}$	$\mathrm{Pa\,kg\,K^{-1}\,kg^{-1}}$	Analytical function
$\frac{\partial X(p,T)}{\partial p}$	$\mathrm{kg\,Pa^{-1}\,kg^{-1}}$	Uses two-point numerical differentiation
$\frac{\partial X(p,T)}{\partial T}$	$\mathrm{kg\,K^{-1}\,kg^{-1}}$	Uses two-point numerical differentiation

3.4 Absorption - Activity

Currently, 10 approaches are implemented in SorpPropLib for absorption working pairs based on activity coefficients to calculate equilibrium pressure p in Pa as a function of temperature T in K, molar composition in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, and molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$. Details of the approaches are presented below.

3.4.1 WilsonFixedDl

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} {}^{v_2}/_{v_1}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right) & \text{if } \Lambda_{12}^*=0 \\ \Lambda_{12}^* & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} {}^{v_1}/_{v_2}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right) & \text{if } \Lambda_{21}^*=0 \\ \Lambda_{21}^* & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
Λ_{12}^*	-	Λ_{21}^*	-	$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$
v_1	$\mathrm{m^3\,mol^{-1}}$	v_2	$\mathrm{m^3\,mol^{-1}}$				

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{mol\,mol^{-1}}$)

3.4.2 WilsonTemperatureDl

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12}x_2\right) + x_2\left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12}x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21}x_1}\right)\right) && \text{, and}\\
\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\Delta\lambda_{12} &= R\left(\Delta\lambda_{12,\mathrm{c}} + \Delta\lambda_{12,\mathrm{t}}\left(T - c\right)\right) && \text{, and}\\
\Delta\lambda_{21} &= R\left(\Delta\lambda_{21,\mathrm{c}} + \Delta\lambda_{21,\mathrm{t}}\left(T - c\right)\right) && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
$\Delta\lambda_{12,\mathrm{c}}$	K	$\Delta\lambda_{21,\mathrm{c}}$	K	$\Delta\lambda_{12,\mathrm{t}}$	-	$\Delta\lambda_{12,\mathrm{t}}$	-
v_1	$\mathrm{m^3\,mol^{-1}}$	v_2	$\mathrm{m^3\,mol^{-1}}$	c	K		

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\text{sat},1}(T))$	$\text{mol}\,\text{mol}^{-1}$	Uses Newton-Raphson method (start: 0.5 $\text{mol}\,\text{mol}^{-1}$)

3.4.3 WangChao

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\text{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{21} x_2\right) + x_2\left(\frac{\Lambda_{21}}{x_1 + \Lambda_{21} x_2} - \frac{\Lambda_{12}}{x_1 \Lambda_{12} + x_2}\right) + \Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2 \Delta\lambda_{21} + x_2 x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1 + {}^{x_2}/_{x_1} \exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1 + {}^{x_1}/_{x_2} \exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21} \exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12} \exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1 - x_{22} && \text{, and}\\
x_{21} &= 1 - x_{11} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
$\Delta\lambda_{12}$	$\text{J}\,\text{mol}^{-1}$	$\Delta\lambda_{21}$	$\text{J}\,\text{mol}^{-1}$	v_1	$\text{m}^3\,\text{mol}^{-1}$	v_2	$\text{m}^3\,\text{mol}^{-1}$
z	-						

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\text{sat},1}(T))$	$\text{mol}\,\text{mol}^{-1}$	Uses Newton-Raphson method (start: 0.5 $\text{mol}\,\text{mol}^{-1}$)

3.4.4 TsubokaKatayama

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{21} x_2\right) + x_2 \left(\frac{\Lambda_{21}}{x_1 + \Lambda_{21} x_2} - \frac{\Lambda_{12}}{x_1 \Lambda_{12} + x_2}\right) + \Phi\right) && \text{, and} \\
\Phi &= \ln\left(x_1 + x_2 \rho_{21}\right) - x_2 \left(\frac{\rho_{21}}{x_1 + x_2 \rho_{21}} - \frac{\rho_{12}}{x_1 \rho_{12} + x_2}\right) && \text{, and} \\
\Lambda_{12} &= \rho_{21} \exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right) && \text{, and} \\
\Lambda_{21} &= \rho_{12} \exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right) && \text{, and} \\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and} \\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	**Unit**	**Par.**	**Unit.**	**Par.**	**Value**	**Par.**	**Value**
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	v_1	$\mathrm{m^3\,mol^{-1}}$	v_2	$\mathrm{m^3\,mol^{-1}}$

Implemented inverse functions and partial derivatives are:

Function	**Unit**	**Implementation**
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{mol\,mol^{-1}}$)

3.4.5 Heil

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	v_1	$\mathrm{m^3\,mol^{-1}}$	v_2	$\mathrm{m^3\,mol^{-1}}$

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p,T,v_1,v_2,p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{mol\,mol^{-1}}$)

3.4.6 FloryHuggins

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^{1}/_{r}\right)\Phi_2\right)+\left(1-{}^{1}/_{r}\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and}\\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and}\\
\Gamma &= {}^{w_0^*}/_{T}\left(1+{}^{w_1}/_{T}\right) && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value
r	-	w_0^*	K	w_1	K

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{mol\,mol^{-1}}$)

3.4.7 NrtlFixedDg

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1 + x_2 G_{21}}\right)^2 + \tau_{12}\frac{G_{12}}{(x_2 + x_1 G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
α_{12}	-	α_{21}	-	Δg_{12}	$\mathrm{J\,mol^{-1}}$	Δg_{21}	$\mathrm{J\,mol^{-1}}$

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{mol\,mol^{-1}}$)

3.4.8 NrtlTemperatureDg

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1 + x_2 G_{21}}\right)^2 + \tau_{12}\frac{G_{12}}{(x_2 + x_1 G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12} + b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21} + b_{21}T && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	**Unit**	**Par.**	**Unit.**	**Par.**	**Value**	**Par.**	**Value**
α_{12}	-	α_{21}	-	a_{12}	$\mathrm{J\,mol^{-1}}$	a_{21}	$\mathrm{J\,mol^{-1}}$
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$				

Implemented inverse functions and partial derivatives are:

Function	**Unit**	**Implementation**
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.5 $\mathrm{mol\,mol^{-1}}$)

3.4.9 UniquacFixedDu

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and} \\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and} \\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and} \\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and} \\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and} \\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	Δu_{21}	$\mathrm{J\,mol^{-1}}$	r_1	-	r_2	-
q_1	-	q_3	-	z	-		

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.6 $\mathrm{mol\,mol^{-1}}$)

3.4.10 UniquacTemperatureDu

The equilibrium pressure p is calculated by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par	Value	Par	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	a_{21}	$\mathrm{J\,mol^{-1}}$	b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$
r_1	-	r_2	-	q_1	-	q_2	-
z	-						

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$x_1(p, T, v_1, v_2, p_{\mathrm{sat},1}(T))$	$\mathrm{mol\,mol^{-1}}$	Uses Newton-Raphson method (start: 0.6 $\mathrm{mol\,mol^{-1}}$)

3.5 Absorption - Mixing

Currently, 3 approaches are implemented in SorpPropLib for absorption working pairs based on mixing rules to calculate equilibrium pressure p in Pa as a function of temperature T in K and molar composition in the liquid phase x in $\mathrm{mol\,mol^{-1}}$. Details of the approaches are presented below.

3.5.1 1pvdw

The equilibrium pressure p is calculated iteratively by applying the one-parameter van der Waals mixing rule (MIXING = -5) to cubic equations of state (see Section 3.1.5):

$$\begin{aligned} a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and} \\ b &= z_1 b_1 + z_2 b_2 && \text{, and} \\ a_{12} &= (a_1 a_2)^{0.5} (1 - k_{12}) && \text{, and} \\ z_j &= x_j \text{ or } y_j \text{ depending on phase} && . \end{aligned}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
EoS	-	Mix	-	$T_{\text{crit},1}$	K	$p_{\text{crit},1}$	Pa
ω_1	-	$\kappa_{1,1}$	-	$\beta_{0,1}$	-	$\beta_{1,1}$	-
$\beta_{2,1}$	-	$\beta_{3,1}$	-	$T_{\text{crit},2}$	K	$p_{\text{crit},2}$	Pa
ω_2	-	$\kappa_{1,2}$	-	$\beta_{0,2}$	-	$\beta_{1,2}$	-
$\beta_{2,2}$	-	$\beta_{3,2}$	-	k_{12}	-	m	-
l_{12}	-	l_{21}	-	t	-		

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$T(p, x_1)$	K	Uses Newton-Raphson method (start value calculated)
$x_1(p, T)$	K	Uses Newton-Raphson method (start: $x_1 = 0.25 \text{mol mol}^{-1}$, $y_1 = 0.99 \text{mol mol}^{-1}$)
$\frac{\partial p(T,x_1)}{\partial T}$	Pa K^{-1}	Uses two-point numerical differentiation
$\frac{\partial p(T,x_1)}{\partial x_1}$	Pa mol mol^{-1}	Uses two-point numerical differentiation

3.5.2 2pvdw

The equilibrium pressure p is calculated iteratively by applying the two-parameter van der Waals mixing rule (MIXING = 5) to cubic equations of state (see Section 3.1.5):

$$
\begin{aligned}
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and} \\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and} \\
a_{12} &= (a_1 a_2)^{0.5} (1 - k_{12}) && \text{, and} \\
b_{12} &= \frac{b_1 + b_2}{2} (1 - m) && \text{, and} \\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
EoS	-	Mix	-	$T_{\text{crit},1}$	K	$p_{\text{crit},1}$	Pa
ω_1	-	$\kappa_{1,1}$	-	$\beta_{0,1}$	-	$\beta_{1,1}$	-
$\beta_{2,1}$	-	$\beta_{3,1}$	-	$T_{\text{crit},2}$	K	$p_{\text{crit},2}$	Pa
ω_2	-	$\kappa_{1,2}$	-	$\beta_{0,2}$	-	$\beta_{1,2}$	-
$\beta_{2,2}$	-	$\beta_{3,2}$	-	k_{12}	-	m	-
l_{12}	-	l_{21}	-	t	-		

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$T(p, x_1)$	K	Uses Newton-Raphson method (start value calculated)
$x_1(p, T)$	K	Uses Newton-Raphson method (start: $x_1 = 0.25 \text{mol mol}^{-1}$, $y_1 = 0.99 \text{mol mol}^{-1}$)
$\frac{\partial p(T,x_1)}{\partial T}$	Pa K^{-1}	Uses two-point numerical differentiation
$\frac{\partial p(T,x_1)}{\partial x_1}$	Pa mol mol^{-1}	Uses two-point numerical differentiation

3.5.3 vdwb

The equilibrium pressure p is calculated iteratively by applying the modified van der Waals and Berthelot mixing rule (MIXING = 10) to cubic equations of state (see

Section 3.1.5):

$$
\begin{aligned}
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and} \\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and} \\
a_{12} &= (a_1 a_2)^{0.5} \left(1 + {}^{t}/_{T}\right) (1 - k_{12}) && \text{, and} \\
b_{12} &= \frac{b_1 + b_2}{2} (1 - m) && \text{, and} \\
k_{12} &= \frac{l_{12} l_{21} (z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and} \\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	**Unit**	**Par.**	**Unit.**	**Par.**	**Value**	**Par.**	**Value**
EoS	-	Mix	-	$T_{\text{crit},1}$	K	$p_{\text{crit},1}$	Pa
ω_1	-	$\kappa_{1,1}$	-	$\beta_{0,1}$	-	$\beta_{1,1}$	-
$\beta_{2,1}$	-	$\beta_{3,1}$	-	$T_{\text{crit},2}$	K	$p_{\text{crit},2}$	Pa
ω_2	-	$\kappa_{1,2}$	-	$\beta_{0,2}$	-	$\beta_{1,2}$	-
$\beta_{2,2}$	-	$\beta_{3,2}$	-	k_{12}	-	m	-
l_{12}	-	l_{21}	-	t	-		

Implemented inverse functions and partial derivatives are:

Function	**Unit**	**Implementation**
$T(p, x_1)$	K	Uses Newton-Raphson method (start value calculated)
$x_1(p, T)$	K	Uses Newton-Raphson method (start: $x_1 = 0.25\text{mol}\,\text{mol}^{-1}$, $y_1 = 0.99\text{mol}\,\text{mol}^{-1}$)
$\frac{\partial p(T,x_1)}{\partial T}$	$\text{Pa}\,\text{K}^{-1}$	Uses two-point numerical differentiation
$\frac{\partial p(T,x_1)}{\partial x_1}$	$\text{Pa}\,\text{mol}\,\text{mol}^{-1}$	Uses two-point numerical differentiation

3.6 Adsorption - Surface

Currently, 3 approaches are implemented in SorpPropLib for conventional adsorption working pairs based on the surface approach to calculate equilibrium pressure p in Pa as a function of temperature T in K and loading w in $\text{kg}\,\text{kg}^{-1}$. In addition, partial derivatives according to the temperature and concentration as well as the inverses of the approaches are implemented in SorpPropLib. Details of the approaches are presented below.

3.6.1 DualSiteSips

The loading w is calculated by:

$$w = \sum_{i=A}^{B} w_{\mathrm{i}} \frac{(b_i p)^{1/\eta_i}}{1 + (b_i p)^{1/\eta_i}} \quad \text{, and}$$

$$b_i = b_{i,0} \exp\left(\frac{Q_i}{RT}\left(1 - \frac{T}{T_0}\right)\right) \quad .$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
$b_{\mathrm{A},0}$	Pa^{-1}	Q_{A}	$\mathrm{J\,mol}^{-1}$	η_{A}	-	w_{A}	$\mathrm{kg\,kg}^{-1}$
T_0	K	$b_{\mathrm{B},0}$	Pa^{-1}	Q_{B}	$\mathrm{J\,mol}^{-1}$	η_{B}	-
w_{B}	$\mathrm{kg\,kg}^{-1}$						

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$p(w,T)$	K	Uses Newton-Raphson method (start: 10000 Pa)
$T(p,w)$	K	Uses Newton-Raphson method (start: 353.15 K)
$\frac{\partial w(p,T)}{\partial p}$	$\mathrm{kg\,kg}^{-1}\,\mathrm{Pa}^{-1}$	Analytical function
$\frac{\partial w(p,T)}{\partial T}$	$\mathrm{kg\,kg}^{-1}\,\mathrm{K}^{-1}$	Analytical function
$\frac{\partial w(p,T)}{\partial p}$	$\mathrm{kg\,kg}^{-1}\,\mathrm{Pa}^{-1}$	Uses two-point numerical differentiation
$\frac{\partial w(p,T)}{\partial T}$	$\mathrm{kg\,kg}^{-1}\,\mathrm{K}^{-1}$	Uses two-point numerical differentiation

3.6.2 Langmuir

The loading w is calculated by:

$$w = \frac{w_{\mathrm{sat}} K p}{1 + K p} \quad \text{, and}$$

$$K = K_0 \exp\left(\frac{\Delta H}{RT}\right) \quad .$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value
ΔH	$\mathrm{J\,mol^{-1}}$	K_0	$\mathrm{Pa^{-1}}$	w_{sat}	$\mathrm{kg\,kg^{-1}}$

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$p(w,T)$	K	Analytical function
$T(p,w)$	K	Analytical function
$\frac{\partial w(p,T)}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function
$\frac{\partial w(p,T)}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function

3.6.3 Toth

The loading w is calculated by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
b_0	$\mathrm{Pa^{-1}}$	m	-	Q^*	K	w_{sat}	$\mathrm{kg\,kg^{-1}}$
c	K	n_0	-	r^*	-		

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$p(w,T)$	K	Analytical function

Function	Unit	Implementation
$T(p, w)$	K	Uses Newton-Raphson method (start: 353.15 K)
$\frac{\partial w(p,T)}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function
$\frac{\partial w(p,T)}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function

3.7 Adsorption - Surface & Vapor Pressure

Currently, 1 approach are implemented in SorpPropLib for conventional adsorption working pairs based on the surface approach to calculate equilibrium pressure p in Pa as a function of temperature T in K, loading w in $\mathrm{kg\,kg^{-1}}$, and vapor pressure p_{sat} in Pa. In addition, partial derivatives according to the temperature and concentration as well as the inverses of the approaches are implemented in SorpPropLib. Details of the approaches are presented below.

3.7.1 Freundlich

The loading w is calculated by:

$$\begin{aligned} w &= A\left({}^{p}/_{p_{\mathrm{sat}}}\right)^{B} && \text{, and} \\ A &= A_0 + A_1 T + A_2 T^2 + A_3 T^3 && \text{, and} \\ B &= B_0 + B_1 T + B_2 T^2 + B_3 T^3 && . \end{aligned}$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
A_0	$\mathrm{kg\,kg^{-1}}$	A_2	$\mathrm{kg\,kg^{-1}\,K^{-2}}$	B_0	-	B_2	$\mathrm{K^{-3}}$
A_1	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	A_3	$\mathrm{kg\,kg^{-1}\,K^{-3}}$	B_1	$\mathrm{K^{-1}}$	B_3	$\mathrm{K^{-2}}$

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$p(w, T, p_{\mathrm{sat}}(T))$	K	Analytical function
$T(p, w, p_{\mathrm{sat}}(T))$	K	Uses Newton-Raphson method (start: 353.15 K)
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T))}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function

Function	Unit	Implementation
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\partial p_{\mathrm{sat}}(T)/\partial T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T))}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\partial p_{\mathrm{sat}}(T)/\partial T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function

3.8 Adsorption - Volumetric

Currently, 3 approaches are implemented in SorpPropLib for conventional adsorption working pairs based on the volumetric approach to calculate equilibrium pressure p in Pa as a function of temperature T in K, loading w in $\mathrm{kg\,kg^{-1}}$, vapor pressure p_{sat} in Pa, and saturated liquid density $\rho_{\mathrm{sat}}^{\mathrm{liq}}$ in $\mathrm{kg\,m^{-3}}$. In addition, partial derivatives according to the temperature and concentration as well as the inverses of the approaches are implemented in SorpPropLib. Details of the approaches are presented below.

3.8.1 DubininAstakhov

The loading w is calculated by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
flag	-	E	$\mathrm{J\,mol^{-1}}$	n	-	W_0	$\mathrm{kg\,kg^{-1}}$

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$p(w,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	K	Analytical function
$T(p,w,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	K	Uses Newton-Raphson method (start: 273.15 K)
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T),\partial p_{\mathrm{sat}}(T)/\partial T,\partial \rho_{\mathrm{sat}}^{\mathrm{liq}}(T)/\partial T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function

Function	Unit	Implementation
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T),\partial p_{\mathrm{sat}}(T)/\partial T,\partial \rho_{\mathrm{sat}}^{\mathrm{liq}}(T)/\partial T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function
$W(A, rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	$\mathrm{m^3\,kg^{-1}}$	Analytical function
$A(W, rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	$\mathrm{J\,mol^{-1}}$	Analytical function
$\frac{\partial W(A,rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial A}$	$\mathrm{mol\,m^3\,kg^{-1}\,J^{-1}}$	Analytical function
$\frac{\partial A(W,rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial W}$	$\mathrm{kg\,J\,mol^{-1}\,m^{-3}}$	Analytical function

3.8.2 DubininArctan1

The loading w is calculated by:

$$
\begin{aligned}
w &= W\rho_{\mathrm{sat}}^{\mathrm{liq}} && \text{, and}\\
W &= \frac{a}{\Pi}\left(\arctan\left(\frac{A-b}{c}\right)+\frac{\Pi}{2}\right)+d && \text{, and}\\
A &= RT\ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

Required coefficients of the equation are:

Par.	Unit	Par.	Unit.	Par.	Value	Par.	Value
a	$\mathrm{m^3\,kg^{-1}}$	b	$\mathrm{J\,mol^{-1}}$	c	$\mathrm{J\,mol^{-1}}$	d	$\mathrm{m^3\,kg^{-1}}$

Implemented inverse functions and partial derivatives are:

Function	Unit	Implementation
$p(w, T, p_{\mathrm{sat}}(T), \rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	K	Analytical function
$T(p, w, p_{\mathrm{sat}}(T), \rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	K	Uses Newton-Raphson method (start: 313.15 K)
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T),\partial p_{\mathrm{sat}}(T)/\partial T,\partial \rho_{\mathrm{sat}}^{\mathrm{liq}}(T)/\partial T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial p}$	$\mathrm{kg\,kg^{-1}\,Pa^{-1}}$	Analytical function
$\frac{\partial w(p,T,p_{\mathrm{sat}}(T),\rho_{\mathrm{sat}}^{\mathrm{liq}}(T),\partial p_{\mathrm{sat}}(T)/\partial T,\partial \rho_{\mathrm{sat}}^{\mathrm{liq}}(T)/\partial T)}{\partial T}$	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	Analytical function
$W(A, rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	$\mathrm{m^3\,kg^{-1}}$	Analytical function
$A(W, rho_{\mathrm{sat}}^{\mathrm{liq}}(T))$	$\mathrm{J\,mol^{-1}}$	Analytical function
$\frac{\partial W(A,rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial A}$	$\mathrm{mol\,m^3\,kg^{-1}\,J^{-1}}$	Analytical function

Function	Unit	Implementation
$\frac{\partial A(W, rho_{\mathrm{sat}}^{\mathrm{liq}}(T))}{\partial W}$	$\mathrm{kg\,J\,mol^{-1}\,m^{-3}}$	Analytical function

4 Refrigerants

4.1 1-Butene

4.1.1 Vapor Pressure - Antoine - ID 1

Name:	1-Butene
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.246960000e+00	c	K	-8.256000000e+00
b	K	1.099207000e+03			

Validity:
Equation is approximately valid for 195.7K $\leq T \leq$ 269.4K.

Visualization:

4.1.2 Vapor Pressure - EoS1 - ID 1

Name:	1-Butene
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$
\begin{aligned}
p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\
\xi &= 1 - \theta && \text{, and} \\
\theta &= {}^{T}/_{T_{\text{crit}}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.192900000e+02	a_4	-	-2.648450000e+00
p_{crit}	Pa	4.006000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.078970000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.878190000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.022560000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 87.8K $\leq T \leq$ 419.29K.

Visualization:

4.1.3 Vapor Pressure - EoSCubic - ID 1

Name:	1-Butene
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.192900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.005100000e+06	β_2	-	0.000000000e+00
ω	-	1.920000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $100.97\text{K} \leq T \leq 356.3965\text{K}$.

Visualization:

4.1.4 Vapor Pressure - EoSCubic - ID 2

Name:	1-Butene
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.192900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.005100000e+06	β_2	-	0.000000000e+00
ω	-	1.920000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 100.97K $\leq T \leq$ 356.3965K.

Visualization:

4.2 2-Propanol

4.2.1 Saturated Liquid Density - EoS1 - ID 1

Name:	2-Propanol
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Scalabrin, G.; Stringari, P. (2009): A Fundamental Equation of State for 2-propanol (C3H8O) in the Extended Equation of State Format. In: Journal of Physical and Chemical Reference Data 38 (2), S. 127–170. DOI: 10.1063/1.3112608.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	b_4	-	2.030000000e+00
T_{crit}	K	5.083000000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.710000000e+02	b_5	-	0.000000000e+00
a_1	-	-3.576000000e-02	a_6	-	0.000000000e+00
b_1	-	3.000000000e-03	b_6	-	0.000000000e+00
a_2	-	-2.955000000e-03	a_7	-	0.000000000e+00
b_2	-	2.600000000e-01	b_7	-	0.000000000e+00
a_3	-	1.445860000e+00	a_8	-	0.000000000e+00
b_3	-	2.700000000e-01	b_8	-	0.000000000e+00
a_4	-	-2.547310000e-01			

Validity:
Equation is approximately valid for $184.9\mathrm{K} \leq T \leq 508.3\mathrm{K}$.

Visualization:

4.2.2 Saturated Liquid Density - EoS1 - ID 2

Name:	2-Propanol
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.082500000e+02	a_5	-	-1.396072528e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.730000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	3.171855311e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	-2.725620146e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	3.574744322e+00			

Validity:
Equation is approximately valid for $184.9\text{K} \leq T \leq 508.25\text{K}$.

Visualization:

4.2.3 Vapor Pressure - Antoine - ID 1

Name:	2-Propanol
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.577950000e+00	c	K	-8.747400000e+01
b	K	1.221423000e+03			

Validity:
Equation is approximately valid for 395.1K $\leq T \leq$ 508.24K.

Visualization:

4.2.4 Vapor Pressure - Antoine - ID 2

Name:	2-Propanol
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.861000000e+00	c	K	-7.581400000e+01
b	K	1.357427000e+03			

Validity:
Equation is approximately valid for 329.92K $\leq T \leq$ 362.41K.

Visualization:

4.2.5 Vapor Pressure - EoS1 - ID 1

Name:	2-Propanol
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Scalabrin, G.; Stringari, P. (2009): A Fundamental Equation of State for 2-propanol (C3H8O) in the Extended Equation of State Format. In: Journal of Physical and Chemical Reference Data 38 (2), S. 127–170. DOI: 10.1063/1.3112608.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.083000000e+02	a_4	-	2.043260000e+01

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	4.764000000e+06	b_4	-	4.510000000e+00
a_1	-	-1.899130000e+01	a_5	-	-1.538320000e+01
b_1	-	1.100000000e+00	b_5	-	7.340000000e+00
a_2	-	1.289860000e+01	a_6	-	0.000000000e+00
b_2	-	1.270000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.674990000e+01	a_7	-	0.000000000e+00
b_3	-	2.890000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 184.9K $\leq T \leq$ 508.3K.

Visualization:

4.2.6 Vapor Pressure - EoS1 - ID 2

Name:	2-Propanol
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.082500000e+02	a_4	-	6.924800000e-01
p_{crit}	Pa	4.762000000e+06	b_4	-	5.000000000e+00
a_1	-	-8.447370000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.174020000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-6.978760000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $184.9\text{K} \leq T \leq 508.25\text{K}$.

Visualization:

4.2.7 Vapor Pressure - EoSCubic - ID 1

Name:	2-Propanol
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.090000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.900000000e+06	β_2	-	0.000000000e+00
ω	-	6.668700000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 212.635K $\leq T \leq$ 432.65K.

Visualization:

4.2.8 Vapor Pressure - EoSCubic - ID 2

Name:	2-Propanol
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.090000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.900000000e+06	β_2	-	0.000000000e+00
ω	-	6.668700000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 212.635K $\leq T \leq$ 432.65K.

Visualization:

4.3 Acetone

4.3.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Acetone
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.081000000e+02	a_5	-	9.269839416e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.740000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.997744525e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	7.618321168e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-7.436492701e-01			

Validity:
Equation is approximately valid for $178.5\mathrm{K} \leq T \leq 508.1\mathrm{K}$.

Visualization:

4.3.2 Vapor Pressure - Antoine - ID 1

Name:	Acetone
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.424480000e+00	c	K	-3.244500000e+01
b	K	1.312253000e+03			

Validity:
Equation is approximately valid for 259.16K $\leq T \leq$ 507.6K.

Visualization:

4.3.3 Vapor Pressure - EoS1 - ID 1

Name:	Acetone
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.081000000e+02	a_4	-	-2.901620000e+00
p_{crit}	Pa	4.692000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.670330000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.964690000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.443800000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 178.5K $\leq T \leq$ 508.1K.

Visualization:

4.3.4 Vapor Pressure - EoSCubic - ID 1

Name:	Acetone
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.081000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.692400000e+06	β_2	-	0.000000000e+00
ω	-	3.071000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $205.275\text{K} \leq T \leq 431.885\text{K}$.

Visualization:

4.3.5 Vapor Pressure - EoSCubic - ID 2

Name:	Acetone
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.081000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.692400000e+06	β_2	-	0.000000000e+00
ω	-	3.071000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 205.275K $\leq T \leq$ 431.885K.

Visualization:

4.4 Ammonia

4.4.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Ammonia
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	4.055000000e+02	a_5	-	-2.842031111e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.250000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.363223556e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	-1.400120000e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.142634667e+00			

Validity:
Equation is approximately valid for $195.49\mathrm{K} \leq T \leq 405.5\mathrm{K}$.

Visualization:

4.4.2 Vapor Pressure - Antoine - ID 1

Name:	Ammonia
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.868860000e+00	c	K	-1.040900000e+01
b	K	1.113928000e+03			

Validity:
Equation is approximately valid for 239.6K $\leq T \leq$ 371.5K.

Visualization:

4.4.3 Vapor Pressure - Antoine - ID 2

Name:	Ammonia
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.187570000e+00	c	K	-8.078000000e+01
b	K	5.067130000e+02			

Validity:
Equation is approximately valid for 164.0K $\leq T \leq$ 239.6K.

Visualization:

4.4.4 Vapor Pressure - EoS1 - ID 1

Name:	Ammonia
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$
\begin{aligned}
p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\
\xi &= 1 - \theta && \text{, and} \\
\theta &= {}^{T}\!/_{T_{\text{crit}}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.055000000e+02	a_4	-	-1.968840000e+00
p_{crit}	Pa	1.135900000e+07	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.302740000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.646380000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.016060000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 195.49K $\leq T \leq$ 405.5K.

Visualization:

4.4.5 Vapor Pressure - EoSCubic - ID 1

Name:	Ammonia
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.055600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	1.136300000e+07	β_2	-	0.000000000e+00
ω	-	2.560000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $224.8135\text{K} \leq T \leq 344.726\text{K}$.

Visualization:

4.4.6 Vapor Pressure - EoSCubic - ID 2

Name:	Ammonia
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.055600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	1.136300000e+07	β_2	-	0.000000000e+00
ω	-	2.560000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 224.8135K $\leq T \leq$ 344.726K.

Visualization:

4.5 Argon

4.5.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Argon
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Tegeler, Ch.; Span, Roland; Wagner, Wolfgang (1999): A New Equation of State for Argon Covering the Fluid Region for Temperatures From the Melting Line to 700 K at Pressures up to 1000 MPa. In: Journal of Physical and Chemical Reference Data 28 (3), S. 779–850. DOI: 10.1063/1.556037.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	b_4	-	4.000000000e+00
T_{crit}	K	1.506870000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	5.356000000e+02	b_5	-	0.000000000e+00
a_1	-	1.500426200e+00	a_6	-	0.000000000e+00
b_1	-	3.340000000e-01	b_6	-	0.000000000e+00
a_2	-	-3.138129000e-01	a_7	-	0.000000000e+00
b_2	-	6.666666667e-01	b_7	-	0.000000000e+00
a_3	-	8.646162200e-02	a_8	-	0.000000000e+00
b_3	-	2.333333333e+00	b_8	-	0.000000000e+00
a_4	-	-4.147752500e-02			

Validity:
Equation is approximately valid for 83.806K $\leq T \leq$ 150.687K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Argon
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	1.506900000e+02	a_5	-	2.236354478e-01
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	5.360000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.670586754e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	5.555796642e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-2.977630597e-02			

Validity:
Equation is approximately valid for $83.806\text{K} \leq T \leq 150.69\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.3 Vapor Pressure - Antoine - ID 1

Name:	Argon
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.295550000e+00	c	K	-2.223300000e+01
b	K	2.152400000e+02			

Validity:
Equation is approximately valid for 83.78K $\leq T \leq$ 150.72K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.4 Vapor Pressure - Antoine - ID 2

Name:	Argon
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.469030000e+00	c	K	2.215600000e+01
b	K	4.810120000e+02			

Validity:
Equation is approximately valid for 114.4K $\leq T \leq$ 150.31K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.5 Vapor Pressure - Antoine - ID 3

Name:	Argon
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.971710000e+00	c	K	4.981900000e+01
b	K	6.589820000e+02			

Validity:
Equation is approximately valid for 129.33K $\leq T \leq$ 147.4K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.6 Vapor Pressure - Antoine - ID 4

Name:	Argon
Equation:	VaporPressure_Antoine
ID:	4
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.734790000e+00	c	K	-6.083000000e+00
b	K	3.026830000e+02			

Validity:
Equation is approximately valid for 90.94K $\leq T \leq$ 101.48K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.7 Vapor Pressure - EoS1 - ID 1

Name:	Argon
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	1.506900000e+02	a_4	-	-1.523120000e+00
p_{crit}	Pa	4.863000000e+06	b_4	-	5.000000000e+00
a_1	-	-5.928010000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.219820000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-5.396700000e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 83.806K $\leq T \leq$ 150.69K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.8 Vapor Pressure - EoSCubic - ID 1

Name:	Argon
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	1.506900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.863000000e+06	β_2	-	0.000000000e+00
ω	-	-2.190000000e-03	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $96.3769\text{K} \leq T \leq 128.0865\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.5.9 Vapor Pressure - EoSCubic - ID 2

Name:	Argon
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)+b\,(v-b)} && \text{, and}\\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	1.506900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.863000000e+06	β_2	-	0.000000000e+00
ω	-	-2.190000000e-03	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $96.3769\text{K} \leq T \leq 128.0865\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Argon'. Thus, data cannot be visualized!

4.6 Benzene

4.6.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Benzene
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Goodwin, Robert D. (1988): Benzene Thermophysical Properties from 279 to 900 K at Pressures to 1000 Bar. In: Journal of Physical and Chemical Reference Data 17 (4), S. 1541–1636. DOI: 10.1063/1.555813.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	2.000000000e+00
T_{crit}	K	5.617500000e+02	a_5	-	2.092670400e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	3.046290000e+02	b_5	-	3.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.960018200e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.062881200e+00	a_8	-	0.000000000e+00
b_3	-	1.000000000e+00	b_8	-	0.000000000e+00
a_4	-	-1.585664000e+00			

Validity:
Equation is approximately valid for $278.67\text{K} \leq T \leq 561.75\text{K}$.

Visualization:

4.6.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Benzene
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.620100000e+02	a_5	-	1.534623856e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	3.060000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.641941503e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.737248366e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-2.169890523e+00			

Validity:
Equation is approximately valid for $278.67\text{K} \leq T \leq 562.01\text{K}$.

Visualization:

4.6.3 Vapor Pressure - Antoine - ID 1

Name:	Benzene
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.725830000e+00	c	K	-1.461000000e+00
b	K	1.660652000e+03			

Validity:
Equation is approximately valid for 333.4K $\leq T \leq$ 373.5K.

Visualization:

4.6.4 Vapor Pressure - Antoine - ID 2

Name:	Benzene
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	1.459100000e-01	c	K	-2.612360000e+02
b	K	3.916500000e+01			

Validity:
Equation is approximately valid for 297.9K $\leq T \leq$ 318.0K.

Visualization:

4.6.5 Vapor Pressure - Antoine - ID 3

Name:	Benzene
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.603620000e+00	c	K	2.080600000e+01
b	K	1.701073000e+03			

Validity:
Equation is approximately valid for 421.56K $\leq T \leq$ 554.8K.

Visualization:

4.6.6 Vapor Pressure - Antoine - ID 4

Name:	Benzene
Equation:	VaporPressure_Antoine
ID:	4
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.018140000e+00	c	K	-5.322600000e+01
b	K	1.203835000e+03			

Validity:
Equation is approximately valid for 287.7K $\leq T \leq$ 354.07K.

Visualization:

4.6.7 Vapor Pressure - EoS1 - ID 1

Name:	Benzene
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$
\begin{aligned}
p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\
\xi &= 1 - \theta && \text{, and} \\
\theta &= {}^{T}/_{T_{\text{crit}}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.620100000e+02	a_4	-	-3.151790000e+00
p_{crit}	Pa	4.901000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.114510000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.839810000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.251580000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 278.67K $\leq T \leq$ 562.01K.

Visualization:

4.6.8 Vapor Pressure - EoS2 - ID 1

Name:	Benzene
Equation:	VaporPressure_EoS2
ID:	1
Reference:	Goodwin, Robert D. (1988): Benzene Thermophysical Properties from 279 to 900 K at Pressures to 1000 Bar. In: Journal of Physical and Chemical Reference Data 17 (4), S. 1541–1636. DOI: 10.1063/1.555813.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{ref}} \exp\left({}^{a_0}/_{\theta} + \sum_{i=1}^{4} a_i \theta^{b_i} + a_5 \xi^{b_5} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.617500000e+02	a_3	-	2.020859327e+01
p_{ref}	Pa	1.000000000e+05	b_3	-	2.000000000e+00
a_0	-	-1.065537528e+01	a_4	-	-7.219556515e+00
a_1	-	2.394191237e+01	b_4	-	3.000000000e+00
b_1	-	0.000000000e+00	a_5	-	4.847283265e+00
a_2	-	-2.238871476e+01	b_5	-	1.700000000e+00
b_2	-	1.000000000e+00			

Validity:
Equation is approximately valid for 278.67K $\leq T \leq$ 561.75K.

Visualization:

4.6.9 Vapor Pressure - EoSCubic - ID 1

Name:	Benzene
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.620200000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.907300000e+06	β_2	-	0.000000000e+00
ω	-	2.110000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 320.4705K $\leq T \leq$ 477.717K.

Visualization:

4.6.10 Vapor Pressure - EoSCubic - ID 2

Name:	Benzene
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.620200000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.907300000e+06	β_2	-	0.000000000e+00
ω	-	2.110000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 320.4705K $\leq T \leq$ 477.717K.

Visualization:

4.7 Butane

4.7.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Butane
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Bücker, D.; Wagner, W. (2006): Reference Equations of State for the Thermodynamic Properties of Fluid Phase n-Butane and Isobutane. In: Journal of Physical and Chemical Reference Data 35 (2), S. 929–1019. DOI: 10.1063/1.1901687.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.500000000e+00
T_{crit}	K	4.251250000e+02	a_5	-	3.043375580e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.280000000e+02	b_5	-	3.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.978745150e+00	a_7	-	0.000000000e+00
b_2	-	3.450000000e-01	b_7	-	0.000000000e+00
a_3	-	8.567995100e-01	a_8	-	0.000000000e+00
b_3	-	1.000000000e+00	b_8	-	0.000000000e+00
a_4	-	-3.418718870e-01			

Validity:
Equation is approximately valid for $134.9\mathrm{K} \leq T \leq 425.125\mathrm{K}$.

Visualization:

4.7.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Butane
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	4.251300000e+02	a_5	-	1.205646930e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.280000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.836397368e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.082646491e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.393101754e+00			

Validity:
Equation is approximately valid for $134.9\text{K} \leq T \leq 425.13\text{K}$.

Visualization:

4.7.3 Vapor Pressure - Antoine - ID 1

Name:	Butane
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.355760000e+00	c	K	-2.071000000e+00
b	K	1.175581000e+03			

Validity:
Equation is approximately valid for 272.66K $\leq T \leq$ 425.0K.

Visualization:

4.7.4 Vapor Pressure - Antoine - ID 2

Name:	Butane
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.850020000e+00	c	K	-3.614600000e+01
b	K	9.096500000e+02			

Validity:
Equation is approximately valid for 195.11K $\leq T \leq$ 272.81K.

Visualization:

4.7.5 Vapor Pressure - Antoine - ID 3

Name:	Butane
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.708120000e+00	c	K	-1.301300000e+01
b	K	1.200475000e+03			

Validity:
Equation is approximately valid for 135.42K $\leq T \leq$ 212.89K.

Visualization:

4.7.6 Vapor Pressure - EoS1 - ID 1

Name:	Butane
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Bücker, D.; Wagner, W. (2006): Reference Equations of State for the Thermodynamic Properties of Fluid Phase n-Butane and Isobutane. In: Journal of Physical and Chemical Reference Data 35 (2), S. 929–1019. DOI: 10.1063/1.1901687.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.251250000e+02	a_4	-	-2.822411300e+00

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	3.796000000e+06	b_4	-	4.500000000e+00
a_1	-	-7.176169030e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.536353360e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.075328690e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $134.9\text{K} \leq T \leq 425.125\text{K}$.

Visualization:

4.7.7 Vapor Pressure - EoS1 - ID 2

Name:	Butane
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.251300000e+02	a_4	-	-2.319750000e+00
p_{crit}	Pa	3.796000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.085620000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.793350000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.000030000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $134.9\text{K} \leq T \leq 425.13\text{K}$.

Visualization:

4.7.8 Vapor Pressure - EoSCubic - ID 1

Name:	Butane
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.251300000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.796000000e+06	β_2	-	0.000000000e+00
ω	-	2.010000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 155.135K $\leq T \leq$ 361.3605K.

Visualization:

4.7.9 Vapor Pressure - EoSCubic - ID 2

Name:	Butane
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.251300000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.796000000e+06	β_2	-	0.000000000e+00
ω	-	2.010000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 155.135K $\leq T \leq$ 361.3605K.

Visualization:

4.8 CarbonDioxide

4.8.1 Saturated Liquid Density - EoS1 - ID 1

Name:	CarbonDioxide
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Span, Roland; Wagner, Wolfgang (1996): A New Equation of State for Carbon Dioxide Covering the Fluid Region from the Triple-Point Temperature to 1100 K at Pressures up to 800 MPa. In: Journal of Physical and Chemical Reference Data 25 (6), S. 1509–1596. DOI: 10.1063/1.555991.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	b_4	-	1.833333333e+00
T_{crit}	K	3.041282000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	4.676000000e+02	b_5	-	0.000000000e+00
a_1	-	1.924510800e+00	a_6	-	0.000000000e+00
b_1	-	3.400000000e-01	b_6	-	0.000000000e+00
a_2	-	-6.238555500e-01	a_7	-	0.000000000e+00
b_2	-	5.000000000e-01	b_7	-	0.000000000e+00
a_3	-	-3.273112700e-01	a_8	-	0.000000000e+00
b_3	-	1.666666667e+00	b_8	-	0.000000000e+00
a_4	-	3.924514200e-01			

Validity:
Equation is approximately valid for $216.59\mathrm{K} \leq T \leq 304.1282\mathrm{K}$.

Visualization:

4.8.2 Saturated Liquid Density - EoS1 - ID 2

Name:	CarbonDioxide
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.041300000e+02	a_5	-	8.102948718e-02
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	4.680000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.918531410e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	3.633354701e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	3.612213675e-01			

Validity:
Equation is approximately valid for $216.59\text{K} \leq T \leq 304.13\text{K}$.

Visualization:

4.8.3 Vapor Pressure - Antoine - ID 1

Name:	CarbonDioxide
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	6.812280000e+00	c	K	-3.494000000e+00
b	K	1.301679000e+03			

Validity:
Equation is approximately valid for 154.26K $\leq T \leq$ 195.89K.

Visualization:

4.8.4 Vapor Pressure - EoS1 - ID 1

Name:	CarbonDioxide
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Span, Roland; Wagner, Wolfgang (1996): A New Equation of State for Carbon Dioxide Covering the Fluid Region from the Triple-Point Temperature to 1100 K at Pressures up to 800 MPa. In: Journal of Physical and Chemical Reference Data 25 (6), S. 1509–1596. DOI: 10.1063/1.555991.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.041282000e+02	a_4	-	-3.299563400e+00
p_{crit}	Pa	7.377300000e+06	b_4	-	4.000000000e+00
a_1	-	-7.060208700e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.939121800e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.646359700e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 216.59K $\leq T \leq$ 304.1282K.

Visualization:

4.8.5 Vapor Pressure - EoS1 - ID 2

Name:	CarbonDioxide
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.041300000e+02	a_4	-	-2.348530000e+00
p_{crit}	Pa	7.377000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.029160000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.539370000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.283300000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 216.59K $\leq T \leq$ 304.13K.

Visualization:

4.8.6 Vapor Pressure - EoSCubic - ID 1

Name:	CarbonDioxide
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.041300000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	7.377300000e+06	β_2	-	0.000000000e+00
ω	-	2.239400000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 249.0785K $\leq T \leq$ 258.5105K.

Visualization:

4.8.7 Vapor Pressure - EoSCubic - ID 2

Name:	CarbonDioxide
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.041300000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	7.377300000e+06	β_2	-	0.000000000e+00
ω	-	2.239400000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 249.0785K $\leq T \leq$ 258.5105K.

Visualization:

4.9 Cyclohexane

4.9.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Cyclohexane
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.536000000e+02	a_5	-	2.988509524e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.730000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.369678022e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	3.108960073e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-4.619653114e+00			

Validity:
Equation is approximately valid for $279.86\mathrm{K} \leq T \leq 553.6\mathrm{K}$.

Visualization:

4.9.2 Vapor Pressure - Antoine - ID 1

Name:	Cyclohexane
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.139830000e+00	c	K	-3.558100000e+01
b	K	1.316554000e+03			

Validity:
Equation is approximately valid for 323.0K $\leq T \leq$ 523.0K.

