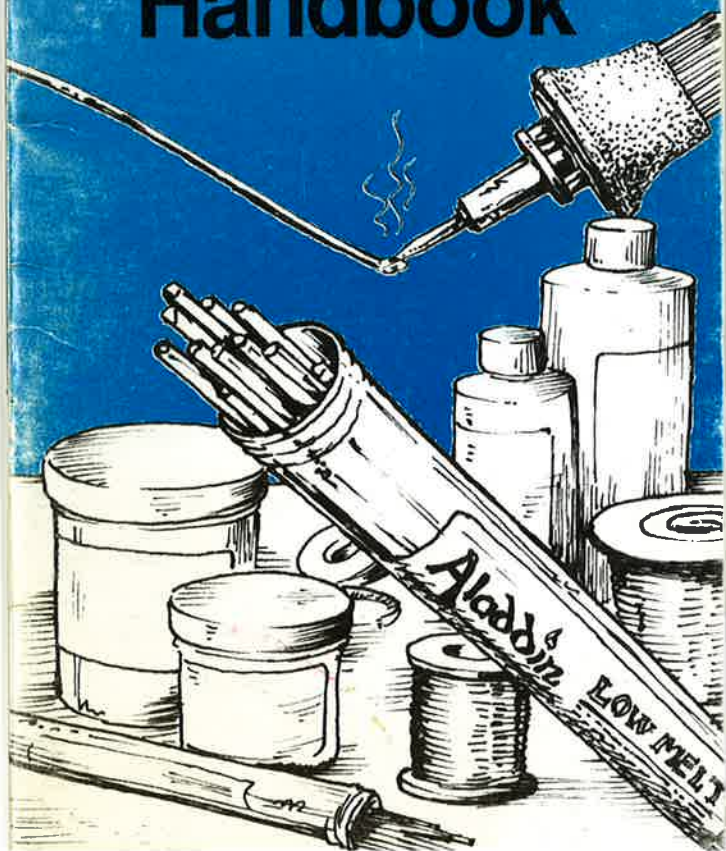
Aladdin
WELDING PRODUCTS, INC.

Your Soldering & Brazing Handbook



About Aladdin Welding Products, Inc.

Aladdin Welding Products, Inc. has grown from one man's dream in 1929 to a welding supply company with expanded global marketing. With Aladdin's specialized experience in the joining processes of White Metal as well as Aluminum, we can easily say that these processes are different, but not difficult.

Soldering and brazing conditions vary and can present special problems. Our 67 years of experience, as well as our extensive reference library, allow us to provide answers to your questions as the need arises.

Today, our list of quality products for the low temperature field of soldering and brazing includes:

- Aladdin 3-in-1 Rod
- Low Melt Aluminum Solder
- Galvanizing Bar
- Aluminum, silver, tin alloy solders in spools, paste and kits
- Several types of flux
- Stainless steel and fiberglass brushes
- Soapstone Pencils
- "Mini" Torch
- "Helping Hands" jig

Created from the original notes of Gordon L. Hill, by his daughter Jeanine, prior to his death in 1994

Warning

Be aware of all factors involved in soldering that could have an influence on your health and safety. Soldering and brazing materials (alloys, fluxes) may produce fumes which are hazardous to your health.

Remember to:

- Read and understand manufacturer's instructions.
- Follow standard safety policies and procedures.
- Work only in a properly ventilated area.
- Wear appropriate eye, ear and body protection.
- Material Safety Data Sheets are available on all Aladdin products by calling 1-800-645-3413.

NOTE:
Although statements, information and statistics in this handbook are believed to be reliable and accurate, Aladdin Welding Products, Inc. does not accept any responsibility for the use that may be made of the information, or for errors that may occur.

Table of Contents

How to use this booklet

To best serve you, we have attempted to provide complete and accurate information about our products and how to use them.

Within these pages you will find tables of materials, specifications, conditions for use and application, special tips on soldering, and brazing techniques for a wide variety of applications. Also, we provide a glossary to help you understand the terms commonly used in the field of soldering and brazing, located on page 22.

Please contact us if you have questions:

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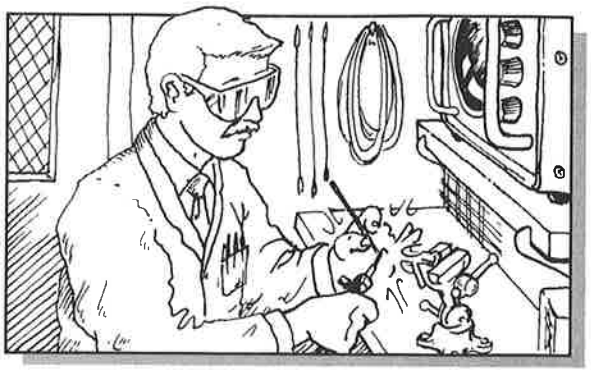
FAX: (616) 243-9233 • (800) 645-3414

Personal Service for over 60 years

The Fundamentals of Soldering

Soldering is a process which joins metals using a filler metal that melts at a lower temperature than the metals being joined. (Solder melts at less than 840°F or 450°C). The solder is distributed between closely fitted surfaces of the joint by capillary action.

