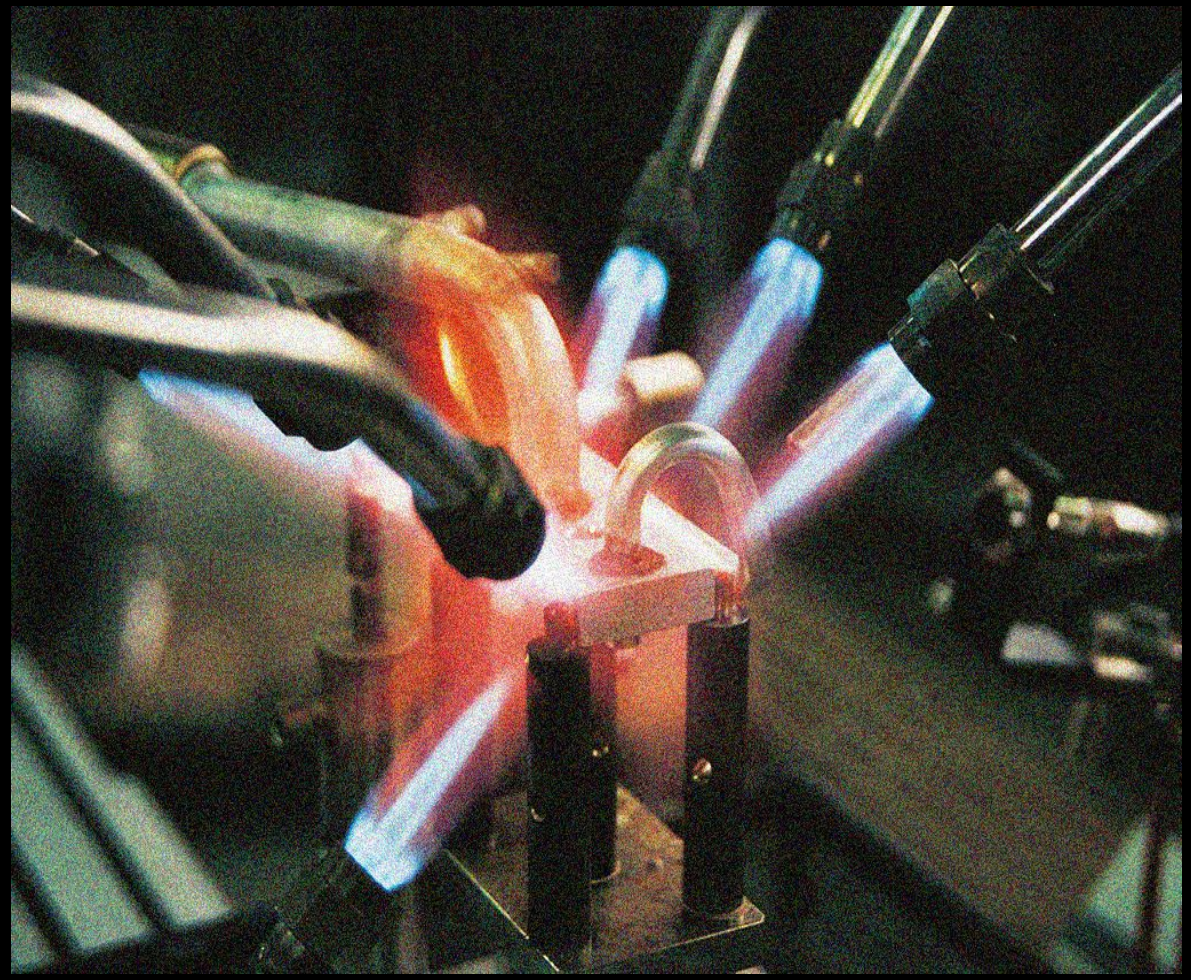
BRAZING: (CHAPTER 8.7)

