THE Student Essential
Technical Guide

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Hints & Tips
Soldering

For large scale soldering a small furnace may be used to provide sufficient uniform heat to the workpiece

TECHNIQUES

There are two general techniques used to apply solid solder:

- **Preplacement -** small pieces of solder are placed at the joint seam prior to heating. Heat is then applied until the solder flows into the joint.
- **Feeding -** the fluxed joint is heated to temperature and the tip of the solder wire is fed into the joint and should melt on contact. Using both these techniques the part of the joint to which the molten solder is required should be heated more strongly than the remainder ensuring the solder will flow towards the hottest section. Continued flame impingement on the molten solder may result in the vaporisation of lower melting point constituents. Higher temperatures may then be required to complete the joint. The time and temperature required to complete a joint must be kept to a minimum.

FLUX

Gold and silver flux residues may normally be removed by soaking in hot water. Any further residues that persist may then be removed by brushing. In difficult cases the workpiece should be impressed in 5 - 10% sulphuric acid solution for 2 - 5 minutes, rinsed in hot water and brushed again.

For mass production, batch or conveyer type furnaces may be used. However, the quantities of components to be soldered must be large enough to justify the relatively high capital expenditure and development of a method for each particular soldering operation. All workpieces can be successfully finished by the standard practices and processes currently available. It must be noted that powdered borax does not always meet the requirements for all applications where the extensive range of solders now available may be used.

Top 10 *Frequently Asked Questions*

Q. WHAT THICKNESS WIRE DO I NEED TO MAKE JUMP RINGS, AND SHOULD IT BE HARD OR SOFT?

A. The most popular size for jump rings is approximately 0.8mm. Half hard or hard is the ideal temper to use.

Q. WHY USE SOLDER PASTE?

A. Rather than buy separate solder and flux, solder paste comes conveniently mixed together in a syringe.

To solder an item of jewellery simply apply the paste to the item that needs soldering, remove excess paste, apply heat to solder as normal.

Using solder paste ensures that you do not have to apply flux and solder separately. The syringe aids easy application and helps remove the often tricky problem of getting the solder to balance on the item before it is soldered. Plus the solder paste mix ensures that solder will not 'jump' off the item when heat is applied.

Q. HOW DO YOU FIT CHAIN INTO CHAIN ENDS - CRIMP OR SOLDER?

A. The best and strongest method is to solder - using hard solder will provide extra strength.

Q. I'M MAKING A PENDANT/BROOCH, WHAT THICKNESS SHEET DO I NEED?

A. 1.0mm sheet is a good place to start because it is easy to manipulate and provides a manageable thickness to work with.

Q. HOW DOES YOUR SCRAP SERVICE WORK?

A. Cookson have been processing jewellery and dental scrap for over 10 years and as the UK's largest Bullion dealer you are guaranteed a reliable, fast and efficient service. We assay our own scrap in house as per our own exact high product specification.

Our dedicated staff can offer you expert advice in dealing with your scrap and are backed by the industries leading technical / analytical team.

Q. HOW MUCH MATERIAL DO YOU NEED TO MAKE A WEDDING RING?

A. This very much depends on the size ring you require.

Cookson Precious Metals Ltd provide a handy conversion chart (see page 10) which does all the hard work for you – providing you with a comparison of:

- British & European Finger sizes
- Internal Diameter (mm & in)
- Internal Circumference (mm)
- Remember the size gives an internal measurement; you will have to increase the length when using a thick metal gauge

Q. HOW DO I USE GIMP?

A. How to use gimp to protect silk and bead cord, plus strengthen your strand

Here's how:

- String the first three beads.
- Carefully cut about 6mm (1/4'') of the Gimp and string it onto your bead cord. Next string one end of the clasp on to cord.
- Leave 100mm (4'') of cord between the needle and the three beads. Thread the cord back through the first bead. The wire will form a loop on which the clasp rests.
- Tie a single knot with both cords between the first and second beads, pulling tightly to secure the knot. String and secure the second knot in the same way.
- Then string through the third bead and trim the excess. Secure each of these end knots with glue.
- String the rest of the strand. Repeat steps 1-5 on the final three beads. (Don't leave extra cord between beads at this end).