NOTE:
Capillary action works best with joint clearances of .001" and .005"



To achieve a proper and sound soldered joint, the following steps should be taken:

- **Joint Design and Fitting:** Design the joint to be soldered so that the clearance between the parts being joined allows the solder to be drawn in between them by capillary action. Secure the parts to be joined in Aladdin's "Helping Hands" adjustable jig.
- **Precleaning** (See page 5)
- **Flux Application** (See page 6)
- **Heat Application** (See page 6)
- **Solder Application** (See page 7)
- **Cool the Joint** (See page 8)
- **Flux Residue Removal** (See page 19)

The Soldering Process

Precleaning

All metal surfaces should be cleaned before assembly to insure a sound soldered joint. There is a much better chance of obtaining a sound joint if all grease, paint, oil, dirt, rust, and oxides have been removed. Flux should not be considered a substitute for precleaning either by chemicals or by mechanical means.

Surfaces can also be prepared by sanding, grinding, filing, cleaning with steel wool, or wire brushing prior to being soldered.

REMEMBER:
Covering the surface with flux is no substitute for thorough precleaning.

Some base metals may also require pre-coating to facilitate the soldering process. Tin, tin-lead, tin-zinc, tin-copper, copper, silver, iron and nickel can be used for this purpose. Pre-coating affords the following advantages:

- the soldering process is more uniform and quicker.
- strong acid fluxes can be avoided.

Pre-coating is especially important in working with aluminum, aluminum bronzes, cast iron and high alloyed steels.

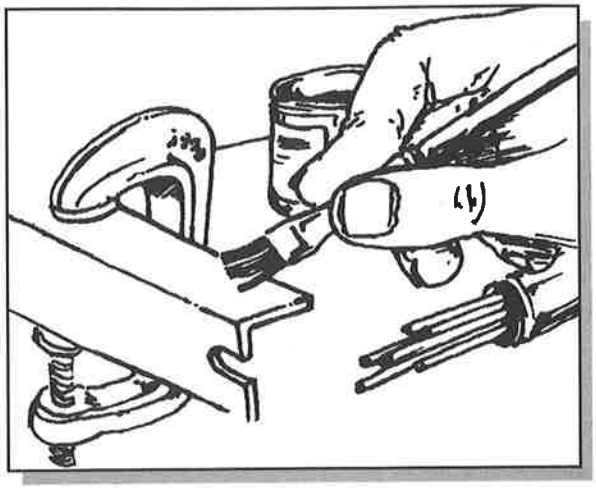
Quick Tips . . .

- *Aluminum can be soldered more successfully once oxides are removed by tinning the surface with an Aladdin's #49 "Knuckle-Saver" stainless steel brush.*

Flux Application

Flux is applied to the surfaces to be soldered. This flux should have the following characteristics:

- Be fluid and effective in absorbing oxides and other contaminants that might be present at soldering temperatures.
- Be a barrier to re-oxidation of the metal surface that has been cleaned.
- Promote wetting of the surface by the solder.



Heat Application

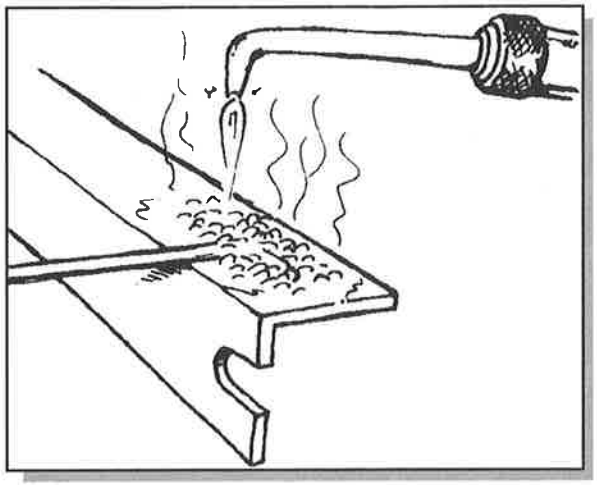
After applying flux, the next step in a soldering operation generally is the application of heat. It is very important to select the proper heating method to heat the metals to soldering temperature before applying the solder.

A number of different heating methods can be used, including:

- Soldering iron—ideal for electronics industry, cast iron, sheet lead, tin, copper, base metals, precious metal coatings
- Torch—copper base metals, tin, cast iron
- Dip Soldering—copper base metals; cast iron

Quick Tips . . .

- *Avoid a "sooty" flame when soldering with a torch. Such conditions prevent the solder from flowing properly.*



Solder Application

Soldering takes place in two steps:

1) wetting the metal surfaces.
2) filling the gap between the wetted surfaces with solder.