BRAZING: INTRODUCTION

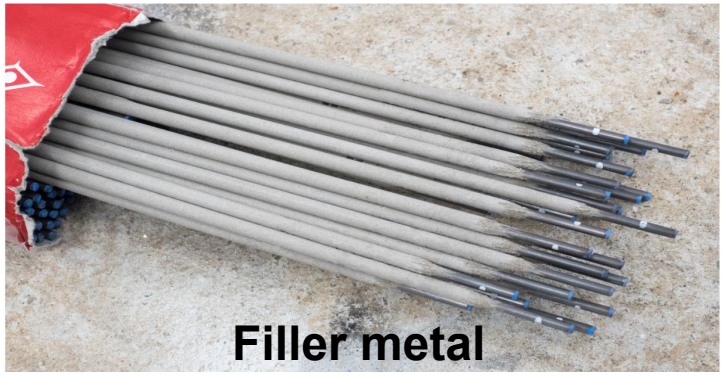
Brazing is a metal-joining process that uses heat to join two or more pieces of metal together. It is often used as an alternative to welding when welding is not possible or practical due to the material's physical characteristics. A unique quality in the brazing process is that it keeps the mechanical properties of the metals which are useful in applications such as silver brazing or other similar metals.



Brazing equipment

Brazing equipment is used to join metals using a filler metal that melts at a lower temperature than the base metals. There are different types of brazing equipment available, each with its own advantages and disadvantages. Here are some of the most common types:

Oxy-fuel torch or Air-acetylene torch : This type of torch uses oxygen and a fuel gas, such as acetylene or propane, to create a flame. Oxy-fuel torches are versatile and can be used for a variety of brazing applications. Air-acetylene torch is useful in small-scale brazing tasks in a workshop setting.



Filler metal: This is the metal that melts to join the base metals. It has a lower melting point than the base metals and comes in various forms, including rods, wires, and sheets. The choice of filler metal depends on the base metals being joined and the desired properties of the joint.

Flux: This is a material that helps remove oxides from the surface of the metals, allowing for better brazing flow and stronger joints. Flux comes in various forms, including paste, powder, and liquid.

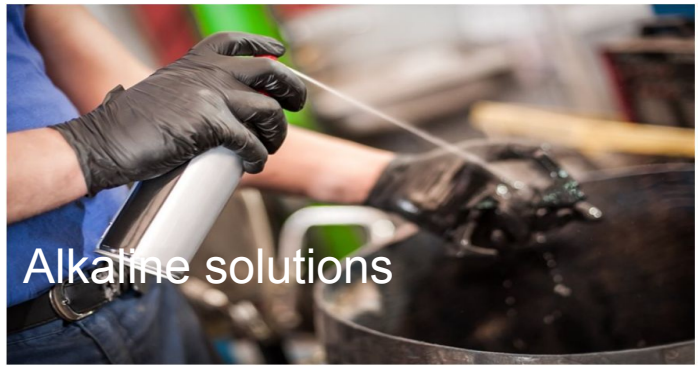
Cleaning solvent, Wire brush, rags: These materials are used for cleaning metal surfaces for brazing etc. Dirt, grease, and oxides hinder filler metal adhesion. Degrease, remove oxides, and wipe clean before brazing, using appropriate methods for the metal type and wearing safety gear.

SURFACE CLEANING

Surface clearing refers to the process of removing dirt, dust, debris, and other unwanted matter from a surface.

There are two main approaches to cleaning surfaces before brazing:

1.Degreasing : This removes oil, grease, and other contaminants that can prevent the filler metal from flowing properly



