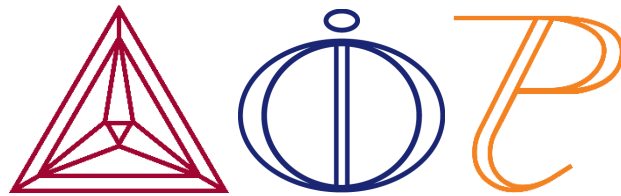




Release Notes:

Thermo-Calc Software Package

Version 2019a



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## Thermo-Calc Version 2019a

### Highlights

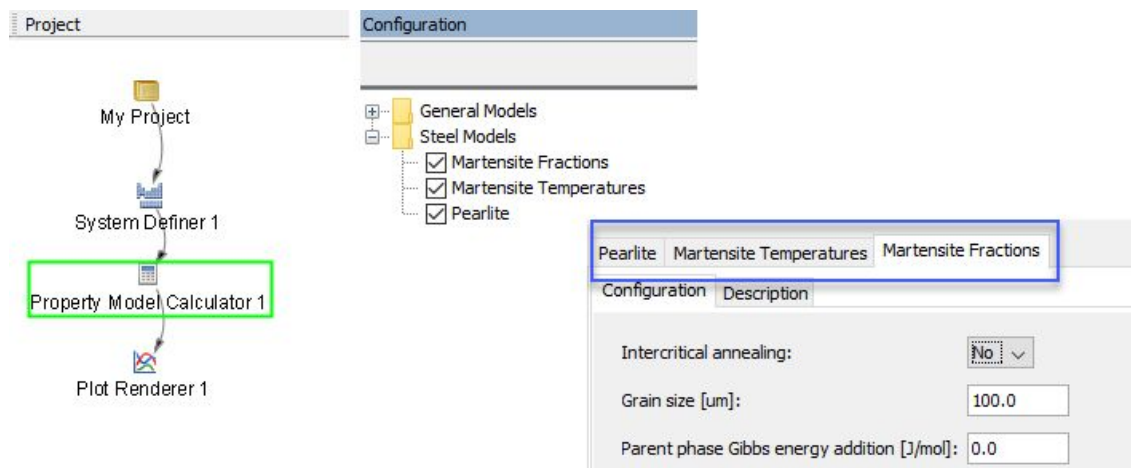
- ★ **Thermo-Calc:** New martensite and pearlite steel models available with the Property Model Calculator and the ability to save higher resolution JPG and PNG images. These steel models can also be used with the new version of TC-Python.
- ★ **Precipitation Module (TC-PRISMA):** You can now pause and resume precipitation calculations giving you more flexibility to adjust the parameters for lengthy simulations. There is also a new *General* growth rate model available in addition to the *Advanced* and *Simplified* models and two new axis variables (precipitate composition and number density distribution).
- ★ **Diffusion Module (DICTRA):** You can now solve single region diffusion problems using assessed molar volumes with new advanced homogenization commands.
- ★ **TC-Python:** Diffusion and property model calculations are now possible with this API, giving the API now the same functionality as Thermo-Calc Graphical Mode.
- ★ **Databases:** New thermodynamic and kinetic versions of the nickel-based, aluminum-based, and titanium-based alloys are available as well as updates to the magnesium-based and high entropy alloys database.

## Thermo-Calc

### New Steel Model Library: Martensite and Pearlite Models

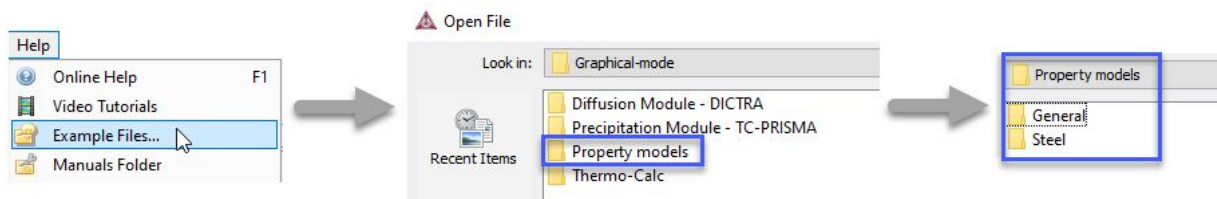
The Property Model Calculator includes three new steel models:

- The **Martensite Fractions Model** calculates the fraction of athermal martensite based on available driving force.
- The **Martensite Temperatures Model** calculates the martensite start temperature based on modeling of the transformation barrier.
- The **Pearlite Model** calculates the thermodynamics and kinetics of pearlite formation from austenite during isothermal heat treatment.



### Steel Model Examples

There are three new examples demonstrating these steel models. The examples are included in a new **Property models** folder available with your installation (in Thermo-Calc choose **Help>Example Files>Property models>Steel**).