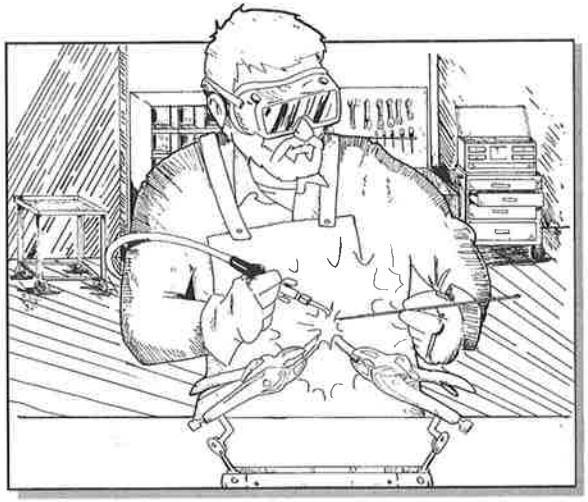
A popular misconception about soldering is that a large amount of solder is required to make a strong, sound joint, but it has been proven that the best joint contains a minimum amount of solder. The strength of a soldered joint depends instead on the effectiveness of the bond between the soldered surfaces.

Cooling the Joint

Once a joint has been soldered, control the cooling process to prevent excessive deformation of the joint.

Proper cooling may be achieved by conducting the heat away from the assembly or by a water spray (or dip) or by an air blast. The method of cooling can be varied to suit the individual soldering job.

HINT:
Aladdin's "Helping Hands" can be extremely helpful for proper jigging of a joint to be soldered and cooled.



Tips for Special Materials

● **Magnesium** can be soldered, but soldering is generally only used for filling small surface defects in castings or small dents in sheets.

Magnesium can easily be joined with Aladdin's AZ61A or AZ92A Magnesium rod or wire and Aladdin's #75 Magnesium Welding Flux.

Use Aladdin's AZ61A for:
- Structural shapes
- Sheet and Castings
- Shipping dock boards
- Motor housings

Use Aladdin's AZ92A for:
- Aircraft parts
- Exotic magnesium metals

● **Aluminum** can be easily soldered with one of the following Aladdin products:

#31 Aladdin 3-in-1 Rod

Uses:
- Kirksite dies
- Power tools
- Aluminum radiators
- Propellers
- Castings
- Boat hulls

#604 Aluminum Solder with
#1 Low Temperature Liquid Soldering Flux

Uses:
- Refrigeration coils
- Other pressure-tight applications

#33 Low Melt Aluminum Solder with
#585 Super Soldering Flux

Uses:
- Refrigeration work
- Pins holes in aluminum castings
- Joining aluminum to dissimilar metals

See the Aladdin White Metal Handbook for

● **Stainless Steel** can be easily soldered with Aladdin's #450 Soft Silver Solder and Aladdin's #3 Soft Soldering Flux. 432° F.

Uses:

- Electrical work
- Utensils
- Dairy and food equipment

Although Stainless Steel can be more difficult than other common soldering because:

- it has a tightly adhering oxide film, or
- it has a lower thermal conductivity.

Aladdin's #450 and #3 simplify the joining process of Stainless Steel.

As with most soldering processes, pre-cleaning is especially important. Polished stainless steel should be roughened prior to soldering. A stronger flux is then necessary to remove the oxide film.

Aladdin's tin-lead solders can also be used successfully for soldering stainless steel using most common soldering procedures.

Quick Tips . . .

#450 Soft Silver Solder

- *contains silver—**no lead, zinc, or cadmium***
- *excellent for stainless, copper, nickel alloys, monel, brass, bronze and other non-ferrous alloys (but not aluminum or magnesium!)*
- *for stainless steel, use Aladdin #3 Soft Soldering Flux; for all other common soldering, use Aladdin #2 Low Acid All-Purpose Flux.*
- *to neutralize #2 and #3 flux, use a baking soda and water solution.*

Immediately following the soldering process, remove any flux residue to prevent staining or corrosion by cleaning the joint with a mix of water and soap, ammonia, soda or commercial detergent.

Solder Selection

The selection of a specific solder is made easier by understanding the melting characteristics of metals and alloys. Pure metals transform from solid to liquid at one temperature. Alloys melt over a temperature range. Solders are selected to:

- provide good flow,
- penetration and wettability, and
- desired joint strength.

Because solders have low strength compared to the metals that are being soldered, the joint should be designed so as not to depend on the strength of the solder.

The solderability of the base materials must also be considered. The selection of flux and surface preparation will be affected by the solderability of the base materials to be joined.

Solders generally have melting points below 840°F (450°C). Tin-lead alloys are the most widely used solder filler metals, except for potable water systems, as they bond with most common metals-such as copper, brass, steel, iron or nickel. Most commercial fluxes, cleaning methods and soldering processes can be used with tin-lead solders. Torch soldering & dipping are widely used.

In describing tin-lead solders, it is customary to identify the tin content first; i.e., 40/60 solder is 40% tin and 60% lead. The higher the tin content, the better the joint.

Tensile strength of tin or lead is approximately 2000 pounds per square inch; when alloyed, the strength of the two metals increases. In general, the strength of the joint is somewhat higher than the strength of the solder.

Quick Tips . . .