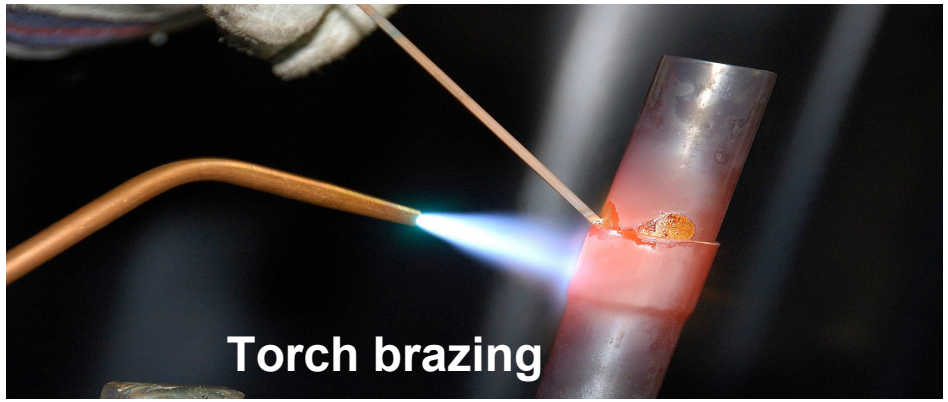
2. Oxidation removal: This removes oxides (layers of metal that form on the surface) that can also hinder brazing. Wire brushing is a simpler option for removing light oxidized residue.

FOUR REQUIREMENT OF BRAZING

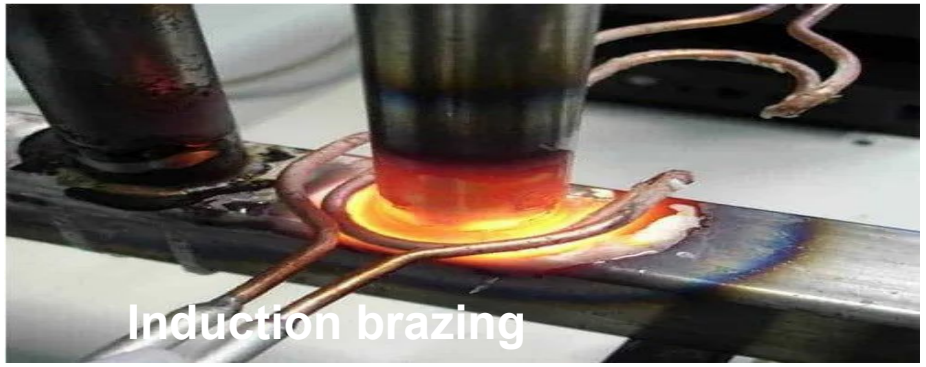
1. Clean Metal
2. Appropriate Filler Rod
3. Flux
4. Heat

COMMON BRAZING TYPES

Torch brazing: This is the most traditional method using a torch with a fuel gas and oxygen to create a flame for heating.



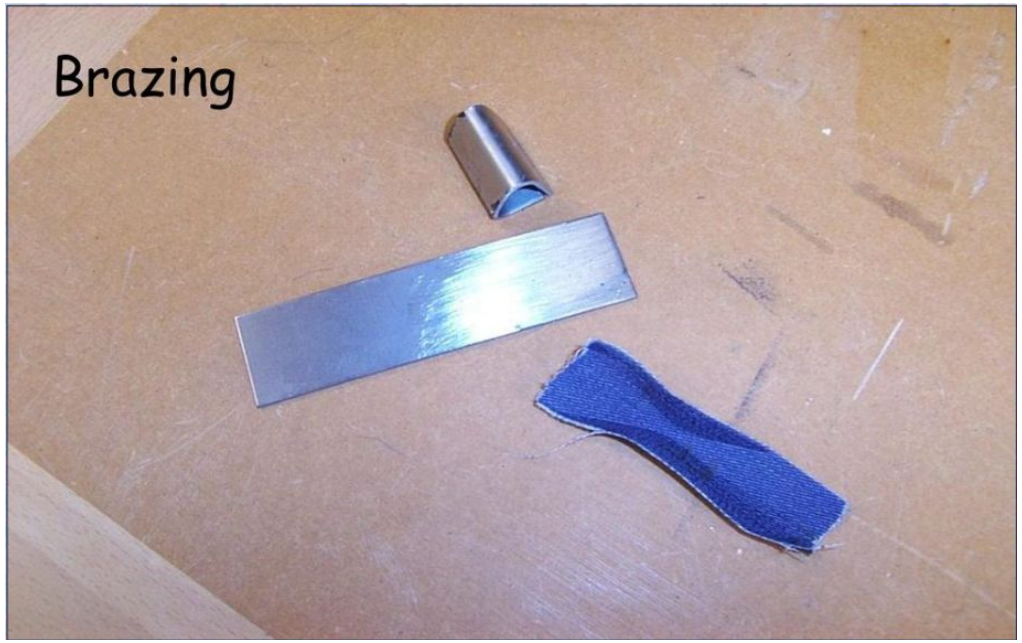
Induction brazing: An electric current creates a magnetic field that heats the joint through induction.