Each example uses the Property Model Calculator plus a property model as indicated.

<b>Example</b>	<b>Description</b>	<b>Example file name</b>
Fe-Cr-C Martensite with Intercritical Annealing	The example uses two models to show how to calculate <i>martensite fractions</i> and <i>martensite temperatures</i> (martensite start, $M_s$ , and 90% transformation temperature $M_{90}$ ).	PM_Fe_01_Fe-Cr-C_martensite_intercritical_annealing

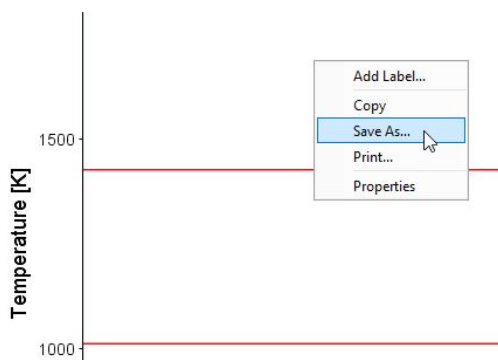
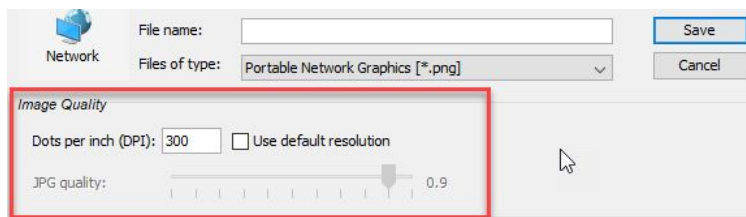
<i>Example</i>	<i>Description</i>	<i>Example file name</i>
Fe-Mn Martensite Morphologies	The example uses the <i>Martensite Temperatures</i> model to show the Ms temperatures of different types of martensites: lath, plate, and epsilon (hcp), compared with experimental epsilon Ms values.	PM_Fe_02_Fe-Mn_martensite_morphologies
Fe-C-Mn Pearlite	The example uses the <i>Pearlite</i> model to show how to calculate pearlite growth rate, lamellar spacing, and times of start (2% transformation) and finish (98% transformation) as functions of isothermal heat treating temperature in an Fe-0.69C-1.80Mn alloy (mass %).	PM_Fe_03_Fe-C-Mn_Pearlite

### Note about licensing for the steel model library

The *Steel models* (martensite and pearlite) are available for free to all users with licenses for TCFE9 and MOBFE4, and a valid maintenance and support subscription.

## Save High Resolution JPG and PNG Images

Save JPG and PNG images with higher image quality. You can now change the image quality for saving JPG and PNG images from the **Results** windows (both in Graphical and Console Mode). After you plot a diagram, right-click it and choose **Save As...** and then change the applicable settings under **Image Quality**.



Search the help for *Saving and Printing the Output* for details about this in both Console and Graphical Mode.

## Improvements and Bug Fixes

### Graphical Mode

#### Project file issues

- Saving and opening project files much faster than in previous releases.
- Fixed a bug that occurred with Binary Calculator project files that did not save the results.
- Fixed a bug in the System Definer where the user defined reference state of components was not saved correctly in the project file.
- Improved the error handling for project file conversion.
- If a project is saved with diffusion and/or precipitation results, these will be removed from the project when converting from earlier versions, i.e. versions 2018b and earlier.

#### Other issues

- Linux OS: Fixed the permissions for the property models directory (where the included or custom models are stored) so that only the user has write permission.
- Fixed a performance issue occurring with property grid calculations for the Equilibrium Calculator and Property Model Calculator. In previous versions, equilibrium calculations were attempted for grid points with a total composition larger than 100%.
- Fixed a bug with the System Definer where an exception was caused when you tried to add an element after running a precipitation calculation.
- Fixed two issues with u-fractions. U-fractions now work when using the Table Renderer and fixed another bug that occurred on the Plot Renderer that prevented settings from being updated correctly after changing a setting.
- Fixed a bug that occurred when using the Ternary template and plotting a phase diagram. Previously the automatic axis limits in the plot did not always match the Equilibrium Calculator axis limits (0-100 ternary diagram).

### Both Graphical and Console Mode

- Fixed loop issue in mapping for case when part of full phase diagram is calculated.
- Windows OS: Fixed an issue where empty plot windows would display on the screen after you resumed a session from sleep or if the screen was turned off.

