



Brazing Alloy and Industrial Silver Alloy Catalogue



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Heritage

The Thessco Group is one of the world's largest manufacturers of Silver Brazing Alloys, Metal Joining Products and Industrial Silver Alloys. Our head office and production site is located in Sheffield, UK with sales offices and warehousing in Paris to serve our European customers.

The manufacture of precious metal alloys has been carried out on our site in Sheffield since 1760. This history, knowledge and experience, coupled with modern computer controlled manufacturing processes ensure that the production of all of our products is to the highest standards.

All Thessco alloys are produced to the British and International quality standards, with precise manufacturing control – both chemically and metallurgically. The Thessco Quality Management System is registered to ISO 9001 : 2015.

At Thessco the manufacturing of alloys starts with the control of the raw materials such as Silver, Copper and Zinc, as well as many other elements to provide a wide range of standard and special alloys.

Alloys are melted using Continuous Casting methods for larger demand alloys or individual electric induction melting for specific manufactured alloys. The alloys are analytically and metallurgically controlled during and after casting to ensure that tight controls on alloy composition, impurity limits, metallurgical structure and physical properties are all maintained to ensure the alloys meet the customers' requirements.

Thessco has a highly capable Technical team who can study and develop specific alloys to solve any technical issues. Our knowledge and experience are a guarantee of our quality and by working with you our research laboratories are constantly developing new products to anticipate future market requirements.



General Purpose Silver Brazing Alloys

These alloys are the optimum choice for a large range of industrial metal joining applications. The free-flowing properties of these alloys, coupled with good joint strengths means that they find use when joining dissimilar parent metals (e.g. stainless steel, mild steels, brasses, bronzes and copper) in a wide range of environments, from industrial cooling to food and pharmaceutical manufacture.

The use of a suitable flux for the parent metal / brazing alloy combination is a requirement for these alloys (see table 5 on page 7 for further guidance).

Table 1 details the alloys that are silicon free and generally preferred by UK manufacturers. Table 2 details the equivalent silicon containing alloys that are generally preferred by European manufacturers.

TABLE 1

Thessco Grade	ISO 17672:2016	Nominal Composition (%)					Melting Range (°C)	
		Silver	Copper	Zinc	Tin	Silicon	Solidus	Liquidus
H12	Ag720a	72	28				780	780
M26T	Ag 156	56	22	17	5.0		620	655
M25T	Ag 155	55	21	22	2.0		630	660
M15T	Ag 145	45	27	25.5	2.5		640	680
M10T	Ag 140	40	30	28	2.0		650	710
M8T	Ag 138	38	32	28	2.0		650	720
M4T	Ag 134	34	36	27.5	2.5		630	730
M0T	Ag 130	30	36	32	2.0		665	755
L18T	Ag 125	25	40	33	2.0		680	760

TABLE 2

Thessco Grade	ISO 17672:2016	Nominal Composition (%)					Melting Range (°C)	
		Silver	Copper	Zinc	Tin	Silicon	Solidus	Liquidus
CS114	Ag 156Si	56	22	17	5.0	0.15	620	655
CS111	Ag 155Si	55	21	22	2.0	0.15	630	660
CS91	Ag 145Si	45	27	25.5	2.5	0.15	640	680
CS81	Ag 140Si	40	30	28	2.0	0.15	650	710
CS77	Ag 138Si	38	32	28	2.0	0.10	650	720
CS71	Ag 134Si	34	36	27.5	2.5	0.10	630	730
CS61	Ag 130Si	30	36	32	2.0	0.15	665	755
CS51	Ag 125Si	25	40	33	2.0	0.15	680	760



Flux-Coated Silver Brazing Alloy Rods

The most popular of the General Purpose Silver Brazing Alloys can be supplied with an especially formulated flux coating which is designed to be particularly fluid and active as the flux is applied relatively late in the brazing cycle. These rods offer the advantages of consistency, safety and convenience when compared to using a bare rod and separate flux paste.

These rods are typically supplied with a white flexible flux coating, however other colours may be available and it is also possible to apply printing to the rods.

We can also offer different ratios of flux to rod dependent on your requirements – please consult our Sales Office for further details of the products available.