Resistance brazing: Electrical resistance to the current flow creates heat at the joint.

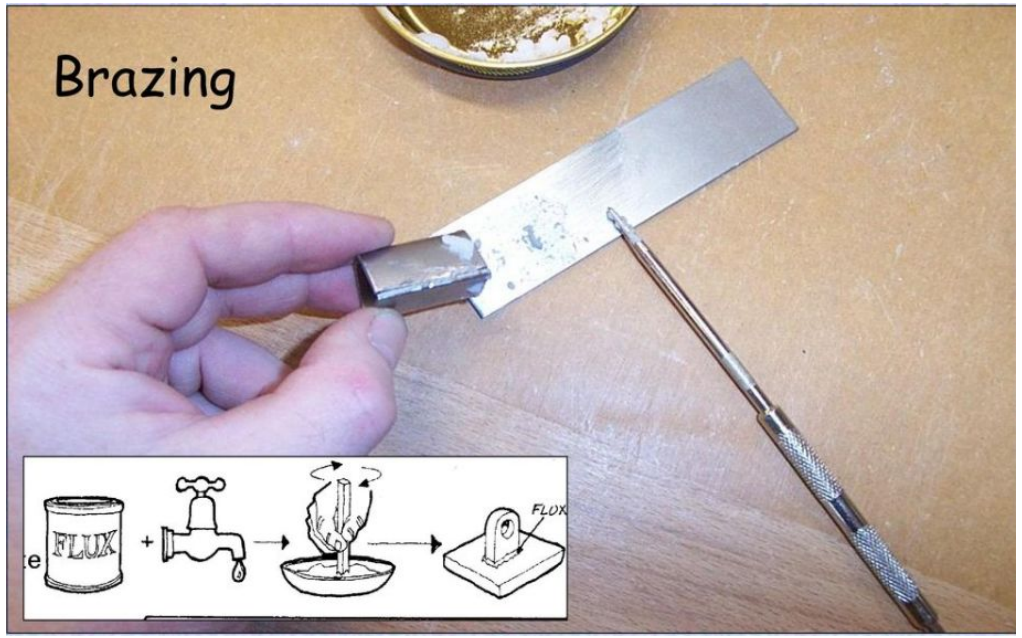
BRAZING PROCESS FOR TORCH BRAZING

1. Clean the metal



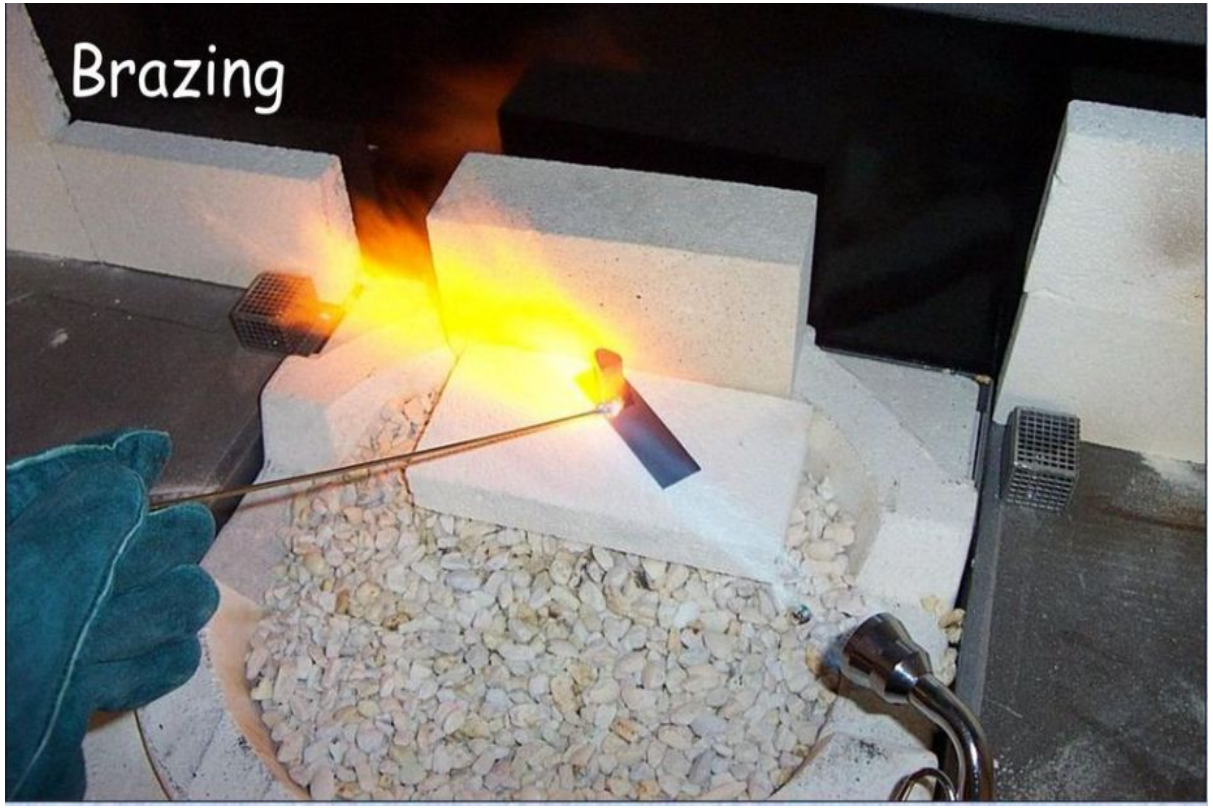
The surfaces of the metals to be joined must be thoroughly cleaned and free of dirt, grease, and oxides. This ensures good adhesion of the razing filler metal

2. Apply the Flux on the metal



Flux helps remove oxides and impurities while promoting wetting (spreading) of the brazing filler metal.

3. Heat the work piece



After the flux is applied at the joint areas, the filler metal is introduced in the form of rods, wires, or sheets. The filler metal is typically held near the joint, and as it melts, it flows by capillary action into the gap between the base metals.

4. Cool down the work piece

Once sufficient filler metal has filled the joint, the heat source is removed, allowing the brazing filler metal to solidify and cool down. During cooling, the brazing filler metal bonds with the base metals, forming a strong joint.

After the joint cools down completely, any residual flux may be cleaned using water or a suitable solvent, wire brush etc. depending on the specific flux type.

Work piece formed

Joint Strength: The strength of the brazed joint depends on factors like the type of filler metal, brazing temperature, and joint design.

Applications: Brazing is used in various applications, including joining pipes, tubes, and sheets in heating and ventilation systems, refrigeration systems, and automotive components. It is Suitable for joining thinner metals or those sensitive to high temperatures. It's also used for joining dissimilar metals.

Join design and support parts

Joining design and support parts involves connecting different components within a system or structure to achieve specific functionalities.

