# Software Development Kits

**For Linking to External Software**

## CALCULATE

**Amount** and **composition** of phases

**Phase transformation temperatures**, such as liquidus and solidus temperatures

**Thermophysical properties**, such as thermal conductivity, density, and more

**Properties of liquids**, such as viscosity and surface tension

**Thermochemical** properties such as Gibbs Energies, chemical potentials, enthalpy, heat capacity, and more

**Driving** forces

**Diffusion** coefficients

**Derivatives** of state functions

**Partition** coefficients

**Precipitation** simulations

**Invariant** temperatures, liquidus-/solidus- temperatures and composition-dependence

**T0-temperature,** A1/A3/A4-temperatures, adiabatic temperature, chill factors, composition derivatives of temperature, and so on

## PLATFORM

**Windows:** All three SDKs

**Linux:** TC-Python and TQ-Interface

**MAC OS:** TC-Python

**Refer** to our website for complete system requirements

## LICENSES

**Single** machine or network install

**Annual** or perpetual options

**License** fees depend on several factors, i.e., database selection

**TC-Toolbox** for MATLAB® requires a separate MATLAB® license

**Software Development Kits (SDKs)** are add-on features that allow users to call Thermo-Calc functions and access the thermodynamic and mobility databases directly from within their own software codes or other software programs. Three SDKs are available: **TC-Python**, **TQ-Interface,** and **TC-Toolbox for MATLAB®.** Each SDK incorporates an application programming interface (API), a programmer's guide, and a collection of examples to help users get started.


### Easy to Use

SDKs make coupling with Thermo-Calc easy, allowing for a dynamic and flexible interaction between Thermo-Calc and a user's own code or other programs. Since calls to Thermo-Calc are made via function and sub-routine calls that are similar in syntax to that used in the Thermo-Calc console mode, users familiar with the console mode commands and experienced in programming will find using the SDKs a natural extension. Documentation on each function and its syntax is provided, along with example codes.

### Extract Most Quantities and Properties

Most of the quantities that are possible to evaluate in Thermo-Calc can be readily extracted using the SDKs. These quantities can be extracted under equilibrium conditions, but also for metastable or non-equilibrium states, by changing the status of the phases under consideration. Additionally, precipitation and diffusion simulations, as well as Property Model and Process Metallurgy Module calculations are possible with TC-Python and TC-Toolbox for MATLAB®.

### Consistently Maintained and Updated

The SDKs are directly linked to the underlying Thermo-Calc code, so they are updated as Thermo-Calc is updated. Thermo-Calc, and thus the SDKs, are on a two-times-per-year release cycle, and customers with a valid Maintenance and Support Subscription for the SDKs receive these updates for free.

### Technical Support and Training

Thermo-Calc is backed by a dedicated customer technical support team. We also have agents around the world, as well as subsidiaries in the USA and South Korea, who provide local customer support.

### High Quality Thermodynamic and Mobility Databases

SDKs allow users to access the same thermodynamic and mobility databases used by Thermo-Calc, the Diffusion Module (DICTRA), and the Precipitation Module (TC-PRISMA). More than 30 thermodynamic and properties databases and 10 mobility databases are available for use with the SDKs.

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## APPLICATIONS

**SDKs** can be used to understand many different phases in the life-cycle of a material, such as:

- Alloy and materials development
- Metallurgical extraction and refining
- Additive manufacturing
- Casting
- Forging/Hot rolling
- Heat treatment
- Joining/Welding/Soldering
- Quality control
- Materials selection
- Corrosion
- Underlying causes of failure
- Waste and recycling

## BENEFITS

**Reduce** costly, time-consuming experiments and testing

**Increase** the value of experiments through better pre-screening and interpretation of the results

**Optimize** and define safe processing windows

**Base** decisions on scientifically supported data and models

**Shorten** development time and bring products to market faster

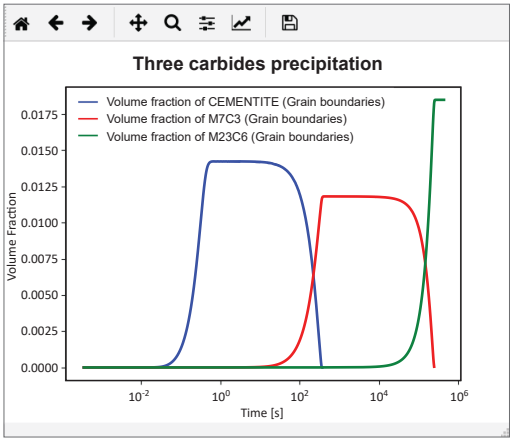
**Build** and safeguard intellectual knowledge

**Improve** the quality and consistency of products through deeper understanding

**Make** predictions that are difficult or even impossible with an experimental approach

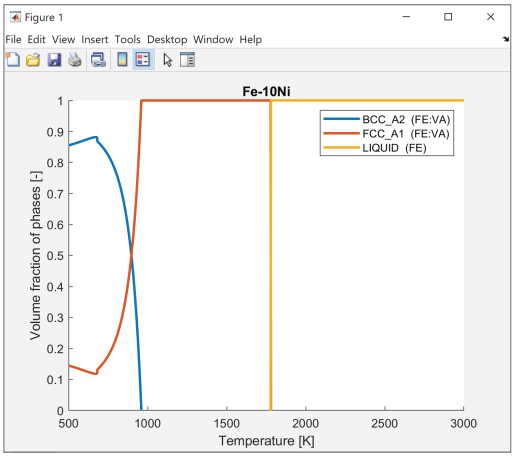
### TC-Python

TC-Python is a powerful Python™ language-based SDK available with Thermo-Calc that allows users to openly couple Thermo-Calc calculations with other software. This API is built in the popular Python language so that users can couple Thermo-Calc with a wide variety of other programs such as numerical packages NumPy and SciPy. TC-Python was designed to be easy to use - it supports intelligent code completion, and an object-oriented approach makes it easy to reuse information.



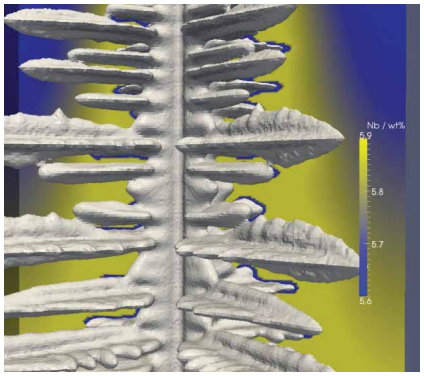

### TC-Toolbox for MATLAB®

TC-Toolbox for MATLAB® provides an interface to the commonly-used MATLAB® software for scientific and engineering computing. The API offers the same functionality as TC-Python, but is well suited for users who already have a license for MATLAB®, want to connect to other programs offered by MATLAB®, or are familiar with the MATLAB® programming language.




### TQ-Interface

TQ-Interface is designed for time-critical, computationally intensive application software that is most likely but not necessarily written in FORTRAN. It constitutes a collection of FORTRAN subroutines and functions supplied in the form of a DLL (Dynamically Linked Library). There are also C functions matching all the FORTRAN subroutines in order to facilitate users who wish to program in languages other than FORTRAN. TQ-Interface offers the fastest calculations of the three SDKs.



**TQ-Interface is successfully used in the MICRESS software package, developed by ACCESS e.V., in Aachen, Germany**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