Ternary Brazing Alloys

These alloys are generally less fluid than the General Purpose Silver Brazing Alloys and their higher brazing temperatures lead to increased demands on the flux used with these alloys.

For this reason they are generally not supplied in a flux-coated form as premature flux exhaustion can result in increased post-braze cleaning costs.

These alloys have a greater strength above 200°C than the General Purpose Silver Brazing Alloys and are used where this is a design consideration.

Table 3 details the alloys that are silicon free and are generally preferred by UK manufacturers.

Table 4 details the equivalent silicon containing alloys that are generally preferred by European manufacturers.

TABLE 3

Thessco Grade	ISO 17672:2016	Nominal Composition (%)				Melting Range (°C)	
		Silver	Copper	Zinc	Silicon	Solidus	Liquidus
H3		63	24	13		690	730
H0		60	26	14		695	730
M14	Ag 244	44	30	26		675	735
M13		43	37	20		690	770
M0	Ag 230	30	38	32		680	765
L18	Ag 225	25	40	35		700	790
T50	Ag 225Si	25	40	35	0.15	700	790
L7		14	51	35		810	835

Available in –Rods & Wire – 0.8mm to 6mm Strip & Foil – from 0.08mm to 3mm thickness Powders & Paste. Safety Data Sheets are available on request.

TABLE 4

Thessco Grade	ISO 17672:2016	Nominal Composition (%)				Melting Range (°C)	
		Silver	Copper	Zinc	Silicon	Solidus	Liquidus
T124		63	24	13	0.15	690	730
T120		60	26	14	0.15	695	730
T88	Ag 244Si	44	30	26	0.15	675	735
T60	Ag 230Si	30	38	32	0.15	680	765
T50	Ag 225Si	25	40	35	0.15	700	790
L13S/T40	Ag 220Si	20	44	36	0.15	690	810
T28		14	51	35	0.15	810	835
L5S/T24	Ag 212Si	12	48	40	0.15	800	830



Flux

The correct choice of flux is the key to good brazing practice and many problems arise from the incorrect selection or ineffective application of flux. A good match between the flux and the brazing alloy / parent metal combination is essential if strong, sound joints are to be produced.

The flux layer performs the critical function of cleaning and protecting the surface of the parent metal during brazing, and so facilitates the 'wetting' and flow of the brazing alloy.

Not only is it important that the proper flux is selected, but also that sufficient flux is applied to the joint area to provide protection throughout the

brazing cycle. A further benefit is, that if excess flux is applied in the immediate joint area, oxidation of adjacent surfaces may be prevented, so reducing post-brazing cleaning costs.

As a guide, the flux selected should be active at least 50°C below the solidus and 50°C above the liquidus of the brazing alloy selected.

Our range of fluxes is available as either powder or paste in a range of packaging. Please consult your Sales Office for technical support.

Specialist fluxes are available for specific customer requirements.

Safety Data Sheets and further information are available on request.

TABLE 5

Thessco Grade	Operating Range (°C)	Characteristics			Forms Available
		Fluidity	Activity	Life	
General Purpose					
Y	550-750	Good	High	Medium	Powder & Paste
U	600-800	Good	High	Med/Long	Powder & Paste
F	650-850	Moderate	Moderate	Long	Powder & Paste
B	750-1000	Moderate	Moderate	Very Long	Powder
HT	750-1200	Moderate	Moderate	Very Long	Powder
Special Application					
U1R	500 - 800	Good	High	Medium	Paste
U25R	500 - 750	Good	High	Medium	Powder
U4 (Gas Application)	550 - 800	Very Good	Medium	Medium	Paste
S1R	500 - 800	Moderate	Medium	Med/Long	Paste
H1R	550 - 880	Moderate	Moderate	Very Long	Paste
H35R	700 -1000	Good	Medium/High	Very Long	Powder & Paste
AL 5	530 - 600	Moderate	Medium/High	Medium	Powder
F670	200 - 400	Very Good	High	Medium	Liquid
Special Purpose					
C	450-700	Very Good	Very High	Short	Powder



Phosphorus Brazing Alloys – Self Fluxing

Brazing with Silver-Copper-Phosphorus and Copper Phosphorus alloys is widely used for the joining of Copper to Copper where the absence of a flux is a major benefit. The self-fluxing action of the Phosphorus ensures that flux entrapment problems are largely avoided and that high standards of joint soundness can be maintained.