- *"Wiping solders" usually contain between 30-40% tin. The combination of good plasticity and moderate melting range*

Lead Free Solders and the law

In 1986, the United States Congress banned the use of lead solder containing more than 0.2% lead, and restricted the lead content of faucets, pipes, and other plumbing materials to 8.0%. Always use lead-free solder for home plumbing repairs—***It's the law!***

Aladdin now has three lead and cadmium free solders from which to choose...

- **#505 Lead-Free Solder**
  97% Tin / 3% Copper can be used for all common soldering and plumbing.
- **95/5 Tin-Antimony**
  95% Tin / 5% Antimony
  Designed for use in electrical or electronic connections; sweating copper tube joints in refrigeration and air conditioning equipment; plumbing and other areas where lead contamination must be avoided.
- **#450 Soft Silver Solder**
  96-96.5% Tin / 3.5-4% Silver
  Excellent for stainless steel, copper, nickel alloys, monel, brass, bronze and other non-ferrous metals (except aluminum and magnesium).

Quick Tips . . .

- *Pure metals melt at a constant temperature and generally are very fluid. Two-metal compositions (binary) have a less constant temperature due to the differing characteristics of the metals.*

Solder Type	Melting Temperature
Low Temperature Solder *Composition: Primarily Tin or Pb-Sn*	300°—500°F
Intermediate Temperature Solder *Composition: Primarily Zn-Cd or Zn-Sn*	500°—700°F
High Temperature Solder *Composition: Primarily Zn*	700°—800°F

(Refer to the solder selection table on Pages 14 through 16 for the appropriate Aladdin solders for your particular application.)

All Aladdin Solders Q-P-L Approved

Meets Mil Spec: QQ-S-571E

Solid Wire Solder — for use when the application calls for solder and a separate flux in tin/lead alloys and lead-free alloys.

Bar Solder — particularly adapted to automotive, sheet metal, and plumbing industry.

Acid and Rosin Core Solder — purest acid makes up the flux core of our acid core solder designed particularly for the automotive radiator industry. Rosin core solder is designed to comply with the demanding specifications in the electronics industry.

The tables that follow describe various Aladdin solders, some common uses, solidus and liquidus temperatures, and the range of

Tin/Lead

Product: (indicated by % of ingredients)	Solidus °F / °C	Liquidus °F / °C	Range °F / °C
35/65 Tin-Lead • Very good wetting properties • High strength • Rosin-Core Wire available **Use For:** • Electronic applications • Industrial Wave Soldering • Joining and general purpose	361 / 183	477 / 247	116 / 64
40/60 Tin-Lead • Very good wetting properties • General purpose solder • High strength • Rosin-Core Wire available **Use For:** • Electronics (Radio & TV) • Sheet metal work • Industrial Wave Soldering • Wiping & Sweat Soldering • All purpose electrical (Rosin Core) • Radiator repair (Acid Core) • Tools, automotive (Acid Core)	361 / 183	455 / 235	94 / 52
50/50 Tin-Lead • Very good wetting properties • High strength • Rosin-Core Wire available **Use For:** • Electronic applications • Sheet metal work • Non-potable water plumbing • Industrial Wave Soldering • Copper and copper alloys • All general purpose • Radiator repair (acid core)	361 / 183	421 / 217	60 / 34
60/40 Tin-Lead • Quick setting • "Eutectic" solder—used when joint cannot be exposed to high temperatures • Very narrow melting range • All methods apply • Used in solder pastes **Use For:** • Delicate instruments and electronic devices; circuit boards (rosin core) • Electronic Wave Soldering • Vapor Phase processes • Copper and copper alloys • Stained glass work	361 / 183	374 / 190	13 / 7
63/37 Tin-Lead • "Eutectic" solder—used when joint cannot be exposed to high temperatures • Very narrow melting range • All methods apply • Used in solder pastes **Use For:** • Delicate instruments and electronic devices • Electronic Wave Soldering • Vapor Phase processes	361 / 183	361 / 183	0 / 0

Product: (indicated by % of ingredients)	Solidus °F / °C	Liquidus °F / °C	Range °F / °C
70/30 Tin-Lead • Special Purpose Solder when high tin content is required **Use For:** • Soldering zinc • Coating various metals	361 / 183	378 / 192	17 / 9
30/70 Tin-Lead BARS • Specialty fabricated for auto body applications **Use For:** • Filling, machine & torch soldering	361 / 183	491 / 255	130 / 72
97/3 Tin-Copper Aladdin #505 Lead-Free • Easy flowing • Stronger than 50/50 or 95/5 • Low melting temperature • CONTAINS NO LEAD, ZINC OR CADMIUM **Use For:** • All plumbing and potable water systems • General purpose	361 / 183	421 / 217	60 / 34
95/5 Tin-Antimony • Higher melting range than Tin-Lead Eutectic solder • Narrow melting range • Good creep properties at elevated temperatures higher than usual tin-lead solders • CONTAINS NO LEAD, ZINC OR CADMIUM • Quick setting **Use For:** • Plumbing, refrigeration and air conditioning • Electrical joints and hot water copper-tube lines operating up to 250°F • Copper and copper alloys	450 / 232	464 / 240	14 / 8
96.5/3.5 Tin-Silver • Good shear strength • Excellent flow and creep characteristics • CONTAINS NO LEAD, ZINC OR CADMIUM **Use For** • Stainless steel for food-handling equipment • Copper pipe and tubing in potable water systems • Excellent for copper, nickel alloys, monel, brass, bronze and other non-ferrous alloys except aluminum or magnesium	430 / 221	430 / 221	0 / 0