Visualization:

4.9.3 Vapor Pressure - Antoine - ID 2

Name:	Cyclohexane
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.992000000e+00	c	K	-4.862100000e+01
b	K	1.216930000e+03			

Validity:
Equation is approximately valid for 303.0K $\leq T \leq$ 343.0K.

Visualization:

4.9.4 Vapor Pressure - Antoine - ID 3

Name:	Cyclohexane
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.171250000e+00	c	K	-1.072900000e+02
b	K	7.806370000e+02			

Validity:
Equation is approximately valid for 315.7K $\leq T \leq$ 353.9K.

Visualization:

4.9.5 Vapor Pressure - Antoine - ID 4

Name:	Cyclohexane
Equation:	VaporPressure_Antoine
ID:	4
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.969880000e+00	c	K	-5.028700000e+01
b	K	1.203526000e+03			

Validity:
Equation is approximately valid for 293.06K $\leq T \leq$ 354.73K.

Visualization:

4.9.6 Vapor Pressure - EoS1 - ID 1

Name:	Cyclohexane
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.536000000e+02	a_4	-	-3.260950000e+00
p_{crit}	Pa	4.075000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.009790000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.574750000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.968200000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 279.86K $\leq T \leq$ 553.6K.

Visualization:

4.9.7 Vapor Pressure - EoSCubic - ID 1

Name:	Cyclohexane
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.536000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.080500000e+06	β_2	-	0.000000000e+00
ω	-	2.096000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $321.839\text{K} \leq T \leq 470.56\text{K}$.

Visualization:

4.9.8 Vapor Pressure - EoSCubic - ID 2

Name:	Cyclohexane
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.536000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.080500000e+06	β_2	-	0.000000000e+00
ω	-	2.096000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 321.839K $\leq T \leq$ 470.56K.

Visualization:

4.10 Cyclohexene

4.10.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Cyclohexene
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.604500000e+02	a_5	-	-4.102241135e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.820000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.126200709e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	-5.617524823e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.535502128e+00			

Validity:
Equation is approximately valid for $223.15\mathrm{K} \leq T \leq 560.45\mathrm{K}$.

Visualization:

4.10.2 Vapor Pressure - Antoine - ID 1

Name:	Cyclohexene
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.997300000e+00	c	K	-4.998000000e+01
b	K	1.221900000e+03			

Validity:
Equation is approximately valid for 310.02K $\leq T \leq$ 364.53K.

Visualization:

4.11 Ethanol

4.11.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Ethanol
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Schroeder, J. A.; Penoncello, S. G.; Schroeder, J. S. (2014): A Fundamental Equation of State for Ethanol. In: Journal of Physical and Chemical Reference Data 43 (4), S. 43102. DOI: 10.1063/1.4895394.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.100000000e+00
T_{crit}	K	5.147100000e+02	a_5	-	-1.654590000e+01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.731951000e+02	b_5	-	1.500000000e+00
a_1	-	1.000000000e+00	a_6	-	3.642940000e+00
b_1	-	0.000000000e+00	b_6	-	3.300000000e+00
a_2	-	9.009210000e+00	a_7	-	0.000000000e+00
b_2	-	5.000000000e-01	b_7	-	0.000000000e+00
a_3	-	-2.316680000e+01	a_8	-	0.000000000e+00
b_3	-	8.000000000e-01	b_8	-	0.000000000e+00
a_4	-	3.090920000e+01			

Validity:
Equation is approximately valid for $159.0\mathrm{K} \leq T \leq 514.71\mathrm{K}$.

Visualization:

4.11.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Ethanol
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.139000000e+02	a_5	-	-1.593705839e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.760000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.732186131e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	-1.504979927e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	2.833717153e+00			

Validity:
Equation is approximately valid for $159.0\text{K} \leq T \leq 513.9\text{K}$.

Visualization:

4.11.3 Vapor Pressure - Antoine - ID 1

Name:	Ethanol
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.246770000e+00	c	K	-4.642400000e+01
b	K	1.598673000e+03			

Validity:
Equation is approximately valid for 292.77K $\leq T \leq$ 366.63K.

Visualization:

4.11.4 Vapor Pressure - Antoine - ID 2

Name:	Ethanol
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.925310000e+00	c	K	-6.181900000e+01
b	K	1.432526000e+03			

Validity:
Equation is approximately valid for 364.8K $\leq T \leq$ 513.91K.

Visualization:

4.11.5 Vapor Pressure - Antoine - ID 3

Name:	Ethanol
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.372290000e+00	c	K	-4.019100000e+01
b	K	1.670409000e+03			

Validity:
Equation is approximately valid for 273.0K $\leq T \leq$ 351.7K.

Visualization:

4.11.6 Vapor Pressure - EoS1 - ID 1

Name:	Ethanol
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Schroeder, J. A.; Penoncello, S. G.; Schroeder, J. S. (2014): A Fundamental Equation of State for Ethanol. In: Journal of Physical and Chemical Reference Data 43 (4), S. 43102. DOI: 10.1063/1.4895394.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.147100000e+02	a_4	-	5.313600000e+01

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	6.268000000e+06	b_4	-	3.700000000e+00
a_1	-	-8.941610000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.617610000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-5.114280000e+01	a_7	-	0.000000000e+00
b_3	-	3.400000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 159.0K $\leq T \leq$ 514.71K.

Visualization:

4.11.7 Vapor Pressure - EoS1 - ID 2

Name:	Ethanol
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.139000000e+02	a_4	-	-2.598600000e-01
p_{crit}	Pa	6.148000000e+06	b_4	-	5.000000000e+00
a_1	-	-8.338010000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	8.719000000e-02	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-3.305780000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $159.0\text{K} \leq T \leq 513.9\text{K}$.

Visualization:

4.11.8 Vapor Pressure - EoSCubic - ID 1

Name:	Ethanol
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.147100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	6.268000000e+06	β_2	-	0.000000000e+00
ω	-	6.460000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 182.85K $\leq T \leq$ 437.5035K.

Visualization:

4.11.9 Vapor Pressure - EoSCubic - ID 2

Name:	Ethanol
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.147100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	6.268000000e+06	β_2	-	0.000000000e+00
ω	-	6.460000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 182.85K $\leq T \leq$ 437.5035K.

Visualization:

4.12 EthyleneGlycol

4.12.1 Saturated Liquid Density - EoS1 - ID 1

Name:	EthyleneGlycol
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	7.191500000e+02	a_5	-	-2.046264000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	3.250000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	4.017209539e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	-4.228480308e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	5.203231077e+00			

Validity:
Equation is approximately valid for 260.6K $\leq T \leq$ 719.15K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'EthyleneGlycol'. Thus, data cannot be visualized!

4.12.2 Vapor Pressure - Antoine - ID 1

Name:	EthyleneGlycol
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.970120000e+00	c	K	-8.499600000e+01
b	K	1.914951000e+03			

Validity:
Equation is approximately valid for 323.0K $\leq T \leq$ 473.0K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'EthyleneGlycol'. Thus, data cannot be visualized!

4.12.3 Vapor Pressure - EoS1 - ID 1

Name:	EthyleneGlycol
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	7.191500000e+02	a_4	-	-1.656600000e+00
p_{crit}	Pa	8.200000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.855750000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.067620000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-5.142710000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 260.6K $\leq T \leq$ 719.15K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'EthyleneGlycol'. Thus, data cannot be visualized!

4.12.4 Vapor Pressure - EoSCubic - ID 1

Name:	EthyleneGlycol
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	7.190000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	1.050900000e+07	β_2	-	0.000000000e+00
ω	-	6.190000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $299.69\text{K} \leq T \leq 611.15\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'EthyleneGlycol'. Thus, data cannot be visualized!

4.12.5 Vapor Pressure - EoSCubic - ID 2

Name:	EthyleneGlycol
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	7.190000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	1.050900000e+07	β_2	-	0.000000000e+00
ω	-	6.190000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $299.69\text{K} \leq T \leq 611.15\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'EthyleneGlycol'. Thus, data cannot be visualized!

4.13 Helium

4.13.1 Vapor Pressure - EoS1 - ID 1

Name:	Helium
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.200000000e+00	a_4	-	8.835000000e-02
p_{crit}	Pa	2.270000000e+05	b_4	-	5.000000000e+00
a_1	-	-4.068560000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.043790000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	1.115940000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 2.1768K $\leq T \leq$ 5.2K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Helium'. Thus, data cannot be visualized!

4.13.2 Vapor Pressure - EoSCubic - ID 1

Name:	Helium
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.195300000e+00	β_1	-	0.000000000e+00
p_{crit}	Pa	2.283200000e+05	β_2	-	0.000000000e+00
ω	-	-3.836000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $2.50332\text{K} \leq T \leq 4.416005\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Helium'. Thus, data cannot be visualized!

4.13.3 Vapor Pressure - EoSCubic - ID 2

Name:	Helium
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.195300000e+00	β_1	-	0.000000000e+00
p_{crit}	Pa	2.283200000e+05	β_2	-	0.000000000e+00
ω	-	-3.836000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $2.50332\text{K} \leq T \leq 4.416005\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Helium'. Thus, data cannot be visualized!

4.14 Hexane

4.14.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Hexane
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.077900000e+02	a_5	-	1.544865022e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.230000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.409838565e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	3.940484305e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.270801794e+00			

Validity:
Equation is approximately valid for $177.83\text{K} \leq T \leq 507.79\text{K}$.

Visualization:

4.14.2 Vapor Pressure - Antoine - ID 1

Name:	Hexane
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.002660000e+00	c	K	-4.878400000e+01
b	K	1.171530000e+03			

Validity:
Equation is approximately valid for 286.18K $\leq T \leq$ 342.69K.

Visualization:

4.14.3 Vapor Pressure - Antoine - ID 2

Name:	Hexane
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.456040000e+00	c	K	-5.389300000e+01
b	K	1.044038000e+03			

Validity:
Equation is approximately valid for 177.7K $\leq T \leq$ 264.93K.

Visualization:

4.14.4 Vapor Pressure - EoS1 - ID 1

Name:	Hexane
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.077900000e+02	a_4	-	-2.828240000e+00
p_{crit}	Pa	3.042000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.610750000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.005270000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.741580000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 177.83K $\leq T \leq$ 507.79K.

Visualization:

4.14.5 Vapor Pressure - EoSCubic - ID 1

Name:	Hexane
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.078200000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.044100000e+06	β_2	-	0.000000000e+00
ω	-	3.000000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $204.5045\text{K} \leq T \leq 431.647\text{K}$.

Visualization:

4.14.6 Vapor Pressure - EoSCubic - ID 2

Name:	Hexane
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.078200000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.044100000e+06	β_2	-	0.000000000e+00
ω	-	3.000000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 204.5045K $\leq T \leq$ 431.647K.

Visualization:

4.15 Isobutane

4.15.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Isobutane
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Miyamoto, H.; Watanabe, K. (2002): A Thermodynamic Property Model for Fluid-Phase Isobutane. In: International Journal of Thermophysics 23 (2), S. 477–499. DOI: 10.1023/A:1015161519954.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	b_4	-	0.000000000e+00
T_{crit}	K	4.078170000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.243600000e+02	b_5	-	0.000000000e+00
a_1	-	1.605620000e+00	a_6	-	0.000000000e+00
b_1	-	3.300000000e-01	b_6	-	0.000000000e+00
a_2	-	-2.374095000e+00	a_7	-	0.000000000e+00
b_2	-	1.000000000e+00	b_7	-	0.000000000e+00
a_3	-	2.098763000e+00	a_8	-	0.000000000e+00
b_3	-	1.100000000e+00	b_8	-	0.000000000e+00
a_4	-	0.000000000e+00			

Validity:
Equation is approximately valid for $113.73\mathrm{K} \leq T \leq 407.817\mathrm{K}$.

Visualization:

4.15.2 Vapor Pressure - Antoine - ID 1

Name:	Isobutane
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.328100000e+00	c	K	9.180000000e-01
b	K	1.132108000e+03			

Validity:
Equation is approximately valid for 261.31K $\leq T \leq$ 408.12K.

Visualization:

4.15.3 Vapor Pressure - Antoine - ID 2

Name:	Isobutane
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.944170000e+00	c	K	-2.980800000e+01
b	K	9.121410000e+02			

Validity:
Equation is approximately valid for 188.06K $\leq T \leq$ 261.54K.

Visualization:

4.15.4 Vapor Pressure - EoS1 - ID 1

Name:	Isobutane
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Bücker, D.; Wagner, W. (2006): Reference Equations of State for the Thermodynamic Properties of Fluid Phase n-Butane and Isobutane. In: Journal of Physical and Chemical Reference Data 35 (2), S. 929–1019. DOI: 10.1063/1.1901687.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.078100000e+02	a_4	-	-2.561909940e+00

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	3.629000000e+06	b_4	-	4.500000000e+00
a_1	-	-6.850931030e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.365431980e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.325426910e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 113.73K $\leq T \leq$ 407.81K.

Visualization:

4.15.5 Vapor Pressure - EoS1 - ID 2

Name:	Isobutane
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Miyamoto, H.; Watanabe, K. (2002): A Thermodynamic Property Model for Fluid-Phase Isobutane. In: International Journal of Thermophysics 23 (2), S. 477–499. DOI: 10.1023/A:1015161519954.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.078170000e+02	a_4	-	-2.191970000e+00
p_{crit}	Pa	3.640000000e+06	b_4	-	4.500000000e+00
a_1	-	-6.995565000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.754758000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.833831000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 113.73K $\leq T \leq$ 407.817K.

Visualization:

4.15.6 Vapor Pressure - EoSCubic - ID 1

Name:	Isobutane
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.078100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.629000000e+06	β_2	-	0.000000000e+00
ω	-	1.840000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 130.7895K $\leq T \leq$ 346.6385K.

Visualization:

4.15.7 Vapor Pressure - EoSCubic - ID 2

Name:	Isobutane
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.078100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.629000000e+06	β_2	-	0.000000000e+00
ω	-	1.840000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 130.7895K $\leq T \leq$ 346.6385K.

Visualization:

4.16 Krypton

4.16.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Krypton
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	2.094800000e+02	a_5	-	1.963675824e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	9.100000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.771438462e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	3.763043956e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.437058242e-01			

Validity:
Equation is approximately valid for 115.78K $\leq T \leq$ 209.48K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Krypton'. Thus, data cannot be visualized!

4.16.2 Vapor Pressure - Antoine - ID 1

Name:	Krypton
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.206400000e+00	c	K	8.855000000e+00
b	K	5.390040000e+02			

Validity:
Equation is approximately valid for 126.68K $\leq T \leq$ 208.0K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Krypton'. Thus, data cannot be visualized!

4.16.3 Vapor Pressure - EoS1 - ID 1

Name:	Krypton
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.200000000e+00	a_4	-	-1.300120000e+00
p_{crit}	Pa	2.270000000e+05	b_4	-	5.000000000e+00
a_1	-	-5.983960000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.343340000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-6.652100000e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 115.78K $\leq T \leq$ 5.2K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Krypton'. Thus, data cannot be visualized!

4.16.4 Vapor Pressure - EoSCubic - ID 1

Name:	Krypton
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	2.094800000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	5.525000000e+06	β_2	-	0.000000000e+00
ω	-	-8.940000000e-04	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 133.147K $\leq T \leq$ 178.058K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Krypton'. Thus, data cannot be visualized!

4.16.5 Vapor Pressure - EoSCubic - ID 2

Name:	Krypton
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	2.094800000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	5.525000000e+06	β_2	-	0.000000000e+00
ω	-	-8.940000000e-04	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $133.147\text{K} \leq T \leq 178.058\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Krypton'. Thus, data cannot be visualized!

4.17 Methane

4.17.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Methane
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Setzmann, U.; Wagner, W. (1991): A New Equation of State and Tables of Thermodynamic Properties for Methane Covering the Range from the Melting Line to 625 K at Pressures up to 100 MPa. In: Journal of Physical and Chemical Reference Data 20 (6), S. 1061–1155. DOI: 10.1063/1.555898.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	b_4	-	0.000000000e+00
T_{crit}	K	1.905640000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	1.626600000e+02	b_5	-	0.000000000e+00
a_1	-	1.990638900e+00	a_6	-	0.000000000e+00
b_1	-	3.540000000e-01	b_6	-	0.000000000e+00
a_2	-	-7.875619700e-01	a_7	-	0.000000000e+00
b_2	-	5.000000000e-01	b_7	-	0.000000000e+00
a_3	-	3.697672300e-02	a_8	-	0.000000000e+00
b_3	-	2.500000000e+00	b_8	-	0.000000000e+00
a_4	-	0.000000000e+00			

Validity:
Equation is approximately valid for $90.694\text{K} \leq T \leq 190.564\text{K}$.

Visualization:

4.17.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Methane
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	1.905600000e+02	a_5	-	4.292723926e-01
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	1.630000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.643309203e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	7.938392638e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-4.515766871e-01			

Validity:
Equation is approximately valid for $90.694\text{K} \leq T \leq 190.56\text{K}$.

Visualization:

4.17.3 Vapor Pressure - Antoine - ID 1

Name:	Methane
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.989500000e+00	c	K	-4.900000000e-01
b	K	4.430280000e+02			

Validity:
Equation is approximately valid for 90.99K $\leq T \leq$ 189.99K.

Visualization:

4.17.4 Vapor Pressure - Antoine - ID 2

Name:	Methane
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	2.002530000e+00	c	K	-4.882300000e+01
b	K	1.258190000e+02			

Validity:
Equation is approximately valid for 96.89K $\leq T \leq$ 110.19K.

Visualization:

4.17.5 Vapor Pressure - Antoine - ID 3

Name:	Methane
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.802350000e+00	c	K	-5.479000000e+00
b	K	4.031060000e+02			

Validity:
Equation is approximately valid for 93.04K $\leq T \leq$ 107.84K.

Visualization:

4.17.6 Vapor Pressure - Antoine - ID 4

Name:	Methane
Equation:	VaporPressure_Antoine
ID:	4
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.220610000e+00	c	K	1.122300000e+01
b	K	5.166890000e+02			

Validity:
Equation is approximately valid for 110.0K $\leq T \leq$ 190.5K.

Visualization:

4.17.7 Vapor Pressure - EoS1 - ID 1

Name:	Methane
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Setzmann, U.; Wagner, W. (1991): A New Equation of State and Tables of Thermodynamic Properties for Methane Covering the Range from the Melting Line to 625 K at Pressures up to 100 MPa. In: Journal of Physical and Chemical Reference Data 20 (6), S. 1061–1155. DOI: 10.1063/1.555898.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$
\begin{aligned}
p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\
\xi &= 1 - \theta && \text{, and} \\
\theta &= {}^{T}\!/_{T_{\text{crit}}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	1.905640000e+02	a_4	-	-1.443048000e+00
p_{crit}	Pa	4.599200000e+06	b_4	-	4.500000000e+00
a_1	-	-6.036219000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.409353000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-4.945199000e-01	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 90.694K $\leq T \leq$ 190.564K.

Visualization:

4.17.8 Vapor Pressure - EoS1 - ID 2

Name:	Methane
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	1.905600000e+02	a_4	-	-1.376480000e+00
p_{crit}	Pa	4.599000000e+06	b_4	-	5.000000000e+00
a_1	-	-6.023880000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.268130000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-5.694800000e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $90.694\text{K} \leq T \leq 190.56\text{K}$.

Visualization:

4.17.9 Vapor Pressure - EoSCubic - ID 1

Name:	Methane
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	1.905600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.599200000e+06	β_2	-	0.000000000e+00
ω	-	1.142000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 104.2981K $\leq T \leq$ 161.976K.

Visualization:

4.17.10 Vapor Pressure - EoSCubic - ID 2

Name:	Methane
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	1.905600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.599200000e+06	β_2	-	0.000000000e+00
ω	-	1.142000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 104.2981K $\leq T \leq$ 161.976K.

Visualization:

4.18 Methanol

4.18.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Methanol
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.133800000e+02	a_5	-	6.843041135e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.820000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	5.842592199e-01	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	8.006268794e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.257337695e+01			

Validity:
Equation is approximately valid for $175.61\mathrm{K} \leq T \leq 513.38\mathrm{K}$.

Visualization:

4.18.2 Vapor Pressure - Antoine - ID 1

Name:	Methanol
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.158530000e+00	c	K	-3.484600000e+01
b	K	1.569613000e+03			

Validity:
Equation is approximately valid for 353.5K $\leq T \leq$ 512.63K.

Visualization:

4.18.3 Vapor Pressure - Antoine - ID 2

Name:	Methanol
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.204090000e+00	c	K	-3.350000000e+01
b	K	1.581341000e+03			

Validity:
Equation is approximately valid for 288.1K $\leq T \leq$ 356.83K.

Visualization:

4.18.4 Vapor Pressure - Antoine - ID 3

Name:	Methanol
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.313010000e+00	c	K	-2.172800000e+01
b	K	1.676569000e+03			

Validity:
Equation is approximately valid for 353.0K $\leq T \leq$ 483.0K.

Visualization:

4.18.5 Vapor Pressure - EoS1 - ID 1

Name:	Methanol
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Kume, D.; Sakoda, N.; Uematsu, M.: An Equation of STate for Thermodynamic Properties for Methanol.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.126000000e+02	a_4	-	-1.504411100e+00
p_{crit}	Pa	8.103500000e+06	b_4	-	3.500000000e+00
a_1	-	-8.857024700e+00	a_5	-	0.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.407244700e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.645250100e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 175.61K $\leq T \leq$ 512.6K.

Visualization:

4.18.6 Vapor Pressure - EoS1 - ID 2

Name:	Methanol
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.133800000e+02	a_4	-	7.066900000e-01
p_{crit}	Pa	8.216000000e+06	b_4	-	5.000000000e+00
a_1	-	-8.729630000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.458600000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.784490000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $175.61\text{K} \leq T \leq 513.38\text{K}$.

Visualization:

4.18.7 Vapor Pressure - EoSCubic - ID 1

Name:	Methanol
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.126000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	8.103500000e+06	β_2	-	0.000000000e+00
ω	-	5.625000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 201.9515K $\leq T \leq$ 435.71K.

Visualization:

4.18.8 Vapor Pressure - EoSCubic - ID 2

Name:	Methanol
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.126000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	8.103500000e+06	β_2	-	0.000000000e+00
ω	-	5.625000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 201.9515K $\leq T \leq$ 435.71K.

Visualization:

4.19 Neon

4.19.1 Vapor Pressure - Antoine - ID 1

Name:	Neon
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.756410000e+00	c	K	-1.503000000e+00
b	K	9.559900000e+01			

Validity:
Equation is approximately valid for $15.9\text{K} \leq T \leq 27.0\text{K}$.

Visualization:

4.19.2 Vapor Pressure - EoS1 - ID 1

Name:	Neon
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.449000000e+01	a_4	-	-1.198510000e+00
p_{crit}	Pa	2.679000000e+06	b_4	-	5.000000000e+00
a_1	-	-5.742380000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.088600000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-5.896000000e-02	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 24.556K $\leq T \leq$ 44.49K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Neon'. Thus, data cannot be visualized!

4.19.3 Vapor Pressure - EoSCubic - ID 1

Name:	Neon
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.440000000e+01	β_1	-	0.000000000e+00
p_{crit}	Pa	2.661600000e+06	β_2	-	0.000000000e+00
ω	-	-3.550000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $28.2394\text{K} \leq T \leq 37.74\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Neon'. Thus, data cannot be visualized!

4.19.4 Vapor Pressure - EoSCubic - ID 2

Name:	Neon
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.440000000e+01	β_1	-	0.000000000e+00
p_{crit}	Pa	2.661600000e+06	β_2	-	0.000000000e+00
ω	-	-3.550000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 28.2394K $\leq T \leq$ 37.74K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Neon'. Thus, data cannot be visualized!

4.20 Nitrogen

4.20.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Nitrogen
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Span, Roland; Lemmon, Eric W.; Jacobsen, Richard T.; Wagner, Wolfgang; Yokozeki, Akimichi (2000): A Reference Equation of State for the Thermodynamic Properties of Nitrogen for Temperatures from 63.151 to 1000 K and Pressures to 2200 MPa. In: Journal of Physical and Chemical Reference Data 29 (6), S. 1361–1433. DOI: 10.1063/1.1349047.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	b_4	-	5.833333333e+00
T_{crit}	K	1.261920000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	3.130000000e+02	b_5	-	0.000000000e+00
a_1	-	1.486542370e+00	a_6	-	0.000000000e+00
b_1	-	3.294000000e-01	b_6	-	0.000000000e+00
a_2	-	-2.804760660e-01	a_7	-	0.000000000e+00
b_2	-	6.666666667e-01	b_7	-	0.000000000e+00
a_3	-	8.941430850e-02	a_8	-	0.000000000e+00
b_3	-	2.666666667e+00	b_8	-	0.000000000e+00
a_4	-	-1.198798660e-01			

Validity:
Equation is approximately valid for $63.151\text{K} \leq T \leq 126.192\text{K}$.

Visualization:

4.20.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Nitrogen
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	1.261900000e+02	a_5	-	1.244762939e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	3.130000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.504544409e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.575880831e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.790635463e+00			

Validity:
Equation is approximately valid for $63.151\text{K} \leq T \leq 126.19\text{K}$.

Visualization:

4.20.3 Vapor Pressure - Antoine - ID 1

Name:	Nitrogen
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.736200000e+00	c	K	-6.788000000e+00
b	K	2.646510000e+02			

Validity:
Equation is approximately valid for 63.14K $\leq T \leq$ 126.0K.

Visualization:

4.20.4 Vapor Pressure - Antoine - ID 2

Name:	Nitrogen
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.637920000e+00	c	K	-6.344000000e+00
b	K	2.578770000e+02			

Validity:
Equation is approximately valid for 63.14K $\leq T \leq$ 78.0K.

Visualization:

4.20.5 Vapor Pressure - EoS1 - ID 1

Name:	Nitrogen
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Span, Roland; Lemmon, Eric W.; Jacobsen, Richard T.; Wagner, Wolfgang; Yokozeki, Akimichi (2000): A Reference Equation of State for the Thermodynamic Properties of Nitrogen for Temperatures from 63.151 to 1000 K and Pressures to 2200 MPa. In: Journal of Physical and Chemical Reference Data 29 (6), S. 1361–1433. DOI: 10.1063/1.1349047.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	1.261920000e+02	a_4	-	-1.775705640e+00
p_{crit}	Pa	3.395800000e+06	b_4	-	5.000000000e+00
a_1	-	-6.124452840e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.263272200e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-7.659100820e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 63.151K $\leq T \leq$ 126.192K.

Visualization:

4.20.6 Vapor Pressure - EoS1 - ID 2

Name:	Nitrogen
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	1.261900000e+02	a_4	-	-1.781730000e+00
p_{crit}	Pa	3.396000000e+06	b_4	-	5.000000000e+00
a_1	-	-6.124980000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.264990000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-7.676500000e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 63.151K $\leq T \leq$ 126.19K.

Visualization:

4.20.7 Vapor Pressure - EoSCubic - ID 1

Name:	Nitrogen
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	1.261900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.395800000e+06	β_2	-	0.000000000e+00
ω	-	3.720000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 72.62365K $\leq T \leq$ 107.2615K.

Visualization:

4.20.8 Vapor Pressure - EoSCubic - ID 2

Name:	Nitrogen
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	1.261900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.395800000e+06	β_2	-	0.000000000e+00
ω	-	3.720000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $72.62365\text{K} \leq T \leq 107.2615\text{K}$.

Visualization:

4.21 Oxygen

4.21.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Oxygen
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	1.546000000e+02	a_5	-	8.728112412e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	4.270000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.752629508e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	9.279569087e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-9.747983607e-01			

Validity:
Equation is approximately valid for $54.361\mathrm{K} \leq T \leq 154.6\mathrm{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Oxygen'. Thus, data cannot be visualized!

4.21.2 Vapor Pressure - Antoine - ID 1

Name:	Oxygen
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.952300000e+00	c	K	-4.144000000e+00
b	K	3.400240000e+02			

Validity:
Equation is approximately valid for 54.36K $\leq T \leq$ 154.33K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Oxygen'. Thus, data cannot be visualized!

4.21.3 Vapor Pressure - EoS1 - ID 1

Name:	Oxygen
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	1.546000000e+02	a_4	-	-1.612880000e+00
p_{crit}	Pa	5.046000000e+06	b_4	-	5.000000000e+00
a_1	-	-6.051480000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.235060000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-6.288300000e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $54.361\text{K} \leq T \leq 154.6\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Oxygen'. Thus, data cannot be visualized!

4.21.4 Vapor Pressure - EoSCubic - ID 1

Name:	Oxygen
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	1.545800000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	5.043000000e+06	β_2	-	0.000000000e+00
ω	-	2.220000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $62.51515\text{K} \leq T \leq 131.393\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Oxygen'. Thus, data cannot be visualized!

4.21.5 Vapor Pressure - EoSCubic - ID 2

Name:	Oxygen
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	1.545800000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	5.043000000e+06	β_2	-	0.000000000e+00
ω	-	2.220000000e-02	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $62.51515\text{K} \leq T \leq 131.393\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Oxygen'. Thus, data cannot be visualized!

4.22 Propane

4.22.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Propane
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Lemmon, Eric W.; McLinden, Mark O.; Wagner, Wolfgang (2009): Thermodynamic Properties of Propane. III. A Reference Equation of State for Temperatures from the Melting Line to 650 K and Pressures up to 1000 MPa. In: J. Chem. Eng. Data 54 (12), S. 3141–3180. DOI: 10.1021/je900217v.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	2.600000000e+00
T_{crit}	K	3.698900000e+02	a_5	-	8.397300000e-02
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.204850000e+02	b_5	-	7.200000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.822050000e+00	a_7	-	0.000000000e+00
b_2	-	3.450000000e-01	b_7	-	0.000000000e+00
a_3	-	6.580200000e-01	a_8	-	0.000000000e+00
b_3	-	7.400000000e-01	b_8	-	0.000000000e+00
a_4	-	2.110900000e-01			

Validity:
Equation is approximately valid for $85.525\text{K} \leq T \leq 369.89\text{K}$.

Visualization:

4.22.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Propane
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.698200000e+02	a_5	-	1.482017195e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.210000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.688905430e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.466864706e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.952962896e+00			

Validity:
Equation is approximately valid for $85.525\text{K} \leq T \leq 369.82\text{K}$.

Visualization:

4.22.3 Vapor Pressure - Antoine - ID 1

Name:	Propane
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.536780000e+00	c	K	2.490600000e+01
b	K	1.149360000e+03			

Validity:
Equation is approximately valid for 277.6K $\leq T \leq$ 360.8K.

Visualization:

4.22.4 Vapor Pressure - Antoine - ID 2

Name:	Propane
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.982920000e+00	c	K	-2.441700000e+01
b	K	8.192960000e+02			

Validity:
Equation is approximately valid for 230.6K $\leq T \leq$ 320.7K.

Visualization:

4.22.5 Vapor Pressure - Antoine - ID 3

Name:	Propane
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.011580000e+00	c	K	-2.276300000e+01
b	K	8.342600000e+02			

Validity:
Equation is approximately valid for 166.02K $\leq T \leq$ 231.41K.

Visualization:

4.22.6 Vapor Pressure - EoS1 - ID 1

Name:	Propane
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, Eric W.; McLinden, Mark O.; Wagner, Wolfgang (2009): Thermodynamic Properties of Propane. III. A Reference Equation of State for Temperatures from the Melting Line to 650 K and Pressures up to 1000 MPa. In: J. Chem. Eng. Data 54 (12), S. 3141–3180. DOI: 10.1021/je900217v.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.698900000e+02	a_4	-	-3.187600000e+00
p_{crit}	Pa	4.251200000e+06	b_4	-	4.800000000e+00
a_1	-	-6.772200000e+00	a_5	-	9.493700000e-01
b_1	-	1.000000000e+00	b_5	-	6.200000000e+00
a_2	-	1.693800000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.334100000e+00	a_7	-	0.000000000e+00
b_3	-	2.200000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $85.525\text{K} \leq T \leq 369.89\text{K}$.

Visualization:

4.22.7 Vapor Pressure - EoS1 - ID 2

Name:	Propane
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.698200000e+02	a_4	-	-2.568270000e+00
p_{crit}	Pa	4.248000000e+06	b_4	-	5.000000000e+00
a_1	-	-6.714800000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.383880000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.309650000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $85.525\text{K} \leq T \leq 369.82\text{K}$.

Visualization:

4.22.8 Vapor Pressure - EoSCubic - ID 1

Name:	Propane
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.698900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.251200000e+06	β_2	-	0.000000000e+00
ω	-	1.521000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 98.35375K $\leq T \leq$ 314.4065K.

Visualization:

4.22.9 Vapor Pressure - EoSCubic - ID 2

Name:	Propane
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.698900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.251200000e+06	β_2	-	0.000000000e+00
ω	-	1.521000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 98.35375K $\leq T \leq$ 314.4065K.

Visualization:

4.23 Propene

4.23.1 Vapor Pressure - EoSCubic - ID 1

Name:	Propene
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.642100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.555000000e+06	β_2	-	0.000000000e+00
ω	-	1.460000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 101.14595K $\leq T \leq$ 309.5785K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'Propene'. Thus, data cannot be visualized!

4.24 Propylene

4.24.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Propylene
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.642100000e+02	a_5	-	7.932532847e-01
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	2.300000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.622817826e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.409465652e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.876542609e+00			

Validity:
Equation is approximately valid for $87.953\text{K} \leq T \leq 364.21\text{K}$.

Visualization:

4.24.2 Vapor Pressure - Antoine - ID 1

Name:	Propylene
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.974880000e+00	c	K	-2.488400000e+01
b	K	7.958190000e+02			

Validity:
Equation is approximately valid for 165.81K $\leq T \leq$ 225.98K.

Visualization:

4.24.3 Vapor Pressure - EoS1 - ID 1

Name:	Propylene
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.642100000e+02	a_4	-	-3.371390000e+00
p_{crit}	Pa	4.555000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-6.599710000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.106470000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-8.499900000e-01	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $87.953\text{K} \leq T \leq 364.21\text{K}$.

Visualization:

4.24.4 Vapor Pressure - EoSCubic - ID 1

Name:	Propylene
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.642100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.555000000e+06	β_2	-	0.000000000e+00
ω	-	1.460000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $101.14595\text{K} \leq T \leq 309.5785\text{K}$.

Visualization:

4.25 R-12

4.25.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-12
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.851200000e+02	a_5	-	1.700945841e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	5.650000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.619186903e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.760933805e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-2.343916460e+00			

Validity:
Equation is approximately valid for $116.1\mathrm{K} \leq T \leq 385.12\mathrm{K}$.

Visualization:

4.25.2 Vapor Pressure - Antoine - ID 1

Name:	R-12
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.811090000e+00	c	K	-3.777300000e+01
b	K	7.820720000e+02			

Validity:
Equation is approximately valid for 154.7K $\leq T \leq$ 243.4K.

Visualization:

4.25.3 Vapor Pressure - EoS1 - ID 1

Name:	R-12
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.851200000e+02	a_4	-	-2.582820000e+00
p_{crit}	Pa	4.136000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-6.920850000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.626150000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.739390000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 116.1K $\leq T \leq$ 385.12K.

Visualization:

4.25.4 Vapor Pressure - EoSCubic - ID 1

Name:	R-12
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.851200000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.136100000e+06	β_2	-	0.000000000e+00
ω	-	1.794800000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $133.515\text{K} \leq T \leq 327.352\text{K}$.

Visualization:

4.25.5 Vapor Pressure - EoSCubic - ID 2

Name:	R-12
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.851200000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.136100000e+06	β_2	-	0.000000000e+00
ω	-	1.794800000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 133.515K $\leq T \leq$ 327.352K.

Visualization:

4.26 R-123

4.26.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-123
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Younglove, Ben A.; McLinden, Mark O. (1994): An International Standard Equation of State for the Thermodynamic Properties of Refrigerant 123 (2,2-Dichloro-1,1,1-Trifluoroethane). In: Journal of Physical and Chemical Reference Data 23 (5), S. 731–779. DOI: 10.1063/1.555950.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	4.568310000e+02	a_5	-	9.536980230e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	5.500000518e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.032125410e+00	a_7	-	0.000000000e+00
b_2	-	3.550000000e-01	b_7	-	0.000000000e+00
a_3	-	6.151386150e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-7.803093750e-01			

Validity:
Equation is approximately valid for $166.0\mathrm{K} \leq T \leq 456.831\mathrm{K}$.

Visualization:

4.26.2 Vapor Pressure - EoS1 - ID 1

Name:	R-123
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Younglove, Ben A.; McLinden, Mark O. (1994): An International Standard Equation of State for the Thermodynamic Properties of Refrigerant 123 (2,2-Dichloro-1,1,1-Trifluoroethane). In: Journal of Physical and Chemical Reference Data 23 (5), S. 731–779. DOI: 10.1063/1.555950.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.568310000e+02	a_4	-	-3.194718270e+00
p_{crit}	Pa	3.661800000e+06	b_4	-	4.000000000e+00
a_1	-	-7.447552680e+00	a_5	-	-1.299823160e+00
b_1	-	1.000000000e+00	b_5	-	6.500000000e+00
a_2	-	2.222058280e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.900077220e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 166.0K $\leq T \leq$ 456.831K.

Visualization:

4.26.3 Vapor Pressure - EoSCubic - ID 1

Name:	R-123
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.568300000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.661800000e+06	β_2	-	0.000000000e+00
ω	-	2.819200000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 190.9K $\leq T \leq$ 388.3055K.

Visualization:

4.26.4 Vapor Pressure - EoSCubic - ID 2

Name:	R-123
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.568300000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.661800000e+06	β_2	-	0.000000000e+00
ω	-	2.819200000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 190.9K $\leq T \leq$ 388.3055K.

Visualization:

4.27 R-1234ze(E)

4.27.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-1234ze(E)
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Thol, Monika; Lemmon, Eric W. (2016): Equation of State for the Thermodynamic Properties of trans-1,3,3,3-Tetrafluoropropene [R-1234ze(E)]. In: Int J Thermophys 37 (3), S. 3710. DOI: 10.1007/s10765-016-2040-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.250000000e+00
T_{crit}	K	3.825130000e+02	a_5	-	1.309600000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	4.892380000e+02	b_5	-	1.900000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.191300000e+00	a_7	-	0.000000000e+00
b_2	-	2.700000000e-01	b_7	-	0.000000000e+00
a_3	-	2.245600000e+00	a_8	-	0.000000000e+00
b_3	-	7.000000000e-01	b_8	-	0.000000000e+00
a_4	-	-1.774700000e+00			

Validity:
Equation is approximately valid for $169.0\mathrm{K} \leq T \leq 382.513\mathrm{K}$.

Visualization:

4.27.2 Vapor Pressure - EoS1 - ID 1

Name:	R-1234ze(E)
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Thol, Monika; Lemmon, Eric W. (2016): Equation of State for the Thermodynamic Properties of trans-1,3,3,3-Tetrafluoropropene [R-1234ze(E)]. In: Int J Thermophys 37 (3), S. 3710. DOI: 10.1007/s10765-016-2040-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.825130000e+02	a_4	-	-4.123800000e+00
p_{crit}	Pa	3.634900000e+06	b_4	-	4.600000000e+00
a_1	-	-7.588800000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.969600000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.082700000e+00	a_7	-	0.000000000e+00
b_3	-	2.200000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 169.0K $\leq T \leq$ 382.513K.

Visualization:

4.27.3 Vapor Pressure - EoSCubic - ID 1

Name:	R-1234ze(E)
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.825100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.634900000e+06	β_2	-	0.000000000e+00
ω	-	3.130000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 194.35K $\leq T \leq$ 325.1335K.

Visualization:

4.27.4 Vapor Pressure - EoSCubic - ID 2

Name:	R-1234ze(E)
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.825100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.634900000e+06	β_2	-	0.000000000e+00
ω	-	3.130000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 194.35K $\leq T \leq$ 325.1335K.

Visualization:

4.28 R-125

4.28.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-125
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Lemmon, Eric W.; Jacobsen, Richard T. (2005): A New Functional Form and New Fitting Techniques for Equations of State with Application to Pentafluoroethane (HFC-125). In: Journal of Physical and Chemical Reference Data 34 (1), S. 69–108. DOI: 10.1063/1.1797813.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	2.900000000e+00
T_{crit}	K	3.391730000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	5.735755800e+02	b_5	-	0.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.668400000e+00	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	8.841500000e-01	a_8	-	0.000000000e+00
b_3	-	6.000000000e-01	b_8	-	0.000000000e+00
a_4	-	4.438300000e-01			

Validity:
Equation is approximately valid for $172.52\mathrm{K} \leq T \leq 339.173\mathrm{K}$.

Visualization:

4.28.2 Vapor Pressure - EoS1 - ID 1

Name:	R-125
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, Eric W.; Jacobsen, Richard T. (2005): A New Functional Form and New Fitting Techniques for Equations of State with Application to Pentafluoroethane (HFC-125). In: Journal of Physical and Chemical Reference Data 34 (1), S. 69–108. DOI: 10.1063/1.1797813.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.391730000e+02	a_4	-	-3.448000000e+00
p_{crit}	Pa	3.617700000e+06	b_4	-	4.600000000e+00
a_1	-	-7.529500000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.902600000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.296600000e+00	a_7	-	0.000000000e+00
b_3	-	2.300000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 172.52K $\leq T \leq$ 339.173K.

Visualization:

4.28.3 Vapor Pressure - EoSCubic - ID 1

Name:	R-125
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.391700000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.617700000e+06	β_2	-	0.000000000e+00
ω	-	3.052000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 198.398K $\leq T \leq$ 288.2945K.

Visualization:

4.28.4 Vapor Pressure - EoSCubic - ID 2

Name:	R-125
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.391700000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.617700000e+06	β_2	-	0.000000000e+00
ω	-	3.052000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 198.398K $\leq T \leq$ 288.2945K.

Visualization:

4.29 R-13 B1

4.29.1 Vapor Pressure - Antoine - ID 1

Name:	R-13 B1
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.585520000e+00	c	K	7.086000000e+00
b	K	1.018310000e+03			

Validity:
Equation is approximately valid for $129.5\text{K} < T < 215.4\text{K}$.

Visualization:

4.30 R-134a

4.30.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-134a
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Tillner-Roth, Reiner; Baehr, Hans Dieter (1994): An International Standard Formulation for the Thermodynamic Properties of 1,1,1,2-Tetrafluoroethane (HFC-134a) for Temperatures from 170 K to 455 K and Pressures up to 70 MPa. In: Journal of Physical and Chemical Reference Data 23 (5), S. 657–729. DOI: 10.1063/1.555958.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\mathrm{sat}}^{\mathrm{liq}}$ in $\mathrm{kg\,m^{-3}}$ is calculated depending on temperature T in

K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	3.333333333e+00
T_{crit}	K	3.741800000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	1.000000000e+00	b_5	-	0.000000000e+00
a_1	-	5.182000000e+02	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	8.841300000e+02	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	4.858400000e+02	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.932900000e+02			

Validity:
Equation is approximately valid for 169.85K $\leq T \leq$ 374.18K.

Visualization:

4.30.2 Vapor Pressure - EoS1 - ID 1

Name:	R-134a
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Tillner-Roth, Reiner; Baehr, Hans Dieter (1994): An International Standard Formulation for the Thermodynamic Properties of 1,1,1,2-Tetrafluoroethane (HFC-134a) for Temperatures from 170 K to 455 K and Pressures up to 70 MPa. In: Journal of Physical and Chemical Reference Data 23 (5), S. 657–729. DOI: 10.1063/1.555958.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.741800000e+02	a_4	-	-3.583758000e+00
p_{crit}	Pa	4.056290000e+06	b_4	-	4.000000000e+00
a_1	-	-7.686556000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.311791000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.039554000e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 169.85K $\leq T \leq$ 374.18K.

Visualization:

4.30.3 Vapor Pressure - EoSCubic - ID 1

Name:	R-134a
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.742100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.059300000e+06	β_2	-	0.000000000e+00
ω	-	3.268400000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $195.3275\text{K} \leq T \leq 318.0785\text{K}$.

Visualization:

4.30.4 Vapor Pressure - EoSCubic - ID 2

Name:	R-134a
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.742100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.059300000e+06	β_2	-	0.000000000e+00
ω	-	3.268400000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 195.3275K $\leq T \leq$ 318.0785K.

Visualization:

4.31 R-142b

4.31.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-142b
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	McLinden, M. O.: Physical Properties of Alternatives to the Fully Halogenated Chlorofluorocarbons.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	4.102500000e+02	a_5	-	7.113558700e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	4.350000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	-2.767150000e-01	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	1.014727500e+01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.391714200e+01			

Validity:
Equation is approximately valid for $142.72\mathrm{K} \leq T \leq 410.25\mathrm{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-142b'. Thus, data cannot be visualized!