High Phosphorus levels give excellent capillary penetration since the fluidity of the molten brazing alloy is controlled by the Phosphorus content. Alloys with high Phosphorus content are less ductile than those with lower Phosphorus and higher Silver contents.

For applications where optimum mechanical strength, or resistance to vibration, is required the lower Phosphorus alloys are necessary (ie Phos 5, Phos 2, Phos OR). The tin-containing alloy, Phos 0T, offers controlled fluidity, a low melting point and joints of good appearance. Phosphorus containing alloys should not be used on Ferrous or Nickel based parent alloys as they will result in brittle joints. This family of alloys can also be used for brazing high copper content alloys, providing that a suitable flux is used. Phos 6N/F67 is designed for Gas Approved Applications. Phos 15 is available in Strip form for the brazing of Electrical contact material.

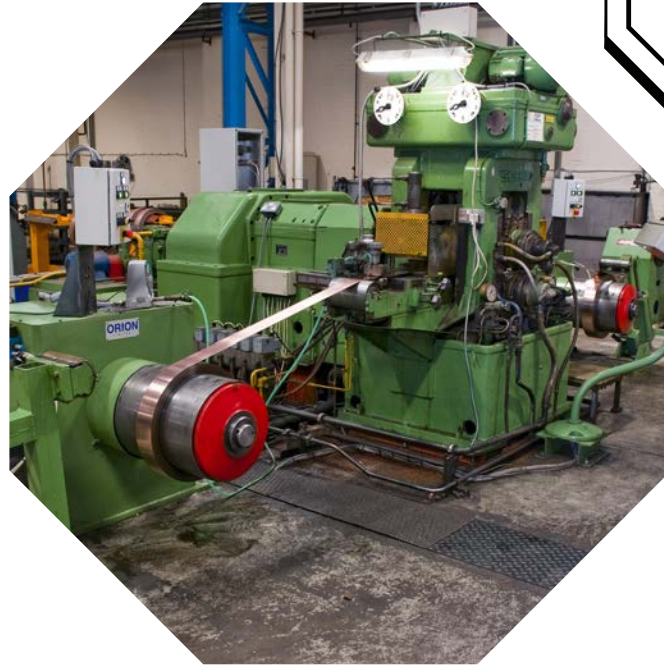
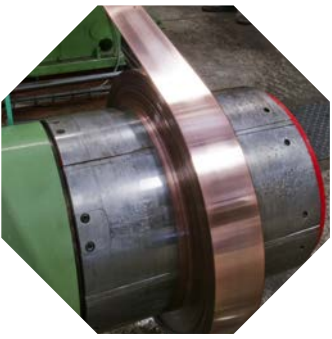
TABLE 6

Thessco Grade	ISO 17672:2016	Nominal Composition (%)				Melting Range (°C)	
		Silver	Copper	Phos	Other	Solidus	Liquidus
Phos 15	CuP284	15.0	80.0	5.0		645	800
Phos 6N/F67 ATG	CuP283a	6.0	86.6	7.3	Ni 0.1	643	813
Phos 6	CuP283	6.0	86.8	7.2		643	813
Phos 5	CuP281	5.0	89.0	6.0		645	815
Phos 2	CuP279	2.0	91.7	6.3		645	825
Phos 0	CuP182		92.2	7.8		710	770
Phos 0L	CuP180		93.0	7.0		710	820
Phos 0R	CuP179		93.8	6.2		710	890
Phos 0A	CuP389		92.0	6.0	Sb 2.0	690	825
Phos 0T	CuP386		86.2	6.8	Sn 7.0	650	700

Available in –Rods & Wire – 1mm to 5mm Strip & Foil – from 0.08mm to 3mm thickness

Other Alloys are available subject to customer requirement.

Safety Data Sheets are available on request. Printing on rods is also available –subject to customers’ requirements’



High Temperature Copper Alloys

These alloys find their main application in joining Tungsten Carbide pieces to Steel shanks for rockdrill bits.

CZ7 is used extensively in the manufacture of Masonry Drill bits.

