TCS Solder Alloy Solutions Database (TCSLD4)

Technical Information

Available Starting with Thermo-Calc Version 2021b

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Contents

About the TCS Solder Alloy Solutions Database (TCSLD)

TCS Solder Alloy Solutions Database (TCSLD) is a thermodynamic database for solder alloys that contains all the important solder alloy systems, e.g., Sn-/Au-/Bi-/Zn-based solders and Cu, Ni, Pd and so forth and the relevant substrate or metallization materials. In addition to thermodynamic data, it has properties data available for molar volume with thermal expansion coefficients.

The database enables pre-screening of potential solder candidate compositions, predictions of various thermodynamic properties and phase equilibria, and provides information on possible interfacial reactions. The results from these predictions can be applied to eliminate candidate solder alloys for which the calculations reveal unsuitable freezing temperature ranges and undesired phases from further testing, and thus to accelerate design of new solder alloys as well as to improve the understanding of existing solder alloys in terms of their processing and in-service behavior. The database is validated where possible against commercial solder alloys and available experimental information.

TCSLD: TCS Solder Alloy Solutions Database Revision History. The current version of the database is TCSLD4.

The CALPHAD Method

The Thermo-Calc databases are developed with the CALPHAD approach based on various types of experimental data and theoretical values (e.g. those from first-principles calculations). It is based on the critical evaluation of binary, ternary, and for some databases, important higher order systems. This enables predictions to be made for multicomponent systems and alloys of industrial importance. Among these, the thermodynamic database is of fundamental importance.

Learn more on our website about the CALPHAD Method and how it is applied to the Thermo-Calc databases.

Use Case Examples

There are examples available to both demonstrate the *validation* of the database and to showcase the types of *calculations* that can be used for different materials or application area.

A range of properties can easily be calculated with TCSLD4, including:

- Liquidus and solidus temperatures as a function of compositions.
- Isothermal or vertical section phase diagrams.
- Phase formation, phase fractions and phase compositions.

- Thermodynamic driving force for the formation of intermetallic compounds (IMCs).
- Predict non-equilibrium solidification behavior of solder alloys. This can be at specific cooling rates when using the 'Back diffusion in primary phase' option with the Scheil Calculator.

By using the Diffusion Module (DICTRA) in conjunction with a suitable mobility database, diffusion-controlled interface reactions during the soldering process can be simulated so that the reliability of solder joints can be predicted to a certain extent, for example to:

- Predict the growth of intermetallic compounds
- Simulate the dissolution of substrate

Combining Databases

It is possible to combine several databases to make calculations using Thermo-Calc. For more information related to a specific type of problem, contact one of our support specialists at info@thermocalc.com. The experts are available to make recommendations on the most suitable database to use for your needs.

TCS Solder Alloy Solutions Database (TCSLD) Resources

Information about the database is available on our website and in the Thermo-Calc software online Help.

- **Website**: On our website the information is both searchable and the database specific PDFs are available to download.
- **Online Help**: Technical database information is included with the Thermo-Calc software online Help. When in Thermo-Calc, press F1 to search for the same information as is contained in the PDF documents described. Depending on the database, there are additional examples available on the website.

Database Specific Documentation

- The *TCS Solder Alloy Solutions Database (TCSLD) Technical Information* PDF document contains version specific information such as the binary and ternary assessed systems, phases and models. It also includes details about the properties data (e.g. viscosity, surface tension, etc.), a list of the included elements, and summaries of the database revision history by version.
- The *TCS Solder Alloy Solutions Database (TCSLD) Examples Collection* PDF document contains a series of validation examples using experimental data, and a set of calculation examples showing some of the ways the database can be used.

Go to the Solder Alloys Databases page on our website where you can access an examples collection and the technical information plus learn more about the compatible kinetic database. Also explore further applications of Thermo-Calc to solders including links to resources such as examples, publications, and more.

Learn more on our website about the CALPHAD Method and how it is applied to the Thermo-Calc databases.

TCSLD4 Elements, Systems, Phases, and Properties Data

Included Elements

There are 21 elements included in the most recent version of the database.

Ag	Al	Au	Bi	Ca	Cd	Co	Cu	Ga	Ge	In
Mg	Mn	Ni	Pb	Pd	Pt	Sb	Si	Sn	Zn	

Assessed Systems and Phases

The most recent version of the database contains:

- 142 binary systems, which can be calculated with the BINARY module in Thermo-Calc Console Mode.
- 72 ternary systems, which can be calculated with the TERNARY module in Thermo-Calc Console Mode.
- 272 solution and intermetallic phases, which covers all the important solder alloy phases.

In most cases, the phases having the same crystal structure are merged as the same phase. The GAS phase is rejected by default when retrieving data from the database. You must manually restore it when it is required for a calculation.

In Console Mode, you can list phases and constituents in the Database (TDB) module and the Gibbs (GES) module. For some phases, supplementary information is included in the definitions. To show the information, it is recommended in the Database (TDB) module to use the command LIST_SYSTEM with the option `Constituents`.

Properties Data

Molar volume, surface tension, and viscosity properties data are included with the database.

For more information about the various thermophysical models, and when in Thermo-Calc, press F1 to search the online help. The details are found under a *General Reference* section.

You can find information on our website about the properties that can be calculated with Thermo-Calc and the Add-on Modules. Additional resources are added on a regular basis so keep checking back or subscribe to our newsletter.

Below is a summary of the available parameters and variables for the databases when working in Thermo-Calc. There are differences when you are working in Console Mode versus Graphical Mode as well as if you use the TC-Python SDK. More details are described in the online help.

Property	*Model Parameters*	*Variables to Show or Plot in Console Mode and TC-Python*
Surface tension	SIGM, XI	`SURF(LIQUID)`
Dynamic viscosity	VISC	`DVIS(LIQUID)`
Kinematic viscosity		`KVIS(LIQUID)`
Molar volume	V0, VA	VM for a system `VM(PHI)` for phase PHI

TCSLD4 Systems

In this section:

TCSLD4 Assessed Binary Systems

Low temperature ordered phases are not fully included in Au-Cu, Co-Pt, Cu-Pd, Cu-Pt, Ni-Pt.