Q. WHY DOES MY SOLDER NOT RUN FREELY?

A. Check that the joint is clean, and that there is no flux on the surface.

Q. WHY HAVE A HALLMARK?

A. Items of jewellery are hallmarked to identify what type of precious metal the piece is made from. Gold, Silver and platinum are all hallmarked.

Items of Silver jewellery which weight below 7.78g, gold items below 1g and Platinum items below 0.5g are exempt and do not require a hallmark. Hallmarks can only be marked by one of the four official assay offices - Birmingham, London, Sheffield & Edinburgh, with each office having its own unique mark.

The Assay offices test all items which require marking, taking a small sample to complete the test. The test confirms the legal standards of fineness or purity. Once happy with the result they will apply the appropriate hallmark to the item

Q. WHAT SOLDER SHOULD I USE WHEN SOLDERING 9CT YELLOW TO SILVER?

A. When soldering 9ct to Silver you can use either Silver or 9ct solder. However if the item is to be hallmarked you must bare in mind the solder must be of hallmarkable quality, and the item will be assayed as the metal with the lowest hallmark, in this instance Silver.

Borax (999 098) or Auflux (998 108) are ideal fluxes for this process.

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Silver – *Avoiding Firestain*

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FIRESTAIN OCCURS WHEN THE COPPER CONTAINED IN SILVER ALLOYS IS OXIDISED DURING ANNEALING OR SOLDERING.
It can be seen as a dark stain on the surface of the metal after polishing. Light firestaining can usually be polished out, or may respond to pickling in a bath of 10% sulphuric acid or another proprietary pickle, however silver plating may be the only answer to heavy firestain.

IF A PROTECTIVE ATMOSPHERE IS NOT AVAILABLE TO CARRY OUT ANNEALING OPERATIONS, THE FOLLOWING STEPS CAN BE TAKEN:
Avoid prolonged heating wherever possible. Ensure that a large enough flame is used to get soldering and annealing jobs completed in the minimum amount of time. The entire workpiece can be coated with a flux which will form a glassy coat on the metal, protecting it from the atmosphere. Use a large, bushy flame when annealing, which allows the job to be completed quickly and provides a slightly reducing atmosphere.

Removing Firestain

Sterling Silver is supplied fire free. Annealing under oxidising conditions, for example in air, will discolour the surface of the silver due to the oxidation of the base metal present, e.g. copper. Copper oxide particularly, is hard and brittle and, if it is not removed from the surface, can be forced into the silver by subsequent working to create hard spots. Cracking may occur in these oxide rich areas during spinning operations. Oxides are removed from the surface by pickling the annealed silver in hot dilute (10%) sulphuric acid. Their presence in the final workpiece produces unsightly fire stains that are extremely difficult and sometimes impossible to remove during finishing or polishing operations.

The silver should be pickled after every anneal that is carried out in air. It is strongly recommended that protective atmospheres are used wherever possible to prevent the formation of surface oxides. Alternatively, Argo-tect may be used to minimise the formation of oxide on or near the surface of silver items being heated under oxidising conditions. The proper use of Argo-tect gives a continuous protective film over the piece. Very deep firestain may require mechanical action to remove it.

Hammered *Effect*

HOW DO I CREATE A HAMMERED EFFECT ON METAL?

To create a hammered effect, the metal that needs to be textured first should be annealed and then held on either a steel stake or flatbed. Before you start hammering, the hammers used should be cleaned to remove any oil or dirt as these will mark the metal. There should be direct contact made through the end of the hammer, the metal and the steel stake. It is also best to work on the metal directly from above, when the hammer is at an angle, it can leave deep marks in the metal which are difficult to remove. As the metal is worked, it does harden so the piece might be required to be annealed again.

To mark the Silver, use a Ball-Pein Hammer (code 999 89P), planishing hammer (code 999 89S or 999 89X).

Which *Solder?*

WHICH SOLDER TO USE - GOLD, SILVER AND (PARTICULARLY) PLATINUM

Solders are typically classified according to their melting points - "easy", "medium" and "hard", referring to the ease of melting the solder. Hence an "easy" solder melts before a "hard" one and this can be used where a sequence of joints are to be made.

Usually a solder must conform to the same hallmarking rules as the metal being joined - for example, a 9ct solder must contain at least 37.5% gold. However, there are some concessions, which are: Platinum solders must contain at least 95% precious metals by weight, chosen from Silver, Gold, Platinum, Palladium, Iridium and Osmium. There is no minimum platinum content specified. Solders for White Golds may be hallmarked on concession down to 50% Gold content. 22ct solder must contain at least 80% Gold.