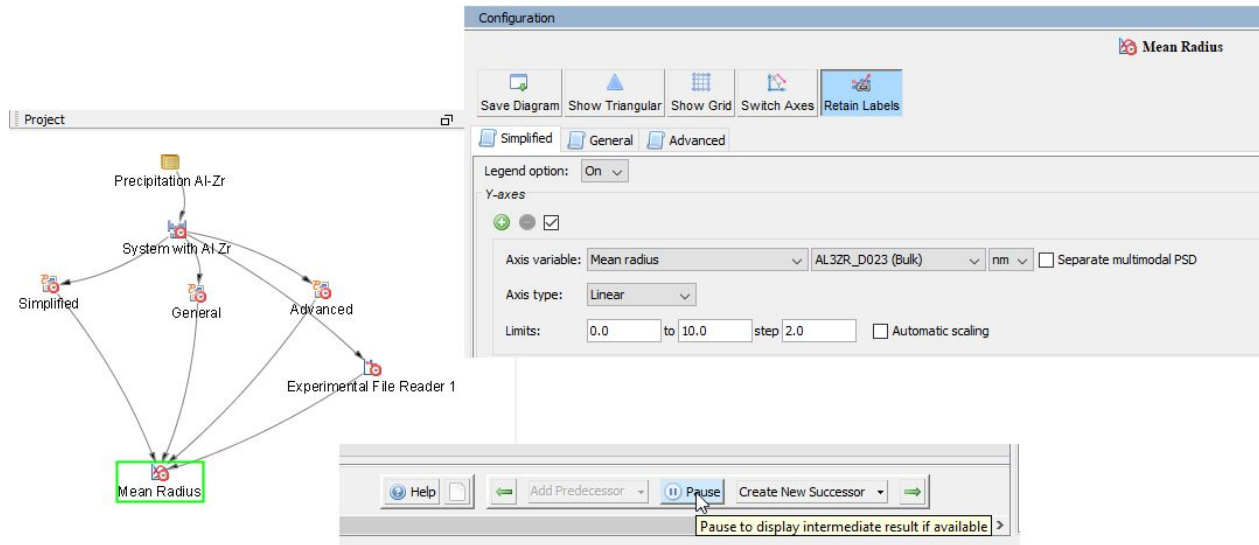
### Console Mode

- When you use the DUMP\_DIAGRAM command, you can now export images to JPG format.

## Precipitation Module (TC-PRISMA)

### Pause, Plot and Tabulate Results and then Continue a Simulation

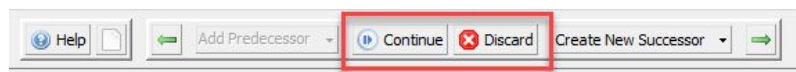
The ability to pause, make adjustments and then continue with a precipitation simulation is now possible. This allows you to visualize the results at various times in the calculation as well as add time at the end of a calculation if you decide more is needed. Click the **Precipitation Calculator** node to **Pause** the calculations.




The screenshot shows the Thermo-Calc interface. On the left, the Project window displays a flowchart with nodes: Precipitation Al-Zr, System with Al-Zr, Simplified, General, Advanced, and Experimental File Reader 1. The 'Mean Radius' node is highlighted with a red border. On the right, the Configuration window is open for the 'Mean Radius' node, showing options like 'Save Diagram', 'Show Triangular', 'Show Grid', 'Switch Axes', and 'Retain Labels'. The 'General' tab is selected, showing 'Legend option: On', 'Y-axes' checked, 'Axis variable: Mean radius', 'Axis type: Linear', and 'Limits: 0.0 to 10.0 step 2.0'. At the bottom, a toolbar contains buttons for 'Help', 'Add Predecessor', 'Pause', and 'Create New Successor'. A tooltip for the 'Pause' button reads 'Pause to display intermediate result if available'.

Event Log		
15:22:56,001	INFO	Time = 9.4001E
15:23:01,193	INFO	Time = 9.4987E
15:23:06,340	INFO	Time = 9.5978E
15:23:11,886	INFO	Time = 9.6975E
15:23:17,115	INFO	Time = 9.7972E

You can watch the calculations progress in the Event Log window. You can also tell it is working by the icons in the **Project** window having a red border around them. Click the **Precipitation Calculator** nodes to **Continue** or **Discard** the calculations.