Aladdin Stock Solders

		Spooled Diameters*						Bars	
		1/8	3/32	1/16	3/64	1/32		½#	1¼#
50/50	Solid	●	●	●	●	●		●	●
	Rosin	●	●	●	●	●			
	Acid	●	●	●	●	●			
40/60	Solid	●	●	●	●	●		●	●
	Rosin	●	●	●	●	●			
	Acid	●	●	●	●	●			
60/40	Solid	●	●	●	●	●		●	●
	Rosin	●	●	●	●	●			
	Acid	●	●	●	●	●			
30/70	Solid	●	●	●				●	●
	Rosin								
	Acid	●	●	●					
35/65	Solid	●	●	●					
	Rosin								
	Acid	●	●	●					
63/37	Solid	●	●	●					
	Rosin								
	Acid								
95/5 Tin Antimony	Solid	●	●	●				●	●
	Rosin								
	Acid								
505 Lead Free	Solid	●	●					●	●
	Rosin								
	Acid								

Meter Bar = 1/4" x 1/4" x 13.5" (approx. 5 oz.)
Cast Bar = 1/2" x 3/4" x 13.5" (approx. 1-1/4 lb. Bar)
Available on 1, 5 and 25 pound spools.

NUMBER OF FEET PER POUND SOLID WIRE SOLDER				
Dia. in Inches	**Percent Tin/Lead**			
	40/60	**50/50**	**60/40**	**Pure Tin**
.250	5.1	5.3	5.5	6.5
.187	9.3	9.7	10.1	11.8
.145	15.0	16.0	17.0	19.0
.125	20.0	21.0	22.0	26.0
.093	36.0	38.0	40.0	46.0
.062	81.0	84.0	89.0	104.0
.032	308.0	322.0	338.0	394.0

Flux-Core Wire Solder will have greater length per pound than the above figures. For standard rosin core and acid core with 3.3% flux by weight, add 27% to solid wire footage.

The Fluxing Process

The function of flux is to enhance wetting of the base metal by the solder by removing films from the pre-cleaned surface. The flux also prevents oxidation during the soldering process. It cleans the metal and lowers the surface tension between the molten metal and the base metal.

Flux is activated when heated, beginning the cleaning and protective processes. It is good practice to use the mildest flux that will do the job. The selection of a flux depends primarily on the solderability of the metal to be soldered, but other factors which influence the selection of flux include:

- the type of assembly being soldered,
- accessibility of soldered joint for flux residue removal after soldering,
- the method of heat application.

Fluxes are classified into two groups:

• ***Acid fluxes*** (corrosive fluxes, zinc chloride is the most common) cut through oxides, etc., with their strong chemical action, making them useful for:

- general purpose soldering,
- automotive applications,
- plumbing applications,
- sheet metal applications.

• ***Rosin fluxes*** (non-corrosive fluxes) leave non-corrosive/non-conductive residues, making them ideal for:

- electronic/electrical work,
- copper and copper wire,
- precoated metals with a solderable finish.

These classifications refer to the residue which remains after the fluxing action is completed.

HINT:
It is a good practice to use the mildest flux that will do the job. Refer to the Flux Selection tables on page 18 for the appropriate Aladdin

Flux Selection

Base Metal	Non Corrosive (Organic)	Corrosive (Inorganic)	* Special
Aluminum			●
Aluminum-Bronze			●
Brass	●	●	
Cast Iron			●
Copper	●	●	
Copper-Nickel		●	
Lead	●	●	
Magnesium			●
Monel		●	
Nickel		●	●
Silver	●	●	
Stainless Steel			●
Steel		●	
Tin	●	●	
Tin-Lead	●	●	
Tin-Zinc	●	●	
Zinc		●	
Zinc-Die Castings			●

Following is a chart of Aladdin fluxes and the base metals on which they are recommended for use:

Base Metal or Applied Finish	Appropriate Aladdin Flux #									
	1	2	3	71	73	75	96	158	255	585
Aluminum	●			●	●					●
Aluminum-Bronze	●									●
Cast Iron							●	●		
Copper	●	●	●				●	●	●	
Lead		●							●	
Magnesium						●				
Nickel		●	●				●			
Silver			●				●			
Stainless Steel			●							
Tin-Lead (Pewter)		●	●							
Zinc (Die Casting)								●		●
#604 Alum. Solder	●									
#450 Soft Solder		●	●							
#33 Low Melt										●
60/40 Tin-Lead		●							●	
50/50 Tin-Lead		●							●	●
40/60 Tin-Lead		●							●	

Flux Residue Clean-up

After a joint has been soldered, the flux residue must be removed or it may corrode the base metal or affect the stability of the joint. This is especially important where soldered joints may be subjected to humid conditions. Zinc chloride flux residues absorb water from the atmosphere.

