TTAL8: ThermoTech Al-based Alloys Database

Database name:	ThermoTech Al-based Alloys Database	*Database acronym:*	TTAL
Database owner:	ThermoTech	*Database version:*	8.1

TTAL8 is a comprehensive database for Al-alloys that can be used for all major types of commercial Al-alloys ranging from pure Al to complex commercial alloys. TTAL8 can be used with Thermo-Calc, the add-on Diffusion Module (DICTRA) and/or Precipitation Module (TC-PRISMA), and the TC-PI programming-interfaces.

Included Elements (25)

Al	B	Bi	C	Ca	Co	Cr	Cu	Fe	H	La	Li	Mg	Mn	Mo	Ni	Pb
Sc	Si	Sn	Sr	Ti	V	Zn	Zr									

Included Phases

Note that the BCC_A2, CBCC_A12, RHOMBO and DHCP phases, and the MC (carbide) phase as well, are always rejected by default; while, if it is necessary for some systems with higher-contents of Fe/Cr/Li/Mo/V/Mn/B/La, they can be restored in the TDB Module. The nomenclature surrounding the various intermetallic phases can differ depending on which reference text is used as a basis.

Liquid	FCC_A1 (Al-dominant)	HCP_A3 (Mg/Ti-dominant)	BCC_A2	
Al13Co4	Al7(Cr,Fe,Mn)	Al2(Cu,Li,Si,Zn)	Al3(Fe,Mn,Ni,...)	
Al3Mg2	Al3M_D022	Al3M_D023	Al3M_L12	Al3Ni
Al3(Ni,Cu)2	Al4(Ca,Sr)	Al6(Mn,Fe,Cu,...)	Al9(Co,Fe,Ni)2	
Al3RE_D019	Al11RE3_alpha	AlLi	AlLiMg_tau	AlLiSi
AlFeSi_alpha	AlFeSi_beta	AlMSi_alpha	AlMSi_beta	Al2(Ca,Sr)Si2
AlCuLi_R	ALCuLi_T1	AlCuLi_T2	AlCuLi_TB	Al2CuMg_S
Al7Cu2(Co,Fe)	Al7Cu4Ni	Al20Cu2Mn3	Al13Cr4Si4	
Al18(Cr,Mn)2Mg3_E	Al2Mg3Zn3_T	Al5Cu2Mg8Si6	Al8FeMg3Si6	
MgZn2	Mg2Si	Mg2(Pb,Sn)_C1	BiPb_epsilon	
MC (TiC/VC/Z-C-carbides)	SiC	Al4C3	Al4SiC4	Al8SiC7
AlB2	(Ti,V,Zr)B2_C32	RHOMBO (pure-B)	GAS (pure-H)	Graphite (pure-C)
DIAMOND_A4 (pure-Si)	BCT_A5 (Sn-dominant)	RHOMBO_A7 (Bi-dominant)	CBCC_A12 (pure-Mn_alpha)	DHCP (pure-La)

Assessed Systems

All phases have been critically assessed and treated by some appropriate thermodynamic models (*e.g.*, the Sublattice Model for solid solutions and liquid mixture phases, the Ideal Gas Model for gas mixture phase, *etc*,), which are applicable to various grades of multicomponent Al-alloys over a wide temperature-pressure-composition range. The FCC_A1 solution phase is modelled using the standard substitutional phase for all elements except for C, B and H which are modelled as interstitials. Following the SGTE standard practice, the MC_{1-x} carbide phase is thus effectively described by an additional composition-set of the (M-/C-rich) FCC_A1 solution. The so-called Global Minimization Technique within the Thermo-Calc software can automatically detect and generate such additional composition-set(s) for the FCC_A1 solution phase (as well as for any other solution phases possibly with miscibility gaps, whenever it is necessary and appropriate).

Validations

The database successfully predicts precipitation hardening reactions and provides excellent results for solution phase treatment temperatures and the formation of the "insoluble" compounds formed as part of the solidification process. One of the striking successes of the database concerns prediction of the non-equilibrium solidification behaviour of Al-alloys. Excellent agreements between the calculated results (f_s *vs* T) and experimental data from for instance Backerud *et al.* (1986) can be obtained using the SCHEIL module in the Thermo-Calc software. The simulation also allows properties like heat evolution and the segregation patterns to be successfully predicted. The phases predicted to form during the solidification process are well matched. It is clear that the database provides very accurate predictions for the solidification behaviour of multicomponent Al-alloys in conditions that are well away from those associated with equilibrium. This provides a stringent test of the capabilities of the TTAL database that it passes remarkably well.

Limits

As in the spirit of the CALPHAD method, predictions can be made for multicomponent systems by extrapolation into multicomponent space of data critically evaluated and assessed based on binary, ternary and in some cases higher order systems. However, critical calculations must always be verified by equilibrium experimental data; it is the user's responsibility to verify the calculations but Thermo-Calc Software AB is interested to know about any significant deviations in order to improve any future release. The TTAL database has been developed primarily for performing various types of calculations of multicomponent Al-based alloys; but please also note that it is not aimed at calculating complete binary/ternary/quaternary phase diagrams.