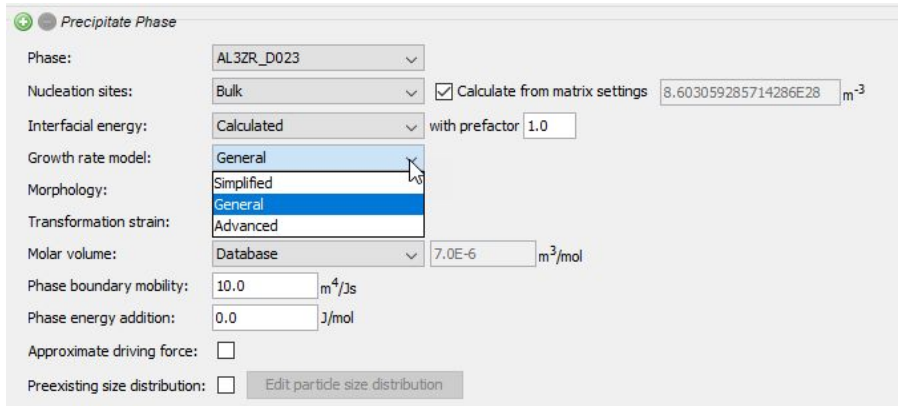
The screenshot shows the toolbar from the previous image, but with the 'Continue' and 'Discard' buttons highlighted by a red rectangular box. The 'Continue' button has a play icon, and the 'Discard' button has a red 'X' icon.

 In Thermo-Calc, press F1 to search the help for more details about the ability to “Pause, Resume and Cancel Precipitation Calculations”.



## New General Growth Rate Model and Example

For the Precipitation Calculator there is a new **General** growth rate model available in addition to the *Advanced* and *Simplified* models. The *General* model is based on the Morral-Purdy model, which follows the same quasi-steady state approximation as the *Simplified* model but takes into account the cross diffusion as well as adjustment of Gibbs-Thomson effect and effective diffusivity.

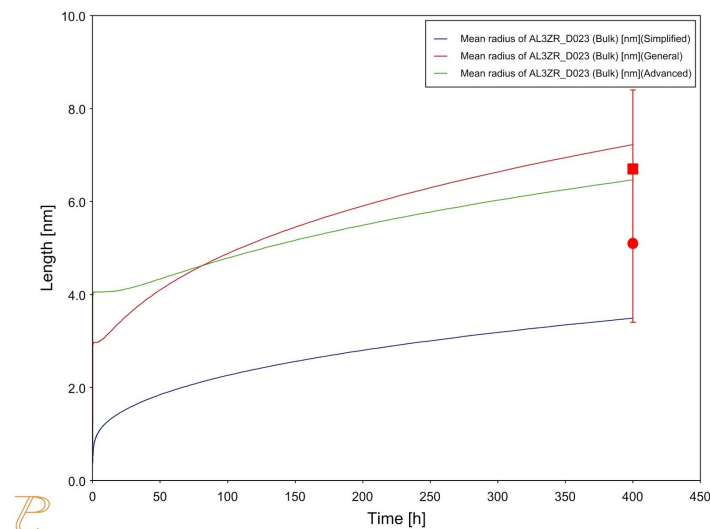



To access the Growth rate model settings, click **Show details** to the right of the Precipitate Phase section.

A new example compares the *Simplified*, *General* and *Advanced* growth rate models for an Al-Zr system. The resulting plot compares the mean radius of the spheres for each AL3ZR\_D023 precipitate phase calculated for each type of growth rate model.



Open the example in Thermo-Calc. From the main menu choose **Help>Example Files>Precipitation Module (TC-PRISMA)>P\_12\_Precipitation\_Al-Zr\_GrowthRateModel\_comparison.tcu**. Also press F1 to search the help for "Growth Rate Model".

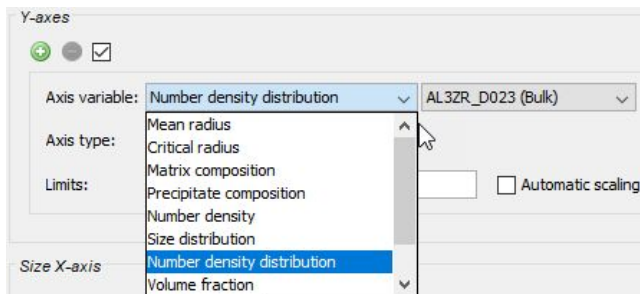


## New Axis Variables - Precipitate Composition and Number Density Distribution

You can now select two new plot variables using the Precipitation Calculator - Precipitate composition and Number density distribution. These variables are found on the Plot Renderer Configuration window.

**Precipitate composition** as a plot variable with the Precipitation Calculator, which tracks the instantaneous composition of precipitate particles. In particular, it is useful to distinguish different composition sets of the same phase (for example, FCC\_A1#2 and FCC\_A1#3).

**Number density distribution** enables you to retrieve the number density (number of particles per unit volume) of precipitates distributed in different particle sizes.



## Bug Fix

Fixed a bug where phases were listed twice for matrix compositions.

## Diffusion Module (DICTRA)

### New Homogenization Model Commands (Console Mode)

There is a new set of commands for use with the Homogenization model.

When in the DICTRA module, you use the `ADVANCED_HOMOGENIZATION_OPTIONS` and subcommands as follows.