1. Mechanical Joining:

This method utilizes physical elements to create a connection between parts. Here are some common techniques:

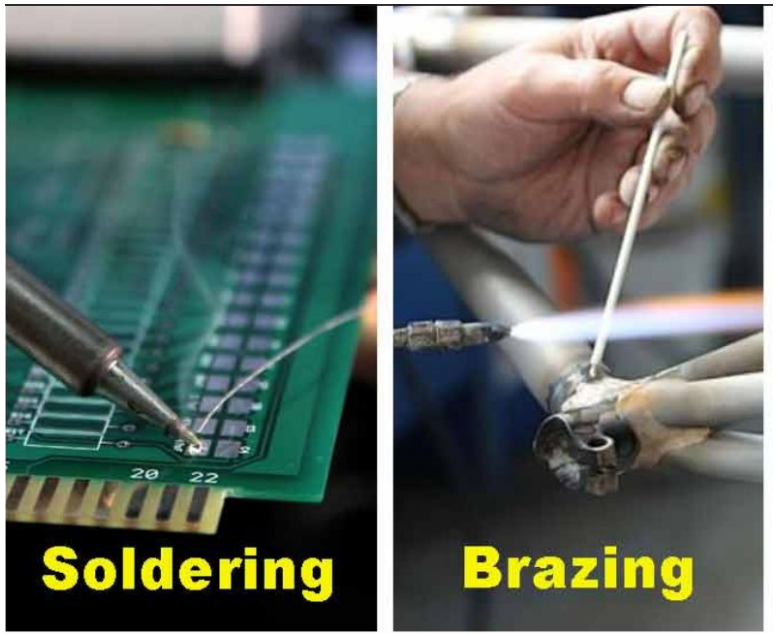
Fasteners

This is a broad category encompassing screws, bolts, nuts, rivets, and others. The specific type chosen depends on situation itself.

Welding

This method uses heat to melt and fuse the materials of the joining parts, creating a permanent joint. Different welding techniques exist, like arc welding, laser welding, and resistance welding

Soldering and brazing

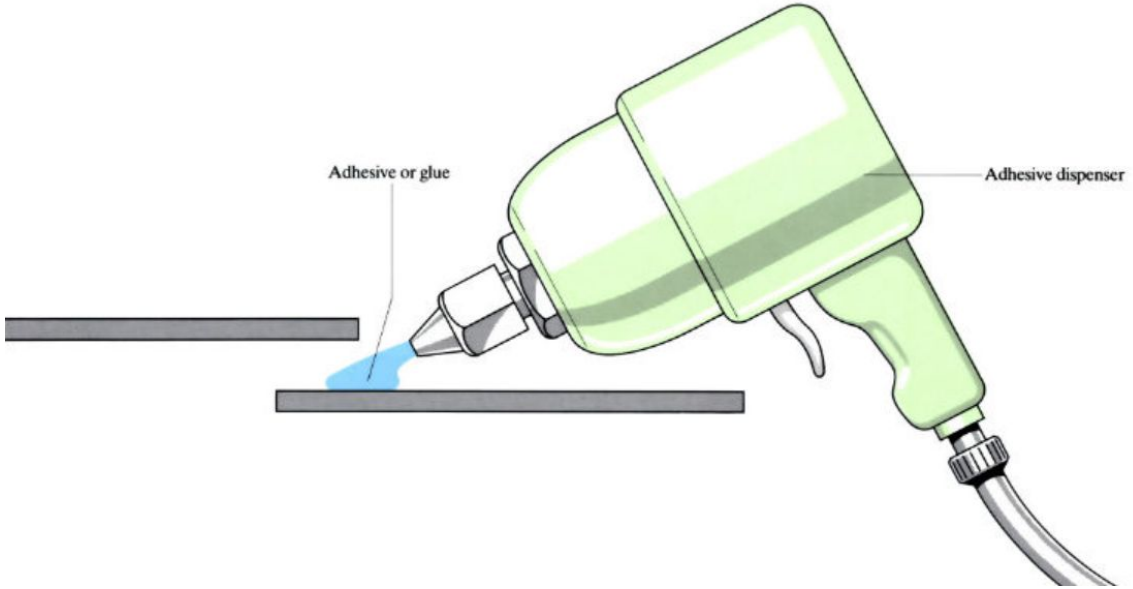


These methods involve using a filler metal that melts at a lower temperature than the base metals to create a strong bond between them. Soldering is typically used for electronics and delicate components, while brazing is used for stronger joints in various applications.