4.31.2 Vapor Pressure - EoS3 - ID 1

Name:	R-142b
Equation:	VaporPressure_EoS3
ID:	1
Reference:	McLinden, M. O.: Physical Properties of Alternatives to the Fully Halogenated Chlorofluorocarbons.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{ref}} \exp\left({}^{a_0}/_{T} + \sum_{i=1}^{2} a_i T^{b_i} + a_3 \xi^{b_3} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	4.102500000e+02	a_2	-	-1.012149000e-03
p_{ref}	Pa	1.000000000e+03	b_2	-	1.000000000e+00
a_0	-	-3.382422000e+03	a_3	-	3.224924000e+00
a_1	-	1.701384000e+01	b_3	-	1.500000000e+00
b_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 142.72K $\leq T \leq$ 410.25K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-142b'. Thus, data cannot be visualized!

4.31.3 Vapor Pressure - EoSCubic - ID 1

Name:	R-142b
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	4.102600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.055000000e+06	β_2	-	0.000000000e+00
ω	-	2.321000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 164.128K $\leq T \leq$ 348.721K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-142b'. Thus, data cannot be visualized!

4.31.4 Vapor Pressure - EoSCubic - ID 2

Name:	R-142b
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	4.102600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.055000000e+06	β_2	-	0.000000000e+00
ω	-	2.321000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $164.128\text{K} \leq T \leq 348.721\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-142b'. Thus, data cannot be visualized!

4.32 R-143a

4.32.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-143a
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Lemmon, Eric W.; Jacobsen, Richard T. (2000): An International Standard Formulation for the Thermodynamic Properties of 1,1,1-Trifluoroethane (HFC-143a) for Temperatures From 161 to 450 K and Pressures to 50 MPa. In: Journal of Physical and Chemical Reference Data 29 (4), S. 521–552. DOI: 10.1063/1.1318909.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	2.666666667e+00
T_{crit}	K	3.458570000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	4.309949380e+02	b_5	-	0.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.795000000e+00	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	8.709000000e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	3.116000000e-01			

Validity:
Equation is approximately valid for $161.34\text{K} \leq T \leq 345.857\text{K}$.

Visualization:

4.32.2 Saturated Liquid Density - EoS1 - ID 2

Name:	R-143a
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.458600000e+02	a_5	-	5.060540603e-01
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	4.310000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.064521114e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	3.698689095e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-6.395081207e-02			

Validity:
Equation is approximately valid for $161.34\text{K} \leq T \leq 345.86\text{K}$.

Visualization:

4.32.3 Vapor Pressure - Antoine - ID 1

Name:	R-143a
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.024230000e+00	c	K	-3.009300000e+01
b	K	7.866450000e+02			

Validity:
Equation is approximately valid for 173.6K $\leq T \leq$ 225.78K.

Visualization:

4.32.4 Vapor Pressure - EoS1 - ID 1

Name:	R-143a
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, Eric W.; Jacobsen, Richard T. (2000): An International Standard Formulation for the Thermodynamic Properties of 1,1,1-Trifluoroethane (HFC-143a) for Temperatures From 161 to 450 K and Pressures to 50 MPa. In: Journal of Physical and Chemical Reference Data 29 (4), S. 521–552. DOI: 10.1063/1.1318909.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.458570000e+02	a_4	-	-2.053200000e+00
p_{crit}	Pa	3.761000000e+06	b_4	-	3.500000000e+00
a_1	-	-7.352600000e+00	a_5	-	-1.735400000e+00
b_1	-	1.000000000e+00	b_5	-	5.500000000e+00
a_2	-	1.916200000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.220300000e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 161.34K $\leq T \leq$ 345.857K.

Visualization:

4.32.5 Vapor Pressure - EoS1 - ID 2

Name:	R-143a
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.458600000e+02	a_4	-	-2.984130000e+00
p_{crit}	Pa	3.762000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.359950000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.712030000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.018790000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 161.34K $\leq T \leq$ 345.86K.

Visualization:

4.32.6 Vapor Pressure - EoSCubic - ID 1

Name:	R-143a
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.458600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.761000000e+06	β_2	-	0.000000000e+00
ω	-	2.615000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 185.541K $\leq T \leq$ 293.981K.

Visualization:

4.32.7 Vapor Pressure - EoSCubic - ID 2

Name:	R-143a
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.458600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	3.761000000e+06	β_2	-	0.000000000e+00
ω	-	2.615000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $185.541\text{K} \leq T \leq 293.981\text{K}$.

Visualization:

4.33 R-152a

4.33.1 Vapor Pressure - Antoine - ID 1

Name:	R-152a
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.234060000e+00	c	K	-3.471400000e+01
b	K	8.961710000e+02			

Validity:
Equation is approximately valid for $160.7\text{K} < T < 246.7\text{K}$.

Visualization:

4.33.2 Vapor Pressure - EoSCubic - ID 1

Name:	R-152a
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.864100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.516800000e+06	β_2	-	0.000000000e+00
ω	-	2.752100000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 177.744K $\leq T \leq$ 328.4485K.

Visualization:

4.33.3 Vapor Pressure - EoSCubic - ID 2

Name:	R-152a
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.864100000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.516800000e+06	β_2	-	0.000000000e+00
ω	-	2.752100000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 177.744K $\leq T \leq$ 328.4485K.

Visualization:

4.34 R-22

4.34.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-22
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Wagner, W.; Marx, V.; Pruss, A. (1993): A new equation of state for chlorodifluoromethane (R22) covering the entire fluid region from 116 K to 550 K at pressures up to 200 MPa. In: International Journal of Refrigeration 16 (6), S. 373–389. DOI: 10.1016/0140-7007(93)90055-D.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.666666667e+00
T_{crit}	K	3.692800000e+02	a_5	-	2.038181240e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	5.200000000e+02	b_5	-	4.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.759600330e+00	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	7.853631550e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.888700410e-01			

Validity:
Equation is approximately valid for $115.73\mathrm{K} \leq T \leq 369.28\mathrm{K}$.

Visualization:

4.34.2 Saturated Liquid Density - EoS1 - ID 2

Name:	R-22
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.692800000e+02	a_5	-	1.694242308e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	5.200000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.738698269e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	1.681093461e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-2.261796539e+00			

Validity:
Equation is approximately valid for $115.73\text{K} \leq T \leq 369.28\text{K}$.

Visualization:

4.34.3 Vapor Pressure - Antoine - ID 1

Name:	R-22
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.365670000e+00	c	K	-1.496400000e+01
b	K	9.475770000e+02			

Validity:
Equation is approximately valid for 232.4K $\leq T \leq$ 358.5K.

Visualization:

4.34.4 Vapor Pressure - Antoine - ID 2

Name:	R-22
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.176930000e+00	c	K	-2.666700000e+01
b	K	8.576730000e+02			

Validity:
Equation is approximately valid for 229.6K $\leq T \leq$ 236.4K.

Visualization:

4.34.5 Vapor Pressure - EoS1 - ID 1

Name:	R-22
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Wagner, W.; Marx, V.; Pruss, A. (1993): A new equation of state for chlorodifluoromethane (R22) covering the entire fluid region from 116 K to 550 K at pressures up to 200 MPa. In: International Journal of Refrigeration 16 (6), S. 373–389. DOI: 10.1016/0140-7007(93)90055-D.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.692800000e+02	a_4	-	-3.259731820e+00
p_{crit}	Pa	4.988500000e+06	b_4	-	4.500000000e+00
a_1	-	-7.149993690e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.221537540e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.923902010e+00	a_7	-	0.000000000e+00
b_3	-	2.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 115.73K $\leq T \leq$ 369.28K.

Visualization:

4.34.6 Vapor Pressure - EoS1 - ID 2

Name:	R-22
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.692800000e+02	a_4	-	-2.731230000e+00
p_{crit}	Pa	4.988000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.092100000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.619050000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.012210000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 115.73K $\leq T \leq$ 369.28K.

Visualization:

4.34.7 Vapor Pressure - EoSCubic - ID 1

Name:	R-22
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.693000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.990000000e+06	β_2	-	0.000000000e+00
ω	-	2.208200000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 133.0895K $\leq T \leq$ 313.905K.

Visualization:

4.34.8 Vapor Pressure - EoSCubic - ID 2

Name:	R-22
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.693000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.990000000e+06	β_2	-	0.000000000e+00
ω	-	2.208200000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 133.0895K $\leq T \leq$ 313.905K.

Visualization:

4.35 R-227ea

4.35.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-227ea
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Lemmon, Eric W.; Span, Roland (2015): Thermodynamic Properties of R-227ea, R-365mfc, R-115, and R-13I1. In: J. Chem. Eng. Data 60 (12), S. 3745–3758. DOI: 10.1021/acs.jced.5b00684.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	4.400000000e-01
T_{crit}	K	3.749000000e+02	a_5	-	2.078400000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	5.942548500e+02	b_5	-	6.000000000e-01
a_1	-	1.000000000e+00	a_6	-	2.170100000e-01
b_1	-	0.000000000e+00	b_6	-	2.750000000e+00
a_2	-	-2.992600000e-01	a_7	-	0.000000000e+00
b_2	-	1.500000000e-01	b_7	-	0.000000000e+00
a_3	-	2.802500000e+00	a_8	-	0.000000000e+00
b_3	-	3.000000000e-01	b_8	-	0.000000000e+00
a_4	-	-1.960200000e+00			

Validity:
Equation is approximately valid for $146.35\mathrm{K} \leq T \leq 374.9\mathrm{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-227ea '. Thus, data cannot be visualized!

4.35.2 Vapor Pressure - EoS1 - ID 1

Name:	R-227ea
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, Eric W.; Span, Roland (2015): Thermodynamic Properties of R-227ea, R-365mfc, R-115, and R-13I1. In: J. Chem. Eng. Data 60 (12), S. 3745–3758. DOI: 10.1021/acs.jced.5b00684.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.749000000e+02	a_4	-	-5.744400000e+00
p_{crit}	Pa	2.925000000e+06	b_4	-	4.800000000e+00
a_1	-	-7.796100000e+00	a_5	-	2.398200000e+00
b_1	-	1.000000000e+00	b_5	-	6.200000000e+00
a_2	-	2.136600000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.602300000e+00	a_7	-	0.000000000e+00
b_3	-	2.200000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 146.35K $\leq T \leq$ 374.9K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-227ea '. Thus, data cannot be visualized!

4.35.3 Vapor Pressure - EoSCubic - ID 1

Name:	R-227ea
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.749000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	2.925000000e+06	β_2	-	0.000000000e+00
ω	-	3.570000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 168.3025K $\leq T \leq$ 318.665K.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-227ea '. Thus, data cannot be visualized!

4.35.4 Vapor Pressure - EoSCubic - ID 2

Name:	R-227ea
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and} \\
a &= 0.45724\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1 + \kappa\left(1 - \sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464 + 1.54226\omega - 0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.749000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	2.925000000e+06	β_2	-	0.000000000e+00
ω	-	3.570000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $168.3025\text{K} \leq T \leq 318.665\text{K}$.

Visualization:
No adsorption or absorption working pair exists, which uses refrigerant 'R-227ea '. Thus, data cannot be visualized!

4.36 R-23

4.36.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-23
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Penoncello, Steven G.; Lemmon, Eric W.; Jacobsen, Richard T.; Shan, Zhengjun (2003): A Fundamental Equation for Trifluoromethane (R-23). In: Journal of Physical and Chemical Reference Data 32 (4), S. 1473–1499. DOI: 10.1063/1.1559671.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	3.100000000e+00
T_{crit}	K	2.992930000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	5.264752000e+02	b_5	-	0.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.263600000e+00	a_7	-	0.000000000e+00
b_2	-	3.700000000e-01	b_7	-	0.000000000e+00
a_3	-	4.700700000e-01	a_8	-	0.000000000e+00
b_3	-	9.400000000e-01	b_8	-	0.000000000e+00
a_4	-	2.866000000e-01			

Validity:
Equation is approximately valid for $118.02\text{K} \leq T \leq 299.293\text{K}$.

Visualization:

4.36.2 Saturated Liquid Density - EoS1 - ID 2

Name:	R-23
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	2.997500000e+02	a_5	-	3.470938213e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	5.260000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.217400380e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	4.115744107e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-5.830380608e+00			

Validity:
Equation is approximately valid for $118.02\text{K} \leq T \leq 299.75\text{K}$.

Visualization:

4.36.3 Vapor Pressure - Antoine - ID 1

Name:	R-23
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.255480000e+00	c	K	-2.201300000e+01
b	K	7.180890000e+02			

Validity:
Equation is approximately valid for 145.36K $\leq T \leq$ 191.19K.

Visualization:

4.36.4 Vapor Pressure - EoS1 - ID 1

Name:	R-23
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Penoncello, Steven G.; Lemmon, Eric W.; Jacobsen, Richard T.; Shan, Zhengjun (2003): A Fundamental Equation for Trifluoromethane (R-23). In: Journal of Physical and Chemical Reference Data 32 (4), S. 1473–1499. DOI: 10.1063/1.1559671.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	2.992930000e+02	a_4	-	-3.199100000e+00

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	4.832000000e+06	b_4	-	3.900000000e+00
a_1	-	-7.263100000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.314000000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-7.850700000e-01	a_7	-	0.000000000e+00
b_3	-	2.400000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 118.02K $\leq T \leq$ 299.293K.

Visualization:

4.36.5 Vapor Pressure - EoS1 - ID 2

Name:	R-23
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	2.997500000e+02	a_4	-	-1.431780000e+00
p_{crit}	Pa	4.869000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.382160000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.962340000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.683920000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 118.02K $\leq T \leq$ 299.75K.

Visualization:

4.36.6 Vapor Pressure - EoSCubic - ID 1

Name:	R-23
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	2.992900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.832000000e+06	β_2	-	0.000000000e+00
ω	-	2.630000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 135.723K $\leq T \leq$ 254.3965K.

Visualization:

4.36.7 Vapor Pressure - EoSCubic - ID 2

Name:	R-23
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	2.992900000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.832000000e+06	β_2	-	0.000000000e+00
ω	-	2.630000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 135.723K $\leq T \leq$ 254.3965K.

Visualization:

4.37 R-32

4.37.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-32
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.512600000e+02	a_5	-	5.416509434e-01
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	4.240000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.111498349e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	5.287551887e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.201009434e-01			

Validity:
Equation is approximately valid for $136.34\mathrm{K} \leq T \leq 351.26\mathrm{K}$.

Visualization:

4.37.2 Vapor Pressure - Antoine - ID 1

Name:	R-32
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.262240000e+00	c	K	-2.855400000e+01
b	K	8.210920000e+02			

Validity:
Equation is approximately valid for 191.19K $\leq T \leq$ 241.33K.

Visualization:

4.37.3 Vapor Pressure - EoS1 - ID 1

Name:	R-32
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Weber, L. A.; Silva, A. M. (1994): Measurements of the Vapor Pressures of Difluoromethane, 1-Chloro-1,2,2,2-tetrafluoroethane, and Pentafluoroethane. In: J. Chem. Eng. Data 39 (4), S. 808–812. DOI: 10.1021/je00016a038.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.513600000e+02	a_4	-	-2.617090000e+00

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	5.793100000e+06	b_4	-	5.000000000e+00
a_1	-	-7.461490000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.736870000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-1.986560000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $136.34\text{K} \leq T \leq 351.36\text{K}$.

Visualization:

4.37.4 Vapor Pressure - EoS1 - ID 2

Name:	R-32
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.512600000e+02	a_4	-	-2.621470000e+00
p_{crit}	Pa	5.783000000e+06	b_4	-	5.000000000e+00
a_1	-	-7.470270000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.755950000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.014290000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 136.34K $\leq T \leq$ 351.26K.

Visualization:

4.37.5 Vapor Pressure - EoSCubic - ID 1

Name:	R-32
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	3.512600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	5.782000000e+06	β_2	-	0.000000000e+00
ω	-	2.769000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 156.791K $\leq T \leq$ 298.571K.

Visualization:

4.37.6 Vapor Pressure - EoSCubic - ID 2

Name:	R-32
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	3.512600000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	5.782000000e+06	β_2	-	0.000000000e+00
ω	-	2.769000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $156.791\text{K} \leq T \leq 298.571\text{K}$.

Visualization:

4.38 R-404a

4.38.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-404a
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Online: https://www.freon.com/en/-/media/files/freon/freon-410a-si-thermodynamic-properties.pdf?rev=6b72bfaa299142d697540982b88a56eb
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.452200000e+02	a_5	-	7.614200000e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	4.845000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000200000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.930000000e-01	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	9.082900000e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-1.378100000e+01			

Validity:
Equation is approximately valid for 200.0K $\leq T \leq$ 345.22K.

Visualization:

4.39 R-407c

4.39.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-407c
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Online: https://www.freon.com/en/-/media/files/freon/freon-410a-si-thermodynamic-properties.pdf?rev=6b72bfaa299142d697540982b88a56eb
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.598900000e+02	a_5	-	0.000000000e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	5.273000000e+02	b_5	-	0.000000000e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	2.350274000e+00	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	-2.029024000e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	2.746460000e+00			

Validity:
Equation is approximately valid for $200.0\text{K} \leq T \leq 359.89\text{K}$.

Visualization:

4.39.2 Vapor Pressure - EoS1 - ID 1

Name:	R-407c
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, E. W. (2003): Pseudo-Pure Fluid Equations of State for the Refrigerant Blends R-410A, R-404A, R-507A, and R-407C. In: International Journal of Thermophysics 24 (4), S. 991–1006. DOI: 10.1023/A:1025048800563.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{sat} &= p_{crit} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{crit}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.593450000e+02	a_4	-	-2.510900000e+00

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	4.631700000e+06	b_4	-	4.700000000e+00
a_1	-	4.872200000e-01	a_5	-	0.000000000e+00
b_1	-	5.400000000e-01	b_5	-	0.000000000e+00
a_2	-	-6.695900000e+00	a_6	-	0.000000000e+00
b_2	-	9.250000000e-01	b_6	-	0.000000000e+00
a_3	-	-1.416500000e+00	a_7	-	0.000000000e+00
b_3	-	2.700000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 215.607K $\leq T \leq$ 359.345K.

Visualization:

4.40 R-410a

4.40.1 Saturated Liquid Density - EoS1 - ID 1

Name:	R-410a
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Online: https://www.freon.com/en/-/media/files/freon/freon-410a-si-thermodynamic-properties.pdf?rev=6b72bfaa299142d697540982b88a56eb
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	3.452800000e+02	a_5	-	-7.171684000e-01
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	4.889000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.984734000e+00	a_7	-	0.000000000e+00
b_2	-	3.333333333e-01	b_7	-	0.000000000e+00
a_3	-	-1.767593000e-01	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.819972000e+00			

Validity:
Equation is approximately valid for $200.0\text{K} \leq T \leq 345.28\text{K}$.

Visualization:

4.40.2 Vapor Pressure - EoS1 - ID 1

Name:	R-410a
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, E. W. (2003): Pseudo-Pure Fluid Equations of State for the Refrigerant Blends R-410A, R-404A, R-507A, and R-407C. In: International Journal of Thermophysics 24 (4), S. 991–1006. DOI: 10.1023/A:1025048800563.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{sat} &= p_{crit} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{crit}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.444940000e+02	a_4	-	-2.802200000e+00

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	4.901200000e+06	b_4	-	4.900000000e+00
a_1	-	-7.281800000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.509300000e+00	a_6	-	0.000000000e+00
b_2	-	1.800000000e+00	b_6	-	0.000000000e+00
a_3	-	-3.269500000e+00	a_7	-	0.000000000e+00
b_3	-	2.400000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 206.6964K $\leq T \leq$ 344.494K.

Visualization:

4.41 R-507a

4.41.1 Vapor Pressure - EoS1 - ID 1

Name:	R-507a
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Lemmon, E. W. (2003): Pseudo-Pure Fluid Equations of State for the Refrigerant Blends R-410A, R-404A, R-507A, and R-407C. In: International Journal of Thermophysics 24 (4), S. 991–1006. DOI: 10.1023/A:1025048800563.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1-\theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	3.437650000e+02	a_4	-	-3.776300000e+00
p_{crit}	Pa	3.704900000e+06	b_4	-	4.600000000e+00
a_1	-	-7.485300000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.011500000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.014100000e+00	a_7	-	0.000000000e+00
b_3	-	2.200000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 206.259K $\leq T \leq$ 343.765K.

Visualization:

4.42 TFE

4.42.1 Vapor Pressure - Antoine - ID 1

Name:	TFE
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.569460000e+00	c	K	-1.119320000e+02
b	K	8.559210000e+02			

Validity:
Equation is approximately valid for $272.8\text{K} < T < 298.6\text{K}$.

Visualization:

4.43 THF

4.43.1 Vapor Pressure - Antoine - ID 1

Name:	THF
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.121180000e+00	c	K	-4.681800000e+01
b	K	1.202942000e+03			

Validity:
Equation is approximately valid for $296.29\text{K} \leq T \leq 372.8\text{K}$.

Visualization:

4.44 Toluene

4.44.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Toluene
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = {}^{T}/_{T_{\text{crit}}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	5.917500000e+02	a_5	-	2.732445548e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	2.920000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	1.505422945e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	2.873821233e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-4.228919520e+00			

Validity:
Equation is approximately valid for $178.0\mathrm{K} \leq T \leq 591.75\mathrm{K}$.

Visualization:

4.44.2 Vapor Pressure - Antoine - ID 1

Name:	Toluene
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.236790000e+00	c	K	-4.595700000e+01
b	K	1.426448000e+03			

Validity:
Equation is approximately valid for 273.13K $\leq T \leq$ 297.89K.

Visualization:

4.44.3 Vapor Pressure - Antoine - ID 2

Name:	Toluene
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.082450000e+00	c	K	-5.350800000e+01
b	K	1.346382000e+03			

Validity:
Equation is approximately valid for 303.0K $\leq T \leq$ 343.0K.

Visualization:

4.44.4 Vapor Pressure - Antoine - ID 3

Name:	Toluene
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.544360000e+00	c	K	3.940000000e-01
b	K	1.738123000e+03			

Validity:
Equation is approximately valid for 420.0K $\leq T \leq$ 580.0K.

Visualization:

4.44.5 Vapor Pressure - Antoine - ID 4

Name:	Toluene
Equation:	VaporPressure_Antoine
ID:	4
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.078270000e+00	c	K	-5.377300000e+01
b	K	1.343943000e+03			

Validity:
Equation is approximately valid for 308.52K $\leq T \leq$ 384.66K.

Visualization:

4.44.6 Vapor Pressure - Antoine - ID 5

Name:	Toluene
Equation:	VaporPressure_Antoine
ID:	5
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.141570000e+00	c	K	-5.050700000e+01
b	K	1.377578000e+03			

Validity:
Equation is approximately valid for 273.0K $\leq T \leq$ 323.0K.

Visualization:

4.44.7 Vapor Pressure - EoS1 - ID 1

Name:	Toluene
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	5.917500000e+02	a_4	-	-2.850420000e+00
p_{crit}	Pa	4.126000000e+06	b_4	-	5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
a_1	-	-7.500510000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	2.089390000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.563680000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 178.0K $\leq T \leq$ 591.75K.

Visualization:

4.44.8 Vapor Pressure - EoSCubic - ID 1

Name:	Toluene
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and}\\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and}\\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and}\\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	5.917500000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.126300000e+06	β_2	-	0.000000000e+00
ω	-	2.657000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for $204.7\text{K} \leq T \leq 502.9875\text{K}$.

Visualization:

4.44.9 Vapor Pressure - EoSCubic - ID 2

Name:	Toluene
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	5.917500000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	4.126300000e+06	β_2	-	0.000000000e+00
ω	-	2.657000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 204.7K $\leq T \leq$ 502.9875K.

Visualization:

4.45 Water

4.45.1 Saturated Liquid Density - EoS1 - ID 1

Name:	Water
Equation:	SaturatedLiquidDensity_EoS1
ID:	1
Reference:	Wagner, W.; Pruß, A. (2002): The IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use. In: Journal of Physical and Chemical Reference Data 31 (2), S. 387–535. DOI: 10.1063/1.1461829.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \quad \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \quad \text{, and}$$

$$\xi = 1 - \theta \quad \text{, and}$$

$$\theta = T/T_{\text{crit}} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.666666667e+00
T_{crit}	K	6.470960000e+02	a_5	-	-1.754934790e+00
ρ_{ref}	$\mathrm{kg\,m^{-3}}$	3.220000000e+02	b_5	-	5.333333333e+00
a_1	-	1.000000000e+00	a_6	-	-4.551703520e+01
b_1	-	0.000000000e+00	b_6	-	1.433333333e+01
a_2	-	1.992740640e+00	a_7	-	-6.746944500e+05
b_2	-	3.333333333e-01	b_7	-	3.666666667e+01
a_3	-	1.099653420e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	-5.108393030e-01			

Validity:
Equation is approximately valid for $273.16\mathrm{K} \leq T \leq 647.096\mathrm{K}$.

Visualization:

4.45.2 Saturated Liquid Density - EoS1 - ID 2

Name:	Water
Equation:	SaturatedLiquidDensity_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Saturated liquid density $\rho_{\text{sat}}^{\text{liq}}$ in $\text{kg}\,\text{m}^{-3}$ is calculated depending on temperature T in K by:

$$\rho_{\text{sat}}^{\text{liq}} = \begin{cases} \rho_{\text{ref}} \exp(\Omega) & \text{if flag } < 0 \\ \rho_{\text{ref}} \Omega & \text{else} \end{cases} \text{, with}$$

$$\Omega = \sum_{i=1}^{8} a_i \xi^{b_i} \text{, and}$$

$$\xi = 1 - \theta \text{, and}$$

$$\theta = T/T_{\text{crit}} \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	b_4	-	1.000000000e+00
T_{crit}	K	6.471000000e+02	a_5	-	-7.701282609e+00
ρ_{ref}	$\text{kg}\,\text{m}^{-3}$	3.220000000e+02	b_5	-	1.333333333e+00
a_1	-	1.000000000e+00	a_6	-	0.000000000e+00
b_1	-	0.000000000e+00	b_6	-	0.000000000e+00
a_2	-	3.397587888e+00	a_7	-	0.000000000e+00
b_2	-	3.500000000e-01	b_7	-	0.000000000e+00
a_3	-	-5.631147516e+00	a_8	-	0.000000000e+00
b_3	-	6.666666667e-01	b_8	-	0.000000000e+00
a_4	-	1.199986242e+01			

Validity:
Equation is approximately valid for $273.16\text{K} \leq T \leq 647.1\text{K}$.

Visualization:

4.45.3 Vapor Pressure - Antoine - ID 1

Name:	Water
Equation:	VaporPressure_Antoine
ID:	1
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	3.559590000e+00	c	K	-1.980430000e+02
b	K	6.437480000e+02			

Validity:
Equation is approximately valid for 379.0K $\leq T \leq$ 583.0K.

Visualization:

4.45.4 Vapor Pressure - Antoine - ID 2

Name:	Water
Equation:	VaporPressure_Antoine
ID:	2
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.402210000e+00	c	K	-3.173700000e+01
b	K	1.838675000e+03			

Validity:
Equation is approximately valid for 273.0K $\leq T \leq$ 303.0K.

Visualization:

4.45.5 Vapor Pressure - Antoine - ID 3

Name:	Water
Equation:	VaporPressure_Antoine
ID:	3
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.203890000e+00	c	K	-3.948500000e+01
b	K	1.733926000e+03			

Validity:
Equation is approximately valid for 304.0K $\leq T \leq$ 333.0K.

Visualization:

4.45.6 Vapor Pressure - Antoine - ID 4

Name:	Water
Equation:	VaporPressure_Antoine
ID:	4
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.076800000e+00	c	K	-4.585400000e+01
b	K	1.659793000e+03			

Validity:
Equation is approximately valid for 334.0K $\leq T \leq$ 363.0K.

Visualization:

4.45.7 Vapor Pressure - Antoine - ID 5

Name:	Water
Equation:	VaporPressure_Antoine
ID:	5
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	5.083540000e+00	c	K	-4.562200000e+01
b	K	1.663125000e+03			

Validity:
Equation is approximately valid for 344.0K $\leq T \leq$ 373.0K.

Visualization:

4.45.8 Vapor Pressure - Antoine - ID 6

Name:	Water
Equation:	VaporPressure_Antoine
ID:	6
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	6.209630000e+00	c	K	7.559000000e+00
b	K	2.354731000e+03			

Validity:
Equation is approximately valid for 293.0K $\leq T \leq$ 343.0K.

Visualization:

4.45.9 Vapor Pressure - Antoine - ID 7

Name:	Water
Equation:	VaporPressure_Antoine
ID:	7
Reference:	P.J. Linstrom and W.G. Mallard, Eds., NIST Chemistry WebBook, NIST Standard Reference Database Number 69, National Institute of Standards and Technology, Gaithersburg MD, 20899, https://doi.org/10.18434/T4D303.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$p_{\text{sat}}/100000 = 10^{a-b/T+c}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	-	4.654300000e+00	c	K	-6.484800000e+01
b	K	1.435264000e+03			

Validity:
Equation is approximately valid for 255.9K $\leq T \leq$ 373.0K.

Visualization:

4.45.10 Vapor Pressure - EoS1 - ID 1

Name:	Water
Equation:	VaporPressure_EoS1
ID:	1
Reference:	Wagner, W.; Pruß, A. (2002): The IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use. In: Journal of Physical and Chemical Reference Data 31 (2), S. 387–535. DOI: 10.1063/1.1461829.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	6.470960000e+02	a_4	-	2.268074110e+01

Par.	Unit	Value	Par.	Unit	Value
p_{crit}	Pa	2.206400000e+07	b_4	-	3.500000000e+00
a_1	-	-7.859517830e+00	a_5	-	-1.596187190e+01
b_1	-	1.000000000e+00	b_5	-	4.000000000e+00
a_2	-	1.844082590e+00	a_6	-	1.801225020e+00
b_2	-	1.500000000e+00	b_6	-	7.500000000e+00
a_3	-	-1.178664970e+01	a_7	-	0.000000000e+00
b_3	-	3.000000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for 273.16K $\leq T \leq$ 647.096K.

Visualization:

4.45.11 Vapor Pressure - EoS1 - ID 2

Name:	Water
Equation:	VaporPressure_EoS1
ID:	2
Reference:	Verein Deutscher Ingenieure (2010): VDI Heat Atlas. 2. Ed. Heidelberg: Springer. Online: http://dx.doi.org/10.1007/978-3-540-77877-6.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K by:

$$\begin{aligned} p_{\text{sat}} &= p_{\text{crit}} \exp\left({}^{1}\!/_{\theta} \sum_{i=1}^{7} a_i \xi^{b_i} \right) && \text{, and} \\ \xi &= 1 - \theta && \text{, and} \\ \theta &= {}^{T}\!/_{T_{\text{crit}}} && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
T_{crit}	K	6.471000000e+02	a_4	-	-2.064720000e+00
p_{crit}	Pa	2.206400000e+07	b_4	-	5.000000000e+00
a_1	-	-7.869750000e+00	a_5	-	0.000000000e+00
b_1	-	1.000000000e+00	b_5	-	0.000000000e+00
a_2	-	1.905610000e+00	a_6	-	0.000000000e+00
b_2	-	1.500000000e+00	b_6	-	0.000000000e+00
a_3	-	-2.308910000e+00	a_7	-	0.000000000e+00
b_3	-	2.500000000e+00	b_7	-	0.000000000e+00

Validity:
Equation is approximately valid for $273.16\text{K} \leq T \leq 647.1\text{K}$.

Visualization:

4.45.12 Vapor Pressure - EoSCubic - ID 1

Name:	Water
Equation:	VaporPressure_EoSCubic
ID:	1
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and} \\
a &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit}})^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.08664R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{(T/T_{\text{crit}})}\right)\right)^2 && \text{, and} \\
\kappa &= 0.48508 + 1.55171\omega - 0.15613\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
EoS	-	-5.000000000e+00	β_0	-	0.000000000e+00
T_{crit}	K	6.471000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	2.206400000e+07	β_2	-	0.000000000e+00
ω	-	3.443000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 314.134K $\leq T \leq$ 550.035K.

Visualization:

4.45.13 Vapor Pressure - EoSCubic - ID 2

Name:	Water
Equation:	VaporPressure_EoSCubic
ID:	2
Reference:	Lemmon, E. W.; Bell, I. H.; Huber, M. L.; McLinden, M. O. (2018): NIST Standard Reference Database 23. Reference Fluid Thermodynamic and Transport Properties-REFPROP, Version 10.0, National Institute of Standards and Technology. Online: https://www.nist.gov/srd/refprop.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients

of vapor and liquid phase are equal. Cubic equation of state is given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and} \\
a &= 0.45724\frac{\left(RT_{\text{crit}}\right)^2}{p_{\text{crit}}}\alpha && \text{, and} \\
b &= 0.07780R\frac{T_{\text{crit}}}{p_{\text{crit}}} && \text{, and} \\
\alpha &= \left(1+\kappa\left(1-\sqrt{\left(T/T_{\text{crit}}\right)}\right)\right)^2 && \text{, and} \\
\kappa &= 0.37464+1.54226\omega-0.26992\omega^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	β_0	-	0.000000000e+00
T_{crit}	K	6.471000000e+02	β_1	-	0.000000000e+00
p_{crit}	Pa	2.206400000e+07	β_2	-	0.000000000e+00
ω	-	3.443000000e-01	β_3	-	0.000000000e+00
κ_1	-	0.000000000e+00			

Validity:
Equation is approximately valid for 314.134K $\leq T \leq$ 550.035K.

Visualization:

60
50
40
30
20
10
0
Pressure p / bar ⟶
350
400
450
500
550
Temperature T / K ⟶

5 Adsorption

5.1 1-Butene

5.1.1 Zeolite pellet 13X

5.1.1.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	1-Butene
Equation:	Toth
ID:	1
Reference:	Lamia, Nabil; Wolff, Luc; Leflaive, Philibert; Leinekugel-Le-Cocq, Damien; Sá Gomes, Pedro; Grande, Carlos A.; Rodrigues, Alírio E. (2008): Equilibrium and Fixed Bed Adsorption of 1-Butene, Propylene and Propane Over 13X Zeolite Pellets. In: Separation Science and Technology 43 (5), S. 1124–1156. DOI: 10.1080/01496390801888136.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001
Diameter of pore	mm	0.0000005
Diameter of extrudate	mm	0.8
Porosity of pellet	-	0.395
Pellet density	$\mathrm{kg\,m^{-3}}$	1357

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature

T in K by:

$$
\begin{aligned}
w &= \frac{w_{\text{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	Pa^{-1}	2.500000000e-10	Q^*	K	6.542816114e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\text{kg}\,\text{kg}^{-1}$	1.178310000e-01
n_0	-	4.520000000e-01			

Validity:
Equation is approximately valid for $0.0\text{Pa} \leq p \leq 110050.0\text{Pa}$, $333.0\text{K} \leq T \leq 393.0\text{K}$, and $0.0\text{kg}\,\text{kg}^{-1} \leq w \leq 0.1155866\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 50
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.85%.

5.2 Ammonia

5.2.1 Zeolite pellet NaX

5.2.1.1 DubininAstakhov - ID 1

Sorbent:	zeolite pellet
Subtype:	NaX
Refrigerant:	Ammonia
Equation:	DubininAstakhov
ID:	1
Reference:	Sun, L. M.; Feng, Y.; Pons, M. (1997): Numerical investigation of adsorptive heat pump systems with thermal wave heat regeneration under uniform-pressure conditions. In: International Journal of Heat and Mass Transfer 40 (2), S. 281–293. DOI: 10.1016/0017-9310(96)00113-5.
Comment:	See original liturate: Vapor pressure in Pa is given by p_sat = 23.0272 - 2748.39 / T.

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in

K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\text{sat}}^{\text{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\text{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	**Unit**	**Value**	**Par.**	**Unit**	**Value**
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.899487468e+04	W_0	$\mathrm{m^3\,kg^{-1}}$	2.220000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.3 Butane

5.3.1 Activated carbon powder Maxsorb III

5.3.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	Butane
Equation:	DubininAstakhov
ID:	1
Reference:	Saha, Bidyut Baran; Chakraborty, Anutosh; Koyama, Shigeru; Yoon, Seong-Ho; Mochida, Isao; Kumja, M. et al. (2008): Isotherms and thermodynamics for the adsorption of n -butane on pitch based activated carbon. In: International Journal of Heat and Mass Transfer 51 (7-8), S. 1582–1589. DOI: 10.1016/j.ijheatmasstransfer.2007.07.031.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002008
Diameter of pellet	mm	0.072
Surface area	$\mathrm{m^2\,g^{-1}}$	3140
Pore volume	$\mathrm{mm\,g^{-3}}$	2.01
Bulk density	$\mathrm{kg\,m^{-3}}$	310

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.050000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.743600000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	8.000000000e-01

Validity:
Equation is approximately valid for 14970.0Pa $\leq p \leq$ 286440.0Pa, 298.15K $\leq T \leq$ 328.15K, and 0.4127kg kg^{-1} $\leq w \leq$ 0.7996kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Temperature, absolute, in K → 0.01

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.18%.

5.4 CarbonDioxide

5.4.1 Activated carbon Norit RB 1

5.4.1.1 Langmuir - ID 1

Sorbent:	activated carbon
Subtype:	Norit RB 1
Refrigerant:	CarbonDioxide
Equation:	Langmuir
ID:	1
Reference:	van der Vaart, Rick; HUISKES, CINDY; Bosch, Hans; Reith, Tom (2000): Single and Mixed Gas Adsorption Equilibria of Carbon Dioxide/Methane on Activated Carbon. In: Adsorption 6 (4), S. 311–323. DOI: 10.1023/A:1026560915422.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} K p}{1 + K p} \quad \text{, and}$$
$$K = K_0 \exp\left(\frac{\Delta H}{RT}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
ΔH	$\mathrm{J\,mol^{-1}}$	2.350000000e+04	w_{sat}	$\mathrm{kg\,kg^{-1}}$	3.494354300e-01
K_0	$\mathrm{Pa^{-1}}$	3.220000000e-10			

Validity:
Equation is approximately valid for $50048.9\mathrm{Pa} \leq p \leq 701434.0\mathrm{Pa}$, $294.5\mathrm{K} \leq T \leq 348.3\mathrm{K}$, and $0.0246555\mathrm{kg\,kg^{-1}} \leq w \leq 0.282155\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.06%.

5.4.2 Activated carbon fiber A-20

5.4.2.1 Langmuir - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	CarbonDioxide
Equation:	Langmuir
ID:	1
Reference:	Saha, Bidyut Baran; Jribi, Skander; Koyama, Shigeru; El-Sharkawy, Ibrahim I. (2011): Carbon Dioxide Adsorption Isotherms on Activated Carbons. In: J. Chem. Eng. Data 56 (5), S. 1974–1981. DOI: 10.1021/je100973t.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000216
Surface area	$\mathrm{m^2\,g^{-1}}$	2000
Pore volume	$\mathrm{mm\,g^{-3}}$	1.03

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} K p}{1 + K p} \quad \text{, and}$$

$$K = K_0 \exp\left(\frac{\Delta H}{RT}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
ΔH	$\mathrm{J\,mol^{-1}}$	1.941000000e+04	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.220000000e+00
K_0	$\mathrm{Pa^{-1}}$	2.210000000e-10			

Validity:
Equation is approximately valid for $60000.0\mathrm{Pa} \leq p \leq 9488000.0\mathrm{Pa}$, $263.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$, and $0.118\mathrm{kg\,kg^{-1}} \leq w \leq 0.992\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 1000000 Pa: 0.2
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.21%.

5.4.2.2 Toth - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	CarbonDioxide
Equation:	Toth
ID:	1
Reference:	Saha, Bidyut Baran; Jribi, Skander; Koyama, Shigeru; El-Sharkawy, Ibrahim I. (2011): Carbon Dioxide Adsorption Isotherms on Activated Carbons. In: J. Chem. Eng. Data 56 (5), S. 1974–1981. DOI: 10.1021/je100973t.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000216
Surface area	$\mathrm{m^2\,g^{-1}}$	2000
Pore volume	$\mathrm{mm\,g^{-3}}$	1.03

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} \quad \text{, and}$$

$$b = b_0 \exp\left(\frac{Q^*}{T}\right) \quad \text{, and}$$

$$n = n_0 + {}^{c}/_{T} \quad \text{, and}$$

$$r = \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	2.550000000e-10	Q^*	K	2.312837387e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.560000000e+00
n_0	-	6.960000000e-01			

Validity:
Equation is approximately valid for 60000.0Pa $\leq p \leq$ 9488000.0Pa, 263.15K $\leq T \leq$ 343.15K, and 0.118kg kg^{-1} $\leq w \leq$ 0.992kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 1000000 Pa: 0.2
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.94%.

5.4.3 Activated carbon powder Maxsorb III

5.4.3.1 Langmuir - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	CarbonDioxide
Equation:	Langmuir
ID:	1
Reference:	Saha, Bidyut Baran; Jribi, Skander; Koyama, Shigeru; El-Sharkawy, Ibrahim I. (2011): Carbon Dioxide Adsorption Isotherms on Activated Carbons. In: J. Chem. Eng. Data 56 (5), S. 1974–1981. DOI: 10.1021/je100973t.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} K p}{1 + K p} \quad \text{, and}$$

$$K = K_0 \exp\left(\frac{\Delta H}{RT}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
ΔH	$\mathrm{J\,mol^{-1}}$	2.056000000e+04	w_{sat}	$\mathrm{kg\,kg^{-1}}$	2.210000000e+00
K_0	$\mathrm{Pa^{-1}}$	1.060000000e-10			

Validity:
Equation is approximately valid for 97000.0Pa $\leq p \leq$ 10164000.0Pa, 263.15K $\leq T \leq$ 343.15K, and 0.121kg $\mathrm{kg^{-1}} \leq w \leq$ 1.719kg $\mathrm{kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 1000000 Pa: 0.2
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.97%.

5.4.3.2 Toth - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	CarbonDioxide
Equation:	Toth
ID:	1
Reference:	Saha, Bidyut Baran; Jribi, Skander; Koyama, Shigeru; El-Sharkawy, Ibrahim I. (2011): Carbon Dioxide Adsorption Isotherms on Activated Carbons. In: J. Chem. Eng. Data 56 (5), S. 1974–1981. DOI: 10.1021/je100973t.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.07

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} \quad \text{, and}$$

$$b = b_0 \exp\left(\frac{Q^*}{T}\right) \quad \text{, and}$$

$$n = n_0 + {}^{c}/_{T} \quad \text{, and}$$

$$r = \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.170000000e-10	Q^*	K	2.449947872e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	3.060000000e+00
n_0	-	6.640000000e-01			

Validity:
Equation is approximately valid for 97000.0Pa $\leq p \leq$ 10164000.0Pa, 263.15K $\leq T \leq$ 343.15K, and 0.121kg kg^{-1} $\leq w \leq$ 1.719kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, relative, in % $\rightarrow$ 0 Pa $<$ p $<$ 1000000 Pa: 0.2
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.79%.

5.4.4 Silica gel pellet

5.4.4.1 Toth - ID 1

Sorbent:	silica gel pellet
Subtype:	
Refrigerant:	CarbonDioxide
Equation:	Toth
ID:	1
Reference:	Wang, Yu; LeVan, M. Douglas (2009): Adsorption Equilibrium of Carbon Dioxide and Water Vapor on Zeolites 5A and 13X and Silica Gel. Pure Components. In: J. Chem. Eng. Data 54 (10), S. 2839–2844. DOI: 10.1021/je800900a.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	5.164000000e-10	Q^*	K	2.330000000e+03
c	K	2.386000000e+02	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	6.543472909e-01
n_0	-	-3.053000000e-01			

Validity:
Equation is approximately valid for $67.2\mathrm{Pa} \leq p \leq 97900.0\mathrm{Pa}$, $283.15\mathrm{K} \leq T \leq 328.15\mathrm{K}$, and $5.28108e-05\mathrm{kg\,kg^{-1}} \leq w \leq 0.05633152\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, relative, in % → 0.067 Pa < p < 13300 Pa: 0.25
- Temperature, absolute, in K → 0.3

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.49%.