The following list provides suggested methods for flux residue removal:

Flux — **Method for Flux Residue Removal**

Zinc chloride base (inorganic) . . . . . Hot water rinse with soda (sodium carbonate); follow with hot water rinse

Organic. . . . . Double hot water rinse

Rosin*. . . . . Organic solvents; alcohol or chlorinated hydrocarbons; follow with hot water rinse

Oily/Greasy Petroleum Base Paste . . . . . Organic solvent

Aluminum (reaction type) . . . . . Rinse in warm water

* Rosin flux residues may remain on the soldered joint unless appearance is of key importance or unless the joint is to be coated or painted.

The Brazing Process

Fundamentals of Brazing

Brazing is a process which joins metals using a filler metal that melts above the temperature of 840°F (450°C). Like soldering, the filler metal should "wet" the base metal and be drawn into the joint by capillary action. Most brazed joints have a large area but a small gap (average clearance is 0.001" to 0.010" [0.025 to 0.25mm]).

Brazing Filler Metal Characteristics

- Ability to form joints with properties (physical and mechanical) necessary for intended use
- Melting point compatible with the base metal with adequate fluidity to flow and be distributed by capillary action
- Adequate homogeneity, stability and proper technique to prevent liquation during the brazing process
- Ability to "wet" surfaces and form a strong bond
- Ability to produce or avoid interactions with base metals depending on requirements of application

Selection of Brazing Filler Metals

The following criteria should be met when selecting a brazing filler metal:

- Compatibility of metals being joined
- Brazing process to be used
- Use of the assembly once it has been brazed
- Brazing temperature
- Joint design
- Filler metal form
- Finished appearance desired

The primary forms of brazing filler metals are shims, rings, washers, strips, slugs, powder or paste fed from hand held filler metal usually in the form of wire or rod.

Troubleshooting

DEFECT → / CAUSE ↓	Alloy Doesn't Wet Surface	Alloy Doesn't Flow	Alloy Flows Away From Joint	Joint Leak/Void Porosity	Joint Separation	Flux Breakdown	Base Metal Melts	Filler Metal Cracks	Cold Solder	Solder Short	Warpage	Staining	Excess Flow or Wetting
Poor Joint Design				●							●		
Inadequate Precleaning	●		●	●									
Improper Positioning			●	●	●						●		
Incorrect Joint Clearance			●	●				●					
Flux/Fluxing	●		●	●			●						
Base Metal			●	●			●						
Filler Metal	●		●	●			●	1					10
Incorrect Temperature	5	3	2	●		6	●		●				9
Post-Cleaning/ Quenching				●	●			4			●	●	
Excess Of Solder										8			
Incorrect Solder (Diameter)													
Soldering/Brazing Technique	●			7									●

1 When joining dissimilar metals, expansion rate may vary causing tension, creating cracks

2 Adjust fitting to proper temperature; direct flame toward fitting

3 Outside of joint is too hot: inside is not hot enough (if brazing a tube, heat tube to conduct heat to the fitting)

4 Cool joint longer before washing flux residue

5 Base metal not up to brazing temperature; joint overheated, so flux is no longer active

6 Excessive heat; soften flame

7 The majority of leaks are a result of incorrect brazing temperature

8 Excess solder can cause the formation of a bridge between two soldered connections

9 Temperature too high

10 Too much filler metal or incorrect filler metal

Quick Tips . . .

- Brazing over previously soldered joints with tin-lead solders is not recommended. The lower melting temperature of the solder may prevent proper alloying between the base and filler metals.
- Any imperfections lessen the strength of a soldered or brazed joint.

Glossary of Terms

Base Metal: The metal or alloy that is welded, brazed, soldered or cut.

Braze: A weld produced by heating an assembly to the brazing temperature using a filler metal having a liquidus above 840°F (450°C) and below the solidus of the base metals. The filler metal is distributed between the surfaces of the joint by capillary action.

Brazing Filler Metal: The metal that fills the capillary joint clearance and has a liquidus above 840°F (450°C) and below the solidus of the base material.

Capillary Action: The phenomenon by which adhesion between the molten filler metal and the base metal (together with surface tension of the molten filler metal) distributes the filler metal between properly fitted surfaces of the joint to be soldered or brazed.

Corrosion: The wearing away or dissolving of metal caused by a chemical reaction (i.e., as water on pipes that water contacts or chemicals touching a metal surface.)

Ductility: The capability of being hammered out thin, as certain metals; malleable; capable of being drawn out into wire; ability to undergo change of form without breaking.

De-wetting: The retraction of solder on an already wetted surface which leaves areas of incomplete coverage, usually a result of Dip Soldering.

Eutectic: An alloy composition which exhibits the lowest melting temperature possible within that system; has a melting point, not a melting range.

Electrical Conductivity: Property of conducting electricity.