	Ag	Al	Au	Bi	Ca	Cd	Co	Cu	Ga	Ge	In	Mg	Mn	Ni	Pb	Pd	Pt	Sb	Si	Sn	Zn
Al	X																				
Au	X	X																			
Bi	X	X	X																		
Ca		X																			
Cd																					
Co	X	X	X	X																	
Cu	X	X	X	X		X	X														
Ga	X	X		X				X													
Ge	X	X	X	X			X	X	X												
In	X	X	X	X			X	X	X	X											
Mg		X							X												
Mn								X													
Ni	X	X	X	X			X	X		X	X										
Pb	X	X	X	X	X	X	X	X		X	X	X		X							
Pd	X	X	X	X			X	X			X			X	X						
Pt	X	X	X	X			X	X	X	X	X			X	X						
Sb	X	X	X	X		X	X	X	X	X	X			X	X	X	X				
Si	X	X	X	X			X	X		X	X			X	X	X	X	X			
Sn	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Zn	X	X	X	X		X	X	X	X	X	X	X		X	X	X		X	X	X	

TCSLD4 Assessed Ternary Systems

In the table, * indicates low temperature ordered phases are not included.

Ternary Systems			
Ag-Al-Cu	Ag-Au-Bi	Ag-Au-Cu*	Ag-Au-Ge
Ag-Au-Ni	Ag-Au-Pb	Ag-Au-Sb	Ag-Au-Si
Ag-Au-Sn	Ag-Bi-Cu	Ag-Bi-In	Ag-Bi-Sb
Ag-Bi-Sn	Ag-Cu-In	Ag-Cu-Pb	Ag-Cu-Pd
Ag-Cu-Sn	Ag-In-Pd	Ag-In-Sb	Ag-In-Sn
Ag-Ni-Sn	Ag-Sb-Sn	Ag-Sb-Zn	Ag-Sn-Zn
Al-Bi-Sn	Al-Bi-Zn	Al-Cu-Sn	Al-Cu-Zn
Al-Ga-Zn	Al-Ge-Zn	Al-Mg-Zn	Al-Pb-Sn
Al-Sn-Zn	Au-Bi-Sb	Au-Bi-Sn	Au-Co-Sn
Au-Cu-Sb*	Au-Ge-Sn	Au-In-Sb	Au-In-Sn
Au-Ni-Sn	Au-Pb-Sn	Au-Pt-Sn	Au-Sb-Sn
Au-Si-Sn	Bi-Cu-Sb	Bi-Cu-Sn	Bi-In-Pb
Bi-In-Sn	Bi-Pb-Sn	Bi-Sb-Sn	Bi-Sn-Zn
Ca-Pb-Sn	Cd-Pb-Sn	Cd-Sb-Zn	Co-Ni-Sb
Cu-In-Sn	Cu-Mn-Sn	Cu-Ni-Pb	Cu-Ni-Sn
Cu-Pb-Sn	Cu-Si-Zn	Cu-Sn-Zn	Ga-Ge-Pt
Ga-Sn-Zn	Ge-Sb-Sn	In-Ni-Sn	In-Pb-Sn
In-Sb-Sn	In-Sn-Zn	Pb-Sb-Sn	Pb-Sn-Zn

TCSLD4 Phases

In this section:

Common Phases for the Solder Alloys

The following lists common phase names and the corresponding Thermo-Calc database phase names for some key solder systems.

Name in the Database	*Common Name and Description*
FCC_A1	Substrate material such as copper, nickel, silver, palladium
CU6SN5_HT_NIAS	Cu6Sn5, or η phase, a common intermetallic compoud which forms at the solder/substrate interface.
CU3SN	Cu3Sn, or ε phase, a common intermetallic compoud which forms at the solder/substrate interface.
NI3SN4	Ni3Sn4, a common intermetallic compoud which forms at the interface between solder alloy and Ni substrate.