5.4.5 Zeolite pellet 13X

5.4.5.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	CarbonDioxide
Equation:	Toth
ID:	1
Reference:	Wang, Yu; LeVan, M. Douglas (2009): Adsorption Equilibrium of Carbon Dioxide and Water Vapor on Zeolites 5A and 13X and Silica Gel. Pure Components. In: J. Chem. Eng. Data 54 (10), S. 2839–2844. DOI: 10.1021/je800900a.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	4.884000000e-07	Q^*	K	2.991000000e+03
c	K	3.805000000e+01	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	5.865230047e-01
n_0	-	7.487000000e-02			

Validity:
Equation is approximately valid for $98.2\mathrm{Pa} \leq p \leq 42500.0\mathrm{Pa}$, $228.15\mathrm{K} \leq T \leq 448.15\mathrm{K}$, and $0.007085449\mathrm{kg\,kg^{-1}} \leq w \leq 0.21608419\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Pressure, relative, in % $\rightarrow$ 0.067 Pa $<$ p $<$ 13300 Pa: 0.25
- Temperature, absolute, in K $\rightarrow$ 0.3

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.53%.

5.4.6 Zeolite pellet 5A

5.4.6.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	5A
Refrigerant:	CarbonDioxide
Equation:	Toth
ID:	1
Reference:	Wang, Yu; LeVan, M. Douglas (2009): Adsorption Equilibrium of Carbon Dioxide and Water Vapor on Zeolites 5A and 13X and Silica Gel. Pure Components. In: J. Chem. Eng. Data 54 (10), S. 2839–2844. DOI: 10.1021/je800900a.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	6.761000000e-11	Q^*	K	5.625000000e+03
c	K	-2.002000000e+01	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	6.427951671e-01
n_0	-	2.700000000e-01			

Validity:
Equation is approximately valid for $5.3\mathrm{Pa} \leq p \leq 108000.0\mathrm{Pa}$, $228.15\mathrm{K} \leq T \leq 448.15\mathrm{K}$, and $0.0044009\mathrm{kg\,kg^{-1}} \leq w \leq 0.21388374\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Pressure, relative, in % $\rightarrow$ 0.067 Pa $<$ p $<$ 13300 Pa: 0.25
- Temperature, absolute, in K $\rightarrow$ 0.3

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.71%.

5.5 Ethanol

5.5.1 Activated carbon AP4-60

5.5.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AP4-60
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000000128
Diameter of pellet	mm	4
Surface area	$m^2\,g^{-1}$	1428
Pore volume	$mm\,g^{-3}$	0.47

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \text{, and}$$

$$A = RT \ln\left(p_{sat}/p\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$J\,mol^{-1}$	1.060000000e+04	W_0	$m^3\,kg^{-1}$	4.500000000e-04

Validity:
Equation is approximately valid for 1260.0Pa $\leq p \leq$ 3540.0Pa, 303.083K $\leq T \leq$ 393.173K, and 0.01557kg kg^{-1} $\leq w \leq$ 0.33722kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 420

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 14.32%.

5.5.2 Activated carbon ATO

5.5.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	ATO
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000118
Diameter of pellet	mm	0.25-0.6
Surface area	$m^2\,g^{-1}$	1745
Pore volume	$mm\,g^{-3}$	0.64

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.700000000e+00
E	$J\,mol^{-1}$	1.120000000e+04	W_0	$m^3\,kg^{-1}$	6.100000000e-04

Validity:

Equation is approximately valid for 1260.0Pa $\leq p \leq$ 3540.0Pa, 303.097K $\leq T \leq$ 393.127K, and 0.04335kg kg^{-1} $\leq w \leq$ 0.42683kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 420

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 12.57%.

5.5.3 Activated carbon COC-L1200

5.5.3.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	COC-L1200
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000118
Diameter of pellet	mm	0.42-1
Surface area	$m^2\,g^{-1}$	1412
Pore volume	$mm\,g^{-3}$	0.49

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$J\,mol^{-1}$	1.330000000e+04	W_0	$m^3\,kg^{-1}$	4.400000000e-04

Validity:

Equation is approximately valid for 1260.0Pa $\leq p \leq$ 3540.0Pa, 303.154K $\leq T \leq$ 393.227K, and 0.04213kg kg^{-1} $\leq w \leq$ 0.31477kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 420

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.1%.

5.5.4 Activated carbon FR20

5.5.4.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	FR20
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000118
Diameter of pellet	mm	0.01
Surface area	$m^2\,g^{-1}$	2180
Pore volume	$mm\,g^{-3}$	0.75

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$J\,mol^{-1}$	1.350000000e+04	W_0	$m^3\,kg^{-1}$	7.500000000e-04

Validity:

Equation is approximately valid for 1260.0Pa $\leq p \leq$ 3540.0Pa, 3303.129K $\leq T \leq$ 393.156K, and 0.02038kg kg^{-1} $\leq w \leq$ 0.54707kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 420

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 21.91%.

5.5.5 Activated carbon SRD 1352/3

5.5.5.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	SRD 1352/3
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000112
Diameter of pellet	mm	0.5-2
Surface area	$m^2\,g^{-1}$	2613
Pore volume	$mm\,g^{-3}$	0.65

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.500000000e+00
E	$J\,mol^{-1}$	8.780000000e+03	W_0	$m^3\,kg^{-1}$	8.200000000e-04

Validity:

Equation is approximately valid for 1260.0Pa $\leq p \leq$ 3540.0Pa, 303.1K $\leq T \leq$ 393.167K, and 0.02782kg kg^{-1} $\leq w \leq$ 0.51764kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 420

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 15.38%.

5.5.6 Activated carbon fiber A-20

5.5.6.1 DubininAstakhov - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Saha, Bidyut Baran; El-Sharkawy, Ibrahim I.; Chakraborty, Anutosh; Koyama, Shigeru; Yoon, Seong-Ho; Ng, Kim Choon (2006): Adsorption Rate of Ethanol on Activated Carbon Fiber. In: J. Chem. Eng. Data 51 (5), S. 1587–1592. DOI: 10.1021/je060071z.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	2.16E-08
Surface area	$\mathrm{m^2\,g^{-1}}$	1930
Pore volume	$\mathrm{mm\,g^{-3}}$	1.028

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.347102960e+03	W_0	$\mathrm{kg\,kg^{-1}}$	7.970000000e-01

Validity:
Equation is approximately valid for 7885.869802Pa $\leq p \leq$ 7885.869802Pa, 300.15K $\leq$

$T \leq 333.15\text{K}$, and $0.281740845\text{kg}\,\text{kg}^{-1} \leq w \leq 0.668876056\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Loading, absolute, in $\text{kg}\,\text{kg}^{-1}$ $\rightarrow$ 0.0000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 11.18%.

5.5.7 Activated carbon powder H2-treated Maxsorb III

5.5.7.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	H2-treated Maxsorb III
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Uddin, Kutub; El-Sharkawy, Ibrahim I.; Miyazaki, Takahiko; Saha, Bidyut Baran; Koyama, Shigeru; Kil, Hyun-Sig et al. (2014): Adsorption characteristics of ethanol onto functional activated carbons with controlled oxygen content. In: Applied Thermal Engineering 72 (2), S. 211–218. DOI: 10.1016/j.applthermaleng.2014.03.062.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	3029
Pore volume	$\mathrm{mm\,g^{-3}}$	1.73

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.900000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.780000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.250000000e+00

Validity:

Equation is approximately valid for 932.7Pa $\leq p \leq$ 55573.2Pa, 303.15K $\leq T \leq$ 353.15K, and 0.22339kg kg^{-1} $\leq w \leq$ 1.2117kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.76%.

5.5.8 Activated carbon powder KOH-H2-treated Maxsorb III

5.5.8.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	KOH-H2-treated Maxsorb III
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Uddin, Kutub; El-Sharkawy, Ibrahim I.; Miyazaki, Takahiko; Saha, Bidyut Baran; Koyama, Shigeru; Kil, Hyun-Sig et al. (2014): Adsorption characteristics of ethanol onto functional activated carbons with controlled oxygen content. In: Applied Thermal Engineering 72 (2), S. 211–218. DOI: 10.1016/j.applthermaleng.2014.03.062.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	2992
Pore volume	$\mathrm{mm\,g^{-3}}$	1.65

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.600000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.331000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.090000000e+00

Validity:

Equation is approximately valid for 984.1Pa $\leq p \leq$ 78150.2Pa, 293.15K $\leq T \leq$ 353.15K, and 0.29155kg kg^{-1} $\leq w \leq$ 1.09586kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.93%.

5.5.9 Activated carbon powder Maxsorb III

5.5.9.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Uddin, Kutub; El-Sharkawy, Ibrahim I.; Miyazaki, Takahiko; Saha, Bidyut Baran; Koyama, Shigeru; Kil, Hyun-Sig et al. (2014): Adsorption characteristics of ethanol onto functional activated carbons with controlled oxygen content. In: Applied Thermal Engineering 72 (2), S. 211–218. DOI: 10.1016/j.applthermaleng.2014.03.062.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	3045
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.900000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.265000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.240000000e+00

Validity:

Equation is approximately valid for 617.2Pa $\leq p \leq$ 44631.4Pa, 303.15K $\leq T \leq$ 343.15K, and 0.14203kg kg^{-1} $\leq w \leq$ 1.202639kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.63%.

5.5.9.2 DubininAstakhov - ID 2

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	2
Reference:	El-Sharkawy, I. I.; Saha, B. B.; Koyama, S.; He, J.; Ng, K. C.; Yap, C. (2008): Experimental investigation on activated carbon–ethanol pair for solar powered adsorption cooling applications. In: International Journal of Refrigeration 31 (8), S. 1407–1413. DOI: 10.1016/j.ijrefrig.2008.03.012.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$m^2\,g^{-1}$	3200

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \text{, and}$$

$$A = RT \ln\left(p_{sat}/p\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.750000000e+00
E	$J\,mol^{-1}$	5.538000000e+03	W_0	$kg\,kg^{-1}$	1.200000000e+00

Validity:
Equation is approximately valid for $7885.869802\text{Pa} \leq p \leq 7885.869802\text{Pa}$, $293.15\text{K} \leq T \leq 333.15\text{K}$, and $0.181\text{kg}\,\text{kg}^{-1} \leq w \leq 1.0012\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Loading, absolute, in $\mathrm{kg\,kg^{-1}}$ → 0.000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 39.55%.

5.5.10 Mof MIL-101Cr

5.5.10.1 DubininAstakhov - ID 1

Sorbent:	mof
Subtype:	MIL-101Cr
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Rezk, Ahmed; AL-Dadah, Raya; Mahmoud, Saad; Elsayed, Ahmed (2013): Investigation of Ethanol/metal organic frameworks for low temperature adsorption cooling applications. In: Applied Energy 112, S. 1025–1031. DOI: 10.1016/j.apenergy.2013.06.041.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.603300000e+00
E	$\mathrm{J\,mol^{-1}}$	6.527400000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.100500000e+00

Validity:
Equation is approximately valid for $288.15\mathrm{K} \leq T \leq 328.15\mathrm{K}$, and $0.14018\mathrm{kg\,kg^{-1}} \leq w \leq 1.20106\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.17%.

5.5.11 Phenol resin composite KOH4-PR

5.5.11.1 DubininAstakhov - ID 1

Sorbent:	phenol resin composite
Subtype:	KOH4-PR
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	El-Sharkawy, Ibrahim I.; Uddin, Kutub; Miyazaki, Takahiko; Baran Saha, Bidyut; Koyama, Shigeru; Kil, Hyun-Sig et al. (2015): Adsorption of ethanol onto phenol resin based adsorbents for developing next generation cooling systems. In: International Journal of Heat and Mass Transfer 81, S. 171–178. DOI: 10.1016/j.ijheatmasstransfer.2014.10.012.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000125
Surface area	$\mathrm{m^2\,g^{-1}}$	3060
Pore volume	$\mathrm{mm\,g^{-3}}$	1.9

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.896960000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.430000000e+00

Validity:
Equation is approximately valid for 1202.5Pa $\leq p \leq$ 35425.5Pa, 303.15K $\leq T \leq$ 343.15K, and 0.22135kg kg^{-1} $\leq w \leq$ 1.43957kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.52%.

5.5.12 Phenol resin composite KOH6-PR

5.5.12.1 DubininAstakhov - ID 1

Sorbent:	phenol resin composite
Subtype:	KOH6-PR
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	El-Sharkawy, Ibrahim I.; Uddin, Kutub; Miyazaki, Takahiko; Baran Saha, Bidyut; Koyama, Shigeru; Kil, Hyun-Sig et al. (2015): Adsorption of ethanol onto phenol resin based adsorbents for developing next generation cooling systems. In: International Journal of Heat and Mass Transfer 81, S. 171–178. DOI: 10.1016/j.ijheatmasstransfer.2014.10.012.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000178
Surface area	$\mathrm{m^2\,g^{-1}}$	2910
Pore volume	$\mathrm{mm\,g^{-3}}$	2.53

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.500000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.146300000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.980000000e+00

Validity:
Equation is approximately valid for 1221.5Pa $\leq p \leq$ 48959.6Pa, 303.15K $\leq T \leq$ 343.15K, and 0.14319kg kg^{-1} $\leq w \leq$ 1.95043kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.1%.

5.5.13 Silica gel composite 19 wt.% LiBr

5.5.13.1 DubininAstakhov - ID 1

Sorbent:	silica gel composite
Subtype:	19 wt.% LiBr
Refrigerant:	Ethanol
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000344
Diameter of pellet	mm	0.7-0.85
Surface area	$m^2\,g^{-1}$	181
Pore volume	$mm\,g^{-3}$	0.73
Porosity of pellet	-	0.73

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.800000000e+00
E	$J\,mol^{-1}$	6.900000000e+03	W_0	$m^3\,kg^{-1}$	6.800000000e-04

Validity:
Equation is approximately valid for 1260.0Pa $\leq p \leq$ 2540.0Pa, 303.116K $\leq T \leq$ 393.225K, and 0.01848kg kg^{-1} $\leq w \leq$ 0.57547kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 420

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 31.19%.

5.6 Isobutane

5.6.1 Mof powder cubtc

5.6.1.1 DualSiteSips - ID 1

Sorbent:	mof powder
Subtype:	cubtc
Refrigerant:	Isobutane
Equation:	DualSiteSips
ID:	1
Reference:	Lamia, Nabil; Jorge, Miguel; Granato, Miguel A.; Almeida Paz, Filipe A.; Chevreau, Hubert; Rodrigues, Alírio E. (2009): Adsorption of propane, propylene and isobutane on a metal–organic framework. Molecular simulation and experiment. In: Chemical Engineering Science 64 (14), S. 3246–3259. DOI: 10.1016/j.ces.2009.04.010.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0016
Surface area	$m^2\,g^{-1}$	1500-2100
Bulk density	$kg\,m^{-3}$	350

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \sum_{i=A}^{B} w_{\mathrm{i}} \frac{(b_i p)^{1/\eta_i}}{1 + (b_i p)^{1/\eta_i}} \quad \text{, and}$$

$$b_i = b_{i,0} \exp\left(\frac{Q_i}{RT}\left(1 - \frac{T}{T_0}\right)\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$b_{\mathrm{A},0}$	Pa^{-1}	8.200000000e-04	$b_{\mathrm{B},0}$	Pa^{-1}	6.000000000e-05
Q_{A}	$J\,mol^{-1}$	3.790000000e+04	Q_{B}	$J\,mol^{-1}$	4.080000000e+04

Par.	Unit	Value	Par.	Unit	Value
η_A	-	5.500000000e-01	η_B	-	1.000000000e+00
w_A	$kg\,kg^{-1}$	2.975744000e-01	w_B	$kg\,kg^{-1}$	6.393200000e-02
T_0	K	3.230000000e+02			

Validity:
Equation is approximately valid for 581.5Pa $\leq p \leq$ 99177.0Pa, 323.0K $\leq T \leq$ 423.0K, and 0.011061398kg kg^{-1} $\leq w \leq$ 0.349172174kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 50
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 15.25%.

5.6.2 Zeolite pellet 13X

5.6.2.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	Isobutane
Equation:	Toth
ID:	1
Reference:	Lamia, Nabil; Wolff, Luc; Leflaive, Philibert; Sá Gomes, Pedro; Grande, Carlos A.; Rodrigues, Alírio E. (2007): Propane/Propylene Separation by Simulated Moving Bed I. Adsorption of Propane, Propylene and Isobutane in Pellets of 13X Zeolite. In: Separation Science and Technology 42 (12), S. 2539–2566. DOI: 10.1080/01496390701515219.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001
Diameter of pore	mm	0.0000005
Diameter of extrudate	mm	0.8
Porosity of pellet	-	0.395
Pellet density	$\mathrm{kg\,m^{-3}}$	1357

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	Pa^{-1}	2.500000000e-10	Q^*	K	5.003329970e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.034536000e-01
n_0	-	8.480000000e-01			

Validity:
Equation is approximately valid for 171.9Pa $\leq p \leq$ 152632.0Pa, 333.0K $\leq T \leq$ 393.0K, and 0.005888137kg kg^{-1} $\leq w \leq$ 0.104210322kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 50
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.81%.

5.7 Methane

5.7.1 Activated carbon AX21

5.7.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AX21
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)$\hat{2}$ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	3106
Pore volume	$\mathrm{mm\,g^{-3}}$	1.29

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.260000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.464100000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	1.080000000e-03

Validity:
Equation is approximately valid for 233.0K $\leq T \leq$ 333.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.7.2 Activated carbon BPL

5.7.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	BPL
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)2̂ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1150
Pore volume	$\mathrm{mm\,g^{-3}}$	0.43

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.540000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.040000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	3.600000000e-04

Validity:
Equation is approximately valid for 273.0K $\leq T \leq$ 333.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.7.3 Activated carbon Calgon AC

5.7.3.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Calgon AC
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)2̂ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1250
Pore volume	$\mathrm{mm\,g^{-3}}$	0.72

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.410000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.955100000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	3.090000000e-04

Validity:
Equation is approximately valid for 293.0K $\leq T \leq$ 313.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.7.4 Activated carbon F30/470

5.7.4.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	F30/470
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)$\hat{2}$ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	994
Pore volume	$\mathrm{mm\,g^{-3}}$	0.39

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.810000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.742900000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	3.890000000e-04

Validity:
Equation is approximately valid for 303.0K $\leq T \leq$ 343.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.7.5 Activated carbon Norit R 1 Extra

5.7.5.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Norit R 1 Extra
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)2̂ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1450
Pore volume	$\mathrm{mm\,g^{-3}}$	0.47

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.730000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.500000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.300000000e-04

Validity:
Equation is approximately valid for 273.0K $\leq T \leq$ 323.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.7.6 Activated carbon Norit RB 1

5.7.6.1 Langmuir - ID 1

Sorbent:	activated carbon
Subtype:	Norit RB 1
Refrigerant:	Methane
Equation:	Langmuir
ID:	1
Reference:	van der Vaart, Rick; HUISKES, CINDY; Bosch, Hans; Reith, Tom (2000): Single and Mixed Gas Adsorption Equilibria of Carbon Dioxide/Methane on Activated Carbon. In: Adsorption 6 (4), S. 311–323. DOI: 10.1023/A:1026560915422.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} K p}{1 + K p} \quad \text{, and}$$

$$K = K_0 \exp\left(\frac{\Delta H}{RT}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
ΔH	$\mathrm{J\,mol^{-1}}$	1.950000000e+04	w_{sat}	$\mathrm{kg\,kg^{-1}}$	7.716442500e-02
K_0	$\mathrm{Pa^{-1}}$	1.170000000e-09			

Validity:
Equation is approximately valid for 44955.8Pa $\leq p \leq$ 700365.0Pa, 294.5K $\leq T \leq$ 348.3K, and 0.00334641$\mathrm{kg\,kg^{-1}} \leq w \leq$ 0.057098$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.68%.

5.7.7 Activated carbon fiber A-20

5.7.7.1 DubininAstakhov - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)2̂ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	2206
Pore volume	$\mathrm{mm\,g^{-3}}$	1.01

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.510000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.198400000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	7.170000000e-04

Validity:
Equation is approximately valid for 278.0K $\leq T \leq$ 348.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.7.8 Activated carbon powder Maxsorb III

5.7.8.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)$\hat{2}$ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.072
Surface area	$\mathrm{m^2\,g^{-1}}$	3276
Pore volume	$\mathrm{mm\,g^{-3}}$	1.79
Solid density	$\mathrm{kg\,m^{-3}}$	2246

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.050000000e+00

Par.	Unit	Value	Par.	Unit	Value
E	$\mathrm{J\,mol^{-1}}$	4.757300000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	2.193000000e-03

Validity:
Equation is approximately valid for $9470.0\mathrm{Pa} \leq p \leq 2197470.0\mathrm{Pa}$, $120.2\mathrm{K} \leq T \leq 348.2\mathrm{K}$, and $0.01285\mathrm{kg\,kg^{-1}} \leq w \leq 0.75044\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.99%.

5.7.9 Activated charcoal pellet Chemviron

5.7.9.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal pellet
Subtype:	Chemviron
Refrigerant:	Methane
Equation:	DubininAstakhov
ID:	1
Reference:	Rahman, Kazi Afzalur; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2012): On thermodynamics of methane+carbonaceous materials adsorption. In: International Journal of Heat and Mass Transfer 55 (4), S. 565–573. DOI: 10.1016/j.ijheatmasstransfer.2011.10.056.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt (i.e., 1/rho_adsorpt = 2.3677e-3 * exp(0.0043* (T - 111.67)) in kg/m3) and vapor pressure (i.e., p_sat = p_crit *(T / T_crit)$\hat{2}$ in Pa if T > T_crit) are required; inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	945
Pore volume	$\mathrm{mm\,g^{-3}}$	0.51

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.860000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.684100000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.070000000e-04

Validity:
Equation is approximately valid for 278.0K $\leq T \leq$ 348.0K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8 Methanol

5.8.1 Activated carbon 207C

5.8.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	207C
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Zhao, Yongling; Hu, Eric; Blazewicz, Antoni (2012): A comparison of three adsorption equations and sensitivity study of parameter uncertainty effects on adsorption refrigeration thermal performance estimation. In: Heat Mass Transfer 48 (2), S. 217–226. DOI: 10.1007/s00231-011-0875-8.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.720000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.843588840e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.500000000e-01

Validity:
Equation is approximately valid for 3250.0Pa $\leq p \leq$ 30350.0Pa, 292.75K $\leq T \leq$ 362.95K, and 0.04$\mathrm{kg\,kg^{-1}} \leq w \leq$ 0.13$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 12.79%.

5.8.2 Activated carbon 207EA

5.8.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	207EA
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Zhao, Yongling; Hu, Eric; Blazewicz, Antoni (2012): A comparison of three adsorption equations and sensitivity study of parameter uncertainty effects on adsorption refrigeration thermal performance estimation. In: Heat Mass Transfer 48 (2), S. 217–226. DOI: 10.1007/s00231-011-0875-8.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.080000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.900405946e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.800000000e-01

Validity:
Equation is approximately valid for 3550.0Pa $\leq p \leq$ 29350.0Pa, 293.05K $\leq T \leq$ 363.05K, and 3550.0$\mathrm{kg\,kg^{-1}} \leq w \leq$ 29350.0$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.38%.

5.8.2.2 DubininAstakhov - ID 2

Sorbent:	activated carbon
Subtype:	207EA
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	2
Reference:	Wu, Jun W.; Madani, S. Hadi; Biggs, Mark J.; Phillip, Pendleton; Lei, Chen; Hu, Eric J. (2015): Characterizations of Activated Carbon–Methanol Adsorption Pair Including the Heat of Adsorptions. In: J. Chem. Eng. Data 60 (6), S. 1727–1731. DOI: 10.1021/je501113y.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of extrudate	mm	0.004
Length of extrudate	mm	0.01
Surface area	$\mathrm{m^2\,g^{-1}}$	951
Pore volume	$\mathrm{mm\,g^{-3}}$	0.663

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.655000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.571233270e+03	W_0	$\mathrm{kg\,kg^{-1}}$	3.300000000e-01

Validity:
Equation is approximately valid for 89.0Pa $\leq p \leq$ 16492.4Pa, 278.15K $\leq T \leq$

298.15K, and $0.020588\,\mathrm{kg\,kg^{-1}} \leq w \leq 0.332976\,\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.44%.

5.8.3 Activated carbon A-35

5.8.3.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	A-35
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Passos, E.; Meunier, F.; Gianola, J. C. (1986): Thermodynamic performance improvement of an intermittent solar-powered refrigeration cycle using adsorption of methanol on activated carbon. In: Journal of Heat Recovery Systems 6 (3), S. 259–264. DOI: 10.1016/0198-7593(86)90010-X.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.150000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.100000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.270000000e-04

Validity:
Equation is approximately valid for $263.15\mathrm{K} \leq T \leq 393.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.4 Activated carbon AC-35

5.8.4.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AC-35
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Douss, N.; Meunier, F. (1988): Effect of operating temperatures on the coefficient of performance of active carbon-methanol systems. In: Heat Recovery Systems and CHP 8 (5), S. 383–392. DOI: 10.1016/0890-4332(88)90042-7.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	1.5

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left(p_{\mathrm{sat}}/p\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.150000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.075211599e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.250000000e-04

Validity:
No data on validity available!

Visualization:

No experimental data exists. Thus, isotherm is not visualized!

5.8.5 Activated carbon AC-5060

5.8.5.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AC-5060
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Alghoul, M. A.; Sulaiman, M. Y.; Sopian, K.; Azmi, B. Z. (2009): Performance of a dual-purpose solar continuous adsorption system. In: Renewable Energy 34 (3), S. 920–927. DOI: 10.1016/j.renene.2008.05.037.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Bulk density	$\mathrm{kg\,m^{-3}}$	760

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.599000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.072573618e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	3.630000000e-04

Validity:
No data on validity available!

Visualization:

No experimental data exists. Thus, isotherm is not visualized!

5.8.6 Activated carbon ACLH

5.8.6.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	ACLH
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Douss, N.; Meunier, F. (1988): Effect of operating temperatures on the coefficient of performance of active carbon-methanol systems. In: Heat Recovery Systems and CHP 8 (5), S. 383–392. DOI: 10.1016/0890-4332(88)90042-7.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	1.5

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.321000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.335225274e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	8.600000000e-04

Validity:
No data on validity available!

Visualization:

No experimental data exists. Thus, isotherm is not visualized!

5.8.7 Activated carbon BPL

5.8.7.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	BPL
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Passos, E.; Meunier, F.; Gianola, J. C. (1986): Thermodynamic performance improvement of an intermittent solar-powered refrigeration cycle using adsorption of methanol on activated carbon. In: Journal of Heat Recovery Systems 6 (3), S. 259–264. DOI: 10.1016/0198-7593(86)90010-X.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.450000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.700000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.140000000e-04

Validity:
Equation is approximately valid for $311.15\mathrm{K} \leq T \leq 400.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.8 Activated carbon CarboTech A35/1

5.8.8.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	CarboTech A35/1
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1414
Porosity of pellet	-	0.88
Bulk density	$\mathrm{kg\,m^{-3}}$	330
Solid density	$\mathrm{kg\,m^{-3}}$	2191

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.760000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.686334274e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	7.860000000e-04

Validity:
Equation is approximately valid for 2910.0Pa $\leq p \leq$ 27900.0Pa, 288.099K $\leq T \leq$ 367.842K, and 0.007435kg kg^{-1} $\leq w \leq$ 0.574349kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 28.57%.

5.8.9 Activated carbon CarboTech C40/1

5.8.9.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	CarboTech C40/1
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1288
Porosity of pellet	-	0.82
Bulk density	$\mathrm{kg\,m^{-3}}$	380
Solid density	$\mathrm{kg\,m^{-3}}$	2142

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.850000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.985780554e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	6.330000000e-04

Validity:
Equation is approximately valid for 3100.0Pa $\leq p \leq$ 28320.0Pa, 288.067K $\leq T \leq$ 393.144K, and 0.005724kg kg^{-1} $\leq w \leq$ 0.470143kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 31.51%.

5.8.10 Activated carbon DEG

5.8.10.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	DEG
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Passos, E.; Meunier, F.; Gianola, J. C. (1986): Thermodynamic performance improvement of an intermittent solar-powered refrigeration cycle using adsorption of methanol on activated carbon. In: Journal of Heat Recovery Systems 6 (3), S. 259–264. DOI: 10.1016/0198-7593(86)90010-X.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.310000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.625000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.340000000e-04

Validity:
Equation is approximately valid for $327.15\mathrm{K} \leq T \leq 361.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.11 Activated carbon G32-H

5.8.11.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	G32-H
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	921
Porosity of pellet	-	0.77
Bulk density	$\mathrm{kg\,m^{-3}}$	370
Solid density	$\mathrm{kg\,m^{-3}}$	2174

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.590000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.687435041e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.820000000e-04

Validity:
Equation is approximately valid for 3200.0Pa $\leq p \leq$ 28000.0Pa, 288.06K $\leq T \leq$ 393.15K, and 0.014091kg kg^{-1} $\leq w \leq$ 0.374907kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 22.59%.

5.8.12 Activated carbon HC-20C

5.8.12.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	HC-20C
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	El-Sharkawy, I. I.; Hassan, M.; Saha, B. B.; Koyama, S.; Nasr, M. M. (2009): Study on adsorption of methanol onto carbon based adsorbents. In: International Journal of Refrigeration 32 (7), S. 1579–1586. DOI: 10.1016/j.ijrefrig.2009.06.011.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.790785223e+03	W_0	$\mathrm{kg\,kg^{-1}}$	7.050000000e-01

Validity:
Equation is approximately valid for 5500.0Pa $\leq p \leq$ 9900.0Pa, 293.15K $\leq T \leq$ 333.15K, and 0.0601$\mathrm{kg\,kg^{-1}} \leq w \leq$ 0.6685$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Temperature, absolute, in K → 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.79%.

5.8.13 Activated carbon Norit R 1 Extra

5.8.13.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Norit R 1 Extra
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1045
Porosity of pellet	-	0.87
Bulk density	$\mathrm{kg\,m^{-3}}$	370
Solid density	$\mathrm{kg\,m^{-3}}$	2139

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.270000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.951221886e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.190000000e-04

Validity:
Equation is approximately valid for 3200.0Pa $\leq p \leq$ 28000.0Pa, 288.117K $\leq T \leq$ 393.003K, and 0.007376kg kg^{-1} $\leq w \leq$ 0.4137kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 30.45%.

5.8.14 Activated carbon Norit RB

5.8.14.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Norit RB
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Passos, E.; Meunier, F.; Gianola, J. C. (1986): Thermodynamic performance improvement of an intermittent solar-powered refrigeration cycle using adsorption of methanol on activated carbon. In: Journal of Heat Recovery Systems 6 (3), S. 259–264. DOI: 10.1016/0198-7593(86)90010-X.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.800000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.150000000e-04

Validity:
Equation is approximately valid for $293.15\mathrm{K} \leq T \leq 293.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.15 Activated carbon Norit RX 3 Extra

5.8.15.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Norit RX 3 Extra
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1111
Porosity of pellet	-	0.75
Bulk density	$\mathrm{kg\,m^{-3}}$	370
Solid density	$\mathrm{kg\,m^{-3}}$	2169

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.060000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.755624733e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.510000000e-04

Validity:
Equation is approximately valid for 3200.0Pa $\leq p \leq$ 28000.0Pa, 288.117K $\leq T \leq$ 393.106K, and 0.00966kg kg^{-1} $\leq w \leq$ 0.424025kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 21.0%.

5.8.16 Activated carbon PKST

5.8.16.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	PKST
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Passos, E.; Meunier, F.; Gianola, J. C. (1986): Thermodynamic performance improvement of an intermittent solar-powered refrigeration cycle using adsorption of methanol on activated carbon. In: Journal of Heat Recovery Systems 6 (3), S. 259–264. DOI: 10.1016/0198-7593(86)90010-X.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.500000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	2.580000000e-04

Validity:
Equation is approximately valid for $364.15\mathrm{K} \leq T \leq 364.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.17 Activated carbon RÜTGERS CG1-3

5.8.17.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	RÜTGERS CG1-3
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1009
Porosity of pellet	-	0.84
Bulk density	$\mathrm{kg\,m^{-3}}$	420
Solid density	$\mathrm{kg\,m^{-3}}$	2259

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.800000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.705847581e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.350000000e-04

Validity:
Equation is approximately valid for 3200.0Pa $\leq p \leq$ 28500.0Pa, 288.212K $\leq T \leq$ 393.016K, and 0.00548kg kg^{-1} $\leq w \leq$ 0.429505kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 38.65%.

5.8.18 Activated carbon WS-480

5.8.18.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	WS-480
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Zhao, Yongling; Hu, Eric; Blazewicz, Antoni (2012): A comparison of three adsorption equations and sensitivity study of parameter uncertainty effects on adsorption refrigeration thermal performance estimation. In: Heat Mass Transfer 48 (2), S. 217–226. DOI: 10.1007/s00231-011-0875-8.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.780000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.654187748e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.700000000e-01

Validity:
Equation is approximately valid for 3000.0Pa $\leq p \leq$ 28800.0Pa, 302.85K $\leq T \leq$ 363.05K, and 0.05$\mathrm{kg\,kg^{-1}} \leq w \leq$ 0.22$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.26%.

5.8.18.2 DubininAstakhov - ID 2

Sorbent:	activated carbon
Subtype:	WS-480
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	2
Reference:	Wu, Jun W.; Madani, S. Hadi; Biggs, Mark J.; Phillip, Pendleton; Lei, Chen; Hu, Eric J. (2015): Characterizations of Activated Carbon–Methanol Adsorption Pair Including the Heat of Adsorptions. In: J. Chem. Eng. Data 60 (6), S. 1727–1731. DOI: 10.1021/je501113y.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.004
Surface area	$\mathrm{m^2\,g^{-1}}$	1231
Pore volume	$\mathrm{mm\,g^{-3}}$	0.464

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.650000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.776748192e+03	W_0	$\mathrm{kg\,kg^{-1}}$	4.900000000e-01

Validity:
Equation is approximately valid for $103.3\mathrm{Pa} \leq p \leq 16460.1\mathrm{Pa}$, $278.15\mathrm{K} \leq T \leq 298.15\mathrm{K}$, and $0.006367\mathrm{kg\,kg^{-1}} \leq w \leq 0.486595\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.56%.

5.8.19 Activated carbon powder Maxsorb III

5.8.19.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	El-Sharkawy, I. I.; Hassan, M.; Saha, B. B.; Koyama, S.; Nasr, M. M. (2009): Study on adsorption of methanol onto carbon based adsorbents. In: International Journal of Refrigeration 32 (7), S. 1579–1586. DOI: 10.1016/j.ijrefrig.2009.06.011.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	3150

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.145845866e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.240000000e+00

Validity:
Equation is approximately valid for 5500.0Pa $\leq p \leq$ 9900.0Pa, 293.15K $\leq T \leq$ 333.15K, and 0.0443kg $\mathrm{kg^{-1}} \leq w \leq$ 1.162kg $\mathrm{kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Temperature, absolute, in K → 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.32%.

5.8.20 Activated charcoal 207E4

5.8.20.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal
Subtype:	207E4
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Jing, Hu; Exell, R.H.B. (1994): Simulation and sensitivity analysis of an intermittent solar-powered charcoal/methanol refrigerator. In: Renewable Energy 4 (1), S. 133–149. DOI: 10.1016/0960-1481(94)90076-0.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.340000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.947289608e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	3.654600000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.21 Activated charcoal Chinese LSZ30

5.8.21.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal
Subtype:	Chinese LSZ30
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Jing, Hu; Exell, R.H.B. (1994): Simulation and sensitivity analysis of an intermittent solar-powered charcoal/methanol refrigerator. In: Renewable Energy 4 (1), S. 133–149. DOI: 10.1016/0960-1481(94)90076-0.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.260000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.941131407e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.050000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.22 Activated charcoal LH

5.8.22.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal
Subtype:	LH
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Jing, Hu; Exell, R.H.B. (1994): Simulation and sensitivity analysis of an intermittent solar-powered charcoal/methanol refrigerator. In: Renewable Energy 4 (1), S. 133–149. DOI: 10.1016/0960-1481(94)90076-0.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.321000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.335225274e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	8.600000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.8.23 Activated charcoal Thai MD6070

5.8.23.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal
Subtype:	Thai MD6070
Refrigerant:	Methanol
Equation:	DubininAstakhov
ID:	1
Reference:	Jing, Hu; Exell, R.H.B. (1994): Simulation and sensitivity analysis of an intermittent solar-powered charcoal/methanol refrigerator. In: Renewable Energy 4 (1), S. 133–149. DOI: 10.1016/0960-1481(94)90076-0.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.120000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.402306290e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	9.880000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9 Nitrogen

5.9.1 Activated carbon AP4-60

5.9.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AP4-60
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000000128
Diameter of pellet	mm	4
Surface area	$m^2\,g^{-1}$	1428
Pore volume	$mm\,g^{-3}$	0.47

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \text{, and}$$

$$A = RT \ln\left(p_{sat}/p\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.500000000e+00
E	$J\,mol^{-1}$	1.890000000e+04	W_0	$m^3\,kg^{-1}$	4.400000000e-04

Validity:
Equation is approximately valid for $214.7065231\mathrm{Pa} \leq p \leq 96174.92104\mathrm{Pa}$, $77.0\mathrm{K} \leq T \leq 77.0\mathrm{K}$, and $0.33211935\mathrm{kg\,kg^{-1}} \leq w \leq 0.572771423\mathrm{kg\,kg^{-1}}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.2 Activated carbon ATO

5.9.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	ATO
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000118
Diameter of pellet	mm	0.25-0.6
Surface area	$m^2\,g^{-1}$	1745
Pore volume	$mm\,g^{-3}$	0.64

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.400000000e+00
E	$J\,mol^{-1}$	2.090000000e+04	W_0	$m^3\,kg^{-1}$	6.300000000e-04

Validity:

Equation is approximately valid for $350.7197052\text{Pa} \leq p \leq 96538.27054\text{Pa}$, $77.0\text{K} \leq T \leq 77.0\text{K}$, and $0.298480609\text{kg}\,\text{kg}^{-1} \leq w \leq 0.425572633\text{kg}\,\text{kg}^{-1}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.3 Activated carbon COC-L1200

5.9.3.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	COC-L1200
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000118
Diameter of pellet	mm	0.42-1
Surface area	$m^2\,g^{-1}$	1412
Pore volume	$mm\,g^{-3}$	0.49

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.400000000e+00
E	$J\,mol^{-1}$	2.390000000e+04	W_0	$m^3\,kg^{-1}$	5.200000000e-04

Validity:

Equation is approximately valid for $350.7197052\text{Pa} \leq p \leq 96538.27054\text{Pa}$, $77.0\text{K} \leq T \leq 77.0\text{K}$, and $0.298480609\text{kg}\,\text{kg}^{-1} \leq w \leq 0.425572633\text{kg}\,\text{kg}^{-1}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.4 Activated carbon CarboTech A35/1

5.9.4.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	CarboTech A35/1
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1414
Porosity of pellet	-	0.88
Bulk density	$\mathrm{kg\,m^{-3}}$	330
Solid density	$\mathrm{kg\,m^{-3}}$	2191

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.200000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.119000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	7.720000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.5 Activated carbon CarboTech C40/1

5.9.5.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	CarboTech C40/1
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$m^2\,g^{-1}$	1288
Porosity of pellet	-	0.82
Bulk density	$kg\,m^{-3}$	380
Solid density	$kg\,m^{-3}$	2142

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.100000000e+00
E	$J\,mol^{-1}$	4.366000000e+03	W_0	$m^3\,kg^{-1}$	6.950000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.6 Activated carbon FR20

5.9.6.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	FR20
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000118
Diameter of pellet	mm	0.01
Surface area	$m^2\,g^{-1}$	2180
Pore volume	$mm\,g^{-3}$	0.75

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.600000000e+00
E	$J\,mol^{-1}$	2.030000000e+04	W_0	$m^3\,kg^{-1}$	7.400000000e-04

Validity:

Equation is approximately valid for $78.69334105\mathrm{Pa} \leq p \leq 94770.09918\mathrm{Pa}$, $77.0\mathrm{K} \leq T \leq 77.0\mathrm{K}$, and $0.345194915\mathrm{kg\,kg^{-1}} \leq w \leq 0.612861598\mathrm{kg\,kg^{-1}}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.7 Activated carbon G32-H

5.9.7.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	G32-H
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	921
Porosity of pellet	-	0.77
Bulk density	$\mathrm{kg\,m^{-3}}$	370
Solid density	$\mathrm{kg\,m^{-3}}$	2174

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.700000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.486000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.690000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.8 Activated carbon Norit R 1 Extra

5.9.8.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Norit R 1 Extra
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1045
Porosity of pellet	-	0.87
Bulk density	$\mathrm{kg\,m^{-3}}$	370
Solid density	$\mathrm{kg\,m^{-3}}$	2139

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.400000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.161000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.300000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.9 Activated carbon Norit RX 3 Extra

5.9.9.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Norit RX 3 Extra
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1111
Porosity of pellet	-	0.75
Bulk density	$\mathrm{kg\,m^{-3}}$	370
Solid density	$\mathrm{kg\,m^{-3}}$	2169

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.200000000e+00
E	$\mathrm{J\,mol^{-1}}$	6.119000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.760000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.10 Activated carbon RÜTGERS CG1-3

5.9.10.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	RÜTGERS CG1-3
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Henninger, S. K.; Schicktanz, M.; Hügenell, P.P.C.; Sievers, H.; Henning, H.-M. (2012): Evaluation of methanol adsorption on activated carbons for thermally driven chillers part I. Thermophysical characterisation. In: International Journal of Refrigeration 35 (3), S. 543–553. DOI: 10.1016/j.ijrefrig.2011.10.004.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1009
Porosity of pellet	-	0.84
Bulk density	$\mathrm{kg\,m^{-3}}$	420
Solid density	$\mathrm{kg\,m^{-3}}$	2259

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.200000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.059000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.450000000e-04

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.9.11 Activated carbon SRD 1352/3

5.9.11.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	SRD 1352/3
Refrigerant:	Nitrogen
Equation:	DubininAstakhov
ID:	1
Reference:	Brancato, V.; Frazzica, A.; Sapienza, A.; Gordeeva, L.; Freni, A. (2015): Ethanol adsorption onto carbonaceous and composite adsorbents for adsorptive cooling system. In: Energy 84, S. 177–185. DOI: 10.1016/j.energy.2015.02.077.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000112
Diameter of pellet	mm	0.5-2
Surface area	$m^2\,g^{-1}$	2613
Pore volume	$mm\,g^{-3}$	0.65

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.700000000e+00
E	$J\,mol^{-1}$	1.890000000e+04	W_0	$m^3\,kg^{-1}$	7.800000000e-04

Validity:

Equation is approximately valid for $123.3833866\text{Pa} \leq p \leq 96246.81372\text{Pa}$, $77.0\text{K} \leq T \leq 77.0\text{K}$, and $0.395659195\text{kg}\,\text{kg}^{-1} \leq w \leq 0.813818229\text{kg}\,\text{kg}^{-1}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.10 Propane

5.10.1 Activated carbon powder Maxsorb III

5.10.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	Propane
Equation:	DubininAstakhov
ID:	1
Reference:	Loh, Wai Soong; Ismail, Azhar Bin; Xi, Baojuan; Ng, Kim Choon; Chun, Won Gee (2012): Adsorption Isotherms and Isosteric Enthalpy of Adsorption for Assorted Refrigerants on Activated Carbons. In: J. Chem. Eng. Data 57 (10), S. 2766–2773. DOI: 10.1021/je3008099.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.220000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.577900000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	9.000000000e-01

Validity:
Equation is approximately valid for 11406.0Pa $\leq p \leq$ 763858.0Pa, 278.15K $\leq T \leq$ 358.15K, and 0.184246kg kg^{-1} $\leq w \leq$ 0.858129kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 5 MPa: 0.1
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.75%.

5.10.2 Carbon molecular sieve 4A

5.10.2.1 DubininAstakhov - ID 1

Sorbent:	carbon molecular sieve
Subtype:	4A
Refrigerant:	Propane
Equation:	DubininAstakhov
ID:	1
Reference:	Grande, Carlos A.; Silva, Viviana M.T.M.; Gigola, Carlos; Rodrigues, Alirio E. (2003): Adsorption of propane and propylene onto carbon molecular sieve. In: Carbon 41 (13), S. 2533–2545. DOI: 10.1016/S0008-6223(03)00304-X.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0003
Diameter of pellet	mm	1.1
Length of extrudate	mm	2.3-5
Porosity of pellet	-	0.315
Pellet density	$\mathrm{kg\,m^{-3}}$	900

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.823000000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	6.028470000e-02

Validity:
Equation is approximately valid for 1834.0Pa $\leq p \leq$ 290732.0Pa, 343.0K $\leq T \leq$ 423.0K, and 0.011958156kg kg^{-1} $\leq w \leq$ 0.053757018kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 500
- Temperature, absolute, in K → 0.5

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.9%.