- `SOLVE_IN_LATTICE_FIXED_FRAME`: Use this command to solve a diffusion problem in the lattice-fixed frame of reference using assessed molar volumes.
- `DEPENDENT_ELEM_BALANCE_FLUXES`: Use this command to set whether the dependent element should balance fluxes at the boundaries.
- `USE_TWO_TYPES_OF_BOUNDARY_CON`: This command enables you to use two types of boundary conditions. During the simulation one arbitrary boundary will be closed, but for the other open boundary and for each element, you can select which of the two entered boundary conditions that should apply.
- `BC_FOR_DEPENDENT_ELEMENT`: Use this command to allow an "active" boundary condition (BC) for a dependent element. The command enables you to enter a "fix flux" or an "activity-/potential-flux function" type of boundary condition for the dependent substitutional element if such a boundary condition is already entered for the independent elements.

Regarding SOLVE\_IN\_LATTICE\_FIXED\_FRAME, this feature is particularly useful when the simplified default behaviour of the DICTRA module with regards to volume is unsuitable. The default assumption regarding volume is that all substitutional elements have the same volume and that all interstitial elements have zero volume. With the SOLVE\_IN\_LATTICE\_FIXED\_FRAME feature turned on the assessed molar volumes from the thermodynamic database are used instead and the notion of substitutional and interstitial elements has no impact on the simulation. A particular case for which the default behaviour is unsuitable concern simulations in which both oxides and metallic solid solutions (like ferrite and austenite) take part: in the oxide oxygen is the substitutional element, but in the metallic solid solution oxygen is an interstitial element.

Regarding the other ADVANCED\_HOMOGENIZATION\_OPTIONS they allow you to set boundary conditions (BCs) in a more flexible manner. The default behaviour is that only one type of BC is allowed per boundary. Further, with the exception of the so-called “gas” BC, the flux of the dependent substitutional element on the boundary is calculated such that there is no net flux of volume across the boundary. With the USE\_TWO\_TYPES\_OF\_BOUNDARY\_CON feature it is possible to have two different types of BCs on the same boundary, though one boundary must then be closed. With the DEPENDENT\_ELEM\_BALANCE\_FLUXES feature it is possible to impose a zero flux at a boundary for the dependent substitutional element. With the BC\_FOR\_DEPENDENT\_ELEMENT feature it is possible to specify the BC for the dependent element in the same manner as for the independent elements. A particular case for which DEPENDENT\_ELEM\_BALANCE\_FLUXES and BC\_FOR\_DEPENDENT\_ELEMENT can be used is to emulate a CVD process by a “fix-flux” type of BC in which arbitrary elements are added at an arbitrary rate to the system.



For more details about these and other commands, in Thermo-Calc, press F1 and search the help.

### **Changes to prompts under the Utilities Homogenization command**

With the addition of the new Advanced Homogenization Options, some adjustments were made to the Utilities Homogenization command.

- *Do not balance external boundary fluxes* prompt is deprecated as it is part of the Advanced Homogenization Options.
- *The Fix external boundary flux of dependent component* prompt is disabled and available more generally as part of the Advanced Homogenization Options.

## **Improvements and Bug Fixes**

### **Both Console and Graphical Mode**

- A bug was fixed that caused database loading errors if several systems with mobility databases were loaded. This fix also applies to all APIs.
- Improved performance of homogenization model simulations when multiple phases are included.
- Fixed a bug with the homogenization model where there were problems with switching composition sets.
- Fixed a bug so that plot legends display the region names as well as when the name contains spaces or special characters.

## Graphical Mode Only

- Fixed a bug on the Diffusion Calculator settings window where you could not previously use the **Edit composition** button when a second diffusion region was added.
- Improved the error handling for diffusion calculations and ensured that error text is included in the Event Log.
- Several bug fixes have been made to selection and configuration of stoichiometric phases or phases that use the DILUTE diffusion model. Simulations involving these phases could sometimes not be started in graphical mode.

## TC-Python API

### New Functionality

TC-Python is a Python™-based SDK introduced in Thermo-Calc 2018a that allows you to couple Thermo-Calc calculations with other software in an open way. The SDK is built in the popular language Python™ to give Thermo-Calc users access to many other libraries, such as numerical packages like NumPy and SciPy, which can now be used in combination with our calculations. TC-Python can also be used from Jupyter notebooks or comparable interactive Python-consoles.

This release of TC-Python adds two more important features, which now gives the API the same functionality as the Graphical Mode version of Thermo-Calc: diffusion calculations and property models.

### Diffusion Calculations

The power of the Diffusion Module (DICTRA) is now available with TC-Python. All of the functionality included with the Graphical Mode, and the majority of the commands available with Console Mode, are implemented for use in TC-Python.