TCSLD4 Models for the Included Phases

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
GAS						E- AG AG1/+1 AG1AL1 AG1AU1 AG1CU1 AG2 AL AL1/+1 AL1/-1 AL1AU1 AL1CU1 AL1SB1 AL2 AU AU1/+1 AU1/-1 AU1CO1 AU1CU1 AU1SI1 AU2 BI BI1/+1 BI2 BI3 BI4 CA CA1/+1 CA2 CD CD1/+1 CO CO1/+1 CO1/-1 CO2 CU CU1/+1 CU1/-1 CU2 GA GA1/+1 GA1/-1 GA2 GE GE1/+1 GE2 IN IN1/+1 IN1SB1 IN1SB2 IN2 MG MG1/+1 MG2 MN MN1/+1 NI NI1/+1 NI1/-1 NI2 PB PB1/+1 PB1/-1 PB2 PD PD1/+1 PT PT1/+1 PT1/-1 SB SB1/+1 SB1/-1 SB2 SB3 SB4 SI SI1/+1 SI1/-1 SI2 SI3 SN SN1/+1 SN2 ZN ZN1/+1 ZN1/-1	
LIQUID						(AG AL AU BI CA CA2PB CA2SN CD CO CU GA GE IN MG MG2PB1 MG2SN1 MN NI PB PD PT PTSN SB SI SN ZN)1	
FCC_A1	Cu	cF4	Fm-3m	A1	225	(AG AL AU BI CA CD CO CU GA GE IN MG MN NI PB PD PT SB SI SN ZN)1(VA)1	
FCC_L12	Cu3Au	cP4	Pm-3m	L12	221	(AG AL AU BI CA CD CO CU GA GE IN MG MN NI PB PD PT SB SI SN ZN)0.75(AG AL AU BI CA CD CO CU GA GE IN MG MN NI PB PD PT SB SI SN ZN)0.25(VA)1	
BCC_A2	W	cI2	Im-3m	A2	229	(AG AL AU BI CA CO CU GA GE IN MN NI PB PD PT SB SI SN ZN VA)1 (VA)3	
BCC_B2	CsCl	cP2	Pm-3m	B2	221	(AG AL AU BI CA CO CU GA GE IN MN NI PB PD PT SB SI SN ZN VA)0.5 (AG AL AU BI CA CO CU GA GE IN MN NI PB PD PT SB SI SN ZN VA)0.5 (VA)3	
CBCC_A12						(CU MN NI SI SN)1(VA)1	
CUBIC_A13	Mn	cP20	P4132	A13	213	(AG AL CO CU MN NI SI SN)1	
BCT_A5	Sn	tI4	I41/amd	A5	141	(AG AL BI CD CU GA IN NI PB SB SI SN ZN)1	
HCP_A3	Mg	hP2	P63/mmc	A3	194	(AG AL AU BI CD CO CU GA GE IN MG NI PB PD PT SB SI SN ZN)1 (VA)0.5	
HCP_ZN	Mg	hP2	P63/mmc	A3	194	(AG AL AU BI CD CO CU GA GE IN MG NI PB PD PT SB SI SN ZN)1 (VA)0.5	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
DIAMOND_A4	C	cF8	Fd-3m	A4	227	(AG AU GA GE SB SI SN)1	
ORTHORHOMBIC_GA	Ga	oS8	Cmce	A11	64	(GA)1	
RHOMBOHEDRAL_A7	As	hR6	R-3m	A7	166	(AG AU BI GE IN PB SB SN ZN)1	
TETRAGONAL_A6	In	tI2	I4/mmm	A6	139	(AL BI GA IN PB SB SN ZN)1	
AG2GA	Mg2In	hP9	P-62m	C22	189	(AG)2(AG GA VA)1	
AG3GA2						(AG)3(GA)2	
AL2CU_C16	Al2Cu	tI12	I 4/m c m	C16	140	(AG AL AU CO CU MN PD)0.33(AL IN MN PB SN)0.67	AgIn2, Al2Cu, AuPb2, CoSn2, MnSn2, Pb2Pd
CU5ZN8_GAMMA_D83	Cu5Zn8	cI52	I-43m	D82	217	(AG AL IN NI SI ZN)4(AG AL CU IN NI SI ZN)1(AG CU IN SN ZN)8	Ag9In4, Ag5Zn8, Al4Cu9, Cu5Zn8, In7Ni3, Ni5Zn8
AG15PT17		c*32				(AG)0.47(PT)0.53	
AG3SB_LT_CU3TI						(AG SB)0.75(AG SB)0.25	Metastable AG3SB_LT (Cu3Ti structure) phase
AG3SN_L60_CU3TI	Cu3Ti	oP8	Pmmn	D0a	59	(AG AU CO CU NI SB ZN)0.75(AG AU BI IN NI SB SN)0.25	Ag3Sb, Ag3Sn, Au3In, Cu3Sb, Ni3Sb, Tao 1 in Cu-Ni-Sn
AGZN_ZETA	(Ag0.56Zn0.44)8Zn	hP9	P-3		147	(AG PB SN ZN)1	
AL2AU_C1_CAF2	CaF2	cF12	Fm-3m	C1	225	(AG AL AU CU GA GE IN MG SB SI SN)0.67(AL AU CO NI PB PT SN)0.33	Al2Au, Al2Pt, AuIn2, CoSi2, Ga2Pt, In2Pt, Mg2Pb, Mg2Sn, NiSi2, PtSn2
ALAU_B31	MnP	mP8	P21/m	B31	11	(AL GA GE PD SI SN)0.5(AU CU NI PD PT VA)0.5	AlAu, NiGe, GePt, NiSi, PdSi, PdSn, PtSi
ALAU2_HT	MoSi2	tI6	I4/mmm	C11b	139	(AL AU)1(AL AU)2	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
ALAU2_LT	MoSi2	oP12, oP30	Pnma		62	(AL)1(AL AU CU)2	
ALAU4_HT	W	cI2	Im-3m	A2	229	(AL AU)1(AU)4	
ALAU4_LT	Au4Al	cP20	P213		198	(AL)0.2(AG AU)0.8	
AL3AU8	Yb8In3	hR132	R-3c		167	(AL)0.27(AU)0.73	
AL4CA	BaAl4	tI10	I4/mmm	D13	139	(AL)4(CA)1	
AL14CA13	Ca13Al14	mS54	C2/m		12	(AL)14(CA)13	
AL3CA8	Ca8In3	aP22	P-1		2	(AL)3(CA)8	
AL13CO4	Al13Co4	oP102	Pmn21		31	(AL)13(CO)4	
AL3CO				cub		(AL)3(CO)1	
AL5CO2_D811	Al5Co2	hP28	P63/mmc	D811	194	(AL)5(CO)2	
AL9CO2	Al9Co2	mP22	P2-1/c	D8d	14	(AL)9(CO)2	
ALCU_GAMMA_HT	Cu5Zn8			D82		(AL ZN)4(AL CU ZN)1(AG CU)8	Al4Cu9
ALCU_ETA	CuAl	mS20	C2/m		12	(AL CU)0.5(AG CU ZN)0.5	
CU6SN5_HT_NIAS	NiAs	hP4	P63/mmc	B81	194	(AG AU CO CU MN NI PD PT VA)1(AG AL BI CU GE IN NI PB SB SI SN)1 (CO CU MN NI PD VA)1	AlCu_D81, AuSn_Delta, BiNi, CoSb_Beta, Co3Sn2, Cu2In_HT, Cu6Sn5_HT, Ge3Ni5_HT, InNi2_HT, Mn(2-x)Sn, NiSb, Ni3Si2_HT, Ni3Sn2, Pb3Pd5_Gamma, PbPt, PdSb, Pd2Sn_HT, PtSn
ALCU_ZETA						(AG CU)0.55(AL IN)0.45	AlCu_Zeta, Cu11In9
AL2CU3_DELTA						(AL)0.4(AG CU)0.6	
ALMG_BETA	Mg28Al45	cF1832	Fd-3m		227	(MG)89(AL ZN)140	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
ALMG_GAMMA	Mg24Y5 / Al12Mg17	cI58	I-43m		217	(MG)5(AL MG ZN)12(AL MG ZN)12	
ALMG_EPS	Mg23Al30	hR159	R-3		148	(MG)23(AL ZN)30	
AL3NI2_D513	Ni2Al3	hP5	P-3m1	D513	164	(AG AL AU GA GE IN PD SN)0.6(AL AU IN NI PD PT)0.4(IN NI VA)0.2	Al3Ni2, Al3Pd2, Al3Pt2, Au3In2, Ga3Pt2, In3Ni2, In3Pd2, In3Pt2
AL3NI_D011	Fe3C	oP16	Pnma	D011	62	(AL PD PT)0.75(NI SI)0.25	Al3Ni, Pd3Si, Pt3Si_HT
AL3NI5	Pt5Ga3	oS16	Cmmm		65	(AL)0.38(NI)0.62	
AL21PT8_TI116	Pt8Al21	tI116	I41/a		88	(AL)21(PD PT)8	Al21Pd8, Al21Pt8
AL2PD5	Ga2Pd5	oP28	Pbmn		62	(AL)2(AL PD)5	
AL3PD		oP*	Pna21		33	(AL)3(PD)1	
ALPD	CsCl	cP2	Pm-3m	B2	221	(AL PD)1(PD VA)1	
AL3PD5_OP16	Rh5Ge3	oP16	Pbam		55	(AL IN)3(PD PT)5	Al3Pd5, Al3Pt5, In3Pd5
AL4PD		hP*	P6322		182	(AL)4(PD)1	
CO2SI_C23	Co2Si-b	oP12	Pnma		62	(AL CO IN PB PD SI SN ZN)1(AL CA CO NI PD PT SI)2	AlPd2, AlPt2, Ca2Sn, Co2Si, InPd2, Ni2Si, Pd2Sn, Pd2Zn
AL21PT5	Li21Si5	cF416	F-43m		216	(AL)0.81(PT)0.19	
COSI_B20	FeSi	cP8	P213	B20	198	(AL CO SI)0.5(CO PT SI)0.5	AlPt, CoSi