5.10.2.2 Toth - ID 1

Sorbent:	carbon molecular sieve
Subtype:	4A
Refrigerant:	Propane
Equation:	Toth
ID:	1
Reference:	Grande, Carlos A.; Silva, Viviana M.T.M.; Gigola, Carlos; Rodrigues, Alirio E. (2003): Adsorption of propane and propylene onto carbon molecular sieve. In: Carbon 41 (13), S. 2533–2545. DOI: 10.1016/S0008-6223(03)00304-X.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0003
Diameter of pellet	mm	1.1
Length of extrudate	mm	2.3-5
Pore volume	$\mathrm{mm\,g^{-3}}$	0.31
Porosity of pellet	-	0.315
Pellet density	$\mathrm{kg\,m^{-3}}$	900

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.547670750e-03	Q^*	K	1.378321189e+03
c	K	0.000000000e+00	r^*	-	1.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
m	-	2.808988764e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	7.747842900e-02
n_0	-	3.560000000e-01			

Validity:
Equation is approximately valid for 2205.0Pa $\leq p \leq$ 291114.0Pa, 343.0K $\leq T \leq$ 423.0K, and 0.011563997kg kg^{-1} $\leq w \leq$ 0.053701768kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 500
- Temperature, absolute, in K $\rightarrow$ 0.5

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.92%.

5.10.3 Mof powder cubtc

5.10.3.1 DualSiteSips - ID 1

Sorbent:	mof powder
Subtype:	cubtc
Refrigerant:	Propane
Equation:	DualSiteSips
ID:	1
Reference:	Lamia, Nabil; Jorge, Miguel; Granato, Miguel A.; Almeida Paz, Filipe A.; Chevreau, Hubert; Rodrigues, Alírio E. (2009): Adsorption of propane, propylene and isobutane on a metal–organic framework. Molecular simulation and experiment. In: Chemical Engineering Science 64 (14), S. 3246–3259. DOI: 10.1016/j.ces.2009.04.010.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0016
Surface area	$m^2\,g^{-1}$	1500-2100
Bulk density	$kg\,m^{-3}$	350

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \sum_{i=A}^{B} w_{\mathrm{i}} \frac{(b_i p)^{1/\eta_i}}{1 + (b_i p)^{1/\eta_i}} \quad \text{, and}$$

$$b_i = b_{i,0} \exp\left(\frac{Q_i}{RT}\left(1 - \frac{T}{T_0}\right)\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$b_{\mathrm{A},0}$	Pa^{-1}	7.000000000e-05	$b_{\mathrm{B},0}$	Pa^{-1}	1.600000000e-04
Q_{A}	$J\,mol^{-1}$	2.870000000e+04	Q_{B}	$J\,mol^{-1}$	3.410000000e+04
η_{A}	-	8.200000000e-01	η_{B}	-	3.200000000e-01
w_{A}	$kg\,kg^{-1}$	2.738423700e-01	w_{B}	$kg\,kg^{-1}$	5.027058000e-02
T_0	K	3.230000000e+02			

Validity:
Equation is approximately valid for 1095.9Pa $\leq p \leq$ 99931.5Pa, 323.0K $\leq T \leq$ 423.0K, and 0.001212227kg kg^{-1} $\leq w \leq$ 0.299726427kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 50
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.42%.

5.10.4 Zeolite crystal 5A

5.10.4.1 DubininAstakhov - ID 1

Sorbent:	zeolite crystal
Subtype:	5A
Refrigerant:	Propane
Equation:	DubininAstakhov
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.240000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.940000000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	1.486170000e-01

Validity:
Equation is approximately valid for 2450.0Pa $\leq p \leq$ 99391.0Pa, 323.0K $\leq T \leq$ 423.0K, and 0.011807775$\mathrm{kg\,kg^{-1}} \leq w \leq$ 0.137102049$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.0%.

5.10.4.2 Toth - ID 1

Sorbent:	zeolite crystal
Subtype:	5A
Refrigerant:	Propane
Equation:	Toth
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001
Diameter of pore	mm	0.00005
Diameter of pellet	mm	1.65-2.5
Porosity of pellet	-	0.35
Pellet density	$\mathrm{kg\,m^{-3}}$	1130
Solid density	$\mathrm{kg\,m^{-3}}$	1740

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.792538349e-04	Q^*	K	1.828139797e+03
c	K	0.000000000e+00	r^*	-	1.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
m	-	2.173913043e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.605130800e-01
n_0	-	4.600000000e-01			

Validity:
Equation is approximately valid for 2475.3Pa $\leq p \leq$ 99591.1Pa, 323.0K $\leq T \leq$ 423.0K, and 0.012344073kg kg^{-1} $\leq w \leq$ 0.137030546kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.61%.

5.10.5 Zeolite pellet 13X

5.10.5.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	Propane
Equation:	Toth
ID:	1
Reference:	Da Silva, Francisco A.; Rodrigues, Alírio E. (1999): Adsorption Equilibria and Kinetics for Propylene and Propane over 13X and 4A Zeolite Pellets. In: Ind. Eng. Chem. Res. 38 (5), S. 2051–2057. DOI: 10.1021/ie980640z.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.002
Diameter of pellet	mm	0.79
Diameter of extrudate	mm	1.5-1.9
Length of extrudate	mm	4-7
Porosity of pellet	-	0.39
Bulk density	$\mathrm{kg\,m^{-3}}$	630-680
Pellet density	$\mathrm{kg\,m^{-3}}$	1358
Solid density	$\mathrm{kg\,m^{-3}}$	2234

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	Pa^{-1}	3.500000000e-10	Q^*	K	4.300000000e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.181799600e-01
n_0	-	5.800000000e-01			

Validity:
Equation is approximately valid for $444.1\mathrm{Pa} \leq p \leq 104549.7\mathrm{Pa}$, $303.0\mathrm{K} \leq T \leq 473.0\mathrm{K}$, and $0.001047304\mathrm{kg\,kg^{-1}} \leq w \leq 0.095440019\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 29.53%.

5.10.5.2 Toth - ID 2

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	Propane
Equation:	Toth
ID:	2
Reference:	Lamia, Nabil; Wolff, Luc; Leflaive, Philibert; Sá Gomes, Pedro; Grande, Carlos A.; Rodrigues, Alírio E. (2007): Propane/Propylene Separation by Simulated Moving Bed I. Adsorption of Propane, Propylene and Isobutane in Pellets of 13X Zeolite. In: Separation Science and Technology 42 (12), S. 2539–2566. DOI: 10.1080/01496390701515219.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001
Diameter of pore	mm	0.0000005
Diameter of extrudate	mm	0.8
Porosity of pellet	-	0.395
Pellet density	$\mathrm{kg\,m^{-3}}$	1357

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} \quad \text{, and}$$

$$b = b_0 \exp\left(\frac{Q^*}{T}\right) \quad \text{, and}$$

$$n = n_0 + {}^{c}/_{T} \quad \text{, and}$$

$$r = \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	2.500000000e-10	Q^*	K	4.438049901e+03

Par.	Unit	Value	Par.	Unit	Value
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	9.701340000e-02
n_0	-	8.920000000e-01			

Validity:
Equation is approximately valid for 367.8Pa $\leq p \leq$ 154298.9Pa, 333.0K $\leq T \leq$ 393.0K, and 0.002644938kg kg^{-1} $\leq w \leq$ 0.096698106kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 50
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 9.77%.

5.10.6 Zeolite pellet 4A

5.10.6.1 Langmuir - ID 1

Sorbent:	zeolite pellet
Subtype:	4A
Refrigerant:	Propane
Equation:	Langmuir
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2003): Propane–propylene binary adsorption on zeolite 4A. In: Adsorption 9 (4), S. 321–329. DOI: 10.1023/A:1026223914143.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} K p}{1 + K p} \quad \text{, and}$$
$$K = K_0 \exp\left(\frac{\Delta H}{RT}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
ΔH	$\mathrm{J\,mol^{-1}}$	1.621460000e+04	w_{sat}	$\mathrm{kg\,kg^{-1}}$	7.727999250e-02
K_0	$\mathrm{Pa^{-1}}$	4.220000000e-08			

Validity:
Equation is approximately valid for $0.0\mathrm{Pa} \leq p \leq 367890.0\mathrm{Pa}$, $423.0\mathrm{K} \leq T \leq 473.0\mathrm{K}$, and $0.0\mathrm{kg\,kg^{-1}} \leq w \leq 0.04762476\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.41%.

5.10.6.2 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	4A
Refrigerant:	Propane
Equation:	Toth
ID:	1
Reference:	Da Silva, Francisco A.; Rodrigues, Alírio E. (1999): Adsorption Equilibria and Kinetics for Propylene and Propane over 13X and 4A Zeolite Pellets. In: Ind. Eng. Chem. Res. 38 (5), S. 2051–2057. DOI: 10.1021/ie980640z.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0034
Diameter of pellet	mm	1.6
Diameter of extrudate	mm	3.2
Length of extrudate	mm	8-12
Porosity of pellet	-	0.34
Bulk density	$\mathrm{kg\,m^{-3}}$	>700
Pellet density	$\mathrm{kg\,m^{-3}}$	1700
Solid density	$\mathrm{kg\,m^{-3}}$	2590

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	Pa^{-1}	6.000000000e-07	Q^*	K	0.000000000e+00
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	8.951691000e-02
n_0	-	1.000000000e+00			

Validity:
Equation is approximately valid for 291.1Pa $\leq p \leq$ 107707.2Pa, 303.0K $\leq T \leq$ 473.0K, and 0.0073kg kg^{-1} $\leq w \leq$ 0.012964kg kg^{-1}.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.10.7 Zeolite pellet 5A

5.10.7.1 DubininAstakhov - ID 1

Sorbent:	zeolite pellet
Subtype:	5A
Refrigerant:	Propane
Equation:	DubininAstakhov
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0011
Diameter of pore	mm	0.00005
Diameter of pellet	mm	2.5
Porosity of pellet	-	0.35
Pellet density	$\mathrm{kg\,m^{-3}}$	1130
Solid density	$\mathrm{kg\,m^{-3}}$	1740

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.470000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.820000000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	1.128960000e-01

Validity:
Equation is approximately valid for 2375.0Pa $\leq p \leq$ 99898.0Pa, 323.0K $\leq T \leq$ 423.0K, and 0.005826051kg kg^{-1} $\leq w \leq$ 0.102996432kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.05%.

5.10.7.2 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	5A
Refrigerant:	Propane
Equation:	Toth
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0011
Diameter of pore	mm	0.00005
Diameter of pellet	mm	1.65-2.5
Porosity of pellet	-	0.35
Pellet density	$\mathrm{kg\,m^{-3}}$	1130
Solid density	$\mathrm{kg\,m^{-3}}$	1740

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	8.989322242e-06	Q^*	K	2.393419865e+03
c	K	0.000000000e+00	r^*	-	1.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
m	-	1.724137931e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.150931700e-01
n_0	-	5.800000000e-01			

Validity:
Equation is approximately valid for 2344.7Pa $\leq p \leq$ 99897.9Pa, 323.0K $\leq T \leq$ 423.0K, and 0.005555781kg kg^{-1} $\leq w \leq$ 0.102417046kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.43%.

5.11 Propylene

5.11.1 Carbon molecular sieve 4A

5.11.1.1 DubininAstakhov - ID 1

Sorbent:	carbon molecular sieve
Subtype:	4A
Refrigerant:	Propylene
Equation:	DubininAstakhov
ID:	1
Reference:	Grande, Carlos A.; Silva, Viviana M.T.M.; Gigola, Carlos; Rodrigues, Alirio E. (2003): Adsorption of propane and propylene onto carbon molecular sieve. In: Carbon 41 (13), S. 2533–2545. DOI: 10.1016/S0008-6223(03)00304-X.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0003
Diameter of pellet	mm	1.1
Length of extrudate	mm	2.3-5
Porosity of pellet	-	0.315
Pellet density	$\mathrm{kg\,m^{-3}}$	900

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	2.123000000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	7.023152000e-02

Validity:
Equation is approximately valid for 109.0Pa $\leq p \leq$ 283009.0Pa, 343.0K $\leq T \leq$ 423.0K, and 0.01275571kg kg^{-1} $\leq w \leq$ 0.062451349kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 500
- Temperature, absolute, in K → 0.5

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.89%.

5.11.1.2 Toth - ID 1

Sorbent:	carbon molecular sieve
Subtype:	4A
Refrigerant:	Propylene
Equation:	Toth
ID:	1
Reference:	Grande, Carlos A.; Silva, Viviana M.T.M.; Gigola, Carlos; Rodrigues, Alirio E. (2003): Adsorption of propane and propylene onto carbon molecular sieve. In: Carbon 41 (13), S. 2533–2545. DOI: 10.1016/S0008-6223(03)00304-X.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0003
Diameter of pellet	mm	1.1
Length of extrudate	mm	2.3-5
Pore volume	$\mathrm{mm\,g^{-3}}$	0.31
Porosity of pellet	-	0.315
Pellet density	$\mathrm{kg\,m^{-3}}$	900

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.398214917e-03	Q^*	K	1.725908295e+03
c	K	0.000000000e+00	r^*	-	1.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
m	-	3.076923077e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	8.108765898e-02
n_0	-	3.250000000e-01			

Validity:
Equation is approximately valid for 540.0Pa $\leq p \leq$ 282903.0Pa, 343.0K $\leq T \leq$ 423.0K, and 0.012668106kg kg^{-1} $\leq w \leq$ 0.062296109kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 500
- Temperature, absolute, in K → 0.5

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.85%.

5.11.2 Mof powder cubtc

5.11.2.1 DualSiteSips - ID 1

Sorbent:	mof powder
Subtype:	cubtc
Refrigerant:	Propylene
Equation:	DualSiteSips
ID:	1
Reference:	Lamia, Nabil; Jorge, Miguel; Granato, Miguel A.; Almeida Paz, Filipe A.; Chevreau, Hubert; Rodrigues, Alírio E. (2009): Adsorption of propane, propylene and isobutane on a metal–organic framework. Molecular simulation and experiment. In: Chemical Engineering Science 64 (14), S. 3246–3259. DOI: 10.1016/j.ces.2009.04.010.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0016
Surface area	$m^2\,g^{-1}$	1500-2100
Bulk density	$kg\,m^{-3}$	350

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \sum_{i=A}^{B} w_{\mathrm{i}} \frac{(b_i p)^{1/\eta_i}}{1 + (b_i p)^{1/\eta_i}} \quad \text{, and}$$

$$b_i = b_{i,0} \exp\left(\frac{Q_i}{RT}\left(1 - \frac{T}{T_0}\right)\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$b_{\mathrm{A},0}$	Pa^{-1}	4.200000000e-04	$b_{\mathrm{B},0}$	Pa^{-1}	6.000000000e-05
Q_{A}	$J\,mol^{-1}$	4.190000000e+04	Q_{B}	$J\,mol^{-1}$	4.700000000e+04
η_{A}	-	1.000000000e+00	η_{B}	-	8.000000000e-01
w_{A}	$kg\,kg^{-1}$	2.983453566e-01	w_{B}	$kg\,kg^{-1}$	5.133728280e-02
T_0	K	3.230000000e+02			

Validity:
Equation is approximately valid for 75.7Pa $\leq p \leq$ 99297.6Pa, 323.0K $\leq T \leq$ 423.0K, and 0.007015955kg kg^{-1} $\leq w \leq$ 0.33063272kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 50
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.87%.

5.11.3 Zeolite crystal 5A

5.11.3.1 DubininAstakhov - ID 1

Sorbent:	zeolite crystal
Subtype:	5A
Refrigerant:	Propylene
Equation:	DubininAstakhov
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.280000000e+00
E	$\mathrm{J\,mol^{-1}}$	2.340000000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	1.578000000e-01

Validity:
Equation is approximately valid for 2383.0Pa $\leq p \leq$ 98972.0Pa, 323.0K $\leq T \leq$ 423.0K, and 0.027331802$\mathrm{kg\,kg^{-1}} \leq w \leq$ 0.150613578$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.35%.

5.11.3.2 Toth - ID 1

Sorbent:	zeolite crystal
Subtype:	5A
Refrigerant:	Propylene
Equation:	Toth
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001
Diameter of pore	mm	0.00005
Diameter of pellet	mm	1.65-2.5
Porosity of pellet	-	0.35
Pellet density	$\mathrm{kg\,m^{-3}}$	1130
Solid density	$\mathrm{kg\,m^{-3}}$	1740

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	8.391732682e-04	Q^*	K	1.683812971e+03
c	K	0.000000000e+00	r^*	-	1.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
m	-	2.500000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.691605548e-01
n_0	-	4.000000000e-01			

Validity:
Equation is approximately valid for 2440.3Pa $\leq p \leq$ 99132.3Pa, 323.0K $\leq T \leq$ 423.0K, and 0.027199923kg kg^{-1} $\leq w \leq$ 0.149766003kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.65%.

5.11.4 Zeolite pellet 13X

5.11.4.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	Propylene
Equation:	Toth
ID:	1
Reference:	Da Silva, Francisco A.; Rodrigues, Alírio E. (1999): Adsorption Equilibria and Kinetics for Propylene and Propane over 13X and 4A Zeolite Pellets. In: Ind. Eng. Chem. Res. 38 (5), S. 2051–2057. DOI: 10.1021/ie980640z.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.002
Diameter of pellet	mm	0.79
Diameter of extrudate	mm	1.5-1.9
Length of extrudate	mm	4-7
Porosity of pellet	-	0.39
Bulk density	$\mathrm{kg\,m^{-3}}$	630-680
Pellet density	$\mathrm{kg\,m^{-3}}$	1358
Solid density	$\mathrm{kg\,m^{-3}}$	2234

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + c/T && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	Pa^{-1}	3.500000000e-10	Q^*	K	5.100000000e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.127737032e-01
n_0	-	6.080000000e-01			

Validity:
Equation is approximately valid for $207.5\mathrm{Pa} \leq p \leq 103413.5\mathrm{Pa}$, $303.0\mathrm{K} \leq T \leq 473.0\mathrm{K}$, and $0.002668276\mathrm{kg\,kg^{-1}} \leq w \leq 0.114398823\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 26.73%.

5.11.4.2 Toth - ID 2

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	Propylene
Equation:	Toth
ID:	2
Reference:	Lamia, Nabil; Wolff, Luc; Leflaive, Philibert; Sá Gomes, Pedro; Grande, Carlos A.; Rodrigues, Alírio E. (2007): Propane/Propylene Separation by Simulated Moving Bed I. Adsorption of Propane, Propylene and Isobutane in Pellets of 13X Zeolite. In: Separation Science and Technology 42 (12), S. 2539–2566. DOI: 10.1080/01496390701515219.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.001
Diameter of pore	mm	0.0000005
Diameter of extrudate	mm	0.8
Porosity of pellet	-	0.395
Pellet density	$\mathrm{kg\,m^{-3}}$	1357

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} \quad \text{, and}$$

$$b = b_0 \exp\left(\frac{Q^*}{T}\right) \quad \text{, and}$$

$$n = n_0 + {}^{c}/_{T} \quad \text{, and}$$

$$r = \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	2.500000000e-10	Q^*	K	5.099547854e+03

Par.	Unit	Value	Par.	Unit	Value
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.089865266e-01
n_0	-	6.580000000e-01			

Validity:
Equation is approximately valid for 269.2Pa $\leq p \leq$ 151780.1Pa, 333.0K $\leq T \leq$ 393.0K, and 0.004055645kg kg^{-1} $\leq w \leq$ 0.10404889kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 50
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.91%.

5.11.5 Zeolite pellet 4A

5.11.5.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	4A
Refrigerant:	Propylene
Equation:	Toth
ID:	1
Reference:	Da Silva, Francisco A.; Rodrigues, Alírio E. (1999): Adsorption Equilibria and Kinetics for Propylene and Propane over 13X and 4A Zeolite Pellets. In: Ind. Eng. Chem. Res. 38 (5), S. 2051–2057. DOI: 10.1021/ie980640z.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0034
Diameter of pellet	mm	1.6
Diameter of extrudate	mm	3.2
Length of extrudate	mm	8-12
Porosity of pellet	-	0.34
Bulk density	$\mathrm{kg\,m^{-3}}$	>700
Pellet density	$\mathrm{kg\,m^{-3}}$	1700
Solid density	$\mathrm{kg\,m^{-3}}$	2590

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	Pa^{-1}	7.400000000e-09	Q^*	K	3.594000000e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	8.542187220e-02
n_0	-	6.660000000e-01			

Validity:
Equation is approximately valid for $207.5\mathrm{Pa} \leq p \leq 102906.9\mathrm{Pa}$, $303.0\mathrm{K} \leq T \leq 473.0\mathrm{K}$, and $0.00287068\mathrm{kg\,kg^{-1}} \leq w \leq 0.114398823\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 17.17%.

5.11.6 Zeolite pellet 5A

5.11.6.1 DubininAstakhov - ID 1

Sorbent:	zeolite pellet
Subtype:	5A
Refrigerant:	Propylene
Equation:	DubininAstakhov
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0011
Diameter of pore	mm	0.00005
Diameter of pellet	mm	2.5
Porosity of pellet	-	0.35
Pellet density	$\mathrm{kg\,m^{-3}}$	1130
Solid density	$\mathrm{kg\,m^{-3}}$	1740

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.130000000e+00
E	$\mathrm{J\,mol^{-1}}$	2.340000000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	1.140368000e-01

Validity:
Equation is approximately valid for 2096.0Pa $\leq p \leq$ 99689.0Pa, 323.0K $\leq T \leq$ 423.0K, and 0.021808381kg kg^{-1} $\leq w \leq$ 0.104713555kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.44%.

5.11.6.2 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	5A
Refrigerant:	Propylene
Equation:	Toth
ID:	1
Reference:	Grande, Carlos A.; Gigola, Carlos; Rodrigues, Alírio E. (2002): Adsorption of Propane and Propylene in Pellets and Crystals of 5A Zeolite. In: Ind. Eng. Chem. Res. 41 (1), S. 85–92. DOI: 10.1021/ie010494o.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of crystal	mm	0.0011
Diameter of pore	mm	0.00005
Diameter of pellet	mm	1.65-2.5
Porosity of pellet	-	0.35
Pellet density	$\mathrm{kg\,m^{-3}}$	1130
Solid density	$\mathrm{kg\,m^{-3}}$	1740

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.680162818e-04	Q^*	K	1.611649558e+03
c	K	0.000000000e+00	r^*	-	1.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
m	-	2.777777778e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.232936382e-01
n_0	-	3.600000000e-01			

Validity:
Equation is approximately valid for 2025.1Pa $\leq p \leq$ 99973.3Pa, 323.0K $\leq T \leq$ 423.0K, and 0.021620991kg kg^{-1} $\leq w \leq$ 0.104631694kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 40

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 88.85%.

5.12 R-1234ze(E)

5.12.1 Activated carbon powder Maxsorb III

5.12.1.1 Toth - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-1234ze(E)
Equation:	Toth
ID:	1
Reference:	Jribi, Skander; Saha, Bidyut Baran; Koyama, Shigeru; Chakraborty, Anutosh; Ng, Kim Choon (2013): Study on activated carbon/HFO-1234ze(E) based adsorption cooling cycle. In: Applied Thermal Engineering 50 (2), S. 1570–1575. DOI: 10.1016/j.applthermaleng.2011.11.066.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$w = \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} \quad \text{, and}$$

$$b = b_0 \exp\left(\frac{Q^*}{T}\right) \quad \text{, and}$$

$$n = n_0 + {}^{c}/_{T} \quad \text{, and}$$

$$r = \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.300000000e-05	Q^*	K	3.863148044e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	3.740000000e+00
n_0	-	2.950000000e-01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.13 R-134a

5.13.1 Activated carbon Maxsorb III

5.13.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	Maxsorb III
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Saha, Bidyut B.; Habib, Khairul; El-Sharkawy, Ibrahim I.; Koyama, Shigeru (2009): Adsorption characteristics and heat of adsorption measurements of R-134a on activated carbon. In: International Journal of Refrigeration 32 (7), S. 1563–1569. DOI: 10.1016/j.ijrefrig.2009.03.010.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.26e-4 * exp(ln(9.39e-4 /7.26e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.072
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.300000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.460000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	1.649000000e-03

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.13.1.2 DubininAstakhov - ID 2

Sorbent:	activated carbon
Subtype:	Maxsorb III
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	2
Reference:	Saha, Bidyut B.; Habib, Khairul; El-Sharkawy, Ibrahim I.; Koyama, Shigeru (2009): Adsorption characteristics and heat of adsorption measurements of R-134a on activated carbon. In: International Journal of Refrigeration 32 (7), S. 1563–1569. DOI: 10.1016/j.ijrefrig.2009.03.010.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.26e-4 * exp(ln(9.39e-4 /7.26e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.072
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.170000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.700000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.945000000e+00

Validity:

No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.13.2 Activated carbon SRD 1352/3

5.13.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	SRD 1352/3
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Saha, Bidyut Baran; El-Sharkawy, Ibrahim I.; Thorpe, Roger; Critoph, Robert E. (2012): Accurate adsorption isotherms of R134a onto activated carbons for cooling and freezing applications. In: International Journal of Refrigeration 35 (3), S. 499–505. DOI: 10.1016/j.ijrefrig.2011.05.002.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.700000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.091659312e+04	W_0	$\mathrm{m^3\,kg^{-1}}$	7.670000000e-04

Validity:
Equation is approximately valid for $131850.0\mathrm{Pa} \leq p \leq 965390.0\mathrm{Pa}$, $303.35\mathrm{K} \leq T \leq 351.65\mathrm{K}$, and $0.42159\mathrm{kg\,kg^{-1}} \leq w \leq 1.20432\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.95%.

5.13.2.2 DubininAstakhov - ID 2

Sorbent:	activated carbon
Subtype:	SRD 1352/3
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	2
Reference:	Saha, Bidyut Baran; El-Sharkawy, Ibrahim I.; Thorpe, Roger; Critoph, Robert E. (2012): Accurate adsorption isotherms of R134a onto activated carbons for cooling and freezing applications. In: International Journal of Refrigeration 35 (3), S. 499–505. DOI: 10.1016/j.ijrefrig.2011.05.002.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.800000000e+00
E	$\mathrm{J\,mol^{-1}}$	9.729715794e+03	W_0	$\mathrm{kg\,kg^{-1}}$	9.260000000e-01

Validity:
Equation is approximately valid for 131850.0Pa $\leq p \leq$ 965390.0Pa, 303.35K $\leq T \leq$ 351.65K, and 0.42159$\mathrm{kg\,kg^{-1}} \leq w \leq$ 1.20432$\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.49%.

5.13.3 Activated carbon granular

5.13.3.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	granular
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Askalany, Ahmed A.; Salem, M.; Ismail, I. M.; Ali, Ahmed Hamza H.; Morsy, M. G. (2012): Experimental study on adsorption–desorption characteristics of granular activated carbon/R134a pair. In: International Journal of Refrigeration 35 (3), S. 494–498. DOI: 10.1016/j.ijrefrig.2011.04.002.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	900
Pore volume	$\mathrm{mm\,g^{-3}}$	0.88
Bulk density	$\mathrm{kg\,m^{-3}}$	510

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.830000000e+00
E	$\mathrm{J\,mol^{-1}}$	9.575000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.680000000e+00

Validity:
Equation is approximately valid for 293.15K $\leq T \leq$ 363.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.13.4 Activated carbon fiber A-20

5.13.4.1 DubininAstakhov - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Saha, Bidyut Baran; El-Sharkawy, Ibrahim I.; Thorpe, Roger; Critoph, Robert E. (2012): Accurate adsorption isotherms of R134a onto activated carbons for cooling and freezing applications. In: International Journal of Refrigeration 35 (3), S. 499–505. DOI: 10.1016/j.ijrefrig.2011.05.002.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.500000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.611656172e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	1.010000000e-03

Validity:
Equation is approximately valid for $139320.0\mathrm{Pa} \leq p \leq 994090.0\mathrm{Pa}$, $299.95\mathrm{K} \leq T \leq 352.35\mathrm{K}$, and $0.44932\mathrm{kg\,kg^{-1}} \leq w \leq 0.93974\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.43%.

5.13.4.2 DubininAstakhov - ID 2

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	2
Reference:	Saha, Bidyut Baran; El-Sharkawy, Ibrahim I.; Thorpe, Roger; Critoph, Robert E. (2012): Accurate adsorption isotherms of R134a onto activated carbons for cooling and freezing applications. In: International Journal of Refrigeration 35 (3), S. 499–505. DOI: 10.1016/j.ijrefrig.2011.05.002.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.400000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.720071086e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.256000000e+00

Validity:
Equation is approximately valid for $139320.0\mathrm{Pa} \leq p \leq 994090.0\mathrm{Pa}$, $299.95\mathrm{K} \leq T \leq 352.35\mathrm{K}$, and $0.44932\mathrm{kg\,kg^{-1}} \leq w \leq 0.93974\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.64%.

5.13.4.3 DubininAstakhov - ID 3

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	3
Reference:	Loh, Wai Soong; Ismail, Azhar Bin; Xi, Baojuan; Ng, Kim Choon; Chun, Won Gee (2012): Adsorption Isotherms and Isosteric Enthalpy of Adsorption for Assorted Refrigerants on Activated Carbons. In: J. Chem. Eng. Data 57 (10), S. 2766–2773. DOI: 10.1021/je3008099.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000216
Surface area	$\mathrm{m^2\,g^{-1}}$	1930
Pore volume	$\mathrm{mm\,g^{-3}}$	1.05
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.490000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.136010000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.290000000e+00

Validity:
Equation is approximately valid for 17485.0Pa $\leq p \leq$ 685047.0Pa, 278.15K $\leq T \leq$

328.15K, and $0.05756\,\mathrm{kg\,kg^{-1}} \leq w \leq 1.28264\,\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 5 MPa: 0.1
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.37%.

5.13.5 Activated carbon powder Maxsorb III

5.13.5.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Loh, Wai Soong; Ismail, Azhar Bin; Xi, Baojuan; Ng, Kim Choon; Chun, Won Gee (2012): Adsorption Isotherms and Isosteric Enthalpy of Adsorption for Assorted Refrigerants on Activated Carbons. In: J. Chem. Eng. Data 57 (10), S. 2766–2773. DOI: 10.1021/je3008099.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.290000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.332690000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.220000000e+00

Validity:
Equation is approximately valid for 19642.9Pa $\leq p \leq$ 694643.0Pa, 278.15K $\leq T \leq$ 358.15K, and 0.497959kg kg^{-1} $\leq w \leq$ 2.21224kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 5 MPa: 0.1
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.0%.

5.13.5.2 Toth - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-134a
Equation:	Toth
ID:	1
Reference:	Jribi, Skander; Saha, Bidyut Baran; Koyama, Shigeru; Chakraborty, Anutosh; Ng, Kim Choon (2013): Study on activated carbon/HFO-1234ze(E) based adsorption cooling cycle. In: Applied Thermal Engineering 50 (2), S. 1570–1575. DOI: 10.1016/j.applthermaleng.2011.11.066.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	3.510000000e-05	Q^*	K	3.027255176e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	4.320000000e+00
n_0	-	3.210000000e-01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.13.6 Activated charcoal pellet Chemviron

5.13.6.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal pellet
Subtype:	Chemviron
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Akkimaradi, Basavaraj S.; Prasad, Madhu; Dutta, Pradip; Srinivasan, Kandadai (2001): Adsorption of 1,1,1,2-Tetrafluoroethane on Activated Charcoal. In: J. Chem. Eng. Data 46 (2), S. 417–422. DOI: 10.1021/je000277e.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.600000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.487000000e+04	W_0	$\mathrm{m^3\,kg^{-1}}$	2.790000000e-04

Validity:

Equation is approximately valid for 23000.0Pa $\leq p \leq$ 649000.0Pa, 273.15K $\leq T \leq$ 353.15K, and 0.145kg kg^{-1} $\leq w \leq$ 0.369kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 2500

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.22%.

5.13.7 Activated charcoal powder Fluka

5.13.7.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal powder
Subtype:	Fluka
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Akkimaradi, Basavaraj S.; Prasad, Madhu; Dutta, Pradip; Srinivasan, Kandadai (2001): Adsorption of 1,1,1,2-Tetrafluoroethane on Activated Charcoal. In: J. Chem. Eng. Data 46 (2), S. 417–422. DOI: 10.1021/je000277e.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	1143
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	9.500000000e-01
E	$\mathrm{J\,mol^{-1}}$	8.897000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.490000000e-04

Validity:
Equation is approximately valid for 42000.0Pa $\leq p \leq$ 622000.0Pa, 273.15K $\leq T \leq$ 353.15K, and 0.122kg kg^{-1} $\leq w \leq$ 0.584kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 2500

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.39%.

5.13.8 Activated charcoal powder Maxsorb

5.13.8.1 DubininAstakhov - ID 1

Sorbent:	activated charcoal powder
Subtype:	Maxsorb
Refrigerant:	R-134a
Equation:	DubininAstakhov
ID:	1
Reference:	Akkimaradi, Basavaraj S.; Prasad, Madhu; Dutta, Pradip; Srinivasan, Kandadai (2001): Adsorption of 1,1,1,2-Tetrafluoroethane on Activated Charcoal. In: J. Chem. Eng. Data 46 (2), S. 417–422. DOI: 10.1021/je000277e.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., 1/rho_adsorpt = 7.2643e-4 * exp(ln(9.39e-4 /7.2643e-4) * (T - 246.78) / (374.21 - 246.78)) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^{n}\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.500000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.269000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	1.548000000e-03

Validity:

Equation is approximately valid for 28000.0Pa $\leq p \leq$ 632000.0Pa, 273.15K $\leq T \leq$ 353.15K, and 0.216kg kg^{-1} $\leq w \leq$ 2.01kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 2500

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.03%.

5.14 R-32

5.14.1 Activated carbon fiber A-20

5.14.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	R-32
Equation:	DubininAstakhov
ID:	1
Reference:	Askalany, Ahmed A.; Saha, Bidyut B.; Uddin, Kutub; Miyzaki, Takahiko; Koyama, Shigeru; Srinivasan, Kandadai; Ismail, Ibrahim M. (2013): Adsorption Isotherms and Heat of Adsorption of Difluoromethane on Activated Carbons. In: J. Chem. Eng. Data 58 (10), S. 2828–2834. DOI: 10.1021/je4005678.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., rho_adsorpt = 1.022 * T - rho_gas(p, T) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	2200
Pore volume	$\mathrm{mm\,g^{-3}}$	1

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.090000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.098000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.580000000e-03

Validity:
Equation is approximately valid for $18790.0\mathrm{Pa} \leq p \leq 1287470.0\mathrm{Pa}$, $298.08\mathrm{K} \leq T \leq 347.37\mathrm{K}$, and $0.05\mathrm{kg\,kg^{-1}} \leq w \leq 0.94\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 4000
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.66%.

5.14.2 Activated carbon powder Maxsorb III

5.14.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-32
Equation:	DubininAstakhov
ID:	1
Reference:	Askalany, Ahmed A.; Saha, Bidyut B.; Uddin, Kutub; Miyzaki, Takahiko; Koyama, Shigeru; Srinivasan, Kandadai; Ismail, Ibrahim M. (2013): Adsorption Isotherms and Heat of Adsorption of Difluoromethane on Activated Carbons. In: J. Chem. Eng. Data 58 (10), S. 2828–2834. DOI: 10.1021/je4005678.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., rho_adsorpt = 1.546 * T - rho_gas(p, T) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3200
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.150000000e+00
E	$\mathrm{J\,mol^{-1}}$	3.939000000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	4.050000000e-03

Validity:
Equation is approximately valid for 112960.0Pa $\leq p \leq$ 1381720.0Pa, 297.95K $\leq T \leq$ 347.46K, and 0.10552kg kg^{-1} $\leq w \leq$ 1.44kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 4000
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.64%.

5.15 R-404a

5.15.1 Activated carbon AquaSorb 2000

5.15.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AquaSorb 2000
Refrigerant:	R-404a
Equation:	DubininAstakhov
ID:	1
Reference:	Ghazy, Mohamed; Askalany, Ahmed A.; Harby, K.; Ahmed, Mahmoud S. (2016): Adsorption isotherms and kinetics of HFC-404A onto bituminous based granular activated carbon for storage and cooling applications. In: Applied Thermal Engineering 105, S. 639–645. DOI: 10.1016/j.applthermaleng.2016.03.057.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., rho_adsorpt = A - B * T - rho_gas(p, T) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00028
Surface area	$\mathrm{m^2\,g^{-1}}$	1050
Pore volume	$\mathrm{mm\,g^{-3}}$	1.04
Bulk density	$\mathrm{kg\,m^{-3}}$	480

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.030000000e+00
E	$\mathrm{J\,mol^{-1}}$	9.578464000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	1.035000000e-03

Validity:
Equation is approximately valid for $14330.0\mathrm{Pa} \leq p \leq 1179920.0\mathrm{Pa}$, $298.15\mathrm{K} \leq T \leq 348.15\mathrm{K}$, and $0.140971\mathrm{kg\,kg^{-1}} \leq w \leq 0.519275\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: NoVaporPressure - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 387.57%.

5.16 R-407c

5.16.1 Activated carbon AquaSorb 2000

5.16.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon
Subtype:	AquaSorb 2000
Refrigerant:	R-407c
Equation:	DubininAstakhov
ID:	1
Reference:	El-sharkawy, M. M.; Askalany, A. A.; Harby, K.; Ahmed, M. S. (2016): Adsorption isotherms and kinetics of a mixture of Pentafluoroethane, 1,1,1,2-Tetrafluoroethane and Difluoromethane (HFC-407C) onto granular activated carbon. In: Applied Thermal Engineering 93, S. 988–994. DOI: 10.1016/j.applthermaleng.2015.10.077.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., rho_adsorpt = A - B * T - rho_gas(p, T) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00028
Surface area	$\mathrm{m^2\,g^{-1}}$	1050
Pore volume	$\mathrm{mm\,g^{-3}}$	1.04
Bulk density	$\mathrm{kg\,m^{-3}}$	480

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.360000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.935559600e+05	W_0	$\mathrm{m^3\,kg^{-1}}$	1.139000000e-03

Validity:
Equation is approximately valid for 6670.0Pa $\leq p \leq$ 870740.0Pa, 298.15K $\leq T \leq$ 348.15K, and 0.039115kg kg^{-1} $\leq w \leq$ 0.421769kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 539.8%.

5.17 R-410a

5.17.1 Activated carbon fiber A-20

5.17.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	R-410a
Equation:	DubininAstakhov
ID:	1
Reference:	Askalany, Ahmed A.; Saha, Bidyut B.; Ismail, Ibrahim M. (2014): Adsorption isotherms and kinetics of HFC410A onto activated carbons. In: Applied Thermal Engineering 72 (2), S. 237–243. DOI: 10.1016/j.applthermaleng.2014.04.075.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., rho_adsorpt = -1.0015 * T - rho_gas(p, T) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.0216
Surface area	$\mathrm{m^2\,g^{-1}}$	2000
Pore volume	$\mathrm{mm\,g^{-3}}$	1.03
Solid density	$\mathrm{kg\,m^{-3}}$	800

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.430000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.263500000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	3.250000000e-03

Validity:
Equation is approximately valid for $59390.0\mathrm{Pa} \leq p \leq 957340.0\mathrm{Pa}$, $283.15\mathrm{K} \leq T \leq 323.15\mathrm{K}$, and $0.1655\mathrm{kg\,kg^{-1}} \leq w \leq 1.09799\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 142.17%.

5.17.2 Activated carbon powder Maxsorb III

5.17.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-410a
Equation:	DubininAstakhov
ID:	1
Reference:	Askalany, Ahmed A.; Saha, Bidyut B.; Ismail, Ibrahim M. (2014): Adsorption isotherms and kinetics of HFC410A onto activated carbons. In: Applied Thermal Engineering 72 (2), S. 237–243. DOI: 10.1016/j.applthermaleng.2014.04.075.
Comment:	See original literature: Use low-level interface for calculations as special form of density of adsorpt is required (i.e., rho_adsorpt = -1.0015 * T - rho_gas(p, T) in kg/m3); inverse functions may not work anymore.

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.072
Surface area	$\mathrm{m^2\,g^{-1}}$	3140
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left(p_{\mathrm{sat}}/p\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.170000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.326960000e+03	W_0	$\mathrm{m^3\,kg^{-1}}$	5.960000000e-03

Validity:
Equation is approximately valid for 48831.0Pa $\leq p \leq$ 819185.0Pa, 283.15K $\leq T \leq$ 323.15K, and 0.21476kg kg^{-1} $\leq w \leq$ 1.81246kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 142.46%.

5.17.2.2 DubininAstakhov - ID 2

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-410a
Equation:	DubininAstakhov
ID:	2
Reference:	Loh, Wai Soong; Ismail, Azhar Bin; Xi, Baojuan; Ng, Kim Choon; Chun, Won Gee (2012): Adsorption Isotherms and Isosteric Enthalpy of Adsorption for Assorted Refrigerants on Activated Carbons. In: J. Chem. Eng. Data 57 (10), S. 2766–2773. DOI: 10.1021/je3008099.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.360000000e+00
E	$\mathrm{J\,mol^{-1}}$	5.254380000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.070000000e+00

Validity:
Equation is approximately valid for 35045.0Pa $\leq p \leq$ 1433809.0Pa, 278.15K $\leq T \leq$

328.15K, and $0.11303\,\mathrm{kg\,kg^{-1}} \leq w \leq 2.08346\,\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 5 MPa: 0.1
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.62%.

5.18 R-507a

5.18.1 Activated carbon fiber A-20

5.18.1.1 DubininAstakhov - ID 1

Sorbent:	activated carbon fiber
Subtype:	A-20
Refrigerant:	R-507a
Equation:	DubininAstakhov
ID:	1
Reference:	Loh, Wai Soong; Ismail, Azhar Bin; Xi, Baojuan; Ng, Kim Choon; Chun, Won Gee (2012): Adsorption Isotherms and Isosteric Enthalpy of Adsorption for Assorted Refrigerants on Activated Carbons. In: J. Chem. Eng. Data 57 (10), S. 2766–2773. DOI: 10.1021/je3008099.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000216
Surface area	$\mathrm{m^2\,g^{-1}}$	1930
Pore volume	$\mathrm{mm\,g^{-3}}$	1.05
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.450000000e+00
E	$\mathrm{J\,mol^{-1}}$	8.100780000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	1.190000000e+00

Validity:
Equation is approximately valid for 15701.0Pa $\leq p \leq$ 1141964.0Pa, 278.15K $\leq T \leq$ 318.15K, and 0.098738kg kg^{-1} $\leq w \leq$ 1.2kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, relative, in % $\rightarrow$ 0 Pa $<$ p $<$ 5 MPa: 0.1
- Temperature, absolute, in K $\rightarrow$ 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 252.56%.

5.18.2 Activated carbon powder Maxsorb III

5.18.2.1 DubininAstakhov - ID 1

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-507a
Equation:	DubininAstakhov
ID:	1
Reference:	Saha, Bidyut B.; El-Sharkawy, Ibrahim I.; Habib, Khairul; Koyama, Shigeru; Srinivasan, Kandadai (2008): Adsorption of Equal Mass Fraction Near an Azeotropic Mixture of Pentafluoroethane and 1,1,1-Trifluoroethane on Activated Carbon. In: J. Chem. Eng. Data 53 (8), S. 1872–1876. DOI: 10.1021/je800204p.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.072
Surface area	$m^2\,g^{-1}$	3142
Pore volume	$mm\,g^{-3}$	1.7

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{sat}}/_{p}\right) \text{ .}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.470000000e+00
E	$J\,mol^{-1}$	5.740000000e+03	W_0	$m^3\,kg^{-1}$	1.175000000e-03

Validity:

No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.18.2.2 DubininAstakhov - ID 2

Sorbent:	activated carbon powder
Subtype:	Maxsorb III
Refrigerant:	R-507a
Equation:	DubininAstakhov
ID:	2
Reference:	Loh, Wai Soong; Ismail, Azhar Bin; Xi, Baojuan; Ng, Kim Choon; Chun, Won Gee (2012): Adsorption Isotherms and Isosteric Enthalpy of Adsorption for Assorted Refrigerants on Activated Carbons. In: J. Chem. Eng. Data 57 (10), S. 2766–2773. DOI: 10.1021/je3008099.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	3150
Pore volume	$\mathrm{mm\,g^{-3}}$	1.7
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.340000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.547250000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.050000000e+00

Validity:
Equation is approximately valid for 4827.0Pa $\leq p \leq$ 1067573.0Pa, 278.15K $\leq T \leq$

318.15K, and $0.19899\,\mathrm{kg\,kg^{-1}} \leq w \leq 2.06674\,\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, relative, in % → 0 Pa < p < 5 MPa: 0.1
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 212.94%.