Flux: Special chemicals used to clean and prevent oxides or other undesirable substances from being formed on freshly cleaned metal, and to dissolve or facilitate the removal of such substances.

Filler Metal: Metal that is added in the process of soldering, brazing or welding.

Flux Residue: That residue remaining on a joint after the soldering process has been completed.

Hard Solders: Alloys that have silver, copper or nickel bases, primarily used in brazing.

Homogeneity: Composition from like parts or characteristics.

Joint Clearance: The dimension between the interfaces of the soldered joint.

Liquation: The separation of liquid and solid phases of an alloy within its melting range.

Liquidus Temperature: The lowest temperature at which an alloy or metal is completely liquid.

Melting Range: That temperature between the solidus and the liquidus where the solder is partially melted.

Melting Point: That temperature at which a solid changes to a liquid state.

Non-ferrous: Materials which contain no iron.

Oxidation: Oxygen combining with other elements.

Organic Flux: A flux that is composed of organic material.

Porosity: Voids or gas pockets in metal.

Solidus Temperature: The highest temperature at which an alloy or metal is completely solid.

Solder: A metal alloy with a melting point below 800° F.

Soldering: Welding processes that produce the coalescence of materials by heating them to the soldering temperature and by using a filler metal with a liquidus not exceeding 840°F (450°C) and below the solidus of the base metal. The filler metal is distributed between closely fitted surfaces of the prepared joint by capillary action.

Sweat Soldering: A form of soldering in which the solder alone holds two pieces of metal together.

Tinning: Pre-coating with solder.

Wetting: The phenomenon whereby a filler metal or flux spreads and adheres (a thin continuous layer) on a solid base metal.

Wipe Soldering: A joint formed by the application of semi-fluid solder shaped by rubbing with a greased cloth.

Helpful Tables

CHEMICAL ELEMENTS, SYMBOLS AND THEIR ATOMIC NUMBERS

Actinium	Ac	89	Hafnium	Hf	72	Praseodymium	Pr	59
Aluminum	Al	13	Helium	He	2	Promethium	Pm	61
Americium	Am	95	Holmium	Ho	67	Protactinium	Pa	91
Antimony	Sb	51	Hydrogen	H	1	Radium	Ra	88
Argon	Ar	18	Indium	In	49	Radon	Rn	86
Arsenic	As	33	Iodine	I	53	Rhenium	Re	75
Astatine	At	85	Iridium	Ir	77	Rhodium	Rh	45
Barium	Ba	56	Iron	Fe	26	Rubidium	Rb	37
Berkelium	Bk	97	Krypton	Kr	36	Ruthenium	Ru	44
Bismuth	Bi	83	Lanthanum	La	57	Samarium	Sm	62
Boron	B	5	Lawrencium	Lr	103	Scandium	Sc	21
Bromine	Br	35	Lead	Pb	82	Selenium	Se	34
Cadmium	Cd	48	Lithium	Li	3	Silicon	Si	14
Caesium	Cs	55	Lutetium	Lu	71	Silver	Ag	47
Calcium	Ca	20	Magnesium	Mg	12	Sodium	Na	11
Californium	Cf	98	Manganese	Mn	25	Strontium	Sr	38
Carbon	C	6	Mendelevium	Md	101	Sulfur	S	16
Cerium	Ce	58	Mercury	Hg	80	Tantalum	Ta	73
Chlorine	Cl	17	Molybdenum	Mo	42	Technetium	Tc	43
Chromium	Cr	24	Neodymium	Nd	60	Tellurium	Te	52
Cobalt	Co	27	Neon	Ne	10	Terbium	Tb	65
Copper	Cu	29	Neptunium	Np	93	Thallium	Tl	81
Curium	Cm	96	Nickel	Ni	28	Thorium	Th	90
Dysprosium	Dy	66	Niobium	Nb	41	Thulium	Tm	69
Einsteinium	Es	99	Nitrogen	N	7	Tin	Sn	50
Erbium	Er	68	Nobelium	No	102	Titanium	Ti	22
Europium	Eu	63	Osmium	Os	76	Tungsten	W	74
Fermium	Fm	100	Oxygen	O	8	Uranium	U	92
Fluorine	F	9	Palladium	Pd	46	Vanadium	V	23
Francium	Fr	87	Phosphorus	P	15	Xenon	Xe	54
Gadolinium	Gd	64	Platinum	Pt	78	Ytterbium	Yb	70
Gallium	Ga	31	Plutonium	Pu	94	Yttrium	Y	39
Germanium	Ge	32	Polonium	Po	84	Zinc	Zn	30
Gold	Au	79	Potassium	K	19	Zirconium	Zr	40