INSB_CF8	ZnS	cF8	F-43m		216	(AL AU IN)0.5(SB)0.5	AlSb, InSb
C15_LAVES	MgCu2	cF24	Fd-3m	C15	227	(AG AL AU CA CU)0.67(AL BI CA CU PB)0.33	Au2Bi, Au2Pb, Al2Ca
AU9IN4_GAMMA_D83	Cu9AL4	cP76	P-43m	D83	215	(AU CU)0.62(AL AU CU IN)0.08(AU AL CU IN SI)0.23(AL IN SI SN)0.08	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
AUIN_BETA						(AU)0.79(IN)0.21	
AUIN_BETA_PRIME	Co10Sb3	hP26	P63/m		176	(AU)0.78(IN)0.22	
AU7IN3	Au7In3	hP60	P-3		147	(AU)0.7(IN)0.3	
AUIN		aP*				(AU)0.5(IN SB SN)0.5	
AU10SN_D024	TiNi3	hP16	P63/mmc	D024	194	(AU GE IN SN)1	AuIn_Alpha1, AuSn_Beta
AUPB3	V3S	tI32	I-42m		111	(AU)0.25(PB)0.75	
AUSB2_C2	FeS2	cP12	Pa-3	C2	205	(AU CO NI PD)0.33(BI IN SB SN)0.67	AuSb2, CoSb2, NiSb2, PdSb2
AUSN2_OP24	AuSn2	oP24	Pbca		61	(AU CU PT)0.33(BI SN)0.67	AuSn2, Bi2Pt
AUSN_ZETA_PRIME	Au5Sn	hR18	R32		155	(AU)0.84(IN SN)0.16	
AUSN4_OS20	PtSn4	oS20	Ccce		68	(AU CU NI PD PT)0.2(IN PB PD SN)0.8	AuSn4, PdSn4, PtSn4
AU5ZN8_GAMMA	Cu5Zn8	cI52		D82		(AU NI ZN)2(AU NI SN ZN)2(AU NI SN ZN)3(SN ZN)6	
EPSILON_HCP	Mg	hP2	P63/mmc	A3	194	(AG AU BI CU IN PB SN ZN)1	AuZn9
AU3ZN_ALPHA1	Ag3Mg					(AU)3(AU ZN)1(ZN)1	
AU3ZN_ALPHA2	Au3Zn	oS32	Cmca		64	(AU)0.75(ZN)0.25	
AU4ZN_ALPHA3	Cu3Pd		Pn2n or Pnmn	Orthohombic	34 or 58	(AU)18(AU ZN)7(ZN)3	
AUZN3_GAMMA2	UH3	cP32	Pm-3n		223	(AU)1(ZN)3	
AUZN4_GAMMA3		hP*	P6/mmm		191	(AU)0.12(AU ZN)0.16(ZN)0.72	
AU5ZN3	Au5Zn3	oI128	Ibam		72	(AU)5(ZN)3	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
AU11ZN14						(AU)11(ZN)14	
AUZN	CsCl	cP2	Pm-3m	B2	221	(AU ZN)0.5(AU ZN)0.5	
AU15ZN85_EPSILON_PRIME						(AU)0.15(ZN)0.85	
BI3IN5_D81	In5Bi3	tI32	I4/mcm		140	(IN)0.62(BI SN)0.38	
BIIN2_HP6	Co1.75Ge	hP6	P63/mmc		194	(IN NI)1(IN NI SN)1(BI IN SN)1	BiIn2, InNi2_RT
BIIN_B10	InBi	tP4	P4/nmm		129	(BI SN)0.5(IN)0.5	
INSN_A6	In	tI2	I4/mmm		139	(BI IN PB SB SN)1	
BI3NI	NiBi3	oP16	Pnma		62	(BI)0.75(NI)0.25	
BI2PD	PdBi2	mS12	C12/m1		12	(BI)0.67(PD)0.33	
BIPD	PdBi	mP16	P1211		3	(BI)0.5(PD)0.5	
BI3PD5		hP16				(BI PD)1(VA)1	
BIPD3	Pd8Bi3	hR132	R3c		161	(BI)0.25(PD)0.75	
BI3PT2	NiAs	hP4	P63/mmc		194	(BI)3(PT)2	
BIPT	NiAs	hP4	P63/mmc		194	(BI)1(PT)1	
CA5PB3	Mn5Si3	hP48	P63mc	D88	186	(CA)0.62(PB)0.38	
CAPB	CuAu	tP4	P4/mmm	L10	123	(CA)0.5(PB)0.5	
CAPB3	Cu3Au	cP4	Pm-3m	L12	221	(CA)0.25(PB SN)0.75	
CA5SN3	Cr5B3	tI32	I4/mcm		140	(CA)0.62(SN)0.38	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
CA36SN23	Yb36Sn23	tP118	P4/mbm		127	(CA)0.61(SN)0.39	
CA31SN20	Pu31Pt20	tI204	I4/mcm		140	(CA)0.61(SN)0.39	
CA7SN6	Ca7Sn6	oP52	Pnma		62	(CA)0.54(SN)0.46	
CASN	CrB	oS80	Cmcm		63	(CA)0.5(SN)0.5	
CASN3	AuCu3	cP4	Pm-3m	L12	221	(CA)0.25(PB SN)0.75	
CDCU2	MgZn2	hP12	P63/mmc		194	(CD)1(CU)2	
CD3CU4	Cu136 (Cu0.5Cd0.5)48Cd97	cF1124	F-43m		216	(CD)0.43(CU)0.57	
CD8CU5	Cu5Zn8	cI52	I-43m	D82	217	(CU)2(CD CU)3(CU)2(CU CD)6	
CD10CU3	Co2Al5	hP28	P63/mmc	D811	194	(CD)0.77(CU)0.23	
CD3SB2						(CD)3(SB)2	Metastable phase Cd3Sb2
CO3GE	Cr3Si	cP8	Pm-3n		223	(CO)0.75(GE)0.25	
CO5GE2		hP*				(CO)0.71(GE)0.29	
CO5GE3	Co1.75Ge	hP6	P63/mmc		194	(CO VA)0.12(CO)0.5(CO GE)0.38	
CO5GE3_ALPHA		oP*	Pbnm		62	(CO)0.62(GE)0.38	
CO5GE7	Co5Ge7	tI24	I4mm		107	(CO)0.42(GE)0.58	
COGE	CoGe	mS16	C12/m1		12	(CO GE)0.5(CO GE)0.5	
COGE2	CoGe2	oS24	Cmce		64	(CO)0.33(GE)0.67	
COIN2	Mg2Cu	oF48	Fddd		70	(CO)1(IN)2	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
COIN3	IrIn3	tP16	P42/mnm		136	(CO)1(IN)3	
COSB3_DELTA	CoAs3	cI32	Im-3	D02	204	(CO NI)0.25(SB)0.75	
CO3SI_HT	Mg3Cd	hP8	P63/mmc		194	(CO CU NI SB SI SN)0.25(CO CU NI SN)0.25(CO CU NI)0.5	
CO2SI_HT						(CO SI)0.67(CO SI)0.33	
COSN_HP6	CoSn	hP6	P6/mmm		191	(CO NI)0.5(IN SN)0.5	CoSn, InNi
COSN3_OS32	PdSn3	oS32	Cmce		64	(CO PB PD)0.25(PD SN)0.75	CoSn3, PdSn3
COZN_LT	Mn	cP20	P4132	A13	213	(CO ZN)1(VA)	
COZN_HT	W	cI2	Im-3m	A2	229	(CO ZN)1(VA)	
COZN_GAMMA	Cu9Al4	cP52	P-43m	D83	215	(CO ZN)1(VA)	
COZN_DELTA						(CO)0.12(ZN)0.88	
COZN_GAMMA1	Zn7.8Co	mS28	C12/m1		12	(CO)0.12(ZN)0.88	
COZN_GAMMA2	Zn13Co	mS28	C12/m1		12	(CO)0.07(ZN)0.93	
CU9GA4_1	Cu9Al4	cP52	P-43m	D83	215	(CU)6(CU GA)3(CU GA)3(GA)1	
CU9GA4_2	CeCu2	cP52				(CU)3(CU VA)3(CU GA)3(GA)4	
CU9GA4_3		cP52				(CU VA)6(CU GA)3(GA)4	
CUGA2	FeSi2	tP3	P4/mmm		123	(CU)1(GA)2	
CUGA_THETA						(CU)0.78(GA)0.22	
CU3GE_ETA		mP8				(CU)0.75(GE)0.25	
CU3GE_EPSILON	Na3As	hP8	P63/mmc	D018	194	(CU)0.77(GE)0.23	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
CU3GE_THETA	BiF3	cF16	Fm-3m	L21	225	(CU)0.73(GE)0.27	
CU3IN_GAMMA	Cu9Al4	cP52	P-43m	D83	215	(AG CU)0.65(AG CU IN)0.12(IN SN)0.23	
CU2IN_LT						(CU)0.64(IN)0.36	
CU7IN3_DELTA	Cu7In3	cP40	P-1		2	(CU)0.7(IN SN)0.3	
CUPD	CsCl	cP2	Pm-3m	B2	221	(CU PD)0.5(CU PD)0.5(VA)1	
CU17SB3_HT	Mg	hP2	P63/mmc	A3	194	(CU)0.85(SB)0.15	
CU10SB3_HT	Cu10Sb3	hP26	P63/m		176	(CU)0.77(SB)0.23	
CU2SB	Cu2Sb	tP6	P4/nmm	C38	129	(CU)0.67(SB)0.33	
CU11SB3	Cu11Sb3	oS28	Amm2		38	(CU)0.8(SB)0.2	
CU33SI7_A13	Mn	cP20	P4132	A13	213	(CO CU ZN)0.84(SI ZN)0.16	
CU15SI4_EPSILON	Cu15Si4	cI76	I-43d	D86	220	(CU ZN)0.79(SI)0.21	
CU9SI2_DELTA		tP*				(CU ZN)0.82(SI)0.17	
CU19SI6_ETA		oS*				(CU ZN)0.76(SI)0.24	
CU3SN	Cu3Sn	oS80	Cmcm		63	(AU CU)0.75(CU IN SB SN)0.25	
CU41SN11	Cu41Sn11	cF416	F-43m		216	(CU)0.79(IN SN)0.21	