TABLE 7

Thessco Grade	Nominal Composition					Melting Range (°C)		ISO 17672 Specifications	Comments
	Ag	Sn	Cu	Zn	Other	Solidus	Liquidus		
CZ5	1		58	bal	Si 0.3	850	870		Brazing cast-iron steel copper
CZ6			60	bal	Si 0.3	875	895	Cu 470a	
CZ7			59	bal	Si 0.3	870	890		Also includes Mn0.7%

CZ5 is also available as Flux-Coated material. Safety Data Sheets are available on request.



Soft Solders

Special Applications

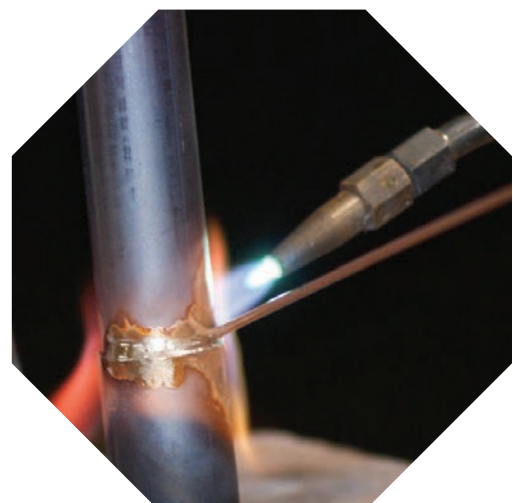
Alloys can be produced as solid or flux cored wire (Flux content 0.5-3.5%), bars or pre-forms. ST400 and ST300 are recommended for use in environments where 'soft' water would corrode conventional tin-lead solders.

The Silver containing alloys resist Silver migration when soldering silver plated components. Special Alloys can be produced upon customers' request.

TABLE 8

Thessco Grade	Nominal Composition					Melting Range (°C)		ISO 17672 Specifications	Comments
	Ag	Sn	Cu	Zn	Other	Solidus	Liquidus		
ST400	4	96				221	224	28	Good colour match for INOX
ST350	3.5	96.5				221	221	28	Good for narrow joint gaps
ST300	3	97				221	225	29	
SC300		97	3			230	250	24	Higher temperature resistance
SC1000		90	10			221	295		
SC4000		60			Pb40	183	190	2	Large Gap Filling Properties
SL300		97			Pb3				Unsuitable for plumbing use

Other materials are available upon request – please consult your Sales Office.
Safety Data Sheets are available on request





Industrial Products Range

The Thessco Group also manufactures Silver Products in different forms for various Industrial applications:

- Silver Electrical Contact Materials
- Silver Sheets and Strips – full range of sizes
- Silver Wires and Sections
- Silver Powders – grain size up to 3mm packed in pots or drums
- Silver Alloys for Water Purification
- Silver Anodes, Sheets, Gold and Silver Salts for the Electroplating Industry

- Silver Tubing
- Alloys for the Silversmithing Industry of guaranteed Hallmarking Quality
- Refining and Recovery Service – our own Refinery produces the highest purity silver, Internationally registered on the London Bullion Market Association as 'Thessco 999 and Thessco 9999'

For further information regarding our full range of products please contact your Sales Office.



Industrial Silver and Contact Materials

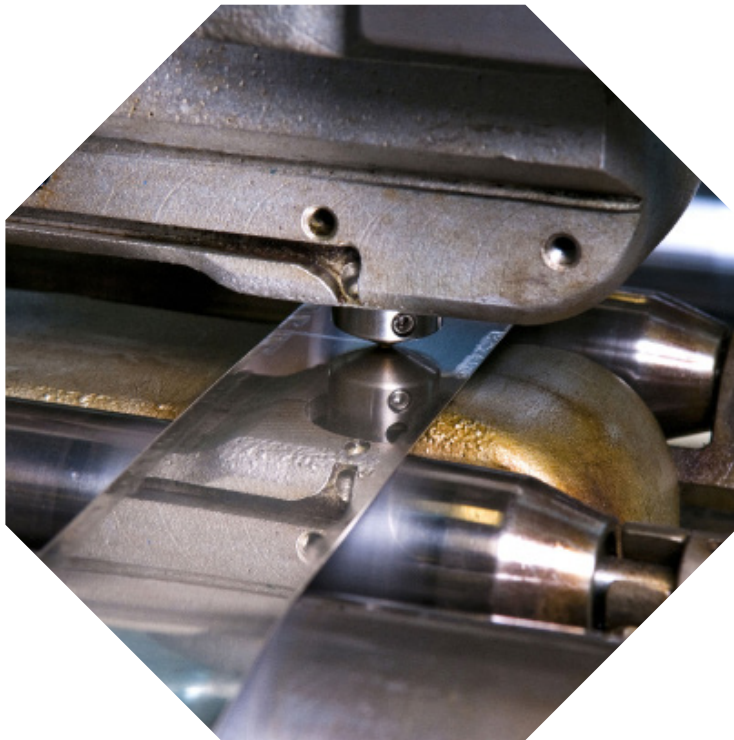
Silver is used both as an individual high purity metal and is also alloyed with other metals for use industrially and decoratively for a vast variety of applications – all using the physical and technical attributes of fine silver in their application.