The Diffusion Module (DICTRA) is an add-on module to Thermo-Calc and it is used for simulation of diffusion controlled transformations in multicomponent systems. You can use up to 3 elements and the demonstration databases with TC-Python to run diffusion simulations. More than 3 elements and advanced calculations require additional licenses.

### Property Model Calculations

You can now also use the property models that are included with Thermo-Calc, as well as the functionality accompanying the Property Model Calculator. These property models can be used as predictive models for material properties based on their chemical composition and temperature. In addition, you can build your own property models in Thermo-Calc using the Property Model Development Framework, and then when these are in Thermo-Calc you can further access them via the TC-Python API.

There are already six general property models available in Thermo-Calc, and as of the 2019a release there are also steel models for martensite and pearlite that can be accessed when you have a valid maintenance license plus the TCFE9 and MOBFE4 databases. See the [New Steel Property Models](#) for details.

## Re-use of results

If you want to re-use results from previously done calculations, you can now set a folder where TC-Python saves all results as well as looks for previous results. This folder can be a network folder and shared by many users. If a previous TC-Python calculation, with the same cache folder and exactly the same settings has run, the calculation is not re-run. The result is instead loaded from disk.

This new feature is done using the function `set_cache_folder`. Search the TC-Python documentation for more information.

Functions for explicitly saving and loading have also been added. This functionality gives a huge performance increase if the same calculation needs to be performed multiple times, for example if just changing the plotting code of a simulation.

## Parameters of User-Databases Can Be Changed Dynamically

It is now possible to change the database parameters dynamically during the program run. This feature is only available for user-databases (i.e. tdb-files). The most important application of that feature is the optimization of database parameters through Python and its scientific libraries (for example `scipy`). Both, thermodynamic and kinetic database parameters can be optimized in that way.

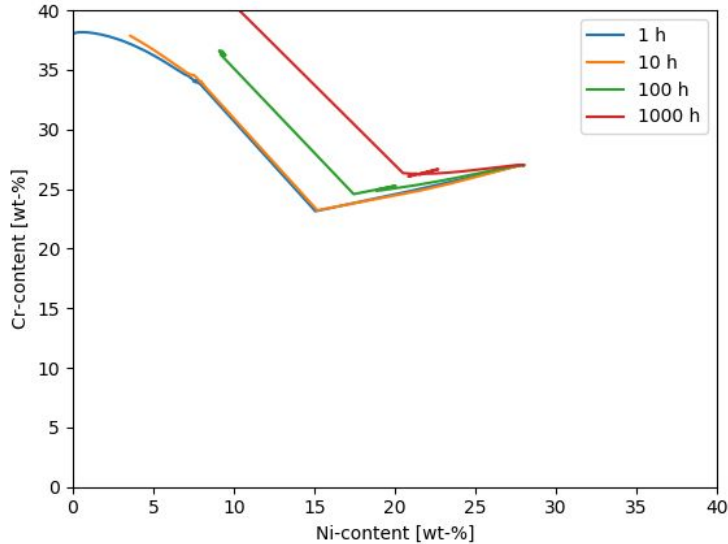
## New Diffusion and Property Model Examples and Updated Documentation

Several new examples are included with this release. You can use these examples to both learn about the use of TC-Python and as a way to build your own calculation simulations. The documentation is also updated to include best practices to work with TC-Python as well as detailed information about the additional features.

To supplement the new functionality available in TC-Python from the Diffusion Module and the Thermo-Calc Property Models, eight new examples are included in your installation package. Descriptions of each example are included in the Thermo-Calc Help. In Thermo-Calc, press F1 and search for *TC-Python Property Model Examples* or *TC-Python Diffusion Examples* or for one of the following example file names.

- `pyex_PM_1_Property_model_interfacial_energy`
- `pyex_PM_2_Property_model_parameter_fitting`
- `pyex_D_01_Diffusion_Single_Phase`
- `pyex_D_02_Diffusion_Moving_Boundary`
- `pyex_D_03_Diffusion_Multiphase`
- `pyex_D_04_Diffusion_Fe-C_Moving_Boundary_Austenite_to_Ferrite`
- `pyex_D_05_Diffusion_Fe_Ni_Cr_Moving_Boundary_Diffusion_Couple`
- `pyex_D_06_Deriving_Diffusion_Coefficients_From_Experiment`

### Diffusion paths in a Fe-Cr-Ni diffusion couple



Plot result from new diffusion example *D\_04*, which simulates the diffusion paths in a moving boundary problem between two multiphase regions.