CU10SN3	Cu10Sn3	hP26	P63		173	(CU NI)0.77(SN)0.23	
CU6SN5_LT	Cu6Sn5	mS44	C12/c1		15	(CU)0.55(SN)0.46	
ZINCBLENDE_B3	ZnS	cF8	F-43m	B3	216	(GA)0.5(SB)0.5	
GENI3_HT	NaTl	cF16	Fd-3m	B32	227	(NI)0.74(GE)0.26	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
GE2NI5_HT	Pd5Sb2	hP84	P63/mmc		194	(NI)0.72(GE)0.28	
GENI2	Co2Si	oP12	Pnma	C23	62	(NI)0.67(GE)0.34	
GE3NI5_C2	Ni5Ge3	mC32	C121/C2		5	(NI PD)0.62(GE PB)0.38	Ge3Ni5, Pb3Pd5
GA6PT		oP*				(GA GE)0.86(PT)0.14	
GA7PT3	Ru3Sn7	cI40	Im-3m		229	(GA GE)0.7(PT)0.3	
GAPT	FeSi	cP8	P213	B20	198	(GA GE)0.5(PT)0.5	
GA3PT5	Pt5Ga3	oS16	Cmmm		65	(GA GE)0.38(PT)0.62	
GAPT2	Pt2Ga	oP24	Pmma		51	(GA GE)0.33(PT)0.67	
GAPT3	Cu3Au	cP4	Pm-3m	L12	221	(GA PT GE)0.25(GA PT)0.75	
GEPT3_MS16	Pt3Ge	mS16	C12/m1		12	(GA GE PT SI)0.25(NI PT)0.75	GePt3, Ni25Si9, Pt3Si_LT
GE2PT	CaCl2	oP6	Pnnm	C35	58	(GA GE)0.67(PT)0.33	
GE3PT2	Pt2Ge3	oP20	Pnma		62	(GA GE)0.6(PT)0.4	
GE2PT3	Pt3Ge2	oP40	Pnma		62	(GA GE)0.4(PT)0.6	
GEPT2	Fe2P	hP9	P-62m		189	(GA GE)0.33(PT)0.67	
IN9NI13	Ni13Ga9	mS44	C12/m1		12	(NI VA)1(IN SN)1(NI)1	
INNI_DELTA	CsCl	cP2	Pm-3m	B2	221	(NI VA)1(IN NI)1	
NI3SN_D019	Mg3Cd	hP8	P63/mmc	D019	194	(AU CO CU MN NI SN)0.75(IN NI SI SN)0.25	InNi3, Mn3Sn, Ni3Sn_LT
B2_INPD	CsCl	cP2	Pm-3m	B2	221	(AG IN PD)0.5(VA PD)0.5	
IN7PD3	Ru3Sn7	cI40	Im-3m		229	(IN)0.71(PD)0.29	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
INPD2_BETA						(IN)0.34(PD)0.66	
INPD3_ALPHA	CuAu	tP2	P4/mmm	L10	123	(IN)0.25(AG PD)0.75	
INPD3_BETA	ZrAl3	tI16	I4/mmm	D023	139	(IN)0.26(PD)0.74	
IN7PT3	Ru3Sn7	cI40	Im-3m		229	(IN)7(PT)3	
INPT	Cu	cF4	Fm-3m	A1	225	(IN PT)1(IN PT)1	
IN5PT6	CuAl	mS20	C12/m1		12	(IN PT)5(IN PT)6	
IN9PT13	Ni13Ga9	mS44	C12/m1		12	(IN)9(IN PT)13	
IN2PT3_ALPHA	Tl2Pt3	hP20	P63/mmc		194	(IN)2(PT)3	
IN2PT3_BETA	Co1.75Ge	hP6	P63/mmc		194	(IN PT)2(IN PT)3	
INPT2	Pt5Ga3	oS16	Cmmm		65	(IN)1(PT)2	
INSN_GAMMA	(Hg0.1Sn0.9)	hP1	P6/mmm		191	(BI IN PB SB SN)1	
MG5GA2	Mg5Ga2	oI28	Ibam		72	(MG)0.71(GA)0.29	
MG2GA	Mg2Ga	hP18	P-62c		190	(MG)0.67(GA)0.33	
MGGA	MgGa	tI32	I41/a		88	(MG)0.5(GA)0.5	
MGGA2	MgGa2	oP24	Pbam		55	(MG)0.33(GA)0.67	
MG2GA5	Mg2Ga5	tI28	I4/mmm		139	(MG)0.29(GA)0.71	
MG7ZN3	Mg51Zn20	oI158	Immm		71	(MG)51(ZN)20	
MGZN	Zr21Re25	hR276	R-3c		167	(MG)12(AL CU ZN)13	
MG2ZN3	Mg4Zn7	mS110	C12/m1		12	(MG)2(AL CU ZN)3	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
MG2ZN11	Mg2Zn11	cP39	Pm-3		200	(AL ZN)5(ZN)6(MG)2	
C14_LAVES	MgZn2	hP12	P63/mmc	C14	194	(AL MG ZN)2(AL MG ZN)1	MgZn2
MN3SN2	Ni3Sn2	oP20	Pnma		62	(MN)3(SN)2	
NI3SB_HT	BiF3	cF16	Fm-3m	D03	225	(SB)0.25(CO NI VA)0.5(NI VA)0.25	
NI5SB2_THETA	Ni5Sb2	mS28	C121		5	(CO NI)0.71(NI SB)0.29	
NI3SI_HT	Fe3C	oP16	Pnma	D011	62	(NI)3(SI)1	
NI3SI2	Ni3Si2	oS80	Cmc21		36	(NI)3(SI)2	
NI5SI2	Ni31Si12	hP43	P321		150	(NI)5(SI)2	
NI3SN4	Ni3Sn4	mS14	C12/m1		12	(CU NI)0.25(IN NI SN)0.25(IN SN)0.5	
NIZN_TP2	CuTi	tP2	P4/mmm	L2a	123	(CU NI PD ZN)0.5(NI PD ZN)0.5	NiZn, PdZn
NIZN8_DELTA	Zn22Ni3	mS50	C12/m1		12	(NI)1(ZN)8	
PBPD3	AuCu3	cP4	Pm-3m	L12	221	(PD)0.75(PB PD)0.25	
PB3PD5_BETA						(PD)1(PB)1(PD VA)1	
PB9PD13	Pd13Pb9	mS88	C12/c1		15	(PD)0.59(PB)0.41	
PBPD	PdPb	aP32	P-1		2	(PD)1(PB)1	
PBPT3	Cu3Au	cP4	Pm-3m	L12	221	(AL NI PB PT SI)0.25(AL NI PT)0.75	
PB4PT	PtPb4	tP10	P4/nbm	D1d	125	(PB)0.8(PT)0.2	
PD3SB	NaTl	cF16	Fd-3m	B32	227	(PD SB)3(SB)1	
PD20SB7	Pd20Sb7	hR81	R-3		148	(PD)20(SB)7	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
PD8SB3	Yb8In3	hR132	R-3c		167	(PD)8(SB)3	
PD5SB2	Pd5Sb2	hP42	P63cm		185	(PD)5(SB)2	
PD2SB	Pd2As	oS24	Cmc21		36	(PD)2(SB)1	
PD5SB3		oP16				(PD SB)5(PD SB)3	
PD21SI4						(PD SI)21(SI)4	
PD5SI	Pd3P0.68	mP24	P1211		4	(PD)5(SI)1	
PD14SI3						(PD)14(SI)3	
PD9SI2	Pd9Si2	oP44	Pnma		62	(PD)9(SI)2	
PD15SI4						(PD)15(SI)4	
PD2SI_ALPHA						(PD SI)2(SI)1	
PD2SI_BETA	Fe2P	hP9	P-62m		189	(PD SI)2(SI)1	
PD39SI20						(PD)39(SI)20	
PD19SI10						(PD)19(SI)10	
PD3SN	Cu3Au	cP4	Pm-3m	L12	221	(PD SN)0.75(PD SN)0.25	
PD20SN13	Pd13Sn9	hP66	P3121		152	(PD SN)0.6(PD SN)0.4	
PDSN2	PdSn2	tI48	I41/acd		142	(PD SN)0.33(SN)0.67	
PD3SN2_ALPHA						(PD)0.6(SN)0.4	
PD3SN2_BETA						(PD)3(SN)2	
PD3SN2_GAMMA						(PD)0.59(SN)0.41	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
PDZN_GAMMA	Zn9(Zn0.5Fe0.5)2Fe2	cI52	I-43m		217	(PD ZN)2(PD ZN)9	
PDZN_BETA	CsCl	cP2	Pm-3m	B2	221	(PD ZN)1(PD ZN)1	
PDZN2	Zn25(Zn0.33Pd0.67)Pd2	oS48	Cmmm		65	(PD)1(ZN)2	
PDZN_ETA						(PD)0.09(ZN)0.91	
PT7SB	CuPt7	cF32	Fm-3m		225	(PT)0.86(SB)0.12	
PT3SB	ZrAl3	tI16	I4/mmm	D023	139	(PT)0.75(SB)0.25	
PT3SB2	Pt3Sb2	oI20	Ibam		72	(PT)0.6(SB)0.4	
PTSB	NiAs	hP4	P63/mmc	B81	194	(PT)0.5(SB)0.5	
PTSB2	FeS2	cP12	Pa-3	C2	205	(PT)0.33(SB)0.67	
PT5SB	AuCu3	cP4	Fm-3m	L12	225	(PT SB)0.83(PT SB)0.17	
PT2SI_LT_ALPHA	ThH2	tI6	I4/mmm		139	(PT)0.67(SI)0.33	
PT2SI_HT_BETA	Fe2P	hP9	P-62m		189	(PT)0.67(SI)0.33	
PT6SI5	Pt6Si5	mP22	P121/m1		11	(PT)0.55(SI)0.46	
PT5SI2						(PT)0.71(SI)0.29	
PT17SI8_BETA	Ni12P5	tI34	I4/m		87	(PT)0.68(SI)0.32	
PT17SI8_ALPHA	Pt12Si5	tP68	P4/n		85	(PT)0.68(SI)0.32	
PT25SI7						(PT)0.78(SI)0.22	
PT2SN3	Pt2Sn3	hP10	P63/mmc		194	(PT)0.4(SN)0.6	
PT3SN	Cu3Au	cP4	Pm-3m	L12	221	(PT)0.75(SN)0.25	