5.19 Water

5.19.1 Mof powder CPO-27(Ni)

5.19.1.1 DubininAstakhov - ID 1

Sorbent:	mof powder
Subtype:	CPO-27(Ni)
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Elsayed, Eman; AL-Dadah, Raya; Mahmoud, Saad; Elsayed, Ahmed; Anderson, Paul A. (2016): Aluminium fumarate and CPO-27(Ni) MOFs. Characterization and thermodynamic analysis for adsorption heat pump applications. In: Applied Thermal Engineering 99, S. 802–812. DOI: 10.1016/j.applthermaleng.2016.01.129.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.1075
Surface area	$\mathrm{m^2\,g^{-1}}$	469.777

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	4.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.001410000e+04	W_0	$\mathrm{kg\,kg^{-1}}$	4.620000000e-01

Validity:
Equation is approximately valid for 4.97Pa $\leq p \leq$ 14163.11Pa, 298.15K $\leq T \leq$ 328.15K, and 0.000397kg kg^{-1} $\leq w \leq$ 0.479969kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 44.91%.

5.19.2 Polymer PS-I

5.19.2.1 DubininAstakhov - ID 1

Sorbent:	polymer
Subtype:	PS-I
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Sultan, Muhammad; El-Sharkawy, Ibrahim I.; Miyazaki, Takahiko; Saha, Bidyut B.; Koyama, Shigeru; Maruyama, Tomohiro et al. (2015): Insights of water vapor sorption onto polymer based sorbents. In: Adsorption 21 (3), S. 205–215. DOI: 10.1007/s10450-015-9663-y.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.002581
Bulk density	$\mathrm{kg\,m^{-3}}$	520-560

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	5.000000000e-01
E	$\mathrm{J\,mol^{-1}}$	8.531337000e+02	W_0	$\mathrm{kg\,kg^{-1}}$	1.200000000e+00

Validity:
Equation is approximately valid for 747.2Pa $\leq p \leq$ 34963.5Pa, 293.15K $\leq T \leq$

363.15K, and $0.05219\,\mathrm{kg\,kg^{-1}} \leq w \leq 0.65117\,\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, relative, in % → 0.002

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.35%.

5.19.3 Polymer PS-II

5.19.3.1 DubininAstakhov - ID 1

Sorbent:	polymer
Subtype:	PS-II
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Sultan, Muhammad; El-Sharkawy, Ibrahim I.; Miyazaki, Takahiko; Saha, Bidyut B.; Koyama, Shigeru; Maruyama, Tomohiro et al. (2015): Insights of water vapor sorption onto polymer based sorbents. In: Adsorption 21 (3), S. 205–215. DOI: 10.1007/s10450-015-9663-y.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.019316
Bulk density	$\mathrm{kg\,m^{-3}}$	800-840

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	5.000000000e-01
E	$\mathrm{J\,mol^{-1}}$	7.535384000e+02	W_0	$\mathrm{kg\,kg^{-1}}$	1.760000000e+00

Validity:
Equation is approximately valid for 760.8Pa $\leq p \leq$ 34728.1Pa, 293.15K $\leq T \leq$

363.15K, and $0.06404\,\mathrm{kg\,kg^{-1}} \leq w \leq 0.89308\,\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, relative, in % → 0.002

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.04%.

5.19.4 Silica gel pellet

5.19.4.1 Freundlich - ID 1

Sorbent:	silica gel pellet
Subtype:	
Refrigerant:	Water
Equation:	Freundlich
ID:	1
Reference:	Saha, B. B.; Koyama, S.; Lee, J. B.; Kuwahara, K.; Alam, K.C.A.; Hamamoto, Y. et al. (2003): Performance evaluation of a low-temperature waste heat driven multi-bed adsorption chiller. In: International Journal of Multiphase Flow 29 (8), S. 1249–1263. DOI: 10.1016/S0301-9322(03)00103-4.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= A\left(p/p_{\mathrm{sat}}\right)^B && \text{, and} \\ A &= A_0 + A_1 T + A_2 T^2 + A_3 T^3 && \text{, and} \\ B &= B_0 + B_1 T + B_2 T^2 + B_3 T^3 && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
A_0	$\mathrm{kg\,kg^{-1}}$	3.119800000e+01	B_0	-	4.158100000e+01
A_1	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	-2.665000000e-01	B_1	$\mathrm{K^{-1}}$	-3.543500000e-01
A_2	$\mathrm{kg\,kg^{-1}\,K^{-2}}$	7.690000000e-04	B_2	$\mathrm{K^{-2}}$	1.019900000e-03
A_3	$\mathrm{kg\,kg^{-1}\,K^{-3}}$	-7.389800000e-07	B_3	$\mathrm{K^{-3}}$	-9.703400000e-07

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.19.4.2 Toth - ID 1

Sorbent:	silica gel pellet
Subtype:	
Refrigerant:	Water
Equation:	Toth
ID:	1
Reference:	Wang, Yu; LeVan, M. Douglas (2009): Adsorption Equilibrium of Carbon Dioxide and Water Vapor on Zeolites 5A and 13X and Silica Gel. Pure Components. In: J. Chem. Eng. Data 54 (10), S. 2839–2844. DOI: 10.1021/je800900a.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	2.787000000e-08	Q^*	K	1.093000000e+03
c	K	2.213000000e+01	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	1.142195901e+05
n_0	-	-1.190000000e-03			

Validity:
Equation is approximately valid for $13.9\mathrm{Pa} \leq p \leq 5250.0\mathrm{Pa}$, $273.15\mathrm{K} \leq T \leq 348.15\mathrm{K}$, and $0.001927635\mathrm{kg\,kg^{-1}} \leq w \leq 0.34229032\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, relative, in % → 0.067 Pa < p < 13300 Pa: 0.25
- Temperature, absolute, in K → 0.3

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.36%.

5.19.5 Silica gel pellet 123

5.19.5.1 DubininArctan1 - ID 1

Sorbent:	silica gel pellet
Subtype:	123
Refrigerant:	Water
Equation:	DubininArctan1
ID:	1
Reference:	Schawe, D. (2000): Theoretical and Experimental Investigations of an Adsorption Heat Pump with Heat Transfer between two Adsorbers. Dissertation. Universität Stuttgart, Stuttgart. Energietechnik.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	2.10E-06
Diameter of pellet	mm	0.5-1.25
Surface area	$\mathrm{m^2\,g^{-1}}$	750
Pore volume	$\mathrm{mm\,g^{-3}}$	0.4
Bulk density	$\mathrm{kg\,m^{-3}}$	650
Pellet density	$\mathrm{kg\,m^{-3}}$	1250
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= W\rho_{\mathrm{sat}}^{\mathrm{liq}} && \text{, and} \\ W &= \frac{a}{\Pi}\left(\arctan\left(\frac{A-b}{c}\right)+\frac{\Pi}{2}\right)+d && \text{, and} \\ A &= RT\ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	$\mathrm{m^3\,kg^{-1}}$	5.072313000e-04	c	$\mathrm{J\,mol^{-1}}$	-1.529906401e+03
b	$\mathrm{J\,mol^{-1}}$	2.351914097e+03	d	$\mathrm{m^3\,kg^{-1}}$	4.128962000e-06

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, absolute, in $\mathrm{kg\,kg^{-1}}$ → 0.000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 17.02%.

5.19.6 Silica gel pellet 125

5.19.6.1 DubininArctan1 - ID 1

Sorbent:	silica gel pellet
Subtype:	125
Refrigerant:	Water
Equation:	DubininArctan1
ID:	1
Reference:	Schawe, D. (2000): Theoretical and Experimental Investigations of an Adsorption Heat Pump with Heat Transfer between two Adsorbers. Dissertation. Universität Stuttgart, Stuttgart. Energietechnik.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	2.10E-06
Diameter of pellet	mm	1-3.5
Surface area	$\mathrm{m^2\,g^{-1}}$	750
Pore volume	$\mathrm{mm\,g^{-3}}$	0.4
Bulk density	$\mathrm{kg\,m^{-3}}$	690-760
Pellet density	$\mathrm{kg\,m^{-3}}$	1250
Solid density	$\mathrm{kg\,m^{-3}}$	2200

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= W\rho_{\mathrm{sat}}^{\mathrm{liq}} && \text{, and} \\ W &= \frac{a}{\Pi}\left(\arctan\left(\frac{A-b}{c}\right)+\frac{\Pi}{2}\right)+d && \text{, and} \\ A &= RT\ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	$\mathrm{m^3\,kg^{-1}}$	4.527805000e-04	c	$\mathrm{J\,mol^{-1}}$	-1.593817135e+03
b	$\mathrm{J\,mol^{-1}}$	2.214052508e+03	d	$\mathrm{m^3\,kg^{-1}}$	6.034706000e-07

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, absolute, in $\mathrm{kg\,kg^{-1}}$ → 0.000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 22.42%.

5.19.7 Silica gel pellet AF-25

5.19.7.1 DubininArctan1 - ID 1

Sorbent:	silica gel pellet
Subtype:	AF-25
Refrigerant:	Water
Equation:	DubininArctan1
ID:	1
Reference:	Schawe, D. (2000): Theoretical and Experimental Investigations of an Adsorption Heat Pump with Heat Transfer between two Adsorbers. Dissertation. Universität Stuttgart, Stuttgart. Energietechnik.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	2.50E-06
Surface area	$\mathrm{m^2\,g^{-1}}$	750
Pore volume	$\mathrm{mm\,g^{-3}}$	0.5
Bulk density	$\mathrm{kg\,m^{-3}}$	600

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= W\rho_{\mathrm{sat}}^{\mathrm{liq}} && \text{, and} \\ W &= \frac{a}{\Pi}\left(\arctan\left(\frac{A-b}{c}\right)+\frac{\Pi}{2}\right)+d && \text{, and} \\ A &= RT\ln\left(p_{\mathrm{sat}}/p\right) && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	$\mathrm{m^3\,kg^{-1}}$	6.452701000e-04	c	$\mathrm{J\,mol^{-1}}$	-1.413377094e+03
b	$\mathrm{J\,mol^{-1}}$	1.617730967e+03	d	$\mathrm{m^3\,kg^{-1}}$	0.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, absolute, in $\mathrm{kg\,kg^{-1}}$ → 0.000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.57%.

5.19.8 Silica gel pellet Fuji

5.19.8.1 DubininArctan1 - ID 1

Sorbent:	silica gel pellet
Subtype:	Fuji
Refrigerant:	Water
Equation:	DubininArctan1
ID:	1
Reference:	Schawe, D. (2000): Theoretical and Experimental Investigations of an Adsorption Heat Pump with Heat Transfer between two Adsorbers. Dissertation. Universität Stuttgart, Stuttgart. Energietechnik.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Surface area	$\mathrm{m^2\,g^{-1}}$	589
Pore volume	$\mathrm{mm\,g^{-3}}$	0.31

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= W\rho_{\mathrm{sat}}^{\mathrm{liq}} && \text{, and} \\ W &= \frac{a}{\Pi}\left(\arctan\left(\frac{A-b}{c}\right)+\frac{\Pi}{2}\right)+d && \text{, and} \\ A &= RT\ln\left(p_{\mathrm{sat}}/p\right) && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	$\mathrm{m^3\,kg^{-1}}$	3.857567000e-04	c	$\mathrm{J\,mol^{-1}}$	-1.786979370e+03
b	$\mathrm{J\,mol^{-1}}$	2.274388346e+03	d	$\mathrm{m^3\,kg^{-1}}$	0.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, absolute, in $\mathrm{kg\,kg^{-1}}$ → 0.000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 9.55%.

5.19.9 Silica gel pellet Fuji A

5.19.9.1 Freundlich - ID 1

Sorbent:	silica gel pellet
Subtype:	Fuji A
Refrigerant:	Water
Equation:	Freundlich
ID:	1
Reference:	SAKODA, AKIYOSHI; SUZUKI, MOTOYUKI (1984): Fundamental study on solar powered adsorption cooling system. In: J. Chem. Eng. Japan / JCEJ 17 (1), S. 52–57. DOI: 10.1252/jcej.17.52.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	0.71

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= A\left(p/p_{\mathrm{sat}}\right)^B && \text{, and} \\ A &= A_0 + A_1 T + A_2 T^2 + A_3 T^3 && \text{, and} \\ B &= B_0 + B_1 T + B_2 T^2 + B_3 T^3 && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
A_0	$\mathrm{kg\,kg^{-1}}$	3.460000000e-01	B_0	-	6.250000000e-01
A_1	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	0.000000000e+00	B_1	$\mathrm{K^{-1}}$	0.000000000e+00
A_2	$\mathrm{kg\,kg^{-1}\,K^{-2}}$	0.000000000e+00	B_2	$\mathrm{K^{-2}}$	0.000000000e+00
A_3	$\mathrm{kg\,kg^{-1}\,K^{-3}}$	0.000000000e+00	B_3	$\mathrm{K^{-3}}$	0.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 18.64%.

5.19.10 Silica gel pellet Fuji RD

5.19.10.1 Freundlich - ID 1

Sorbent:	silica gel pellet
Subtype:	Fuji RD
Refrigerant:	Water
Equation:	Freundlich
ID:	1
Reference:	Miyazaki, T.; Akisawa, A.; Saha, B. B.; El-Sharkawy, I. I.; Chakraborty, A. (2009): A new cycle time allocation for enhancing the performance of two-bed adsorption chillers. In: International Journal of Refrigeration 32 (5), S. 846–853. DOI: 10.1016/j.ijrefrig.2008.12.002.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= A\left(p/p_{\mathrm{sat}}\right)^B && \text{, and} \\ A &= A_0 + A_1 T + A_2 T^2 + A_3 T^3 && \text{, and} \\ B &= B_0 + B_1 T + B_2 T^2 + B_3 T^3 && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
A_0	$\mathrm{kg\,kg^{-1}}$	-6.531400000e+00	B_0	-	-1.558700000e+01
A_1	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	7.245200000e-02	B_1	$\mathrm{K^{-1}}$	1.591500000e-01
A_2	$\mathrm{kg\,kg^{-1}\,K^{-2}}$	-2.395100000e-04	B_2	$\mathrm{K^{-2}}$	-5.061200000e-04
A_3	$\mathrm{kg\,kg^{-1}\,K^{-3}}$	2.549300000e-04	B_3	$\mathrm{K^{-3}}$	5.329000000e-07

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.19.10.2 Freundlich - ID 2

Sorbent:	silica gel pellet
Subtype:	Fuji RD
Refrigerant:	Water
Equation:	Freundlich
ID:	2
Reference:	Cho, Soon-Haeng; Kim, Jong-Nam (1992): Modeling of a silica gel/water adsorption-cooling system. In: Energy 17 (9), S. 829–839. DOI: 10.1016/0360-5442(92)90101-5.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= A\left(p/p_{\mathrm{sat}}\right)^B && \text{, and} \\ A &= A_0 + A_1 T + A_2 T^2 + A_3 T^3 && \text{, and} \\ B &= B_0 + B_1 T + B_2 T^2 + B_3 T^3 && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
A_0	$\mathrm{kg\,kg^{-1}}$	5.220000000e-01	B_0	-	6.250000000e-01
A_1	$\mathrm{kg\,kg^{-1}\,K^{-1}}$	0.000000000e+00	B_1	$\mathrm{K^{-1}}$	0.000000000e+00
A_2	$\mathrm{kg\,kg^{-1}\,K^{-2}}$	0.000000000e+00	B_2	$\mathrm{K^{-2}}$	0.000000000e+00
A_3	$\mathrm{kg\,kg^{-1}\,K^{-3}}$	0.000000000e+00	B_3	$\mathrm{K^{-3}}$	0.000000000e+00

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.19.10.3 Toth - ID 1

Sorbent:	silica gel pellet
Subtype:	Fuji RD
Refrigerant:	Water
Equation:	Toth
ID:	1
Reference:	Chua, H. T.; Ng, K. C.; Wang, W.; Yap, C.; Wang, X. L. (2004): Transient modeling of a two-bed silica gel–water adsorption chiller. In: International Journal of Heat and Mass Transfer 47 (4), S. 659–669. DOI: 10.1016/j.ijheatmasstransfer.2003.08.010.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	1.622222222e-12	Q^*	K	5.835031230e+03
c	K	0.000000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	4.500000000e-01
n_0	-	1.200000000e+01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

5.19.11 Silica gel pellet Fuji RD 2560

5.19.11.1 DubininAstakhov - ID 1

Sorbent:	silica gel pellet
Subtype:	Fuji RD 2560
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Thu, Kyaw; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2013): Thermo-physical properties of silica gel for adsorption desalination cycle. In: Applied Thermal Engineering 50 (2), S. 1596–1602. DOI: 10.1016/j.applthermaleng.2011.09.038.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.00000132
Surface area	$m^2\,g^{-1}$	636.4

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \text{, and}$$

$$A = RT \ln\left(p_{sat}/p\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.350000000e+00
E	$J\,mol^{-1}$	4.384000000e+03	W_0	$m^3\,kg^{-1}$	3.270000000e-04

Validity:
Equation is approximately valid for $177.6967317\text{Pa} \leq p \leq 3021.839798\text{Pa}$, $298.15\text{K} \leq T \leq 298.15\text{K}$, and $0.054920716\text{kg}\,\text{kg}^{-1} \leq w \leq 0.363416915\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.56%.

5.19.12 Silica gel pellet KD A5BW

5.19.12.1 DubininAstakhov - ID 1

Sorbent:	silica gel pellet
Subtype:	KD A5BW
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Thu, Kyaw; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2013): Thermo-physical properties of silica gel for adsorption desalination cycle. In: Applied Thermal Engineering 50 (2), S. 1596–1602. DOI: 10.1016/j.applthermaleng.2011.09.038.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000014
Surface area	$m^2\,g^{-1}$	769.1

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \text{, and}$$

$$A = RT \ln\left(p_{sat}/p\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.250000000e+00
E	$J\,mol^{-1}$	3.585000000e+03	W_0	$m^3\,kg^{-1}$	4.550000000e-04

Validity:
Equation is approximately valid for $172.5202371\text{Pa} \leq p \leq 3000.537872\text{Pa}$, $298.15\text{K} \leq T \leq 298.15\text{K}$, and $0.042329083\text{kg}\,\text{kg}^{-1} \leq w \leq 0.42624181\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.29%.

5.19.13 Silica gel pellet Mayekawa A++

5.19.13.1 DubininAstakhov - ID 1

Sorbent:	silica gel pellet
Subtype:	Mayekawa A++
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Thu, Kyaw; Chakraborty, Anutosh; Saha, Bidyut Baran; Ng, Kim Choon (2013): Thermo-physical properties of silica gel for adsorption desalination cycle. In: Applied Thermal Engineering 50 (2), S. 1596–1602. DOI: 10.1016/j.applthermaleng.2011.09.038.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000138
Surface area	$m^2\,g^{-1}$	836.6

Equation and parameters:
Loading w in $kg\,kg^{-1}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{sat}^{liq} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left(A/E\right)^n\right) \text{, and}$$

$$A = RT \ln\left(p_{sat}/p\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	1.350000000e+00
E	$J\,mol^{-1}$	3.804000000e+03	W_0	$m^3\,kg^{-1}$	3.804000000e-04

Validity:
Equation is approximately valid for $168.4151785\text{Pa} \leq p \leq 3016.175134\text{Pa}$, $298.15\text{K} \leq T \leq 298.15\text{K}$, and $0.050099199\text{kg}\,\text{kg}^{-1} \leq w \leq 0.428702545\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 14.99%.

5.19.14 Silica gel pellet Siogel

5.19.14.1 DubininAstakhov - ID 1

Sorbent:	silica gel pellet
Subtype:	Siogel
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Sapienza, Alessio; Velte, Andreas; Girnik, Ilya; Frazzica, Andrea; Füldner, Gerrit; Schnabel, Lena; Aristov, Yuri (2017): "Water - Silica Siogel" working pair for adsorption chillers. Adsorption equilibrium and dynamics. In: Renewable Energy 110, S. 40–46. DOI: 10.1016/j.renene.2016.09.065.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.000002
Surface area	$\mathrm{m^2\,g^{-1}}$	800
Pore volume	$\mathrm{mm\,g^{-3}}$	0.4
Bulk density	$\mathrm{kg\,m^{-3}}$	620-800

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.100000000e+00
E	$\mathrm{J\,mol^{-1}}$	3.962200000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	3.800000000e-01

Validity:
Equation is approximately valid for 1000.0Pa $\leq p \leq$ 3900.0Pa, 303.057K $\leq T \leq$ 419.518K, and 0.001831kg kg^{-1} $\leq w \leq$ 0.25151kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, relative, in % → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 14.88%.

5.19.15 Silica gel pellet WS

5.19.15.1 DubininArctan1 - ID 1

Sorbent:	silica gel pellet
Subtype:	WS
Refrigerant:	Water
Equation:	DubininArctan1
ID:	1
Reference:	Schawe, D. (2000): Theoretical and Experimental Investigations of an Adsorption Heat Pump with Heat Transfer between two Adsorbers. Dissertation. Universität Stuttgart, Stuttgart. Energietechnik.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	2.50E-06
Surface area	$\mathrm{m^2\,g^{-1}}$	650
Pore volume	$\mathrm{mm\,g^{-3}}$	0.4
Bulk density	$\mathrm{kg\,m^{-3}}$	700

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$\begin{aligned} w &= W\rho_{\mathrm{sat}}^{\mathrm{liq}} && \text{, and} \\ W &= \frac{a}{\Pi}\left(\arctan\left(\frac{A-b}{c}\right)+\frac{\Pi}{2}\right)+d && \text{, and} \\ A &= RT\ln\left(p_{\mathrm{sat}}/p\right) && . \end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a	$\mathrm{m^3\,kg^{-1}}$	5.046468000e-04	c	$\mathrm{J\,mol^{-1}}$	-1.308650854e+03
b	$\mathrm{J\,mol^{-1}}$	1.805355210e+03	d	$\mathrm{m^3\,kg^{-1}}$	0.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Loading, absolute, in $\mathrm{kg\,kg^{-1}}$ → 0.000001

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.65%.

5.19.16 Zeolite pellet

5.19.16.1 DubininAstakhov - ID 1

Sorbent:	zeolite pellet
Subtype:	
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Douss, N.; Meunier, F. (1988): Effect of operating temperatures on the coefficient of performance of active carbon-methanol systems. In: Heat Recovery Systems and CHP 8 (5), S. 383–392. DOI: 10.1016/0890-4332(88)90042-7.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pellet	mm	1.5

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	1.000000000e+00	n	-	2.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.959737633e+04	W_0	$\mathrm{m^3\,kg^{-1}}$	2.690000000e-04

Validity:
No data on validity available!

Visualization:

No experimental data exists. Thus, isotherm is not visualized!

5.19.17 Zeolite pellet 13X

5.19.17.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	13X
Refrigerant:	Water
Equation:	Toth
ID:	1
Reference:	Wang, Yu; LeVan, M. Douglas (2009): Adsorption Equilibrium of Carbon Dioxide and Water Vapor on Zeolites 5A and 13X and Silica Gel. Pure Components. In: J. Chem. Eng. Data 54 (10), S. 2839–2844. DOI: 10.1021/je800900a.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	2.408000000e-10	Q^*	K	6.852000000e+03
c	K	-4.199000000e+00	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	2.718751143e-01
n_0	-	3.974000000e-01			

Validity:
Equation is approximately valid for $10.5\mathrm{Pa} \leq p \leq 1830.0\mathrm{Pa}$, $273.15\mathrm{K} \leq T \leq 373.15\mathrm{K}$, and $0.04828095\mathrm{kg\,kg^{-1}} \leq w \leq 0.257618504\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, relative, in % → 0.067 Pa < p < 13300 Pa: 0.25
- Temperature, absolute, in K → 0.3

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.31%.

5.19.18 Zeolite pellet 5A

5.19.18.1 Toth - ID 1

Sorbent:	zeolite pellet
Subtype:	5A
Refrigerant:	Water
Equation:	Toth
ID:	1
Reference:	Wang, Yu; LeVan, M. Douglas (2009): Adsorption Equilibrium of Carbon Dioxide and Water Vapor on Zeolites 5A and 13X and Silica Gel. Pure Components. In: J. Chem. Eng. Data 54 (10), S. 2839–2844. DOI: 10.1021/je800900a.
Comment:	None

Properties of sorbent:
Property data of sorbent and subtype does not exist.

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa and temperature T in K by:

$$
\begin{aligned}
w &= \frac{w_{\mathrm{sat}} b^m p}{\left(1 + b^r p^n\right)^{1/n}} && \text{, and} \\
b &= b_0 \exp\left(\frac{Q^*}{T}\right) && \text{, and} \\
n &= n_0 + {}^{c}/_{T} && \text{, and} \\
r &= \begin{cases} n & \text{if } r^* < 0 \\ r^* & \text{else} \end{cases} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
b_0	$\mathrm{Pa^{-1}}$	4.714000000e-13	Q^*	K	9.955000000e+03
c	K	-5.114000000e+01	r^*	-	-1.000000000e+00
m	-	1.000000000e+00	w_{sat}	$\mathrm{kg\,kg^{-1}}$	4.226750038e-01
n_0	-	3.548000000e-01			

Validity:
Equation is approximately valid for $14.7\mathrm{Pa} \leq p \leq 1660.0\mathrm{Pa}$, $273.15\mathrm{K} \leq T \leq 373.15\mathrm{K}$, and $0.047200034\mathrm{kg\,kg^{-1}} \leq w \leq 0.248610864\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, relative, in % → 0.067 Pa < p < 13300 Pa: 0.25
- Temperature, absolute, in K → 0.3

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.63%.

5.19.19 Zeotype pellet AQSOA-Z01

5.19.19.1 DubininAstakhov - ID 1

Sorbent:	zeotype pellet
Subtype:	AQSOA-Z01
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Wei Benjamin Teo, How; Chakraborty, Anutosh; Fan, Wu (2017): Improved adsorption characteristics data for AQSOA types zeolites and water systems under static and dynamic conditions. In: Microporous and Mesoporous Materials 242, S. 109–117. DOI: 10.1016/j.micromeso.2017.01.015.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000074
Surface area	$\mathrm{m^2\,g^{-1}}$	130-250
Pore volume	$\mathrm{mm\,g^{-3}}$	0.071

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	5.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.000000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.100000000e-01

Validity:

Equation is approximately valid for 476.7Pa $\leq p \leq$ 17942.6Pa, 298.0K $\leq T \leq$ 333.0K, and 0.000788kg kg^{-1} $\leq w \leq$ 0.218824kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 38.42%.

5.19.19.2 DubininAstakhov - ID 2

Sorbent:	zeotype pellet
Subtype:	AQSOA-Z01
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	2
Reference:	Kayal, Sibnath; Baichuan, Sun; Saha, Bidyut Baran (2016): Adsorption characteristics of AQSOA zeolites and water for adsorption chillers. In: International Journal of Heat and Mass Transfer 92, S. 1120–1127. DOI: 10.1016/j.ijheatmasstransfer.2015.09.060.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000074
Surface area	$\mathrm{m^2\,g^{-1}}$	132
Pore volume	$\mathrm{mm\,g^{-3}}$	0.087

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	5.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	4.000000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.100000000e-01

Validity:
Equation is approximately valid for $127.0\mathrm{Pa} \leq p \leq 9334.3\mathrm{Pa}$, $298.0\mathrm{K} \leq T \leq 338.0\mathrm{K}$, and $0.001131\mathrm{kg\,kg^{-1}} \leq w \leq 0.212104\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.01

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 39.7%.

5.19.20 Zeotype pellet AQSOA-Z02

5.19.20.1 DubininAstakhov - ID 1

Sorbent:	zeotype pellet
Subtype:	AQSOA-Z02
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Wei Benjamin Teo, How; Chakraborty, Anutosh; Fan, Wu (2017): Improved adsorption characteristics data for AQSOA types zeolites and water systems under static and dynamic conditions. In: Microporous and Mesoporous Materials 242, S. 109–117. DOI: 10.1016/j.micromeso.2017.01.015.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000037
Surface area	$\mathrm{m^2\,g^{-1}}$	650-770
Pore volume	$\mathrm{mm\,g^{-3}}$	0.27

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	2.900000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.600000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.850000000e-01

Validity:

Equation is approximately valid for 149.4Pa $\leq p \leq$ 17959.1Pa, 298.0K $\leq T \leq$ 333.0K, and 0.046033kg kg^{-1} $\leq w \leq$ 0.293742kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.8%.

5.19.20.2 DubininAstakhov - ID 2

Sorbent:	zeotype pellet
Subtype:	AQSOA-Z02
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	2
Reference:	Kayal, Sibnath; Baichuan, Sun; Saha, Bidyut Baran (2016): Adsorption characteristics of AQSOA zeolites and water for adsorption chillers. In: International Journal of Heat and Mass Transfer 92, S. 1120–1127. DOI: 10.1016/j.ijheatmasstransfer.2015.09.060.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000037
Diameter of pellet	mm	0.17
Surface area	$\mathrm{m^2\,g^{-1}}$	590
Pore volume	$\mathrm{mm\,g^{-3}}$	0.2769

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$
\begin{aligned}
w &= \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} && \text{, and} \\
W &= W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) && \text{, and} \\
A &= RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	3.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	7.000000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	3.100000000e-01

Validity:
Equation is approximately valid for $79.92\mathrm{Pa} \leq p \leq 6944.81\mathrm{Pa}$, $298.0\mathrm{K} \leq T \leq 333.0\mathrm{K}$, and $0.018837\mathrm{kg\,kg^{-1}} \leq w \leq 0.304504\mathrm{kg\,kg^{-1}}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.01

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 18.78%.

5.19.21 Zeotype pellet AQSOA-Z05

5.19.21.1 DubininAstakhov - ID 1

Sorbent:	zeotype pellet
Subtype:	AQSOA-Z05
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Wei Benjamin Teo, How; Chakraborty, Anutosh; Fan, Wu (2017): Improved adsorption characteristics data for AQSOA types zeolites and water systems under static and dynamic conditions. In: Microporous and Mesoporous Materials 242, S. 109–117. DOI: 10.1016/j.micromeso.2017.01.015.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Diameter of pore	mm	0.0000074
Surface area	$\mathrm{m^2\,g^{-1}}$	210-330
Pore volume	$\mathrm{mm\,g^{-3}}$	0.07

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \quad \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \quad \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \quad .$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	6.000000000e+00
E	$\mathrm{J\,mol^{-1}}$	2.700000000e+03	W_0	$\mathrm{kg\,kg^{-1}}$	2.200000000e-01

Validity:

Equation is approximately valid for 849.4Pa $\leq p \leq$ 13946.4Pa, 298.0K $\leq T \leq$ 333.0K, and 0.000463kg kg^{-1} $\leq w \leq$ 0.225151kg kg^{-1}.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.15

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 56.57%.

5.19.22 Zeotype powder ETS-10

5.19.22.1 DubininAstakhov - ID 1

Sorbent:	zeotype powder
Subtype:	ETS-10
Refrigerant:	Water
Equation:	DubininAstakhov
ID:	1
Reference:	Pinheiro, Joana M.; Valente, Anabela A.; Salústio, Sérgio; Ferreira, Nelson; Rocha, João; Silva, Carlos M. (2015): Application of the novel ETS-10/water pair in cyclic adsorption heating processes. Measurement of equilibrium and kinetics properties and simulation studies. In: Applied Thermal Engineering 87, S. 412–423. DOI: 10.1016/j.applthermaleng.2015.05.011.
Comment:	None

Properties of sorbent:

Property	Unit	Value
Porosity of pellet	-	0.58
Solid density	$\mathrm{kg\,m^{-3}}$	2553

Equation and parameters:
Loading w in $\mathrm{kg\,kg^{-1}}$ is calculated depending on pressure p in Pa, temperature T in K, and vapor pressure p_{sat} in Pa by:

$$w = \begin{cases} W\rho_{\mathrm{sat}}^{\mathrm{liq}} & \text{if flag} \geq 0 \\ W & \text{else} \end{cases} \text{, and}$$

$$W = W_0 \exp\left(-\left({}^{A}/_{E}\right)^n\right) \text{, and}$$

$$A = RT \ln\left({}^{p_{\mathrm{sat}}}/_{p}\right) \text{.}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
flag	-	-1.000000000e+00	n	-	1.980000000e+00
E	$\mathrm{J\,mol^{-1}}$	1.398623832e+04	W_0	$\mathrm{kg\,kg^{-1}}$	1.290000000e-01

Validity:

Equation is approximately valid for $2.81\text{Pa} \leq p \leq 6603.69\text{Pa}$, $298.0\text{K} \leq T \leq 348.0\text{K}$, and $0.000618\text{kg}\,\text{kg}^{-1} \leq w \leq 0.135792\text{kg}\,\text{kg}^{-1}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 87.32%.

6 Absorption

6.1 2-Propanol

6.1.1 Ionic liquid [BMIM]+[(CF3SO2)2N]-

6.1.1.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	NrtlFixedDg
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	8.000000000e-01	α_{21}	-	8.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	7.020333600e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-8.547912000e+02

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.21%.

6.1.1.2 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	UniquacFixedDu
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.200766160e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-1.562096400e+02
r_1	-	2.779100000e+00	r_2	-	1.116000000e+01
q_1	-	2.508000000e+00	q_2	-	1.020000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.37%.

6.1.1.3 UniquacFixedDu - ID 2

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	UniquacFixedDu
ID:	2
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.200800000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.562000000e+02
r_1	-	2.789000000e+00	r_2	-	1.116000000e+01
q_1	-	2.508000000e+00	q_2	-	1.020000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.22%.

6.1.1.4 WilsonFixedDl - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	WilsonFixedDl
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2\left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.276789440e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	9.689725600e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	7.692000000e+01	v_2	$\mathrm{m^3\,mol^{-1}}$	2.917100000e+02

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.42%.

6.1.2 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.1.2.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	NrtlFixedDg
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	6.000000000e-01	α_{21}	-	6.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	7.795628800e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-1.003867120e+03

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.27%.

6.1.2.2 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	UniquacFixedDu
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.536364800e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-2.923904720e+02
r_1	-	2.779100000e+00	r_2	-	9.890000000e+00
q_1	-	2.508000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.62%.

6.1.2.3 UniquacFixedDu - ID 2

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	UniquacFixedDu
ID:	2
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.536400000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-2.924000000e+02
r_1	-	2.789000000e+00	r_2	-	9.890000000e+00
q_1	-	2.508000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.7%.

6.1.2.4 WilsonFixedDl - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	2-Propanol
Equation:	WilsonFixedDl
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2\left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.189343840e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.673600000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	7.692000000e+01	v_2	$\mathrm{m^3\,mol^{-1}}$	2.445800000e+02

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.02%.

6.2 Acetone

6.2.1 Ionic liquid [BMIM]+[(CF3SO2)2N]-

6.2.1.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	NrtlFixedDg
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	4.700000000e-01	α_{21}	-	4.700000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	4.093876640e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-5.089417600e+03

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.9%.

6.2.1.2 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	UniquacFixedDu
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.368795600e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.368795600e+03
r_1	-	2.573500000e+00	r_2	-	1.116000000e+01
q_1	-	2.336000000e+00	q_2	-	1.020000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.77%.

6.2.1.3 UniquacFixedDu - ID 2

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	UniquacFixedDu
ID:	2
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.368800000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.368800000e+03
r_1	-	2.573500000e+00	r_2	-	1.116000000e+01
q_1	-	2.336000000e+00	q_2	-	1.020000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.06%.

6.2.1.4 WilsonFixedDl - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	WilsonFixedDl
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2\left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-2.000412240e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-2.410360560e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	7.404000000e+01	v_2	$\mathrm{m^3\,mol^{-1}}$	2.917100000e+02

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.71%.

6.2.2 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.2.2.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	NrtlFixedDg
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	4.700000000e-01	α_{21}	-	4.700000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	4.612441600e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-4.922057600e+03

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.71%.

6.2.2.2 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	UniquacFixedDu
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.393857760e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.393857760e+03
r_1	-	2.573500000e+00	r_2	-	9.890000000e+00
q_1	-	2.336000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.79%.

6.2.2.3 UniquacFixedDu - ID 2

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	UniquacFixedDu
ID:	2
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.393900000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.393900000e+03
r_1	-	2.573500000e+00	r_2	-	9.890000000e+00
q_1	-	2.336000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 9.49%.

6.2.2.4 WilsonFixedDl - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Acetone
Equation:	WilsonFixedDl
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2\left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-2.864115360e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-2.185052160e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	7.404000000e+01	v_2	$\mathrm{m^3\,mol^{-1}}$	2.445800000e+02

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.58%.

6.2.3 Ionic liquid [MMIM]+[(CH3)2PO4]-

6.2.3.1 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3)2PO4]-
Refrigerant:	Acetone
Equation:	UniquacFixedDu
ID:	1
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	5.173100000e+04	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-2.380600000e+03
r_1	-	2.573000000e+00	r_2	-	7.162000000e+00
q_1	-	2.336000000e+00	q_2	-	5.844000000e+00
z	-	1.000000000e+01			

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.59%.

6.3 Benzene

6.3.1 Inoic liquid [BMIM]+[(CF3SO2)2N]-

6.3.1.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Benzene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	1.569126000e+05	a_{21}	$\mathrm{J\,mol^{-1}}$	7.416000000e+02
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-2.518600000e+02	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-3.960000000e+00

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.01%.

6.3.2 Inoic liquid [C2H5NH]+[C2H5OC2H4OSO3]-

6.3.2.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[C2H5NH]+[C2H5OC2H4OSO3]-
Refrigerant:	Benzene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and}\\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	1.053950000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	-1.719500000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.47%.

6.3.3 Inoic liquid [EMIM]+[(CF3SO2)2N]-

6.3.3.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Benzene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	4.512030000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	8.422000000e+02
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-4.537000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-3.320000000e+00

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 72.92%.

6.3.4 Inoic liquid [EMIM]+[C2H5OSO3]-

6.3.4.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[EMIM]+[C2H5OSO3]-
Refrigerant:	Benzene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and}\\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	2.811520000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	-1.595100000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	5.292000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.420000000e+00

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 36.92%.

6.3.5 Inoic liquid [MMIM]+[(CFH3SO2)2N]-

6.3.5.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[MMIM]+[(CFH3SO2)2N]-
Refrigerant:	Benzene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and}\\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	-6.099440000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	-5.319100000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-3.409200000e+02	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	1.510000000e+01

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 23.96%.

6.3.6 Ionic liquid [BMIM]+[(CF3SO2)2N]-

6.3.6.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Benzene
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	0.000000000e+00	a_{21}	$\mathrm{J\,mol^{-1}}$	-7.490000000e+02
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	1.294000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-3.500000000e+00
r_1	-	1.116000000e+01	r_2	-	2.400000000e+00
q_1	-	1.020000000e+01	q_2	-	3.188000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.3.7 Ionic liquid [C2H5NH]+[C2H5OC2H4OSO3]-

6.3.7.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[C2H5NH]+[C2H5OC2H4OSO3]-
Refrigerant:	Benzene
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	6.965000000e+02	a_{21}	$\mathrm{J\,mol^{-1}}$	1.149300000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00
r_1	-	8.780000000e+00	r_2	-	2.400000000e+00
q_1	-	6.960000000e+00	q_2	-	3.188000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.3.8 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.3.8.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Benzene
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	7.518000000e+02	a_{21}	$\mathrm{J\,mol^{-1}}$	-8.167000000e+02
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	7.030000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.490000000e+00
r_1	-	9.890000000e+00	r_2	-	2.400000000e+00
q_1	-	8.780000000e+00	q_2	-	3.188000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.3.9 Ionic liquid [EMIM]+[C2H5OSO3]-

6.3.9.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[C2H5OSO3]-
Refrigerant:	Benzene
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	8.890200000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	-3.943000000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-2.145000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	1.183000000e+01
r_1	-	7.940000000e+00	r_2	-	2.400000000e+00
q_1	-	7.210000000e+00	q_2	-	3.188000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.3.10 Ionic liquid [MMIM]+[(CH3SO2)2N]-

6.3.10.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3SO2)2N]-
Refrigerant:	Benzene
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	5.347200000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	1.942300000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-6.750000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	2.300000000e+00
r_1	-	9.260000000e+00	r_2	-	2.400000000e+00
q_1	-	8.080000000e+00	q_2	-	3.188000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.4 CarbonDioxide

6.4.1 Ionic liquid [C10mim][NTf2]

6.4.1.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[C10mim][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\mathrm{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\mathrm{crit},1}$	K	3.042000000e+02	$T_{\mathrm{crit},2}$	K	8.000000000e+02
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	1.867000000e+06
ω_1	-	2.236000000e-01	ω_2	-	5.741000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	5.600000000e-03	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.19%.

6.4.1.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[C10mim][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	8.000000000e+02
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	1.867000000e+06
ω_1	-	2.236000000e-01	ω_2	-	5.741000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	6.250000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa $\rightarrow$ 7.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.05%.

6.4.2 Ionic liquid [C4mim][NTf2]

6.4.2.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[C4mim][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= \left(a_1 a_2\right)^{0.5}\left(1-k_{12}\right) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{\left(RT_{\mathrm{crit},j}\right)^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{\left(T/T_{\mathrm{crit},j}\right)}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\mathrm{crit},1}$	K	3.042000000e+02	$T_{\mathrm{crit},2}$	K	1.077000000e+03

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	2.765000000e+06
ω_1	-	2.236000000e-01	ω_2	-	3.004000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	4.930000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.45%.

6.4.2.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[C4mim][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	1.077000000e+03
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	2.765000000e+06
ω_1	-	2.236000000e-01	ω_2	-	3.004000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	5.120000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa $\rightarrow$ 7.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.54%.

6.4.3 Ionic liquid [N1,8,8,8][NTf2]

6.4.3.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[N1,8,8,8][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= \left(a_1 a_2\right)^{0.5}\left(1-k_{12}\right) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{\left(RT_{\mathrm{crit},j}\right)^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{\left(T/T_{\mathrm{crit},j}\right)}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\mathrm{crit},1}$	K	3.042000000e+02	$T_{\mathrm{crit},2}$	K	7.506000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	1.064000000e+06
ω_1	-	2.236000000e-01	ω_2	-	9.962000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	-8.000000000e-04	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.7%.

6.4.3.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[N1,8,8,8][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	7.506000000e+02
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	1.064000000e+06
ω_1	-	2.236000000e-01	ω_2	-	9.962000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.470000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa $\rightarrow$ 7.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.05%.

6.4.4 Ionic liquid [N4,1,1,1][NTf2]

6.4.4.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[N4,1,1,1][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	1.079600000e+03

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	2.588000000e+06
ω_1	-	2.236000000e-01	ω_2	-	3.334000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	-6.000000000e-04	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.15%.

6.4.4.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[N4,1,1,1][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	1.079600000e+03
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	2.588000000e+06
ω_1	-	2.236000000e-01	ω_2	-	3.334000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	-1.800000000e-03	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa $\rightarrow$ 7.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.4%.

6.4.5 Ionic liquid [P6,6,6,14][Cl]

6.4.5.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[P6,6,6,14][Cl]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\left(v+b\right)+b\left(v-b\right)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= \left(a_1 a_2\right)^{0.5}\left(1-k_{12}\right) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{\left(RT_{\mathrm{crit},j}\right)^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{\left(T/T_{\mathrm{crit},j}\right)}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\mathrm{crit},1}$	K	3.042000000e+02	$T_{\mathrm{crit},2}$	K	8.039000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	8.510000000e+05
ω_1	-	2.236000000e-01	ω_2	-	8.915000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	9.120000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.77%.

6.4.5.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[P6,6,6,14][Cl]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	8.039000000e+02
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	8.510000000e+05
ω_1	-	2.236000000e-01	ω_2	-	8.915000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.111000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa $\rightarrow$ 7.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.7%.

6.4.6 Ionic liquid [P6,6,6,14][NTf2]

6.4.6.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[P6,6,6,14][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	8.055000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	7.950000000e+05
ω_1	-	2.236000000e-01	ω_2	-	7.947000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	-3.200000000e-03	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.74%.

6.4.6.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[P6,6,6,14][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	8.055000000e+02
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	7.950000000e+05
ω_1	-	2.236000000e-01	ω_2	-	7.947000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	4.880000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.99%.

