Software Development Kits

**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 simply changing the status of the phases under consideration. Additionally, precipitation and diffusion simulations, as well as Property Model Calculations are also 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 a subsidiary in the USA, 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.
**APPLICATIONS**

SDRs 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**

This API uses 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. This kit is ideal for fast realization of ideas and visualization of results during research and development activities. The API includes nearly all calculation types available in Thermo-Calc Graphical Mode, including diffusion and precipitation simulations. The program was designed to be easy to use, for instance, it supports intelligent code completion and an object-oriented approach.

**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.

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**Three carbides precipitation**

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<th>Volume fraction of CEMENTITE (Grain boundaries)</th>
<th>Volume fraction of M7C3 (Grain boundaries)</th>
<th>Volume fraction of M23C6 (Grain boundaries)</th>
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**Figure 1**

- Fe-10Ni

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