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
SBSN_B1_NACL	NaCl	cF8	Fm-3m	B1	166	(BI GE IN SB SN)0.5(BI GE IN PB SB SN)0.5	
SB2SN3						(SB)0.4(AG SN)0.6	
SB9ZN11_GAMMA						(SB)0.45(ZN)0.55	
SB19ZN31_ETA		oP30	Pmmn		59	(SB)0.38(ZN)0.62	
SB4ZN6_ZETA	Zn2.83Sb	oP192	Pccn		56	(SB)0.4(ZN)0.6	
SB17ZN23_LT	Zn5.38Sb5	hR66	R-3c		167	(SB)0.42(CD ZN)0.57	
SB17ZN23_HT						(SB)0.42(ZN)0.57	
SBZN	CdSb	oP16	Pbca	Be	61	(SB)0.5(CD ZN)0.5	
AGINPD						(AG)0.16(IN)0.26(PD)0.58	Ag-In-Pd ternary phase, AgInPd
AL3CU5ZN2	Cu3.2 (Zn0.18Al0.82)4Al0.9	hR27	R-3m		166	(AL CU)1(AL)4(CU)4(ZN)1	Al-Cu-Zn ternary phase, Al3Cu5Zn2
ALMGZN_PHI	Mg21(Zn,Al)17	oP152	Pbcm		57	(MG)6(AL ZN)5	Al-Mg-Zn ternary phase, PHI
T_PHASE	(Al,Zn)49Mg32	cI162 or cI160	Im-3		204	(MG)26(AL MG)6(AL MG ZN)48(AL)1	Solution (Al,Zn)49Mg32, stable in Al-Mg-Zn
AUBISN						(AU)0.48(SN)0.11(BI SN)0.41	Au-Bi-Sn ternary phase, AuBiSn
AUCOSN4	Ni3Sn4	mS14	C12/m1		12	(AU)0.15(CO)0.25(SN)0.6	Au-Co-Sn ternary phase, AuCoSn4
AU2CU2SN	La2Sb	tI12	I4/mmm		139	(AU)0.4(CU)0.4(SN)0.2	Au-Cu-Sn ternary phase, Au2Cu2Sn
AU4IN3SN3	Pt2Sn3	hP10	P63/mmc	D5b	194	(AU)0.4(IN SN)0.3(IN SN)0.3	Au-In-Sn ternary phase, Au4In3Sn3