Basic *Polishing guide*

Polishing can be completed by hand or by machine. However, in either case there are a few standard stages that are usually followed. You can achieve a variety of finishes on metal, including highly polished, matt and textured.

FINISHING

The first step in finishing is filing to remove surface marks from the metal and get the desired shape. Files take away a lot of metal, so care must be taken. It is a good idea to try and keep the piece as unmarked as possible by this stage as no amount of final polishing will remove deep scratches.

Then a variety of abrasives can be used to continue the filing stage. Sandpaper is available in varying grades to remove surface marks. It can also be used on sticks, taped down flat or on pendant drill mandrels, etc. This helps to ensure that all surfaces of the piece are reached. There are also various pendant drill attachments that can be used, e.g. rubber abrasives etc. Water of Ayr stones are lightly abrasive and are used with water. Care must be taken at all stages not to take away too much metal by overworking the piece.

Textured and matt finishes can be achieved at any stage of this process, by using punches, heating methods, frosting wheels, pendant drill attachments etc. The best way to clean up a textured surface is using bristle brushes by hand or machine, polish is optional with these brushes.

THE VARIOUS POLISHING COMPOUNDS AVAILABLE COME IN TWO MAIN TYPES:

- Tripoli Lustre, or equivalent grade polishes, for general-purpose use, with a fairly high abrasive content. The best mops to use with Tripoli are the calico mops, which can be loaded with polish and cleaned with mop rakes.
- Rouge, coming in various grades/types for different metals and used with calico mops or for final polishing the softer reflex type mops.

These polishes can be used by hand or on mops/brushes etc. for machine polishing. A variety of mops / brushes and felts can be used. However the most important rule is never to mix polishes on mops, always keep polishes and polishing tools separate and wash the metal being polished between stages.

Always use eye, breathing and hand protection when using polishing machinery and make sure you have nothing that could catch in the machinery, e.g. hair, clothing, jewellery etc.

Table of *Comparative weights*

To use the table below, simply take the unit figure of the metal to which comparison is required and then follow the line to the right or left of this figure that is the relative weight unit for the chosen metal. Typically, a silver model may be made for subsequent casting using the cuttlefish method producing a casting in 18ct Yellow Gold HB.

	PURE PLAT.	FINE GOLD	22ct DS	18ct MW	18ct HB	14ct AY	GW PD	9ct DF	STERLING	COPPER	BRASS	WAX
Pure Platinum	1.00	0.90	0.83	0.75	0.72	0.60	0.54	0.52	0.48	0.42	0.40	0.05
Fine Gold	1.11	1.00	0.92	0.84	0.80	0.67	0.60	0.58	0.53	0.47	0.45	0.05
22ct DS	1.21	1.08	1.00	0.91	0.87	0.73	0.66	0.63	0.58	0.51	0.49	0.06
18ct MW	1.33	1.19	1.10	1.00	0.96	0.80	0.72	0.69	0.64	0.56	0.54	0.06
18ct HB	1.39	1.25	1.15	1.05	1.00	0.84	0.75	0.72	0.66	0.58	0.56	0.06
14ct AY	1.65	1.48	1.37	1.25	1.19	1.00	0.90	0.86	0.79	0.69	0.67	0.08
GW Palladium	1.84	1.65	1.52	1.39	1.32	1.11	1.00	0.96	0.88	0.77	0.75	0.09
9ct DF	1.92	1.72	1.59	1.45	1.38	1.16	1.04	1.00	0.92	0.80	0.78	0.09
Sterling Silver	2.09	1.87	1.73	1.57	1.50	1.26	1.14	1.09	1.00	0.87	0.84	0.10
Copper	2.39	2.14	1.98	1.80	1.72	1.44	1.29	1.24	1.14	1.00	0.97	0.11
Brass (90/10)	2.47	2.22	2.05	1.86	1.78	1.49	1.35	1.29	1.18	1.03	1.00	0.11
Wax	21.50	19.30	17.80	16.20	15.50	13.00	11.70	11.20	10.30	9.00	8.70	1.00

The model of a man's signet ring has been made out of silver and weighs 7.9 grammes. Looking at the table along the sterling silver horizontal line and then matching this with the intersection of the 18ct Yellow Gold HB gives the number 1.50.