6.4.7 Ionic liquid [Pyrr4,1][NTf2]

6.4.7.1 MixingRule - ID 1

Sorbent:	ionic liquid
Subtype:	[Pyrr4,1][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	1
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	1.093100000e+03

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	7.380000000e+06	$p_{\mathrm{crit},2}$	Pa	2.425000000e+06
ω_1	-	2.236000000e-01	ω_2	-	3.467000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	5.260000000e-03	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 17.24%.

6.4.7.2 MixingRule - ID 2

Sorbent:	ionic liquid
Subtype:	[Pyrr4,1][NTf2]
Refrigerant:	CarbonDioxide
Equation:	MixingRule
ID:	2
Reference:	Manic, Marina S.; Queimada, António J.; Macedo, Eugénia A.; Najdanovic-Visak, Vesna (2012): High-pressure solubilities of carbon dioxide in ionic liquids based on bis(trifluoromethylsulfonyl)imide and chloride. In: The Journal of Supercritical Fluids 65, S. 1–10. DOI: 10.1016/j.supflu.2012.02.016.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	3.042000000e+02	$T_{\text{crit},2}$	K	1.093100000e+03
$p_{\text{crit},1}$	Pa	7.380000000e+06	$p_{\text{crit},2}$	Pa	2.425000000e+06
ω_1	-	2.236000000e-01	ω_2	-	3.467000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	5.680000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa → 7.00E+03
- Temperature, absolute, in K → 0.1

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.08%.

6.5 Cyclohexane

6.5.1 Inoic liquid [BMIM]+[(CF3SO2)2N]-

6.5.1.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Cyclohexane
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	6.391100000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	4.691500000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.929000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.283000000e+01

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 40.75%.

6.5.2 Inoic liquid [EMIM]+[(CF3SO2)2N]-

6.5.2.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Cyclohexane
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	3.671460000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	9.986400000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	6.000000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.736000000e+01

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 26.56%.

6.5.3 Inoic liquid [EMIM]+[C2H5OSO3]-

6.5.3.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[EMIM]+[C2H5OSO3]-
Refrigerant:	Cyclohexane
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and}\\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	-2.612900000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	1.360890000e+04
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-5.774000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-2.519000000e+01

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 69.9%.

6.5.4 Inoic liquid [MMIM]+[(CFH3SO2)2N]-

6.5.4.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[MMIM]+[(CFH3SO2)2N]-
Refrigerant:	Cyclohexane
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	3.748100000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	7.324900000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-2.534000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.332000000e+01

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 55.75%.

6.5.5 Ionic liquid [BMIM]+[(CF3SO2)2N]-

6.5.5.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Cyclohexane
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	-1.202800000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	2.743600000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	3.410000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-2.350000000e+00
r_1	-	1.116000000e+01	r_2	-	3.240000000e+00
q_1	-	1.020000000e+01	q_2	-	4.064000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.5.6 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.5.6.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Cyclohexane
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	1.908866000e+05	a_{21}	$\mathrm{J\,mol^{-1}}$	1.268500000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-5.174400000e+02	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-4.970000000e+00
r_1	-	9.890000000e+00	r_2	-	3.240000000e+00
q_1	-	8.780000000e+00	q_2	-	4.064000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.5.7 Ionic liquid [EMIM]+[C2H5OSO3]-

6.5.7.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[C2H5OSO3]-
Refrigerant:	Cyclohexane
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	-3.432810000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	4.016400000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	2.932600000e+02	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-1.075000000e+01
r_1	-	7.940000000e+00	r_2	-	3.240000000e+00
q_1	-	7.210000000e+00	q_2	-	4.064000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.5.8 Ionic liquid [MMIM]+[(CH3SO2)2N]-

6.5.8.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3SO2)2N]-
Refrigerant:	Cyclohexane
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	1.126400000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	1.216900000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-3.300000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	4.150000000e+00
r_1	-	9.260000000e+00	r_2	-	3.240000000e+00
q_1	-	8.080000000e+00	q_2	-	4.064000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.6 Cyclohexene

6.6.1 Inoic liquid [EMIM]+[(CF3SO2)2N]-

6.6.1.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Cyclohexene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	4.964320000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	1.132440000e+04
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	6.886000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-2.960000000e+01

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.7 Ethanol

6.7.1 Ionic liquid [MMIM]+[(CH3)2PO4]-

6.7.1.1 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3)2PO4]-
Refrigerant:	Ethanol
Equation:	UniquacFixedDu
ID:	1
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-5.866000000e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-2.027500000e+03
r_1	-	2.105000000e+00	r_2	-	7.162000000e+00
q_1	-	1.972000000e+00	q_2	-	5.844000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.22%.

6.8 Hexane

6.8.1 Inoic liquid [EMIM]+[(CF3SO2)2N]-

6.8.1.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Hexane
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and} \\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	1.500340000e+04	a_{21}	$\mathrm{J\,mol^{-1}}$	6.107000000e+02
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	2.803000000e+01	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	1.285000000e+01

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 50.53%.

6.8.2 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.8.2.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Hexane
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	-2.451700000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	5.699700000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	3.230000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	-4.780000000e+00
r_1	-	9.890000000e+00	r_2	-	3.856000000e+00
q_1	-	8.780000000e+00	q_2	-	4.500000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.9 Isobutane

6.9.1 Lubricant POE ISO7

6.9.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE ISO7
Refrigerant:	Isobutane
Equation:	MixingRule
ID:	1
Reference:	Marcelino Neto, Moisés A.; Barbosa, Jader R. (2008): Solubility, density and viscosity of a mixture of R-600a and polyol ester oil. In: International Journal of Refrigeration 31 (1), S. 34–44. DOI: 10.1016/j.ijrefrig.2007.08.004.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	-5.000000000e+00
$T_{\text{crit},1}$	K	4.078100000e+02	$T_{\text{crit},2}$	K	7.430500000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	3.629000000e+06	$p_{\mathrm{crit},2}$	Pa	1.127000000e+06
ω_1	-	1.840000000e-01	ω_2	-	7.915000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.749000000e-02	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Temperature, absolute, in K → 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.42%.

6.10 Methanol

6.10.1 Ionic liquid [MMIM]+[(CH3)2PO4]-

6.10.1.1 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3)2PO4]-
Refrigerant:	Methanol
Equation:	UniquacFixedDu
ID:	1
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-2.409900000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-2.864500000e+03
r_1	-	1.431000000e+00	r_2	-	7.162000000e+00
q_1	-	1.432000000e+00	q_2	-	5.844000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.32%.

6.11 R-12

6.11.1 Lubricant AB32

6.11.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	AB32
Refrigerant:	R-12
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.851500000e+02	$T_{\mathrm{crit},2}$	K	8.570000000e+02
$p_{\mathrm{crit},1}$	Pa	4.116000000e+06	$p_{\mathrm{crit},2}$	Pa	1.015000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000200000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	3.965100000e-01	$\beta_{1,2}$	-	8.920000000e-01
$\beta_{2,1}$	-	-6.152000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	1.160000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	0.000000000e+00
l_{12}	-	3.390000000e-02	l_{21}	-	3.850000000e-02
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.11.2 Naphthenic

6.11.2.1 Heil - ID 1

Sorbent:	naphthenic
Subtype:	
Refrigerant:	R-12
Equation:	Heil
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((56.211-0.020808*((T-273.15)*1.8+32))*16.0185)*0.325 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.024000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	8.040000000e+02
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 228.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.82%.

6.11.2.2 NrtlFixedDg - ID 1

Sorbent:	naphthenic
Subtype:	
Refrigerant:	R-12
Equation:	NrtlFixedDg
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-1.105000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	4.571000000e+03

Validity:
Equation is approximately valid for $228.15\mathrm{K} \leq T \leq 394.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 9.5%.

6.11.2.3 TsubokaKatayama - ID 1

Sorbent:	naphthenic
Subtype:	
Refrigerant:	R-12
Equation:	TsubokaKatayama
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((56.211-0.020808*((T-273.15)*1.8+32))*16.0185)*0.325 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	5.170000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	2.029000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 228.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.41%.

6.11.2.4 WangChao - ID 1

Sorbent:	naphthenic
Subtype:	
Refrigerant:	R-12
Equation:	WangChao
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((56.211-0.020808*((T-273.15)*1.8+32))*16.0185)*0.325 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	J mol^{-1}	-1.890000000e+02	$\Delta\lambda_{21}$	J mol^{-1}	2.199000000e+03
v_1	m^3 mol^{-1}	1.000000000e+00	v_2	m^3 mol^{-1}	1.000000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 228.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 9.32%.

6.11.2.5 WilsonFixedDl - ID 1

Sorbent:	naphthenic
Subtype:	
Refrigerant:	R-12
Equation:	WilsonFixedDl
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((56.211-0.020808*((T-273.15)*1.8+32))*16.0185)*0.325 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.986000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	2.639000000e+02
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:

Equation is approximately valid for 228.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.95%.

6.11.3 Paraffinic

6.11.3.1 Heil - ID 1

Sorbent:	paraffinic
Subtype:	
Refrigerant:	R-12
Equation:	Heil
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((55.37-0.020428*((T-273.15)*1.8+32))*16.0185)*0.5 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.307000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.615000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.83%.

6.11.3.2 NrtlFixedDg - ID 1

Sorbent:	paraffinic
Subtype:	
Refrigerant:	R-12
Equation:	NrtlFixedDg
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-2.059000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	6.981000000e+03

Validity:
Equation is approximately valid for $255.15\mathrm{K} \leq T \leq 394.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.29%.

6.11.3.3 TsubokaKatayama - ID 1

Sorbent:	paraffinic
Subtype:	
Refrigerant:	R-12
Equation:	TsubokaKatayama
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((55.37-0.020428*((T-273.15)*1.8+32))*16.0185)*0.5 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.847000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-4.437000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 12.79%.

6.11.3.4 UniquacFixedDu - ID 1

Sorbent:	paraffinic
Subtype:	
Refrigerant:	R-12
Equation:	UniquacFixedDu
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	5.897000000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	2.770000000e+02
r_1	-	2.624300000e+00	r_2	-	2.450000000e+01
q_1	-	2.376000000e+00	q_2	-	2.028000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $255.15\mathrm{K} \leq T \leq 394.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 162.47%.

6.11.3.5 WangChao - ID 1

Sorbent:	paraffinic
Subtype:	
Refrigerant:	R-12
Equation:	WangChao
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((55.37-0.020428*((T-273.15)*1.8+32))*16.0185)*0.5 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	J mol^{-1}	-4.300000000e+01	$\Delta\lambda_{21}$	J mol^{-1}	4.115000000e+03
v_1	m^3 mol^{-1}	1.000000000e+00	v_2	m^3 mol^{-1}	1.000000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.23%.

6.11.3.6 WilsonFixedDl - ID 1

Sorbent:	paraffinic
Subtype:	
Refrigerant:	R-12
Equation:	WilsonFixedDl
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((55.37-0.020428*((T-273.15)*1.8+32))*16.0185)*0.5 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.634000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	7.415000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:

Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 9.58%.

6.12 R-123

6.12.1 Lubricant MO56

6.12.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	MO56
Refrigerant:	R-123
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	4.568300000e+02	$T_{\mathrm{crit},2}$	K	8.320000000e+02
$p_{\mathrm{crit},1}$	Pa	3.668000000e+06	$p_{\mathrm{crit},2}$	Pa	1.104000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001600000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.792500000e-01	$\beta_{1,2}$	-	1.020000000e+00
$\beta_{2,1}$	-	-7.111000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	1.580000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-4.800000000e-02
l_{12}	-	3.840000000e-02	l_{21}	-	3.840000000e-02
t	-	7.580000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.13 R-1234ze(E)

6.13.1 Lubricant POE

6.13.1.1 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-1234ze(E)
Equation:	NrtlFixedDg
ID:	1
Reference:	Bock, Jessica (2015): VAPOR-LIQUID EQUILIBRIA OF A LOW GWP REFRIGERANT, R-1234ZE(E), MIXED WITH A POE LUBRICANT. PhD Thesis. University of Illinois at Urbana-Champaign, Illinois.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-3.082700000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	7.567500000e+03

Validity:
Equation is approximately valid for $273.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.13.1.2 UniquacFixedDu - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-1234ze(E)
Equation:	UniquacFixedDu
ID:	1
Reference:	Bock, Jessica (2015): VAPOR-LIQUID EQUILIBRIA OF A LOW GWP REFRIGERANT, R-1234ZE(E), MIXED WITH A POE LUBRICANT. PhD Thesis. University of Illinois at Urbana-Champaign, Illinois.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.662800000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.981200000e+03
r_1	-	2.740000000e+00	r_2	-	2.940000000e+01
q_1	-	2.490000000e+00	q_2	-	2.436000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $273.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.13.1.3 WilsonFixedDl - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-1234ze(E)
Equation:	WilsonFixedDl
ID:	1
Reference:	Bock, Jessica (2015): VAPOR-LIQUID EQUILIBRIA OF A LOW GWP REFRIGERANT, R-1234ZE(E), MIXED WITH A POE LUBRICANT. PhD Thesis. University of Illinois at Urbana-Champaign, Illinois.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/(993.89-0.75658*(T-273.15))*0.7 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2 \left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} {}^{v_2}/_{v_1} \exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} {}^{v_1}/_{v_2} \exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.000000000e+04	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.908000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for $273.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14 R-125

6.14.1 Hexadecane

6.14.1.1 UniquacFixedDu - ID 1

Sorbent:	hexadecane
Subtype:	
Refrigerant:	R-125
Equation:	UniquacFixedDu
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1997): The solubility of HFC 125, HFC 134a, HFC 143a and HFC 152a in n -eicosane, n -hexadecane, n -tridecane and 2, 6, 10, 14-tetramethylpentadecane. In: Can. J. Chem. Eng. 75 (3), S. 544–550. DOI: 10.1002/cjce.5450750308.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.679000000e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	2.618900000e+03
r_1	-	2.610000000e+00	r_2	-	2.314000000e+01
q_1	-	2.490000000e+00	q_2	-	1.706000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 293.15K $\leq T \leq$ 363.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.2 Lubricant BAB15

6.14.2.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB15
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.393300000e+02	$T_{\mathrm{crit},2}$	K	7.633500000e+02
$p_{\mathrm{crit},1}$	Pa	3.629000000e+06	$p_{\mathrm{crit},2}$	Pa	1.199000000e+06
ω_1	-	3.034900000e-01	ω_2	-	7.160750000e-01
$\kappa_{1,1}$	-	-5.020000000e-02	$\kappa_{1,2}$	-	-1.331000000e-01
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.645000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.74%.

6.14.3 Lubricant BAB32

6.14.3.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB32
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.393300000e+02	$T_{\mathrm{crit},2}$	K	7.728900000e+02
$p_{\mathrm{crit},1}$	Pa	3.629000000e+06	$p_{\mathrm{crit},2}$	Pa	1.138000000e+06
ω_1	-	3.034900000e-01	ω_2	-	6.947280000e-01
$\kappa_{1,1}$	-	-5.020000000e-02	$\kappa_{1,2}$	-	-9.860000000e-02
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.837000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.82%.

6.14.4 Lubricant HAB15

6.14.4.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HAB15
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.391900000e+02	$T_{\mathrm{crit},2}$	K	7.550000000e+02
$p_{\mathrm{crit},1}$	Pa	3.637000000e+06	$p_{\mathrm{crit},2}$	Pa	1.145000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.773600000e-01	$\beta_{1,2}$	-	9.500000000e-01
$\beta_{2,1}$	-	-1.977000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.770000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.570000000e-01
l_{12}	-	9.150000000e-02	l_{21}	-	1.297000000e-01
t	-	1.220000000e+01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.5 Lubricant HAB32

6.14.5.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HAB32
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.391900000e+02	$T_{\mathrm{crit},2}$	K	7.580000000e+02
$p_{\mathrm{crit},1}$	Pa	3.637000000e+06	$p_{\mathrm{crit},2}$	Pa	1.073000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.773600000e-01	$\beta_{1,2}$	-	1.115000000e+00
$\beta_{2,1}$	-	-1.977000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.770000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.536000000e-01
l_{12}	-	1.276000000e-01	l_{21}	-	1.422000000e-01
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.6 Lubricant HC16

6.14.6.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HC16
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.391900000e+02	$T_{\mathrm{crit},2}$	K	7.170000000e+02
$p_{\mathrm{crit},1}$	Pa	3.637000000e+06	$p_{\mathrm{crit},2}$	Pa	1.419000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.773600000e-01	$\beta_{1,2}$	-	7.310000000e-01
$\beta_{2,1}$	-	-1.977000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.770000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-2.174000000e-01
l_{12}	-	1.556000000e-01	l_{21}	-	1.556000000e-01
t	-	5.420000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.7 Lubricant PEB6

6.14.7.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB6
Refrigerant:	R-125
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	3.940000000e+00	w_0^*	K	9.930000000e+02
w_1	K	-2.710000000e+02			

Validity:
Equation is approximately valid for $323.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 43.2%.

6.14.8 Lubricant PEB8

6.14.8.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-125
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	5.810000000e+00	w_0^*	K	9.980000000e+02
w_1	K	-2.380000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 33.89%.

6.14.8.2 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\text{crit},1}$	K	3.391900000e+02	$T_{\text{crit},2}$	K	7.930000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	3.637000000e+06	$p_{\mathrm{crit},2}$	Pa	7.720000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.773600000e-01	$\beta_{1,2}$	-	9.410000000e-01
$\beta_{2,1}$	-	-1.977000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.770000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	1.190000000e-02
l_{12}	-	5.000000000e-04	l_{21}	-	5.000000000e-04
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.9 Lubricant PEC9

6.14.9.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEC9
Refrigerant:	R-125
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	6.910000000e+00	w_0^*	K	9.970000000e+02
w_1	K	-2.080000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 33.34%.

6.14.10 Lubricant POE

6.14.10.1 Heil - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-125
Equation:	Heil
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/(993.89-0.75658*(T-273.15))*0.7 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	6.420000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	5.493000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 243.15K $\leq T \leq$ 333.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.55%.

6.14.10.2 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-125
Equation:	NrtlFixedDg
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-3.363000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	8.481000000e+03

Validity:
Equation is approximately valid for $243.15\mathrm{K} \leq T \leq 333.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 12.85%.

6.14.10.3 TsubokaKatayama - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-125
Equation:	TsubokaKatayama
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2; Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	9.180000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-4.941000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 243.15K $\leq T \leq$ 333.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.10.4 UniquacFixedDu - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-125
Equation:	UniquacFixedDu
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.715000000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-5.700000000e+02
r_1	-	2.610000000e+00	r_2	-	2.940000000e+01
q_1	-	2.490000000e+00	q_2	-	2.436000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $243.15\mathrm{K} \leq T \leq 333.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 18.8%.

6.14.10.5 WangChao - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-125
Equation:	WangChao
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.; Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-3.810000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	4.579000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $-243.15\mathrm{K} \leq T \leq 333.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.10.6 WilsonFixedDl - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-125
Equation:	WilsonFixedDl
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/(993.89-0.75658*(T-273.15))*0.7 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda_{12}^* = 0 \\ \Lambda_{12}^* & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda_{21}^* = 0 \\ \Lambda_{21}^* & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ_{12}^*	-	0.000000000e+00	Λ_{21}^*	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.441000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	2.000000000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 16.29%.

6.14.11 Lubricant POE32

6.14.11.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE32
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.391900000e+02	$T_{\mathrm{crit},2}$	K	8.640000000e+02
$p_{\mathrm{crit},1}$	Pa	3.637000000e+06	$p_{\mathrm{crit},2}$	Pa	8.740000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.773600000e-01	$\beta_{1,2}$	-	9.130000000e-01
$\beta_{2,1}$	-	-1.977000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.770000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	2.960000000e-02
l_{12}	-	1.790000000e-02	l_{21}	-	2.900000000e-03
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.12 Lubricant POE68

6.14.12.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE68
Refrigerant:	R-125
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.391900000e+02	$T_{\mathrm{crit},2}$	K	7.460000000e+02
$p_{\mathrm{crit},1}$	Pa	3.637000000e+06	$p_{\mathrm{crit},2}$	Pa	6.820000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.773600000e-01	$\beta_{1,2}$	-	1.249000000e+00
$\beta_{2,1}$	-	-1.977000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.770000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	2.460000000e-02
l_{12}	-	2.450000000e-02	l_{21}	-	4.700000000e-03
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.14.13 Pentaerythritol tetrapentanoate ester

6.14.13.1 FloryHuggins - ID 1

Sorbent:	pentaerythritol tetrapentanoate ester
Subtype:	
Refrigerant:	R-125
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1999): Solubility of HFC32, HFC125, HFC134a, HFC143a, and HFC152a in a Pentaerythritol Tetrapentanoate Ester. In: J. Chem. Eng. Data 44 (4), S. 823–828. DOI: 10.1021/je980235e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	3.470000000e+00	w_0^*	K	9.670000000e+02
w_1	K	-2.620000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 34.66%.

6.15 R-13 B1

6.15.1 Lubricant AB32

6.15.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	AB32
Refrigerant:	R-13 B1
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.402000000e+02	$T_{\mathrm{crit},2}$	K	8.570000000e+02
$p_{\mathrm{crit},1}$	Pa	3.960000000e+06	$p_{\mathrm{crit},2}$	Pa	1.015000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.004200000e-01	$\beta_{1,2}$	-	8.920000000e-01
$\beta_{2,1}$	-	-8.728000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	2.920000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-2.990000000e-02
l_{12}	-	5.980000000e-02	l_{21}	-	1.994000000e-01
t	-	6.090000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16 R-134a

6.16.1 Triegdme

6.16.1.1 WilsonTemperatureDl - ID 1

Sorbent:	TriEGDME
Subtype:	
Refrigerant:	R-134a
Equation:	WilsonTemperatureDl
ID:	1
Reference:	Marchi, Paolo; Scalabrin, Giancarlo; Ihmels, E. Christian; Fischer, Kai; Gmehling, Jürgen (2006): Bubble pressure measurements for the (1,1,1,2-tetrafluoroethane+triethylene glycol dimethyl ether) system. In: The Journal of Chemical Thermodynamics 38 (11), S. 1247–1253. DOI: 10.1016/j.jct.2006.03.004.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and} \\
\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and} \\
\Delta\lambda_{12} &= R\left(\Delta\lambda_{12,\mathrm{c}}+\Delta\lambda_{12,\mathrm{t}}\left(T-c\right)\right) && \text{, and} \\
\Delta\lambda_{21} &= R\left(\Delta\lambda_{21,\mathrm{c}}+\Delta\lambda_{21,\mathrm{t}}\left(T-c\right)\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12,\mathrm{c}}$	K	-1.491280000e+02	$\Delta\lambda_{21,\mathrm{c}}$	K	3.681890000e+02

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12,t}$	-	9.592910000e-01	$\Delta\lambda_{12,t}$	-	9.291260000e-01
v_1	$m^3\,mol^{-1}$	1.000000000e+00	v_2	$m^3\,mol^{-1}$	1.000000000e+00
c	K	2.731500000e+02			

Validity:
Equation is approximately valid for 283.15K $\leq T \leq$ 323.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1.00E+02
- Temperature, absolute, in K → 0.03

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.69%.

6.16.2 Hexadecane

6.16.2.1 UniquacFixedDu - ID 1

Sorbent:	hexadecane
Subtype:	
Refrigerant:	R-134a
Equation:	UniquacFixedDu
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1997): The solubility of HFC 125, HFC 134a, HFC 143a and HFC 152a in n -eicosane, n -hexadecane, n -tridecane and 2, 6, 10, 14-tetramethylpentadecane. In: Can. J. Chem. Eng. 75 (3), S. 544–550. DOI: 10.1002/cjce.5450750308.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-2.128000000e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	2.810100000e+03
r_1	-	2.460000000e+00	r_2	-	2.314000000e+01
q_1	-	2.360000000e+00	q_2	-	1.706000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $293.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.3 Lubricant BAB15

6.16.3.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB15
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	7.633500000e+02
$p_{\mathrm{crit},1}$	Pa	4.059300000e+06	$p_{\mathrm{crit},2}$	Pa	1.199000000e+06
ω_1	-	3.268400000e-01	ω_2	-	7.160750000e-01
$\kappa_{1,1}$	-	-7.700000000e-03	$\kappa_{1,2}$	-	-1.331000000e-01
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.496000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.78%.

6.16.4 Lubricant BAB32

6.16.4.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB32
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	7.728900000e+02
$p_{\mathrm{crit},1}$	Pa	4.059300000e+06	$p_{\mathrm{crit},2}$	Pa	1.138000000e+06
ω_1	-	3.268400000e-01	ω_2	-	6.947280000e-01
$\kappa_{1,1}$	-	-7.700000000e-03	$\kappa_{1,2}$	-	-9.860000000e-02
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.598000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.73%.

6.16.5 Lubricant HAB32

6.16.5.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HAB32
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	7.580000000e+02
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	1.073000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	1.115000000e+00
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.661000000e-01
l_{12}	-	1.146000000e-01	l_{21}	-	1.332000000e-01
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.6 Lubricant HC13

6.16.6.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HC13
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	6.760000000e+02
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	1.720000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	7.900000000e-01
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.734000000e-01
l_{12}	-	8.590000000e-02	l_{21}	-	1.068000000e-01
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.7 Lubricant HC16

6.16.7.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HC16
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	7.170000000e+02
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	1.419000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	7.310000000e-01
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.630000000e-01
l_{12}	-	9.280000000e-02	l_{21}	-	1.074000000e-01
t	-	4.190000000e+00			

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 85.4%.

6.16.8 Lubricant HC20

6.16.8.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HC20
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	7.670000000e+02
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	1.115000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	1.076000000e+00
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.536000000e-01
l_{12}	-	7.820000000e-02	l_{21}	-	1.029000000e-01
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.9 Lubricant PAG

6.16.9.1 Heil - ID 1

Sorbent:	lubricant
Subtype:	PAG
Refrigerant:	R-134a
Equation:	Heil
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((62.365-0.024864*((T-273.15)*1.8+32))*16.0185)*2 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.667000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-4.626000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 21.26%.

6.16.9.2 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	PAG
Refrigerant:	R-134a
Equation:	NrtlFixedDg
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{\left(x_2+x_1G_{12}\right)^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-4.788000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-3.590000000e+02

Validity:
Equation is approximately valid for $263.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 18.57%.

6.16.9.3 TsubokaKatayama - ID 1

Sorbent:	lubricant
Subtype:	PAG
Refrigerant:	R-134a
Equation:	TsubokaKatayama
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((62.365-0.024864*((T-273.15)*1.8+32))*16.0185)*2 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-2.470000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-1.525900000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 23.73%.

6.16.9.4 WangChao - ID 1

Sorbent:	lubricant
Subtype:	PAG
Refrigerant:	R-134a
Equation:	WangChao
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((62.365-0.024864*((T-273.15)*1.8+32))*16.0185)*2 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.715000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-1.609000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 19.66%.

6.16.9.5 WilsonFixedDl - ID 1

Sorbent:	lubricant
Subtype:	PAG
Refrigerant:	R-134a
Equation:	WilsonFixedDl
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((62.365-0.024864*((T-273.15)*1.8+32))*16.0185)*2 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	3.441000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-8.128000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:

Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.89%.

6.16.10 Lubricant PEB6

6.16.10.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB6
Refrigerant:	R-134a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	7.030000000e+00	w_0^*	K	9.730000000e+02
w_1	K	-2.330000000e+02			

Validity:
Equation is approximately valid for $323.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 36.58%.

6.16.11 Lubricant PEB8

6.16.11.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-134a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	6.940000000e+00	w_0^*	K	8.080000000e+02
w_1	K	-2.030000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 31.22%.

6.16.11.2 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\text{crit},1}$	K	3.742100000e+02	$T_{\text{crit},2}$	K	7.930000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	7.720000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	9.410000000e-01
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.930000000e-02
l_{12}	-	5.040000000e-02	l_{21}	-	3.590000000e-02
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.12 Lubricant PEC9

6.16.12.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEC9
Refrigerant:	R-134a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	1.041000000e+01	w_0^*	K	9.380000000e+02
w_1	K	-1.760000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 28.28%.

6.16.13 Lubricant POE

6.16.13.1 Heil - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	Heil
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	9.480000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	3.993000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.31%.

6.16.13.2 Heil - ID 2

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	Heil
ID:	2
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.122000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	4.417000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 11.03%.

6.16.13.3 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	NrtlFixedDg
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{\left(x_2+x_1G_{12}\right)^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-2.528000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	7.421000000e+03

Validity:
Equation is approximately valid for $255.15\mathrm{K} \leq T \leq 394.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.03%.

6.16.13.4 NrtlFixedDg - ID 2

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	NrtlFixedDg
ID:	2
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{\left(x_2+x_1G_{12}\right)^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-2.784000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	9.498000000e+03

Validity:
Equation is approximately valid for $263.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 13.28%.

6.16.13.5 TsubokaKatayama - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	TsubokaKatayama
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.721000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-5.389000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 18.15%.

6.16.13.6 TsubokaKatayama - ID 2

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	TsubokaKatayama
ID:	2
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.366000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-1.201300000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 44.24%.

6.16.13.7 UniquacFixedDu - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	UniquacFixedDu
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	9.710000000e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	1.334000000e+03
r_1	-	2.460000000e+00	r_2	-	2.401000000e+01
q_1	-	2.360000000e+00	q_2	-	2.018000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $255.15\mathrm{K} \leq T \leq 394.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 64.78%.

6.16.13.8 UniquacFixedDu - ID 2

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	UniquacFixedDu
ID:	2
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.144000000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	7.980000000e+01
r_1	-	2.460000000e+00	r_2	-	2.940000000e+01
q_1	-	2.360000000e+00	q_2	-	2.436000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $263.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.51%.

6.16.13.9 WangChao - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	WangChao
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-1.360000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	4.212000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.78%.

6.16.13.10 WangChao - ID 2

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	WangChao
ID:	2
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.886000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	2.000000000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for $-263.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 10.58%.

6.16.13.11 WilsonFixedDl - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	WilsonFixedDl
ID:	1
Reference:	Grebner, J. J. (1992): The Effects of Oil on the Thermodynamic Properties of Dichlorodifluoromethane (R-12) and Tetrafluoroethane (R-134a). Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-13. Online verfügbar unter http://hdl.handle.net/2142/9702.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.003000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.756900000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:

Equation is approximately valid for 255.15K $\leq T \leq$ 394.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.58%.

6.16.13.12 WilsonFixedDl - ID 2

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-134a
Equation:	WilsonFixedDl
ID:	2
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.510000000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.844900000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:

Equation is approximately valid for 263.15K $\leq T \leq$ 343.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.44%.

6.16.14 Lubricant POE Castrol SW 46

6.16.14.1 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE Castrol SW 46
Refrigerant:	R-134a
Equation:	NrtlFixedDg
ID:	1
Reference:	Fleming, J. S.; Yan, Y. (2003): The prediction of vapour–liquid equilibrium behaviour of HFC blend–oil mixtures from commonly available data. In: International Journal of Refrigeration 26 (3), S. 266–274. DOI: 10.1016/S0140-7007(02)00130-5.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	3.936000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-1.240000000e+03

Validity:
Equation is approximately valid for $253.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.15 Lubricant POE32

6.16.15.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE32
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	8.640000000e+02
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	8.740000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	9.130000000e-01
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.060000000e-02
l_{12}	-	5.610000000e-02	l_{21}	-	2.540000000e-02
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.73%.

6.16.16 Lubricant POE68

6.16.16.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE68
Refrigerant:	R-134a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.742100000e+02	$T_{\mathrm{crit},2}$	K	7.460000000e+02
$p_{\mathrm{crit},1}$	Pa	4.059000000e+06	$p_{\mathrm{crit},2}$	Pa	6.820000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.002500000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	5.053200000e-01	$\beta_{1,2}$	-	1.249000000e+00
$\beta_{2,1}$	-	-4.983000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.090000000e-02
l_{12}	-	6.780000000e-02	l_{21}	-	3.510000000e-02
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.16.17 Pentaerythritol tetrapentanoate ester

6.16.17.1 FloryHuggins - ID 1

Sorbent:	pentaerythritol tetrapentanoate ester
Subtype:	
Refrigerant:	R-134a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1999): Solubility of HFC32, HFC125, HFC134a, HFC143a, and HFC152a in a Pentaerythritol Tetrapentanoate Ester. In: J. Chem. Eng. Data 44 (4), S. 823–828. DOI: 10.1021/je980235e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	6.170000000e+00	w_0^*	K	8.780000000e+02
w_1	K	-2.210000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 30.38%.

6.17 R-143a

6.17.1 Lubricant BAB15

6.17.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB15
Refrigerant:	R-143a
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00
$T_{\mathrm{crit},1}$	K	3.458600000e+02	$T_{\mathrm{crit},2}$	K	7.633500000e+02
$p_{\mathrm{crit},1}$	Pa	3.764100000e+06	$p_{\mathrm{crit},2}$	Pa	1.199000000e+06
ω_1	-	2.604900000e-01	ω_2	-	7.160750000e-01
$\kappa_{1,1}$	-	-3.990000000e-02	$\kappa_{1,2}$	-	-1.331000000e-01
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.293000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.74%.

6.17.2 Lubricant BAB32

6.17.2.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB32
Refrigerant:	R-143a
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.458600000e+02	$T_{\mathrm{crit},2}$	K	7.728900000e+02
$p_{\mathrm{crit},1}$	Pa	3.764100000e+06	$p_{\mathrm{crit},2}$	Pa	1.138000000e+06
ω_1	-	2.604900000e-01	ω_2	-	6.947280000e-01
$\kappa_{1,1}$	-	-3.990000000e-02	$\kappa_{1,2}$	-	-9.860000000e-02
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.380000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.25%.

6.17.3 Lubricant HAB15

6.17.3.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HAB15
Refrigerant:	R-143a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.462000000e+02	$T_{\mathrm{crit},2}$	K	7.550000000e+02
$p_{\mathrm{crit},1}$	Pa	3.759000000e+06	$p_{\mathrm{crit},2}$	Pa	1.145000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000600000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.587400000e-01	$\beta_{1,2}$	-	9.500000000e-01
$\beta_{2,1}$	-	-4.846000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.430000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-9.000000000e-02
l_{12}	-	5.800000000e-02	l_{21}	-	9.040000000e-02
t	-	-3.680000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.17.4 Lubricant HC16

6.17.4.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HC16
Refrigerant:	R-143a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.462000000e+02	$T_{\mathrm{crit},2}$	K	7.170000000e+02
$p_{\mathrm{crit},1}$	Pa	3.759000000e+06	$p_{\mathrm{crit},2}$	Pa	1.419000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000600000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.587400000e-01	$\beta_{1,2}$	-	7.310000000e-01
$\beta_{2,1}$	-	-4.846000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.430000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.544000000e-01
l_{12}	-	1.167000000e-01	l_{21}	-	1.167000000e-01
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.17.5 Lubricant PEB6

6.17.5.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB6
Refrigerant:	R-143a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	4.310000000e+00	w_0^*	K	7.720000000e+02
w_1	K	-1.990000000e+02			

Validity:
Equation is approximately valid for $323.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 48.49%.

6.17.6 Lubricant PEB8

6.17.6.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-143a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	5.760000000e+00	w_0^*	K	7.030000000e+02
w_1	K	-1.620000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.17.6.2 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-143a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\text{crit},1}$	K	3.462000000e+02	$T_{\text{crit},2}$	K	7.930000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	3.759000000e+06	$p_{\mathrm{crit},2}$	Pa	7.720000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.000600000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.587400000e-01	$\beta_{1,2}$	-	9.410000000e-01
$\beta_{2,1}$	-	-4.846000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	-1.430000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	9.590000000e-02
l_{12}	-	-8.450000000e-02	l_{21}	-	-9.340000000e-02
t	-	-4.190000000e+01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.17.7 Lubricant PEC9

6.17.7.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEC9
Refrigerant:	R-143a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	7.790000000e+00	w_0^*	K	8.170000000e+02
w_1	K	-1.520000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 37.87%.

6.17.8 Pentaerythritol tetrapentanoate ester

6.17.8.1 FloryHuggins - ID 1

Sorbent:	pentaerythritol tetrapentanoate ester
Subtype:	
Refrigerant:	R-143a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1999): Solubility of HFC32, HFC125, HFC134a, HFC143a, and HFC152a in a Pentaerythritol Tetrapentanoate Ester. In: J. Chem. Eng. Data 44 (4), S. 823–828. DOI: 10.1021/je980235e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and}\\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and}\\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	5.280000000e+00	w_0^*	K	8.490000000e+02
w_1	K	-1.830000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.18 R-152a

6.18.1 Lubricant HC16

6.18.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HC16
Refrigerant:	R-152a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.864400000e+02	$T_{\mathrm{crit},2}$	K	7.170000000e+02
$p_{\mathrm{crit},1}$	Pa	4.520000000e+06	$p_{\mathrm{crit},2}$	Pa	1.419000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001200000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.849500000e-01	$\beta_{1,2}$	-	7.310000000e-01
$\beta_{2,1}$	-	-8.508000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	1.460000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.254000000e-01
l_{12}	-	7.880000000e-02	l_{21}	-	9.000000000e-02
t	-	3.490000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.18.2 Lubricant PEB6

6.18.2.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB6
Refrigerant:	R-152a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	5.190000000e+00	w_0^*	K	4.910000000e+02
w_1	K	-2.050000000e+02			

Validity:
Equation is approximately valid for $323.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoSCubic - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 33.59%.

6.18.3 Lubricant PEB8

6.18.3.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-152a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	9.760000000e+00	w_0^*	K	7.070000000e+02
w_1	K	-1.690000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.18.3.2 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-152a
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\text{crit},1}$	K	3.864400000e+02	$T_{\text{crit},2}$	K	7.930000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	4.520000000e+06	$p_{\mathrm{crit},2}$	Pa	7.720000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001200000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.849500000e-01	$\beta_{1,2}$	-	9.410000000e-01
$\beta_{2,1}$	-	-8.508000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	1.460000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	9.400000000e-02
l_{12}	-	-6.560000000e-02	l_{21}	-	-8.200000000e-02
t	-	-1.450000000e+01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.18.4 Lubricant PEC9

6.18.4.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEC9
Refrigerant:	R-152a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	1.003000000e+01	w_0^*	K	6.540000000e+02
w_1	K	-1.520000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoSCubic - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 27.35%.

6.18.5 Pentaerythritol tetrapentanoate ester

6.18.5.1 FloryHuggins - ID 1

Sorbent:	pentaerythritol tetrapentanoate ester
Subtype:	
Refrigerant:	R-152a
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1999): Solubility of HFC32, HFC125, HFC134a, HFC143a, and HFC152a in a Pentaerythritol Tetrapentanoate Ester. In: J. Chem. Eng. Data 44 (4), S. 823–828. DOI: 10.1021/je980235e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and}\\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and}\\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	4.620000000e+00	w_0^*	K	4.820000000e+02
w_1	K	-2.040000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.19 R-22

6.19.1 Lubricant AB32

6.19.1.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	AB32
Refrigerant:	R-22
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.691700000e+02	$T_{\mathrm{crit},2}$	K	8.570000000e+02
$p_{\mathrm{crit},1}$	Pa	4.978000000e+06	$p_{\mathrm{crit},2}$	Pa	1.015000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001100000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.329500000e-01	$\beta_{1,2}$	-	8.920000000e-01
$\beta_{2,1}$	-	-6.214000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	1.500000000e-02	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-3.950000000e-02
l_{12}	-	5.690000000e-02	l_{21}	-	6.940000000e-02
t	-	3.290000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.19.2 Lubricant POE

6.19.2.1 Heil - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-22
Equation:	Heil
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-2.240000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	6.371000000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 253.15K $\leq T \leq$ 333.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 28.25%.

6.19.2.2 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-22
Equation:	NrtlFixedDg
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{\left(x_2+x_1G_{12}\right)^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-4.709000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-9.670000000e+02

Validity:
Equation is approximately valid for $253.15\mathrm{K} \leq T \leq 333.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 27.05%.

6.19.2.3 TsubokaKatayama - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-22
Equation:	TsubokaKatayama
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-8.890000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-1.147200000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
Equation is approximately valid for 253.15K $\leq T \leq$ 333.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from figure
- Pressure, absolute, in Pa $\rightarrow$ 3.45E+02
- Temperature, absolute, in K $\rightarrow$ 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 36.26%.

6.19.2.4 UniquacFixedDu - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-22
Equation:	UniquacFixedDu
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.366000000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	4.115000000e+03
r_1	-	1.590000000e+00	r_2	-	2.940000000e+01
q_1	-	1.390000000e+00	q_2	-	2.436000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $253.15\mathrm{K} \leq T \leq 333.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 35.06%.

6.19.2.5 WangChao - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-22
Equation:	WangChao
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	J mol^{-1}	-1.070000000e+03	$\Delta\lambda_{21}$	J mol^{-1}	5.716000000e+03
v_1	m^3 mol^{-1}	1.000000000e+00	v_2	m^3 mol^{-1}	1.000000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 253.15K $\leq T \leq$ 333.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 27.01%.

6.19.2.6 WilsonFixedDl - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-22
Equation:	WilsonFixedDl
ID:	1
Reference:	Martz, W. L.; Jacobi, A. M. (1994): Refrigerant-Oil Mixtures and Local Composition Modeling. Hg. v. Air Conditioning and Refrigeration Center. College of Engineering. University of Illinois at Urbana-Champaign. Air Conditioning and Refrigeration Center TR-68. Online verfügbar unter http://hdl.handle.net/2142/10986.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/((61.387-0.024138*((T-273.15)*1.8+32))*16.0185)*0.59 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-4.030000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	2.000000000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:

Equation is approximately valid for 253.15K $\leq T \leq$ 333.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from figure
- Pressure, absolute, in Pa → 3.45E+02
- Temperature, absolute, in K → 0.12

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 36.48%.

6.19.3 Lubricant POE Castrol SW 46

6.19.3.1 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE Castrol SW 46
Refrigerant:	R-22
Equation:	NrtlFixedDg
ID:	1
Reference:	Fleming, J. S.; Yan, Y. (2003): The prediction of vapour–liquid equilibrium behaviour of HFC blend–oil mixtures from commonly available data. In: International Journal of Refrigeration 26 (3), S. 266–274. DOI: 10.1016/S0140-7007(02)00130-5.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	2.818000000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-4.620000000e+03

Validity:
Equation is approximately valid for $253.15\mathrm{K} \leq T \leq 343.15\mathrm{K}$.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.20 R-23

6.20.1 1-phenyloctane

6.20.1.1 MixingRule - ID 1

Sorbent:	1-Phenyloctane
Subtype:	
Refrigerant:	R-23
Equation:	MixingRule
ID:	1
Reference:	Bogatu, Cristina; Geană, Dan; Vîlcu, Rodica; Duţă, Anca; Poot, Wim; Loos, Theo W. de (2010): Fluid phase equilibria in the binary system trifluoromethane+1-phenyloctane. In: Fluid Phase Equilibria 295 (2), S. 186–193. DOI: 10.1016/j.fluid.2010.04.013.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1+b_2}{2}\,(1-m) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.37464 + 1.54226\omega_j - 0.26992\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	1.000000000e+01	Mix	-	5.000000000e+00
$T_{\mathrm{crit},1}$	K	2.993000000e+02	$T_{\mathrm{crit},2}$	K	7.250000000e+02
$p_{\mathrm{crit},1}$	Pa	4.858000000e+06	$p_{\mathrm{crit},2}$	Pa	1.980000000e+06
ω_1	-	2.670000000e-01	ω_2	-	5.720000000e-01
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.480000000e-01	m	-	-1.400000000e-02
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 253.15K $\leq T \leq$ 368.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Pressure, absolute, in Pa $\rightarrow$ 3.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.01
- Concentration / Molar fraction, absolute, in $\mathrm{kg\,kg^{-1}}$ / $\mathrm{mol\,mol^{-1}}$ $\rightarrow$ 1.00E-03

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.79%.