For more information about the key features, including an installation video, go to our website:  
<https://www.thermocalc.com/products-services/software/tc-python/>

## Improvements and Bug Fixes

- You can now use TC-Python from within an interactive Jupyter Notebook and a Python console as well as similar products. Details about the implementation can be found in the TC-Python help in the *Best Practices* section.
- Certain conditions (temperature and pressure) can be changed without re-calculating the equilibrium. This can be applied to efficiently calculate the room-temperature composition of the phases in many technical materials that is actually controlled by the frozen-in equilibrium at higher temperatures.
- All structural information from the databases can now be obtained through the System object in TC-Python. That comprises for example the sublattices of phases and their constituents, the state of a phase (gas, liquid, ...), if an element is interstitial or if there is molar volume data for the phase available.
- The reference state for components can now be defined in TC-Python.
- Fixed a bug in TC-Python example `pyex_T_01` where a wrong indexing in `numpy.meshgrid` was used.
- Beginning from version 2019a it is now safe to run with `TCPython()` in a loop without getting hanging Java-processes. This is an important improvement especially for multi-processing applications and Jupyter-notebooks.
- For macOS: Mac users have full access to the TC-Python examples directory (it was previously read only).
- For Linux OS: Fixed an issue where appending a user mobility database caused the library to crash.

- Added the ability to add a list of starting equilibria for phase diagrams.

## Updating TC-Python from 2018b to 2019a

Note the following if you installed earlier versions of TC-Python with Thermo-Calc. When updating to a newer version of Thermo-Calc, you always also need to install the latest version of TC-Python. It is not sufficient to run the installer of Thermo-Calc. See the section “Updating to a newer version” in the TC-Python Quick Installation Guide. A PDF of this manual is available on our website or search the online help if you have already installed Thermo-Calc.

## Databases

### Database Models

#### GES model: Effective Bond Energy Formalism

The Effective Bond Energy Formalism (EBEF) most recently proposed by Dupin et al. [1, 2] has been implemented in Thermo-Calc 2019a. This model provides a first approximation to estimate the stability of all endmembers in the Compound Energy Formalism (CEF) for a multicomponent complex phase through an expansion using effective bond energies that can be obtained by fitting to binary endmember DFT data. Due to a significant reduction of the number of necessary parameters, this model allows the use of as many sublattices as there are occupied Wyckoff sites and meanwhile potentially cuts the computational time.

[1] N. Dupin et al., Calphad XLVII conference, May 27-June 1, 2018, Queretaro, Mexico.

[2] N. Dupin et al., in press, J. Res. Natl. Inst. Stan., 2018.

### Type Definition Improvement

An improvement to some database TYPE\_DEFINITION commands is made for the phases that use *never disorder partitioning model*. Previously NEVER\_DISORDER\_PAR did not automatically restore the other\_phase needed for evaluating this\_phase. You can now use NEVER\_DISORDER\_PAR and the disordered part of the phase is restored automatically when the ordered part is entered in the System Definer. For example:

```
TYPE_DEFINITION A GES AMEND_PHASE_DESCRIPTION SIGMA
NEVER_DISORDER_PAR DIS_SIG,,,!
```

## Nickel-based Superalloys: New Thermodynamic and Kinetic Databases

### TCNI9

#### Major updates from TCNI8.1 to TCNI9

- The major updates in TCNI9 is the addition of Ca, Mg and S elements. In total 58 binary and many ternary systems are added to the database. More than 150 new phases are added for a total of 680 phases.
- The calculation of W-partitioning between the liquid and solid phase during the solidification of nickel alloys was improved with the help of new experimental data.

- The stability and composition profile of B2 phase in Ni-Al-Co-Cr alloys was improved.
- The thermodynamic description of several ternary systems were revised including B-Ni-Si, Cr-Mo-Nb, Cr-Nb-V, Al-Ni-V, and Mo-Ni-Si.
- The Laves phase description was modified in several system to improve the predictions of stability and composition profile of this phase.
- In addition several bugs from the previous versions were fixed such as one that erroneously causes ordering in copper containing FCC\_A1 phase.

## MOBNI5

### Updates from MOBNI4 to MOBNI5

The change from MOBNI4 to MOBNI5 is the addition of atomic mobilities of Ca, Mg, and S in FCC\_A1, L12, BCC\_A2, B2 and liquid phases.