So, the approximate weight of a similar ring cast in 18ct HB would be:

7.90 grammes x 1.50 = 11.85 grammes in 18ct Yellow HB Gold.

Unit *Conversion*

Multiply the known unit by the figure to the right of the measurement you desire. For instance, how many grains are in 3 carats?

known	x	# from chart	=	answer
3	x	3.0865	=	9.2595

CARATS	to grains	x 3.0865
	to grams	x 0.2
	to milligrams	x 200
GRAINS	to carats	x 0.324
	to grams	x 0.0648
	to milligrams	x 64.799
	to oz, avoir	x 0.002286
	to oz, troy	x 0.00208
	to pennyweight	x 0.04167
GRAMS	to carat	x 5
	to grains	x 15.4324
	to oz, avoir	x 0.03527
	to oz, troy	x 0.03215
	to pennyweight	x 0.64301
KILOGRAMS	to oz, avoir.	x 35.274
	to oz, troy	x 32.1507
	to pennyweight	x 643.015
	to lb, avoir	x 2.2046
	to lb, troy	x 2.6792
OZ, AVOIRDUPOIS	to grains	x 437.5
	to grams	x 28.3495
	to oz, troy	x 0.91146
	to pennyweight	x 18.2291
	to lb, troy	x .07595
OZ, TROY	to grains	x 480
	to grams	x 31.1035
	to oz, avoir	x 1.0971
	to pennyweight	x 20
	to lb, avoir	x 0.06857
PENNYWEIGHTS (DWT)	to grains	x 24
	to grams	x 1.5551
	to oz, avoir	x 0.05486

LB, AVOIRDUPOIS	to grains	x 7000
	to grams	x 453.59
	to kilogram	x 0.4536
	to oz, troy	x 14.5833
LB, TROY	to gram	x 373.242
	to kilogram	x 0.3732
	to oz, avoir	x 13.165
	to lb, avoir	x 0.82286
FEET	to centimetres	x 30.48
	to metres	x 0.3048
METRES	to feet	x 3.2808
	to inches	x 29.37
	to yards	x 1.0936
MILLIMETRES	to feet	x 0.00328
	to inches	x 0.03937
	to centimetres	x 2.54
	to metres	x 0.0254
	to millimetres	x 25.4
CUBIC CM	to cubic inches	x 0.061
	to US £1. oz.	x 0.0338
	to cu cm	x 16.387
	to litres	x 0.01639
	to US £1.oz.	x 0.554
US GALLONS	to litre	x 3.785
	to cubic inches	x 231
	to cubic feet	x 0.1337
LITRES	to US gallon	x 0.2642
	to US quart	x 1.0567

Information that will see you through every year of course.

Ring *Sizing*

FINGER SIZE		INTERNAL DIA.		INTERNAL
British	Euro	mm	ins	Circum. mm
A		12.1	0.48	37.5
	38	12.1	0.48	
A½		12.3	0.48	38.4
	39	12.4	0.49	
B		12.5	0.49	39.0
B½		12.7	0.50	39.6
	40	12.7	0.50	
C		12.9	0.51	40.2
C½	41	13.1	0.51	40.8
D		13.2	0.52	41.4
	42	13.4	0.53	
D½		13.4	0.53	42.0
E		13.6	0.54	42.6
	43	13.7	0.54	
E½		13.8	0.54	43.2
	44	14.0	0.55	
F		14.0	0.55	43.8
F½		14.2	0.56	44.4
	45	14.3	0.56	
G		14.4	0.57	45.0
G½		14.6	0.58	45.6
	46	14.6	0.58	
H		14.8	0.58	46.2
	47	15.0	0.59	
H½		15.0	0.59	46.8
I		15.2	0.60	47.4
	48	15.3	0.60	
I½		15.4	0.61	48.0
	49	15.6	0.61	
J		15.6	0.61	48.6
J½		15.8	0.62	49.2
	50	15.9	0.63	
K		16.0	0.63	49.8
K½		16.2	0.64	50.4
	51	16.2	0.64	
L		16.4	0.65	51.0
	52	16.6	0.65	
L½		16.6	0.65	51.6
M		16.8	0.66	52.2
	53	16.9	0.66	
M½		17.0	0.67	52.8
N		17.2	0.68	53.5
	54	17.2	0.68	