Industrially, Silver and its alloys are used when consistent electrical conductivity and resistance are necessary physical characteristics in the parts being manufactured. For instance, electrical fuses and resistors and temperature sensitive devices are all produced using fine silver and its alloys.

A substantial use for silver is in the manufacture of electrical contacts. It is used as a prime material as fine silver, and is also alloyed with various metals to produce reliable, consistent contact pieces used throughout the electrical industry for the making and breaking of electrical current in switches and other electrical current interrupting devices. The electrical conductivity of the Silver, and its ability to dissipate heat are the prime physical characteristics of Silver-bearing contacts, and other metals used in partnership alloys give the end product extra durability and strength not found in Fine Silver alone.

Typical examples of Industrial Silver Applications:

- The manufacture of Electrical Contacts covering all ranges of electrical loadings.
- Silver alloys are used for Fusible Safety devices.
- Pure Silver is used for Medical / Electrical units ie Heart Monitors & Pacemakers
- Silver Alloy Tubing is used in Medical Appliance manufacture. Various scopes and other medical instruments are used because of Silver's limited infection risk and the malleability of the raw material.
- 9999 Silver is used in the manufacture of Sea-Water batteries and Under-water buoys.
- Silver Alloys are used in Musical Instrument manufacture.
- Pure Silver is used in the manufacture of decorative Architectural glass.
- Pure Silver is used as an electrical Anode in Water Purification.
- Silver is used universally for its decorative finish and also for its durability in the production of practical everyday food and drink articles and objets d'art of both simple and highly complex shapes and designs.
- Fine Silver is used in many Chemical and Pharmaceutical products and their preparation.



Silver Copper Alloys

Silver has the highest electrical conductivity and the highest thermal conductivity of any metal. In this respect it is the best contact material available. It is, however, rarely recommended for use in light-duty applications because of its tendency to tarnish.

The voltage at heavier duties is normally sufficient to break down these sulphide films so that their presence does not affect contact performance.

The addition of copper to Fine Silver has the beneficial effect of increasing hardness and arc-resistance. These alloys have better anti-welding properties for applications up to 100A, but are not as good as Silver-Nickel on "make". At the same time, however, contact resistance increases as does tarnishing.

TABLE 9

MATERIAL	DENSITY g/cc	ANNEALED Hv	SOLIDUS °C	ELECTRICAL CONDUCTIVITY %IACS	ELECTRICAL RESISTIVITY μΩ.cm
Fine Silver (99.99%)	10.5	26	962	107	1.59
Fine Silver (99.97%)	10.5	26	962	106	1.6
Fine Silver (99.9%)	10.5	26	962	106	1.6
Contact Grade Silver	10.5	30	960	95	1.8
Silver 3% Copper	10.4	65	900	91	1.9
Silver 7.5% Copper	10.4	75	800	86	2.0
Silver 10% Copper	10.3	80	779	86	2.0
Silver 20% Copper	10.2	85	779	86	2.0
Silver 28% Copper	10.0	100	779	82	2.1
Silver 50% Copper	9.7	110	779	82	2.1

Silver Nickel Alloys



Nickel is only soluble in Silver up to 0.15% and as a consequence most of the alloys in this group of materials are produced by powder metallurgical techniques. This range of materials plays an important role as a heavier-duty material than Fine Silver.