Name	Prototype	Pearson	Spacegroup	Strukturbericht	SG#	Sublattice	Notes
AUNI2SN4	AuNi2Sn4	hR21	R-3m		166	(SN)0.57(AU)0.14(NI)0.29	Au-Ni-Sn ternary phase, AuNi2Sn4
AUPT2SN4_TAO		mS*				(AU)1(PT)2(SN)4	Au-Pt-Sn ternary phase, AuPt2Sn4
CU77INSN23						(CU)0.77(IN SN)0.23	Cu-In-Sn ternary phase, Cu77InSn23
CU2IN3SN						(CU)0.33(IN)0.5(SN)0.17	Cu-In-Sn ternary phase, Cu2In3Sn
CUNI2SN						(CU)0.23(NI)0.5(SN)0.27	Cu-Ni-Sn ternary phase, tao 2
CU4MNSN						(CU)0.67(SN)0.17(MN)0.17	Cu-Mn-Sn ternary phase,Cu4MnSn
GA11GEPT7						(GA)0.58(GE)0.05(PT)0.37	
GA3GEPT8	Co2Si-b	oP12	Pnma		62	(GA GE)0.33(PT)0.67	
GAGEPT6	Ir3Si	tI16	I4/mcm	D0'c	140	(GA GE)0.25(PT)0.75	
INNI6SN5	C2MoU					(NI)1(IN SN)1	In-Ni-Sn ternary phase, InNi6Sn5