FINGER SIZE		INTERNAL DIA.		INTERNAL
British	Euro	mm	ins	Circum. mm
N½		17.4	0.68	54.1
	55	17.5	0.69	
O		17.6	0.69	54.7
O½		17.8	0.70	55.4
	56	17.8	0.70	
P		18.0	0.71	56.0
	57	18.1	0.71	
P½		18.2	0.72	56.7
Q		18.4	0.72	57.3
	58	18.5	0.73	
Q½		18.6	0.73	57.9
R		18.8	0.74	5
	59	18.8	0.74	
R½		19.0	0.75	59.2
	60	19.1	0.75	
S		19.2	0.75	59.9
S½		19.4	0.76	60.5
	61	19.4	0.76	
T		19.5	0.77	61.1
	62	19.7	0.78	
T½		19.7	0.78	61.8
U		19.9	0.79	62.4
	63	20.1	0.79	
U½		20.1	0.79	63.0
V		20.3	0.80	63.7
	64	20.4	0.80	
V½		20.5	0.81	64.3
	65	20.7	0.81	
W		20.7	0.82	64.9
W½		20.9	0.82	65.5
	66	21.0	0.83	
X		21.1	0.83	66.1
X½		21.3	0.84	66.7
		21.3	0.84	66.7
Y		21.5	0.85	67.3
	68	21.6	0.85	
Y½		21.7	0.85	67.9
Z		21.9	0.86	68.5
	69	22.0	0.86	
Z½		22.1	0.87	
Z+1		22.3	0.88	
Z+2		22.7	0.89	
Z+3		23.1	0.91	

Metal Gauge *Conversion Chart*

Inch	Nearest Metric Equivalent	Birmingham Metal Gauge
0.001	0.025	-
0.0012	0.03	-
0.0016	0.04	-
0.002	0.05	-
0.0024	0.06	-
0.0028	0.07	-
0.0032	0.08	-
0.0036	0.09	-
0.004	0.10	-
0.0044	0.11	-
0.0048	0.12	-
0.005	0.12	-
0.0052	0.13	-
0.006	0.15	-
0.0065	0.17	-
0.0068	0.17	-
0.007	0.18	-
0.0076	0.19	-
0.008	0.20	-
0.0084	0.21	-
0.0085	0.22	1
0.009	0.23	-
0.0092	0.23	-
0.0095	0.24	2
0.010	0.25	-
0.0105	0.27	3
0.0108	0.27	-
0.011	0.28	-
0.0116	0.30	-
0.012	0.31	4
0.0124	0.32	-
0.013	0.33	-
0.0136	0.35	-
0.014	0.36	5
0.0148	0.38	-
0.015	0.38	-
0.016	0.41	6
0.0164	0.42	-
0.017	0.43	-
0.018	0.46	-
0.0185	0.47	-
0.019	0.48	7
0.020	0.51	-
0.0215	0.55	8

Inch	Nearest Metric Equivalent	Birmingham Metal Gauge
0.022	0.56	-
0.024	0.61	9
0.025	0.64	-
0.027	0.69	-
0.028	0.71	10
0.030	0.76	-
0.032	0.81	11
0.033	0.84	-
0.035	0.89	12
0.036	0.91	-
0.038	0.97	13
0.039	0.99	-
0.040	1.02	-
0.042	1.07	-
0.043	1.09	14
0.046	1.17	-
0.048	1.22	15
0.049	1.24	-
0.051	1.30	16
0.055	1.40	17
0.056	1.42	-
0.058	1.47	-
0.059	1.50	18
0.060	1.52	-
0.062	1.58	19
0.064	1.63	-
0.065	1.65	20
0.067	1.70	-
0.069	1.75	21
0.072	1.83	-
0.073	1.85	22
0.074	1.88	-
0.077	1.96	23
0.080	2.03	-
0.082	2.08	24
0.083	2.11	-
0.086	2.18	-
0.090	2.29	25
0.091	2.31	-
0.092	2.34	-
0.095	2.41	-
0.0966	2.44	-
0.100	2.54	26
0.102	2.59	-
0.104	2.64	-
0.109	2.77	-
0.110	2.79	-
0.112	2.85	27
0.116	2.95	-
0.120	3.05	-
0.121	3.07	-
0.124	3.15	28
0.128	3.25	-
0.134	3.40	-