6.20.1.2 MixingRule - ID 2

Sorbent:	1-Phenyloctane
Subtype:	
Refrigerant:	R-23
Equation:	MixingRule
ID:	2
Reference:	Bogatu, Cristina; Geană, Dan; Vîlcu, Rodica; Duţă, Anca; Poot, Wim; Loos, Theo W. de (2010): Fluid phase equilibria in the binary system trifluoromethane+1-phenyloctane. In: Fluid Phase Equilibria 295 (2), S. 186–193. DOI: 10.1016/j.fluid.2010.04.013.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1+b_2}{2}\,(1-m) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3}-1)}\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= 0.48508 + 1.55171\omega_j - 0.15613\omega_j^2 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-5.000000000e+00	Mix	-	5.000000000e+00
$T_{\text{crit},1}$	K	2.993000000e+02	$T_{\text{crit},2}$	K	7.250000000e+02
$p_{\text{crit},1}$	Pa	4.858000000e+06	$p_{\text{crit},2}$	Pa	1.980000000e+06
ω_1	-	2.670000000e-01	ω_2	-	5.720000000e-01

Par.	Unit	Value	Par.	Unit	Value
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.500000000e-01	m	-	-1.300000000e-02
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 253.15K $\leq T \leq$ 368.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa $\rightarrow$ 3.00E+03
- Temperature, absolute, in K $\rightarrow$ 0.01
- Concentration / Molar fraction, absolute, in $\mathrm{kg\,kg^{-1}}$ / $\mathrm{mol\,mol^{-1}}$ $\rightarrow$ 1.00E-03

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.47%.

6.21 R-32

6.21.1 R-125

6.21.1.1 Heil - ID 1

Sorbent:	R-125
Subtype:	
Refrigerant:	R-32
Equation:	Heil
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	8.780000000e+01	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.100000000e+01
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.1.2 NrtlFixedDg - ID 1

Sorbent:	R-125
Subtype:	
Refrigerant:	R-32
Equation:	NrtlFixedDg
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	2.375000000e+02	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-3.981000000e+02

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.1.3 TsubokaKatayama - ID 1

Sorbent:	R-125
Subtype:	
Refrigerant:	R-32
Equation:	TsubokaKatayama
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	-6.940000000e+01	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-1.010000000e+01
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.1.4 UniquacFixedDu - ID 1

Sorbent:	R-125
Subtype:	
Refrigerant:	R-32
Equation:	UniquacFixedDu
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	1.256000000e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	9.000000000e-01
r_1	-	1.430000000e+00	r_2	-	2.610000000e+00
q_1	-	1.420000000e+00	q_2	-	2.490000000e+00
z	-	1.000000000e+01			

Validity:
No data on validity available!

Visualization:

No experimental data exists. Thus, isotherm is not visualized!

6.21.1.5 WangChao - ID 1

Sorbent:	R-125
Subtype:	
Refrigerant:	R-32
Equation:	WangChao
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	7.870000000e+01	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	0.000000000e+00
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00
z	-	1.000000000e+01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.1.6 WilsonFixedDl - ID 1

Sorbent:	R-125
Subtype:	
Refrigerant:	R-32
Equation:	WilsonFixedDl
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2 \left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} {}^{v_2}/_{v_1} \exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} {}^{v_1}/_{v_2} \exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.907000000e+02	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	4.000000000e-01
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.2 Lubricant BAB15

6.21.2.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB15
Refrigerant:	R-32
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.512550000e+02	$T_{\mathrm{crit},2}$	K	7.633500000e+02
$p_{\mathrm{crit},1}$	Pa	5.782000000e+06	$p_{\mathrm{crit},2}$	Pa	1.199000000e+06
ω_1	-	2.768000000e-01	ω_2	-	7.160750000e-01
$\kappa_{1,1}$	-	-4.990000000e-02	$\kappa_{1,2}$	-	-1.331000000e-01
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.339000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.96%.

6.21.3 Lubricant BAB32

6.21.3.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	BAB32
Refrigerant:	R-32
Equation:	MixingRule
ID:	1
Reference:	Takigawa, Katsuya; Sandler, Stanley I.; Yokozeki, Akimichi (2002): Solubility and viscosity of refrigerant/lubricant mixtures. Hydrofluorocarbon/alkylbenzene systems. In: International Journal of Refrigeration 25 (8), S. 1014–1024. DOI: 10.1016/S0140-7007(02)00025-7.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b) + b\,(v-b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1 b_1 + z_2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1-k_{12}) && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= 0.45724\frac{(RT_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.07780R\frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \left(1+\kappa_j\left(1-\sqrt{(T/T_{\text{crit},j})}\right)\right)^2 && \text{, and}\\
\kappa_j &= \kappa_{0,j} + \kappa_{1,j}\left(1+\sqrt{(T/T_{\text{crit},j})}\right)(0.7 - T/T_{\text{crit},j}) && \text{, and}\\
\kappa_{0,j} &= 0.378893 + 1.4897153\omega_j - 0.17131848\omega_j^2 + 0.0196554\omega_j^3 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	2.000000000e+01	Mix	-	-5.000000000e+00

Par.	Unit	Value	Par.	Unit	Value
$T_{\mathrm{crit},1}$	K	3.512550000e+02	$T_{\mathrm{crit},2}$	K	7.728900000e+02
$p_{\mathrm{crit},1}$	Pa	5.782000000e+06	$p_{\mathrm{crit},2}$	Pa	1.138000000e+06
ω_1	-	2.768000000e-01	ω_2	-	6.947280000e-01
$\kappa_{1,1}$	-	-4.990000000e-02	$\kappa_{1,2}$	-	-9.860000000e-02
$\beta_{0,1}$	-	0.000000000e+00	$\beta_{0,2}$	-	0.000000000e+00
$\beta_{1,1}$	-	0.000000000e+00	$\beta_{1,2}$	-	0.000000000e+00
$\beta_{2,1}$	-	0.000000000e+00	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	0.000000000e+00	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	1.457000000e-01	m	-	0.000000000e+00
l_{12}	-	0.000000000e+00	l_{21}	-	0.000000000e+00
t	-	0.000000000e+00			

Validity:
Equation is approximately valid for 313.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table
- Temperature, absolute, in K $\rightarrow$ 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 8.37%.

6.21.4 Lubricant HAB32

6.21.4.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	HAB32
Refrigerant:	R-32
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.512600000e+02	$T_{\mathrm{crit},2}$	K	7.580000000e+02
$p_{\mathrm{crit},1}$	Pa	5.782000000e+06	$p_{\mathrm{crit},2}$	Pa	1.073000000e+06
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001900000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.833300000e-01	$\beta_{1,2}$	-	1.115000000e+00
$\beta_{2,1}$	-	-7.538000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	6.730000000e-03	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	-1.536000000e-01
l_{12}	-	1.276000000e-01	l_{21}	-	1.422000000e-01
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.5 Lubricant PEB6

6.21.5.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB6
Refrigerant:	R-32
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	7.770000000e+00	w_0^*	K	6.800000000e+02
w_1	K	-2.090000000e+02			

Validity:
Equation is approximately valid for $323.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 49.56%.

6.21.6 Lubricant PEB8

6.21.6.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-32
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	1.158000000e+01	w_0^*	K	7.750000000e+02
w_1	K	-1.770000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 41.26%.

6.21.6.2 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	PEB8
Refrigerant:	R-32
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\text{mol}\,\text{m}^{-3}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\text{crit},j})^2}{p_{\text{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\text{crit},j}}{p_{\text{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\text{crit},j}}/_{T} - {}^{T}/_{T_{\text{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\text{crit},1}$	K	3.512600000e+02	$T_{\text{crit},2}$	K	7.930000000e+02

Par.	Unit	Value	Par.	Unit	Value
$p_{\mathrm{crit},1}$	Pa	5.782000000e+06	$p_{\mathrm{crit},2}$	Pa	7.720000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001900000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.833300000e-01	$\beta_{1,2}$	-	9.410000000e-01
$\beta_{2,1}$	-	-7.538000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	6.730000000e-03	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	1.210000000e-02
l_{12}	-	2.005800000e+01	l_{21}	-	6.980000000e-02
t	-	-7.820000000e+01			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.7 Lubricant PEC9

6.21.7.1 FloryHuggins - ID 1

Sorbent:	lubricant
Subtype:	PEC9
Refrigerant:	R-32
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (2000): Solubility of HFCs in Pentaerythritol Tetraalkyl Esters. In: J. Chem. Eng. Data 45 (1), S. 97–103. DOI: 10.1021/je990171n.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	1.493000000e+01	w_0^*	K	8.390000000e+02
w_1	K	-1.580000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 39.22%.

6.21.8 Lubricant POE

6.21.8.1 Heil - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-32
Equation:	Heil
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/(993.89-0.75658*(T-273.15))*0.7 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= x_2^2\left(\tau_{12}\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}\right)^2+\tau_{12}\frac{\Lambda_{12}}{\left(x_1\Lambda_{12}+x_2\right)^2}\right) && \text{, and}\\
\Delta\Lambda_{12} &= {}^{v_2}/_{v_1}\exp\left(-\tau_{12}\right) && \text{, and}\\
\Delta\Lambda_{21} &= {}^{v_1}/_{v_2}\exp\left(-\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\lambda_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\lambda_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.204500000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	6.706600000e+03
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1730 Pa for p < 3.45 bar | 17300 Pa for p < 34.5 bar
- Temperature, absolute, in K → 0.21
- Concentration / Molar fraction, relative, in % → 4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.23%.

6.21.8.2 NrtlFixedDg - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-32
Equation:	NrtlFixedDg
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	5.000000000e-01	α_{21}	-	5.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-2.852100000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	2.000000000e+04

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1730 Pa for p < 3.45 bar | 17300 Pa for p < 34.5 bar
- Temperature, absolute, in K → 0.21
- Concentration / Molar fraction, relative, in % → 4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.43%.

6.21.8.3 TsubokaKatayama - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-32
Equation:	TsubokaKatayama
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \ln\left(x_1+x_2\rho_{21}\right)-x_2\left(\frac{\rho_{21}}{x_1+x_2\rho_{21}}-\frac{\rho_{12}}{x_1\rho_{12}+x_2}\right) && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\Delta\lambda_{12}/RT\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\Delta\lambda_{21}/RT\right) && \text{, and}\\
\rho_{12} &= v_1/v_2 && \text{, and}\\
\rho_{21} &= v_2/v_1 && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	1.143900000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	-1.505720000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1730 Pa for p < 3.45 bar | 17300 Pa for p < 34.5 bar
- Temperature, absolute, in K → 0.21
- Concentration / Molar fraction, relative, in % → 4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 24.64%.

6.21.8.4 UniquacFixedDu - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-32
Equation:	UniquacFixedDu
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-2.000000000e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	2.000000000e+04
r_1	-	1.430000000e+00	r_2	-	2.940000000e+01
q_1	-	1.420000000e+00	q_2	-	2.436000000e+01
z	-	1.000000000e+01			

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1730 Pa for p < 3.45 bar | 17300 Pa for p < 34.5 bar
- Temperature, absolute, in K → 0.21
- Concentration / Molar fraction, relative, in % → 4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 31.92%.

6.21.8.5 WangChao - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-32
Equation:	WangChao
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state, for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{21}x_2\right)+x_2\left(\frac{\Lambda_{21}}{x_1+\Lambda_{21}x_2}-\frac{\Lambda_{12}}{x_1\Lambda_{12}+x_2}\right)+\Phi\right) && \text{, and}\\
\Phi &= \frac{1}{RT}\frac{z}{2}\left(x_{21}^2\Delta\lambda_{21}+x_2x_{22}\frac{x_{12}}{x_1}\Delta\lambda_{12}\right) && \text{, and}\\
x_{11} &= \left(1+{}^{x_2}/_{x_1}\exp\left(-{}^{\Delta\lambda_{21}}/_{RT}\right)\right)^{-1} && \text{, and}\\
x_{22} &= \left(1+{}^{x_1}/_{x_2}\exp\left(-{}^{\Delta\lambda_{12}}/_{RT}\right)\right)^{-1} && \text{, and}\\
\Lambda_{12} &= \rho_{21}\exp\left(-\frac{\Delta\lambda_{12}}{RT}\right) && \text{, and}\\
\Lambda_{21} &= \rho_{12}\exp\left(-\frac{\Delta\lambda_{21}}{RT}\right) && \text{, and}\\
\rho_{12} &= {}^{v_1}/_{v_2} && \text{, and}\\
\rho_{21} &= {}^{v_2}/_{v_1} && \text{, and}\\
x_{12} &= 1-x_{22} && \text{, and}\\
x_{21} &= 1-x_{11} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
$\Delta\lambda_{12}$	$J\,mol^{-1}$	2.084500000e+03	$\Delta\lambda_{21}$	$J\,mol^{-1}$	1.577441000e+05
v_1	$m^3\,mol^{-1}$	1.000000000e+00	v_2	$m^3\,mol^{-1}$	1.000000000e+00
z	-	1.000000000e+01			

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1730 Pa for p < 3.45 bar | 17300 Pa for p < 34.5 bar
- Temperature, absolute, in K → 0.21

- Concentration / Molar fraction, relative, in % → 4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 17.75%.

6.21.8.6 WilsonFixedDl - ID 1

Sorbent:	lubricant
Subtype:	POE
Refrigerant:	R-32
Equation:	WilsonFixedDl
ID:	1
Reference:	Burton, C.; Jacobi, A. M.; Mehendale, S. S. (1999): Vapor-liquid equilibrium for R-32 and R-410A mixed with a polyol ester. Non-ideality and local composition modeling. In: International Journal of Refrigeration 22 (6), S. 458–471. DOI: 10.1016/S0140-7007(99)00012-2.
Comment:	See original literature: Use low-level interface to input molar volumes of both components, which are calculated by propper equations of state (i.e., v_POE = 1/(993.89-0.75658*(T-273.15))*0.7 in m3/mol), for calculations.

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda_{12}^* = 0 \\ \Lambda_{12}^* & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda_{21}^* = 0 \\ \Lambda_{21}^* & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ_{12}^*	-	0.000000000e+00	Λ_{21}^*	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	2.650400000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	2.000000000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00	v_2	$\mathrm{m^3\,mol^{-1}}$	1.000000000e+00

Validity:
No data on validity available!

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1
- Special refrigerant functions as described by comment and CoolProp

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Pressure, absolute, in Pa → 1730 Pa for p < 3.45 bar | 17300 Pa for p < 34.5 bar
- Temperature, absolute, in K → 0.21
- Concentration / Molar fraction, relative, in % → 4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.35%.

6.21.9 Lubricant POE32

6.21.9.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE32
Refrigerant:	R-32
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.512600000e+02	$T_{\mathrm{crit},2}$	K	8.640000000e+02
$p_{\mathrm{crit},1}$	Pa	5.782000000e+06	$p_{\mathrm{crit},2}$	Pa	8.740000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001900000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.833300000e-01	$\beta_{1,2}$	-	9.130000000e-01
$\beta_{2,1}$	-	-7.538000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	6.730000000e-03	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	0.000000000e+00
l_{12}	-	6.460000000e-02	l_{21}	-	2.660000000e-02
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.10 Lubricant POE68

6.21.10.1 MixingRule - ID 1

Sorbent:	lubricant
Subtype:	POE68
Refrigerant:	R-32
Equation:	MixingRule
ID:	1
Reference:	Yokozeki, A. (2001): Solubility of Refrigerant in Various Lubricants. In: International Journal of Thermophysics 22 (4), S. 1057–1071. DOI: 10.1023/A:1010695705260.
Comment:	None

Equation and parameters:
Vapor pressure p_{sat} in Pa is calculated depending on temperature T in K and molar volume v in $\mathrm{mol\,m^{-3}}$ by using cubic equation of state. For this purpose, molar volumes of liquid and vapor phase are changed iteratively until fugacity coefficients of vapor and liquid phase are equal. Cubic equation of state and mixing rules are given by:

$$
\begin{aligned}
p &= R\frac{T}{v-b} - \frac{a}{v\,(v+b)} && \text{, and}\\
a &= z_1^2 a_1 + 2 z_1 z_2 a_{12} + 2_2^2 a_2 && \text{, and}\\
b &= z_1^2 b_1 + 2 z_1 z_2 b_{12} + 2_2^2 b_2 && \text{, and}\\
a_{12} &= (a_1 a_2)^{0.5}\,(1 + {}^{t}/_{T})\,(1 - k_{12}) && \text{, and}\\
b_{12} &= \frac{b_1 + b_2}{2}\,(1 - m) && \text{, and}\\
k_{12} &= \frac{l_{12} l_{21}\,(z_1 + z_2)}{l_{21} z_1 + l_{12} z_2} && \text{, and}\\
z_j &= x_j \text{ or } y_j \text{ depending on phase} && \text{, and}\\
a_j &= \frac{1}{9\,(2^{1/3} - 1)}\frac{(R T_{\mathrm{crit},j})^2}{p_{\mathrm{crit},j}}\alpha_j && \text{, and}\\
b_j &= 0.08664 R \frac{T_{\mathrm{crit},j}}{p_{\mathrm{crit},j}} && \text{, and}\\
\alpha_j &= \beta_{0,j} + \sum_{i=1}^{3} \beta_{i,j}\theta_j^i && \text{, and}\\
\theta_j &= {}^{T_{\mathrm{crit},j}}/_{T} - {}^{T}/_{T_{\mathrm{crit},j}} && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
EoS	-	-1.000000000e+01	Mix	-	1.000000000e+01
$T_{\mathrm{crit},1}$	K	3.512600000e+02	$T_{\mathrm{crit},2}$	K	7.460000000e+02
$p_{\mathrm{crit},1}$	Pa	5.782000000e+06	$p_{\mathrm{crit},2}$	Pa	6.820000000e+05
ω_1	-	0.000000000e+00	ω_2	-	0.000000000e+00
$\kappa_{1,1}$	-	0.000000000e+00	$\kappa_{1,2}$	-	0.000000000e+00
$\beta_{0,1}$	-	1.001900000e+00	$\beta_{0,2}$	-	1.000000000e+00
$\beta_{1,1}$	-	4.833300000e-01	$\beta_{1,2}$	-	1.249000000e+00
$\beta_{2,1}$	-	-7.538000000e-02	$\beta_{2,2}$	-	0.000000000e+00
$\beta_{3,1}$	-	6.730000000e-03	$\beta_{3,2}$	-	0.000000000e+00
k_{12}	-	0.000000000e+00	m	-	1.280000000e-02
l_{12}	-	8.710000000e-02	l_{21}	-	1.380000000e-02
t	-	0.000000000e+00			

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.21.11 Pentaerythritol tetrapentanoate ester

6.21.11.1 FloryHuggins - ID 1

Sorbent:	pentaerythritol tetrapentanoate ester
Subtype:	
Refrigerant:	R-32
Equation:	FloryHuggins
ID:	1
Reference:	Wahlström, Åsa; Vamling, Lennart (1999): Solubility of HFC32, HFC125, HFC134a, HFC143a, and HFC152a in a Pentaerythritol Tetrapentanoate Ester. In: J. Chem. Eng. Data 44 (4), S. 823–828. DOI: 10.1021/je980235e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(\ln\left(1-\left(1-{}^1\!/_r\right)\Phi_2\right)+\left(1-{}^1\!/_r\right)\Phi_2+\Gamma\Phi_2^2\right) && \text{, and} \\
\Phi_2 &= r\frac{x_2}{x_1+rx_2} && \text{, and} \\
\Gamma &= {}^{w_0^*}\!/_T\left(1+{}^{w_1}\!/_T\right) && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
r	-	9.780000000e+00	w_0^*	K	8.060000000e+02
w_1	K	-1.970000000e+02			

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 363.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 41.17%.

6.22 TFE

6.22.1 Nmp

6.22.1.1 Antoine - ID 1

Sorbent:	NMP
Subtype:	
Refrigerant:	TFE
Equation:	Antoine
ID:	1
Reference:	Shiming, Xu; Yanli, Liu; Lisong, Zhang (2001): Performance research of self regenerated absorption heat transformer cycle using TFE-NMP as working fluids. In: International Journal of Refrigeration 24 (6), S. 510–518. DOI: 10.1016/S0140-7007(00)00071-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	6.819900000e+00	B_0	K	-2.076890000e+00
A_1	-	5.752530000e-03	B_1	K	1.537680000e-03
A_2	-	1.100930000e-04	B_2	K	2.581010000e-05
A_3	-	-1.848890000e-06	B_3	K	7.325510000e-07
A_4	-	7.875230000e-09	B_4	K	-7.196460000e-06

Validity:
No data on validity available!

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.23 THF

6.23.1 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.23.1.1 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	THF
Equation:	UniquacFixedDu
ID:	1
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	2.353400000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-1.298800000e+03
r_1	-	2.941000000e+00	r_2	-	9.890000000e+00
q_1	-	2.720000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_Antoine - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 1.67%.

6.23.2 Ionic liquid [MMIM]+[(CH3)2PO4]-

6.23.2.1 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3)2PO4]-
Refrigerant:	THF
Equation:	UniquacFixedDu
ID:	1
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	6.594000000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-1.331800000e+03
r_1	-	2.941000000e+00	r_2	-	7.162000000e+00
q_1	-	2.720000000e+00	q_2	-	5.844000000e+00
z	-	1.000000000e+01			

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_Antoine - ID 1
- Saturated liquid density: NoSaturatedLiquidDensity - ID 1

The uncertainity of the experimental data is:

- Data source $\rightarrow$ Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 15.18%.

6.24 Toluene

6.24.1 Inoic liquid [C2H5NH]+[C2H5OC2H4OSO3]-

6.24.1.1 NrtlTemperatureDg - ID 1

Sorbent:	inoic liquid
Subtype:	[C2H5NH]+[C2H5OC2H4OSO3]-
Refrigerant:	Toluene
Equation:	NrtlTemperatureDg
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
\Delta g_{12} &= a_{12}+b_{12}T && \text{, and}\\
\Delta g_{21} &= a_{21}+b_{21}T && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.000000000e-01	α_{21}	-	2.000000000e-01
a_{12}	$\mathrm{J\,mol^{-1}}$	8.690600000e+03	a_{21}	$\mathrm{J\,mol^{-1}}$	1.291000000e+02
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.03%.

6.24.2 Ionic liquid [C2H5NH]+[C2H5OC2H4OSO3]-

6.24.2.1 UniquacTemperatureDu - ID 1

Sorbent:	ionic liquid
Subtype:	[C2H5NH]+[C2H5OC2H4OSO3]-
Refrigerant:	Toluene
Equation:	UniquacTemperatureDu
ID:	1
Reference:	Kato, Ryo; Krummen, Michael; Gmehling, Jürgen (2004): Measurement and correlation of vapor–liquid equilibria and excess enthalpies of binary systems containing ionic liquids and hydrocarbons. In: Fluid Phase Equilibria 224 (1), S. 47–54. DOI: 10.1016/j.fluid.2004.05.009.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
\Delta u_{ij} &= a_{ij} + b_{ij} T && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_{12}	$\mathrm{J\,mol^{-1}}$	2.095000000e+02	a_{21}	$\mathrm{J\,mol^{-1}}$	1.627700000e+03
b_{12}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00	b_{21}	$\mathrm{J\,mol^{-1}\,K^{-1}}$	0.000000000e+00
r_1	-	8.780000000e+00	r_2	-	2.968000000e+00
q_1	-	6.960000000e+00	q_2	-	3.923000000e+00
z	-	6.000000000e+00			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.25 Water

6.25.1 Libr

6.25.1.1 Duehring - ID 1

Sorbent:	LiBr
Subtype:	
Refrigerant:	Water
Equation:	Duehring
ID:	1
Reference:	Handbook AF. American society of heating, refrigerating and air-conditioning engineers. Inc: Atlanta, GA, USA. 2009
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$
\begin{aligned}
p &= {}^{1}\!/_{r} 10^{C+\frac{D}{T_{\mathrm{ref}}}+\frac{E}{T_{\mathrm{ref}}^2}} && \text{, and} \\
T_{\mathrm{ref}} &= q + \frac{(nT+m-B)}{A} && \text{, and} \\
A &= \sum_{i=0}^{3} a_0 X_{\mathrm{cor}}^i && \text{, and} \\
B &= \sum_{i=0}^{3} b_0 X_{\mathrm{cor}}^i && \text{, and} \\
X_{\mathrm{cor}} &= 100X && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_0	-	-2.007550000e+00	b_0	-	3.211280000e+02
a_1	-	1.697600000e-01	b_1	-	-1.932200000e+01
a_2	-	-3.133362000e-03	b_2	-	3.743800000e-01
a_3	-	1.976680000e-05	b_3	-	-2.063700000e-03
C	-	6.211470000e+00	D	K	-2.886373000e+03
m	-	3.200000000e+01	E	K^2	-3.372694600e+05
n	-	1.800000000e+00	q	-	4.597200000e+02
r	Pa^{-1}	1.450000000e-04			

Validity:

Equation is approximately valid for 277.15K $\leq T \leq$ 450.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.25.2 Libr/ch3cook ratio 2/1

6.25.2.1 Antoine - ID 1

Sorbent:	LiBr/CH3COOK
Subtype:	ratio 2/1
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Lucas, Antonio de; Donate, Marina; Rodríguez, Juan F. (2006): Vapour pressures, densities, and viscosities of the (water+lithium bromide+potassium acetate) system and (water+lithium bromide+sodium lactate) system. In: The Journal of Chemical Thermodynamics 38 (2), S. 123–129. DOI: 10.1016/j.jct.2005.04.007.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	6.950000000e+00	B_0	K	-1.640000000e+00
A_1	-	-1.330000000e-02	B_1	K	1.830000000e-03
A_2	-	-9.020000000e-06	B_2	K	-2.520000000e-06
A_3	-	0.000000000e+00	B_3	K	0.000000000e+00
A_4	-	0.000000000e+00	B_4	K	0.000000000e+00

Validity:
Equation is approximately valid for 293.15K $\leq T \leq$ 333.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa → 100
- Temperature, absolute, in K → 0.01
- Concentration / Molar fraction, absolute, in $\mathrm{kg\,kg^{-1}}$ / $\mathrm{mol\,mol^{-1}}$ → 1.00E-07

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.51%.

6.25.3 Libr/h2n(ch2)2oh ratio 3/5/1

6.25.3.1 Antoine - ID 1

Sorbent:	LiBr/H2N(CH2)2OH
Subtype:	ratio 3/5/1
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Kim, Jin-Soo; Park, Young; Lee, Huen (1996): Densities and Viscosities of the Water + Lithium Bromide + Ethanolamine System. In: J. Chem. Eng. Data 41 (4), S. 678–680. DOI: 10.1021/je9503259.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	1.227900000e+02	B_0	K	-3.833350000e+01
A_1	-	-7.188120000e+00	B_1	K	2.259820000e+00
A_2	-	1.658530000e-01	B_2	K	-5.165830000e-02
A_3	-	-1.688300000e-03	B_3	K	5.197140000e-04
A_4	-	6.412610000e-06	B_4	K	-1.956930000e-06

Validity:
Equation is approximately valid for 318.15K $\leq T \leq$ 418.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Temperature, relative, in % → 0.4

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 14.58%.

6.25.4 Libr/ho(ch2)3oh ratio 3/5/1

6.25.4.1 Antoine - ID 1

Sorbent:	LiBr/HO(CH2)3OH
Subtype:	ratio 3/5/1
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Park, Young; Kim, Jin-Soo; Lee, Huen (1997): Physical properties of the lithium bromide + 1,3-propanediol + water system. In: International Journal of Refrigeration 20 (5), S. 319–325. DOI: 10.1016/S0140-7007(97)00021-2.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	-2.429190000e+02	B_0	K	8.218560000e+01
A_1	-	1.662950000e+01	B_1	K	-5.585050000e+00
A_2	-	-4.093380000e-01	B_2	K	1.376500000e-01
A_3	-	4.420600000e-03	B_3	K	-1.489240000e-03
A_4	-	-1.767920000e-05	B_4	K	5.958560000e-06

Validity:
Equation is approximately valid for 325.15K $\leq T \leq$ 395.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Temperature, absolute, in K → 0.2

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 25.64%.

6.25.5 Libr/lii-oh(ch2)3oh massRatio 174/57/15

6.25.5.1 Antoine - ID 1

Sorbent:	LiBr/LiI-OH(CH2)3OH
Subtype:	massRatio 174/57/15
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Kim, Jin-Soo; Lee, Huen (2001): Solubilities, Vapor Pressures, Densities, and Viscosities of the LiBr + LiI + HO(CH 2) 3 OH + H 2 O System. In: J. Chem. Eng. Data 46 (1), S. 79–83. DOI: 10.1021/je000154u.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	9.537943000e+00	B_0	K	-2.181261000e+00
A_1	-	-1.303482000e-01	B_1	K	2.793675000e-02
A_2	-	1.919265000e-03	B_2	K	-3.596105000e-04
A_3	-	-7.926247000e-06	B_3	K	2.400981000e-08
A_4	-	0.000000000e+00	B_4	K	0.000000000e+00

Validity:
Equation is approximately valid for 339.15K $\leq T \leq$ 444.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.5%.

6.25.6 Libr/lino3 massRatio 348/69

6.25.6.1 Antoine - ID 1

Sorbent:	LiBr/LiNO3
Subtype:	massRatio 348/69
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Iyoki, Shigeki; Yamanaka, Ryousuke; Uemura, Tadashi (1993): Physical and thermal properties of the water-lithium bromide-lithium nitrate system. In: International Journal of Refrigeration 16 (3), S. 191–200. DOI: 10.1016/0140-7007(93)90048-D.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+00
A_0	-	3.559780000e+00	B_0	K	-6.695280000e-01
A_1	-	6.304910000e-01	B_1	K	-1.020250000e-01
A_2	-	-2.171200000e-02	B_2	K	3.552500000e-03
A_3	-	3.144770000e-04	B_3	K	-5.127410000e-05
A_4	-	-1.628200000e-06	B_4	K	2.436950000e-07

Validity:
Equation is approximately valid for $320.15\mathrm{K} \leq T \leq 442.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 0.45%.

6.25.7 Libr/lino3/lii/licl ratio 5/1/1/2

6.25.7.1 Antoine - ID 1

Sorbent:	LiBr/LiNO3/LiI/LiCl
Subtype:	ratio 5/1/1/2
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Koo, Kee-Kahb; Lee, Hyung-Rae; Jeong, Siyoung; Oh, Young-Sam; Park, Dal-Ryung; Baek, Young-Soon (1998): Solubilities, Vapor Pressures, Densities, and Viscosities of the (Water + Lithium Bromide + Lithium Iodide + Lithium Chloride) System. In: J. Chem. Eng. Data 43 (5), S. 722–725. DOI: 10.1021/je980063l.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	-1.276429000e+03	B_0	K	4.374120000e+02
A_1	-	8.764646000e+01	B_1	K	-3.008232000e+01
A_2	-	-2.233375000e+00	B_2	K	7.690697000e-01
A_3	-	2.517102000e-02	B_3	K	-8.697553000e-03
A_4	-	-1.058556000e-04	B_4	K	3.669313000e-05

Validity:
Equation is approximately valid for $330.15\mathrm{K} \leq T \leq 410.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.923607258526586e+189%.

6.25.8 Libr/ch3ch(oh)coona ratio 2/1

6.25.8.1 Antoine - ID 1

Sorbent:	Libr/CH3CH(OH)COONa
Subtype:	ratio 2/1
Refrigerant:	Water
Equation:	Antoine
ID:	1
Reference:	Lucas, Antonio de; Donate, Marina; Rodríguez, Juan F. (2006): Vapour pressures, densities, and viscosities of the (water+lithium bromide+potassium acetate) system and (water+lithium bromide+sodium lactate) system. In: The Journal of Chemical Thermodynamics 38 (2), S. 123–129. DOI: 10.1016/j.jct.2005.04.007.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$p/d = 10^{\sum_{i=0}^{4}\left(A_i + \frac{1000 B_i}{T-c}\right)(100X)^i}$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
c	K	4.315000000e+01	d	Pa	1.000000000e+03
A_0	-	6.770000000e+00	B_0	K	-1.640000000e+00
A_1	-	5.110000000e-03	B_1	K	5.260000000e-04
A_2	-	-2.200000000e-04	B_2	K	-5.790000000e-07
A_3	-	0.000000000e+00	B_3	K	0.000000000e+00
A_4	-	0.000000000e+00	B_4	K	0.000000000e+00

Validity:
Equation is approximately valid for $298.15\mathrm{K} \leq T \leq 333.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

- Pressure, absolute, in Pa → 100
- Temperature, absolute, in K → 0.01
- Concentration / Molar fraction, absolute, in kg kg^{-1} / mol mol^{-1} → 1.00E-07

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 3.31%.

6.25.9 Naoh-koh-csoh

6.25.9.1 Duehring - ID 1

Sorbent:	NaOH-KOH-CsOH
Subtype:	
Refrigerant:	Water
Equation:	Duehring
ID:	1
Reference:	Herold, Keith E.; Radermacher, Reinhard; Howe, Lawrence; Erickson, Donald C. (1991): Development of an absorption heat pump water heater using an aqueous ternary hydroxide working fluid. In: International Journal of Refrigeration 14 (3), S. 156–167. DOI: 10.1016/0140-7007(91)90070-W.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on concentration X in $\mathrm{kg\,kg^{-1}}$ and temperature T in K by:

$$
\begin{aligned}
p &= {}^{1}\!/_{r} 10^{C+\frac{D}{T_{\mathrm{ref}}}+\frac{E}{T_{\mathrm{ref}}^2}} && \text{, and} \\
T_{\mathrm{ref}} &= q + \frac{(nT+m-B)}{A} && \text{, and} \\
A &= \sum_{i=0}^{3} a_0 X_{\mathrm{cor}}^i && \text{, and} \\
B &= \sum_{i=0}^{3} b_0 X_{\mathrm{cor}}^i && \text{, and} \\
X_{\mathrm{cor}} &= 100X && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
a_0	-	6.164233723e+00	b_0	-	-5.380343163e+01
a_1	-	-2.746665026e-01	b_1	-	5.004848451e+00
a_2	-	4.916023734e-03	b_2	-	-1.228273028e-01
a_3	-	-2.859098259e-05	b_3	-	1.096142341e-03
C	-	6.427154896e+00	D	K	-1.208919437e+03
m	-	0.000000000e+00	E	$\mathrm{K^2}$	-1.661599630e+05
n	-	1.000000000e+00	q	-	2.731500000e+02
r	$\mathrm{Pa^{-1}}$	1.000000000e-03			

Validity:
Equation is approximately valid for 282.15K $\leq T \leq$ 443.15K.

Visualization:
No experimental data exists. Thus, isotherm is not visualized!

6.25.10 Ionic liquid [BMIM]+[(CF3SO2)2N]-

6.25.10.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	NrtlFixedDg
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	3.000000000e-01	α_{21}	-	3.000000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	1.943551680e+04	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-3.489832560e+02

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 28.12%.

6.25.10.2 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	UniquacFixedDu
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	3.453055200e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	3.057123280e+03
r_1	-	9.200000000e-01	r_2	-	1.116000000e+01
q_1	-	1.400000000e+00	q_2	-	1.020000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 28.46%.

6.25.10.3 UniquacFixedDu - ID 2

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	UniquacFixedDu
ID:	2
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-1.056836560e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	3.545856320e+03
r_1	-	9.200000000e-01	r_2	-	1.116000000e+01
q_1	-	1.400000000e+00	q_2	-	1.020000000e+01
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 4.35%.

6.25.10.4 WilsonFixedDl - ID 1

Sorbent:	ionic liquid
Subtype:	[BMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	WilsonFixedDl
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1 + \Lambda_{12} x_2\right) + x_2 \left(\frac{\Lambda_{12}}{x_1 + \Lambda_{12} x_2} - \frac{\Lambda_{21}}{x_2 + \Lambda_{21} x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12} = 0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21} = 0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	7.985164000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.673600000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.807000000e+01	v_2	$\mathrm{m^3\,mol^{-1}}$	2.917100000e+02

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 11.84%.

6.25.11 Ionic liquid [DEMA][OMs]

6.25.11.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[DEMA][OMs]
Refrigerant:	Water
Equation:	NrtlFixedDg
ID:	1
Reference:	Römich, Christiane; Merkel, Nina C.; Valbonesi, Alessandro; Schaber, Karlheinz; Sauer, Sven; Schubert, Thomas J. S. (2012): Thermodynamic Properties of Binary Mixtures of Water and Room-Temperature Ionic Liquids. Vapor Pressures, Heat Capacities, Densities, and Viscosities of Water + 1-Ethyl-3-methylimidazolium Acetate and Water + Diethylmethylammonium Methane Sulfonate. In: J. Chem. Eng. Data 57 (8), S. 2258–2264. DOI: 10.1021/je300132e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	7.086200000e-01	α_{21}	-	7.086200000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	-1.051400000e+03	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-5.039900000e+03

Validity:
Equation is approximately valid for 303.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Temperature, absolute, in K → 0.01

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 5.45%.

6.25.12 Ionic liquid [EMIM]+[(CF3SO2)2N]-

6.25.12.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	NrtlFixedDg
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and}\\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and}\\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and}\\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and}\\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and}\\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	2.800000000e-01	α_{21}	-	2.800000000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	1.291307920e+04	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-1.458375040e+03

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1

- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 17.31%.

6.25.12.2 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	UniquacFixedDu
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	6.721177600e+01	Δu_{21}	$\mathrm{J\,mol^{-1}}$	2.906499280e+03
r_1	-	9.200000000e-01	r_2	-	9.890000000e+00
q_1	-	1.400000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 19.54%.

6.25.12.3 UniquacFixedDu - ID 2

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	UniquacFixedDu
ID:	2
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-2.304170640e+02	Δu_{21}	$\mathrm{J\,mol^{-1}}$	3.309585840e+03
r_1	-	9.200000000e-01	r_2	-	9.890000000e+00
q_1	-	1.400000000e+00	q_2	-	8.780000000e+00
z	-	1.000000000e+01			

Validity:
Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 2.76%.

6.25.12.4 WilsonFixedDl - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM]+[(CF3SO2)2N]-
Refrigerant:	Water
Equation:	WilsonFixedDl
ID:	1
Reference:	Döker, Michael; Gmehling, Jürgen (2005): Measurement and prediction of vapor–liquid equilibria of ternary systems containing ionic liquids. In: Fluid Phase Equilibria 227 (2), S. 255–266. DOI: 10.1016/j.fluid.2004.11.010.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, molar volumes of both components (v_1 and v_2) in $\mathrm{m^3\,mol^{-1}}$, and vapor pressure $p_{\mathrm{sat},1}$ in Pa. If molar volumes less than zero are used as function arguements, constant molar volumes given by parameter record are used. Equilibrium equation is given by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(-\ln\left(x_1+\Lambda_{12}x_2\right)+x_2\left(\frac{\Lambda_{12}}{x_1+\Lambda_{12}x_2}-\frac{\Lambda_{21}}{x_2+\Lambda_{21}x_1}\right)\right) && \text{, and} \\
\Lambda_{12} &= \begin{cases} v_2/v_1 \exp\left(-\Delta\lambda_{12}/RT\right) & \text{if } \Lambda^*_{12}=0 \\ \Lambda^*_{12} & \text{else} \end{cases} && \text{, and} \\
\Lambda_{21} &= \begin{cases} v_1/v_2 \exp\left(-\Delta\lambda_{21}/RT\right) & \text{if } \Lambda^*_{21}=0 \\ \Lambda^*_{21} & \text{else} \end{cases} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Λ^*_{12}	-	0.000000000e+00	Λ^*_{21}	-	0.000000000e+00
$\Delta\lambda_{12}$	$\mathrm{J\,mol^{-1}}$	7.363840000e+03	$\Delta\lambda_{21}$	$\mathrm{J\,mol^{-1}}$	1.673600000e+04
v_1	$\mathrm{m^3\,mol^{-1}}$	1.807000000e+01	v_2	$\mathrm{m^3\,mol^{-1}}$	2.445800000e+02

Validity:
Equation is approximately valid for $353.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 28.45%.

6.25.13 Ionic liquid [EMIM][OAc]

6.25.13.1 NrtlFixedDg - ID 1

Sorbent:	ionic liquid
Subtype:	[EMIM][OAc]
Refrigerant:	Water
Equation:	NrtlFixedDg
ID:	1
Reference:	Römich, Christiane; Merkel, Nina C.; Valbonesi, Alessandro; Schaber, Karlheinz; Sauer, Sven; Schubert, Thomas J. S. (2012): Thermodynamic Properties of Binary Mixtures of Water and Room-Temperature Ionic Liquids. Vapor Pressures, Heat Capacities, Densities, and Viscosities of Water + 1-Ethyl-3-methylimidazolium Acetate and Water + Diethylmethylammonium Methane Sulfonate. In: J. Chem. Eng. Data 57 (8), S. 2258–2264. DOI: 10.1021/je300132e.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and} \\
\gamma_1 &= \exp\left(x_2^2\left(\tau_{21}\left(\frac{G_{21}}{x_1+x_2G_{21}}\right)^2+\tau_{12}\frac{G_{12}}{(x_2+x_1G_{12})^2}\right)\right) && \text{, and} \\
G_{12} &= \exp\left(-\alpha_{12}\tau_{12}\right) && \text{, and} \\
G_{21} &= \exp\left(-\alpha_{21}\tau_{21}\right) && \text{, and} \\
\tau_{12} &= {}^{\Delta g_{12}}/_{RT} && \text{, and} \\
\tau_{21} &= {}^{\Delta g_{21}}/_{RT} && \text{, and} \\
x_2 &= 1-x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
α_{12}	-	1.024300000e-01	α_{21}	-	1.024300000e-01
Δg_{12}	$\mathrm{J\,mol^{-1}}$	2.893800000e+04	Δg_{21}	$\mathrm{J\,mol^{-1}}$	-2.569100000e+04

Validity:
Equation is approximately valid for $303.15\mathrm{K} \leq T \leq 353.15\mathrm{K}$.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table
- Temperature, absolute, in K → 0.01

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 6.74%.

6.25.14 Ionic liquid [MMIM]+[(CH3)2PO4]-

6.25.14.1 UniquacFixedDu - ID 1

Sorbent:	ionic liquid
Subtype:	[MMIM]+[(CH3)2PO4]-
Refrigerant:	Water
Equation:	UniquacFixedDu
ID:	1
Reference:	Kato, Ryo; Gmehling, Jürgen (2005): Measurement and correlation of vapor–liquid equilibria of binary systems containing the ionic liquids [EMIM][(CF3SO2)2N], [BMIM][(CF3SO2)2N], [MMIM][(CH3)2PO4] and oxygenated organic compounds respectively water. In: Fluid Phase Equilibria 231 (1), S. 38–43. DOI: 10.1016/j.fluid.2005.01.002.
Comment:	None

Equation and parameters:
Pressure p in Pa is calculated depending on molar fraction of refrigerant in the liquid phase x_1 in $\mathrm{mol\,mol^{-1}}$, temperature T in K, and vapor pressure $p_{\mathrm{sat},1}$ in Pa by:

$$
\begin{aligned}
p &= \gamma_1 x_1 p_{\mathrm{sat},1} && \text{, and}\\
\gamma_1 &= \exp\left(\ln\left({}^{\Phi_1}/_{x_1}\right) + q_1 {}^{z}/_{2} \ln\left({}^{\Theta_1}/_{\Phi_1}\right) + l_1 - {}^{\Phi_1}/_{x_2}\left(x_1 l_1 + x_2 l_2\right) + \Gamma\right) && \text{, and}\\
\Gamma &= -q_1 \ln\left(\Theta_1 + \Theta_2 \tau_{21}\right) + q_1 - q_1 \left(\frac{\Theta_1}{\Theta_1 + \Theta_2 \tau_{21}} + \frac{\Theta_2 \tau_{12}}{\Theta_1 \tau_{12} + \Theta_2}\right) && \text{, and}\\
\tau_{ij} &= \exp\left({}^{\Delta u_{ij}}/_{RT}\right) && \text{, and}\\
l_i &= {}^{z}/_{2}\left(r_i - q_i\right)\left(r_i - 1\right) && \text{, and}\\
\Theta_i &= \frac{q_i x_i}{\sum_{j=1}^{2} q_j x_j} && \text{, and}\\
\Phi_i &= \frac{r_i x_i}{\sum_{j=1}^{2} r_j x_j} && \text{, and}\\
x_2 &= 1 - x_1 && .
\end{aligned}
$$

The parameters of the equation are:

Par.	Unit	Value	Par.	Unit	Value
Δu_{12}	$\mathrm{J\,mol^{-1}}$	-2.949300000e+03	Δu_{21}	$\mathrm{J\,mol^{-1}}$	-3.130100000e+03
r_1	-	9.200000000e-01	r_2	-	7.162000000e+00
q_1	-	1.400000000e+00	q_2	-	5.844000000e+00
z	-	1.000000000e+01			

Validity:

Equation is approximately valid for 353.15K $\leq T \leq$ 353.15K.

Visualization:

To generate the figure, the following refrigerant functions were selected:

- Vapor pressure: VaporPressure_EoS1 - ID 1
- Saturated liquid density: SaturatedLiquidDensity_EoS1 - ID 1

The uncertainity of the experimental data is:

- Data source → Data was taken from table

The mean absolute percentage error (MAPE) between the experimental and calculated data results in 7.68%.