TCSLD4 Properties Data

Model Descriptions

For more information about the various thermophysical models, and when in Thermo-Calc, press F1 to search the online help. The details are found under a *General Reference* section.

You can find information on our website about the properties that can be calculated with Thermo-Calc and the Add-on Modules. Additional resources are added on a regular basis so keep checking back or subscribe to our newsletter.

Examples

Go to the Solder Alloys Databases page on our website where you can access an examples collection and the technical information plus learn more about the compatible kinetic database. Also explore further applications of Thermo-Calc to solders including links to resources such as examples, publications, and more.

TCSLD: TCS Solder Alloy Solutions Database Revision History

Current Database Version

Database name (acronym):	**TCS Solder Alloy Solutions Database (TCSLD)**
Database owner:	**Thermo-Calc Software AB**
Database version:	**4.1**
First release:	**TCSLD1 was released in 2010**

Changes in the Most Recent Database Release

TCSLD4.0 to TCSLD4.1

Software release 2022a (December 2021/January 2022)

- Sn-Bi binary system is updated.
- More viscosity and surface tension parameters were added. All thermodynamically assessed systems now have VISC/SURF parameters.
- Viscosity of Ag-Au is re-assessed and added for Ag-Au-Cu.
- The description of the molar volume of BCT_A5 Sn is corrected.

Previous Releases

TCSLD3.3 to TCSLD4

Software release 2021b (June 2021)

Addition of surface tension and viscosity thermophysical property data.

TCSLD3.2 to TCSLD3.3

Software release 2020b (June 2020)

- Added 3 binary systems Ga-Bi, Ga-Sb, Ga-In

TCSLD3.1.1 TO TCSLD3.2

Software release version: 2017a (March 2017)

- Ca is added together with some Ca-related systems: Al-Ca, Ca-Sn, Ca-Pb, Ca-Pb-Sn
- Added the Mg-Sn and Mg-Pb binary systems.
- Added the Bi-Cu-Sb ternary system.
- Updated the Ag-Au-Cu system.

TCSLD3.1 TO TCSLD3.1.1

Released with the 2015b update in March 2016.

- Thermodynamic assessments of the Ga-Ge and Ga-Pt binary systems are added.
- Thermodynamic descriptions of the Ag-Cu-Pd and Ga-Ge-Pt ternary systems are included.

TCSLD3.0 TO TCSLD3.1

Software release version: 2015b (December 2015)

- Volume data for the liquid phase are updated for some Ag/Bi/Cu/In-containing binary systems and a few Ag-containing ternary systems.
- Thermodynamic description of the Au-Pb-Sn ternary system is added.

TCSLD2 TO TCSLD3.0

Software release version: 2015a (June 2015)

- Volume data, including molar volume and thermal expansion, have been added in TCSLD3. This allows for the calculations of volume fraction of phases, density, thermal expansion and lattice parameters etc.
- Four elements, Cd, Ga, Mg, Mn, have been added in TCSLD3. The thermodynamic assessments of the Ag-Ga, Al-Ga, Al-Mg, Cd-Cu, Cd-Pb, Cd-Sb, Cd-Sn, Cd-Zn, Cu-Ga, Cu-Mn, Ga-Mg, Ga-Sn, Ga-Zn, Mn-Sn, Mg-Zn binary systems have been implemented. The following ternary systems have also been assessed: Al-Ga-Zn, Al-Mg-Zn, Cd-Pb-Sn, Cd-Sb-Zn, Cu-Mn-Sn, Ga-Sn-Zn.

TCSLD1 TO TCSLD2

Software release version: 4.0 (June 2014)

The thermodynamic assessments of the Ge-Pt and Pt-Sb binary systems have been included in TCSLD2. The descriptions of Ag-Ge, Ag-Pd, Al-Au, Al-Bi, Al-Co, Al-Si, Au-Bi, Au-Co, Au-Ge, Au-Sb, Bi-Cu, Bi-Ni, Bi-Sn, Co-Ge, Co-Zn, Cu-Ge, Cu-Pb, Cu-Zn, Ge-Ni, Ge-Sb, In-Pb, Ni-Sn, Ni-Zn, Pb-Pt, Pb-Sb, Pb-Zn have been updated, taking into account newly available experimental data and/or the compatibility in higher order systems. In most cases, especially when it is important, the phases having the same crystal structure have been merged as the same phase.

The following ternary systems have been implemented in TCSLD2: Ag-Au-Ge, Ag-In-Pd, Al-Cu-Sn, Al-Ge-Zn, Al-Sn-Zn, Au-Cu-Sb, Au-Ge-Sn, Co-Ni-Sb, Cu-Ni-Sn, Ge-Sb-Sn, In-Pb-Sn, Pb-Sb-Sn, Pb-Sn-Zn. The descriptions of Ag-Au-Pb, Ag-Au-Sn, Ag-Bi-Sn, Ag-Cu-In, Ag-Sb-Sn, Ag-Sb-Zn, Ag-Sn-Zn, Al-Bi-Sn, Al-Bi-Zn, Al-Cu-Zn, Au-Bi-Sn, Au-In-Sb, Au-In-Sn, Au-Ni-Sn, Au-Sb-Sn, Bi-In-Sn, Bi-Sb-Sn, Cu-In-Sn, Cu-Si-Zn, In-Ni-Sn, In-Sb-Sn have been updated on a basis of critical evaluation of available experimental and theoretical data. Please note that minor revisions have also been made on many other binary and ternary systems.