They have a relatively low contact-resistance and high resistance to arc-erosion, especially when switching direct current. Its resistance to welding is superior to that of Fine Silver, but inferior to that of Silver- Metal Oxide in applications over 100A.

TABLE 10

MATERIAL	DENSITY g/cc	ANNEALED Hv	SOLIDUS °C	ELECTRICAL CONDUCTIVITY %IACS	ELECTRICAL RESISTIVITY Ω.cm
Silver 0.15% Nickel	10.5	40	962*	102	1.8
Silver 10% Nickel	10.2	50	962*	86	2.0
Silver 15% Nickel	10.1	55	962*	82	2.1
Silver 20% Nickel	10.0	60	962*	78	2.2
Silver 30% Nickel	9.8	75	962*	69	2.5

*Incipient fusion of conduction phase begins at 962°C. Forms available – Wire 1mm – 6mm dia. Strip sizes on request

Silver Metal Oxide Alloys

Silver Metal Oxide systems are used for heavier duty applications.

They are suitable for switching currents up to 3000A.

SILVER CADMIUM OXIDE

Cadmium Oxide confers an anti-welding property to an electrical contact. The higher the oxide content the more resistant to sticking or welding it becomes. Two different methods are used to manufacture these products – CADOSIL is produced from Silver Cadmium Oxide powders which are blended, compacted and sintered. The CADOSIL grades are predominantly supplied in wire form, their even

structure being particularly suited to contact heading applications.

The CADOSIL SB grades are supplied in strip forms. GD materials are produced by the internal oxidation of a Silver Cadmium alloy. This product is typically supplied in sheet or strip form. The SB designation denotes that a Silver backing has been bonded to one side to assist subsequent joining processes. Silver Cadmium Oxide Tips are also available.

With increasing Cadmium Oxide content the arc-resistance, hardness and contact resistance increase as well as weld resistance, but there is also a decrease in the ductility and conductivity of the material. Silver Cadmium Oxide

alloys are weld resistant up to 3000A and have low arc-erosion when switching 100 to 3000A. They have good arc-

extinguishing properties which, above 70A, are better than other metal oxide systems.

TABLE 11

MATERIAL	DENSITY g/cc	ANNEALED Hv	SOLIDUS °C	ELECTRICAL CONDUCTIVITY %IACS	ELECTRICAL RESISTIVITY μΩ.cm
Cadosil 10 (Ag10CdO)	10.0	85	962	83	2.08
Cadosil 12 (Ag12CdO)	9.9	90	962	78	2.21
Cadosil 15 (Ag15CdO)	9.8	90	962	75	2.30
Cadosil 10SB (Ag10CdO)	10.0	85	962	83	2.08
Cadosil 15SB (Ag15CdO)	9.8	95	962	75	2.30
GD MATERIALS					
GD 25 (Ag10CdO)	10.0	60	962	82	2.10
GD35 (Ag15CdO)	9.8	65	962	75	2.30
GD25SB (Ag10CdO)	10.0	60	962	82	2.10
GD35SB (Ag15CdO)	9.8	65	962	75	2.30

SILVER TIN OXIDE

These alloys are chemically produced and processed by powder metallurgical techniques. The oxide content ranges from 8 to 12%. Tin oxide alone does not confer the required electrical characteristics and so it is used in combination with other oxides to

tailor the properties to the application. The most popular grades are those using Bismuth Oxide to give good arc quenching characteristics and a consistent contact resistance throughout the life of the contact. They are generally supplied as silver-backed strips.

TABLE 12

MATERIAL	DENSITY g/cc	ANNEALED Hv	SOLIDUS °C	ELECTRICAL CONDUCTIVITY %IACS	ELECTRICAL RESISTIVITY μΩ.cm
GT 92 BC	9.7	70	962	84	2.00
GT 90 BC	9.6	75	962	82	2.10
GT 88 BC	9.5	80	962	80	2.20

Industrial Silver Materials – Wire and Strips

We can provide Rods from 1mm to 65mm and Wires from 0.05mm diameter to 6mm, available as coiled / spooled to customer requirements.

Strips can be produced at a wide range of sizes to customer specifications and tolerances, either annealed or with required hardness. Maximum width up to 200mm x 0.1mm; minimum width down to 1mm x 0.025mm.



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