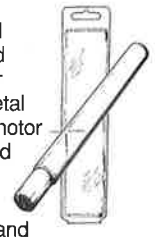
FRACTIONS — DECIMALS — MILLIMETERS

	DECIMAL	mm		DECIMAL	mm
1/64	.0156	0.396	33/64	.5156	13.096
1/32	.0312	.793	17/32	.5312	13.493
3/64	.0468	1.190	35/64	.5468	13.890
1/16	.0625	1.587	9/16	.5625	14.287
5/64	.0781	1.984	37/64	.5781	14.684
3/32	.0937	2.381	19/32	.5937	15.081
7/64	.1093	2.778	39/64	.6093	15.478
1/8	.125	3.175	5/8	.625	15.875
9/64	.1406	3.571	41/64	.6406	16.271
5/32	.1562	3.968	21/32	.6562	16.668
11/64	.1718	4.365	43/64	.6718	17.065
3/16	.1875	4.762	11/16	.6875	17.462
13/64	.2031	5.159	45/64	.7031	17.859
7/32	.2187	5.556	23/32	.7187	18.256
15/64	.2343	5.953	47/64	.7343	18.653
1/4	.250	6.350	3/4	.750	19.050
17/64	.2656	6.746	49/64	.7656	19.446
9/32	.2812	7.143	25/32	.7812	19.843
19/64	.2968	7.540	51/64	.7968	20.240
5/16	.3125	7.937	13/16	.8125	20.637
21/64	.3281	8.334	53/64	.8281	21.034
11/32	.3437	8.731	27/32	.8437	21.431
23/64	.3593	9.128	55/64	.8593	21.828
3/8	.375	9.525	7/8	.875	22.225
25/64	.3906	9.921	57/64	.8906	22.621
13/32	.4062	10.318	29/32	.9062	23.018
27/64	.4218	10.715	59/64	.9218	23.415
7/16	.4375	11.112	15/16	.9375	23.812
29/64	.4531	11.509	61/64	.9531	24.209
15/32	.4687	11.906	31/32	.9687	24.606
31/64	.4843	12.303	63/64	.9843	25.003

Other Helpful Aladdin Products

#37 Fiberglass Brush

5 - 1/2" x 5/8"



Fine grade fiberglass strands coated with plastic. A gentle brushing action cleans and polishes a variety of surfaces - metallic and non-metallic - without scratching. Perfect for cleaning printed circuit boards, precious metal surfaces, electrical contacts, solder joints, motor commutators, etc. May be used to clean and polish plastic molds.

Also used for removing epoxy, epoxy adhesives, rust, paint oxidation, corrosion, and for heliarc welding.

Protective covering is cut back as brush wears enabling entire brush length to be used.

#45 Acid Brush

5-3/4" x 1/2"

100% black horsehair. General purpose brush. Flat face tin ferrule handle. 1 gross per box or by the dozen.

#46 "Scratcher" Whisk Brush

5-1/2" x 1-1/4" (Brush face width)

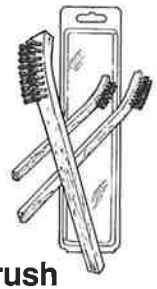
Handy general purpose brush for cleaning and removing chips, solder, etc. 1 dozen per box.

#47 "Big Boy" Stainless Steel Tinning Brush

14" x 1" Heavy Duty

Excellent industrial tool for general cleaning purposes.

#48 "Mini" Stainless Steel Tinning Brush



7-3/4" x 1/2" Bent handle

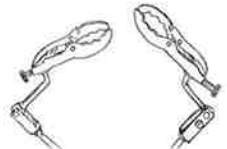
Frequently used in the aircraft and missile industries in aluminum welding. Available in individual packages or bulk lots of 100.

#49 "Knuckle-Saver" Stainless Steel Tinning Brush

8-5/8" x 1/2" Bent Handle

Great in-between size for easy tinning of aluminum. Slanting angle handle to save your knuckles. Perfect for tinning the surface when using Aladdin 3-in-1 Rod. Available in individual packages or bulk lots of 100.

#1003 "Helping Hands"



Adjustable Jig

- All metal made in the U.S.A.
- Holds work in any desired position
- Perfect for a variety of soldering or brazing jobs
- Many other applications (i.e., gluing or painting)

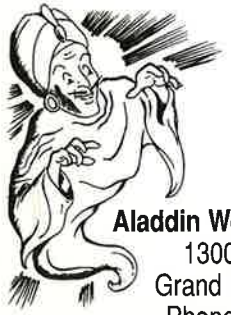
In appreciation… a very special thank you for the patience of my wife who encouraged me to put my personal approach to assisting and encouraging the layperson in the interesting field of soldering and brazing by offering this graphic handbook. Also a special acknowledgement to our daughter, who so capably organized, programmed and typed the accumulated material and deciphered my notes in between her responsibilities as head of operations. To David McCord, M.R.W. Creative Services, for always responding with graphics and suggestions when called on out of the blue with a new idea for marketing Aladdin products.

I also wish to express appreciation for 23 years as Secretary of the West Michigan Chapter of the American Welding Society. In retrospect, those years were equivalent to a degree in metallurgy in the most accredited university. In some respects, a much more practical approach to launching a successful manufacturing business by day to day answering of questions originating from entrepreneurs of small business. The American Welding Society has always been extremely helpful by developing their extensive library and making it accessible to their members.

Gordon L. Hill
1912-1994

Notes

Contact your local distributor.



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