## Titanium and Titanium Aluminide-based Alloys: New Thermodynamic and Kinetic Databases

### TCTI2

#### Major updates from TCTI1 to TCTI2

- Volume data for most of the phases assessed.
- 4 new elements added: Ag, H, Pd, Pt
- 33 new binary systems are assessed: Ti-Ag, Ti-H, Ti-Pd, Ti-Pt, Ag-Pd, Al-Pd, Cr-Pd, Mo-Pd, Ni-Pd, Pd-V, Pd-Zr, Al-H, B-H, C-H, Co-H, Cr-H, Fe-H, Hf-H, Mn-H, Mo-H, N-H, Nb-H, Ni-H, O-H, Re-H, Ru-H, Si-H, Sn-H, Ta-H, V-H, W-H, Y-H, Zr-H. Most of these are H-containing.
- 24 new ternary systems are modelled: Ti-Ag-Pd, Ti-Al-Fe, Ti-Al-H, Ti-Al-Pd, Ti-Al-Y, Ti-B-Si, Ti-C-Si, Ti-Cr-H, Ti-Cr-O, Ti-Cr-Si, Ti-Fe-Mo, Ti-H-Ni, Ti-H-O, Ti-H-Zr, Ti-Mo-O, Ti-Nb-O, Ti-Nb-Si, Ti-Ni-Pd, Ti-O-Si, Ti-O-Ta, Ti-O-V, Ti-O-W, Ti-O-Zr, Ti-Pd-V.

### MOBTI3

#### Major updates from MOBTI2 to MOBTI3

MOBTI3 is compatible and recommended for use in combination with the TCTI2 (TCS Ti/TiAl-based Alloys Thermodynamic Database).

- 4 new elements added: Ag, H, Pd, Pt
- 7 new binary systems added: Ag-Ti, Al-H, H-Ti, H-V, H-Nb, H-Mo, Pd-Ti
- 4 new ternary systems added: H-Mo-Ti, H-Ti-V, H-Nb-V, H-Al-Ti

## Aluminum-based Alloys: New Thermodynamic and Kinetic Databases

### TCAL6

#### Major updates from TCAL5 to TCAL6

- Added a new element Mo, the Al-Mo and Mo-Si binary systems, and the Al-Mo-Si ternary system
- FCC\_A1 is now independently modeled and no longer coupled with FCC\_L12. The FCC\_L12 phase modeled with the partitioning model is now separated and named as ORD\_L12.



- Updated the Al-Cu-Mg-Zn metastable precipitates of industrial importance: S\_prime and T\_prime are remodeled; S\_DPrime is newly modeled; especially, the Eta\_prime phase is remodeled by considering the Cu solubility.

## MOBAL5

### Major updates from MOBAL4 to MOBAL5

- Added Mo and Al-Mo.
- FCC\_A1 is now independently modeled and no longer coupled with FCC\_L12. The FCC\_L12 phase modeled with the partitioning model is now separated and named as ORD\_L12.

## Magnesium-based Alloys: Updated Thermodynamic Database

### TCMG5.1

The Al-Mn, Al-Fe and Al-Fe-Mn systems were updated.

## High Entropy Alloys: Updated Thermodynamic Database

### TCHEA3.1

#### Updates from TCHEA3 to TCHEA3.1

- The Mn-Ni-Si ternary is critically assessed in full composition and temperature ranges.
- Some bug fixes e.g. avoid the fictitious HCP\_ZN phase appears in Zn-free systems, adjust the phase stability of GAMMA\_D03, CRSI2\_C40, C15- & C36- laves phases in some systems.

## Documentation

In Thermo-Calc, press F1 to search the online help.

## New Examples

There are several new examples described elsewhere in this document:

- TC-Python [New Diffusion and Property Model Examples and Updated Documentation](#)
- Precipitation Module (TC-PRISMA) see [New General Growth Rate Model and Example](#)
- Property Model Calculator see [Steel Model Examples](#)

## Renamed and Moved General Property Model Examples

In order to keep all examples related to the Property Model Calculator in one place, there is a new **Property models** folder and new prefix number for each of the the following General examples (in Thermo-Calc choose **Help>Example Files>Property models>General**).

Old Name	New Name
T_10: Phase Transition	PM_G_01: Phase Transition

T_11: Coarsening and Interfacial Energy	PM_G_02: Coarsening and Interfacial Energy
T_12: Driving Force and Interfacial Energy	PM_G_03: Driving Force and Interfacial Energy

## Installation

### TC-Python

- See [Updating TC-Python from 2018b to 2019a](#).
- For TC-Python installation issues, review the Troubleshooting section in the TC-Python help. For example, information about pip installations behind a proxy server are now included.

### TC-Toolbox for MATLAB

- Fixed a bug that prevented the unattended installation to use a non-standard MATLAB installation path.

### Linux and macOS

- For Linux installations, you no longer need to install a runtime library (libgfortran 4.4 or higher) for GNU Fortran applications.
- For macOS: You can now use the 2018b uninstaller program to remove the software. Previously the program would quit unexpectedly on macOS.

### Installation Disk Space Requirement

Due to precompiled databases added to the Thermo-Calc installation, 2 GB of disk space is recommended for the 2019a installation.

## Platform Roadmap

For information about platforms being phased out visit

<http://www.thermocalc.com/products-services/software/system-requirements/platformroadmap/>.