Press-fitting

This method involves forcing a slightly larger diameter component into a slightly smaller diameter hole. The interference creates frictional force holding the parts together.

2. **Adhesive Joining**:



This method uses adhesives to bond parts together. Adhesives come in various forms, including liquid epoxies, acrylics, and pressure-sensitive tapes. This method offers advantages like good sealing, stress distribution, and the ability to join dissimilar materials. However, factors like surface preparation, adhesive properties, and curing time need consideration.

BRAZING OPERATIONS:

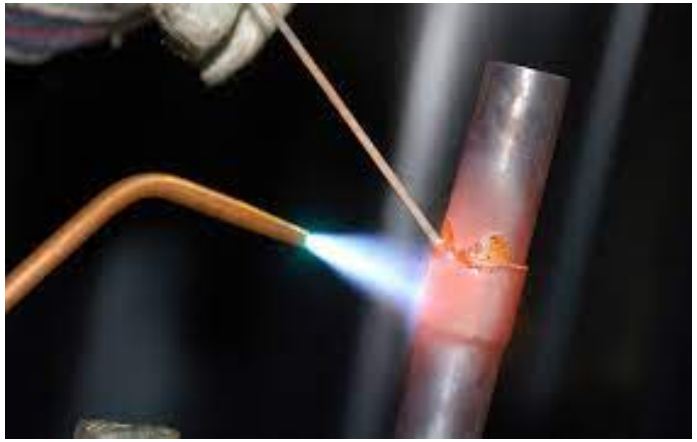
CLEANING

Parts to be joined must be cleaned and degreased. The presence of contaminants such as oxides, paint, grease/oil and any other form of contamination, will affect the final result, giving rise to brittle joints and potentially to dangerous metal fumes.

HEATING

- Manual brazing is usually performed with acetylene torches or with other fuel gases like propane, methane or hydrogen. Torch brazed joints must reach the melting temperature of the filler metal as quickly as possible, to avoid microstructural changes of the material. The brazing process must be completed in a suitable time with regard to the flux life. The latter is limited both by temperature and heating time; beyond these limits, the flux will be saturated with oxides and its effectiveness will decrease.

- During the heating stage, the joint area should be heated uniformly. If the components have different thicknesses, the part with the greater weight is heated first. When the materials have a different thermal conductivity, it is advisable to heat first the component with the lower conductivity, since it absorbs less heat.



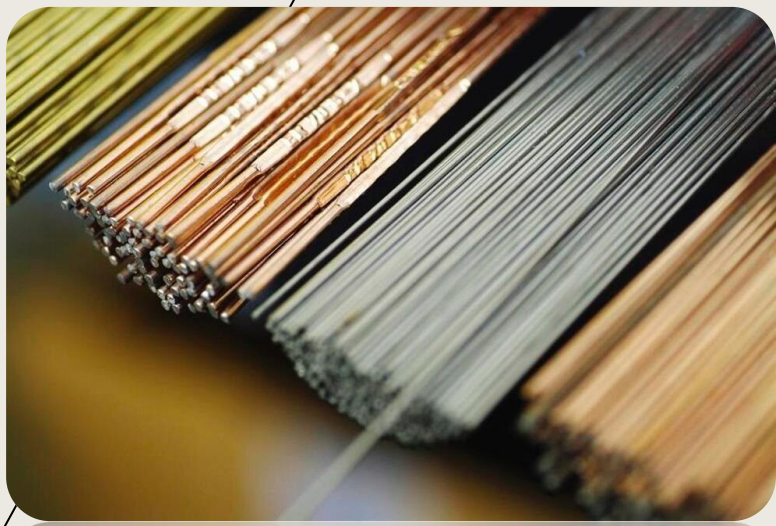
- If the heating is insufficient or there is a thermal difference between the components, the overlapping area will be brazed in a discontinuous way, giving rise to a brittle joint.

FILLER METAL APPLICATIONS

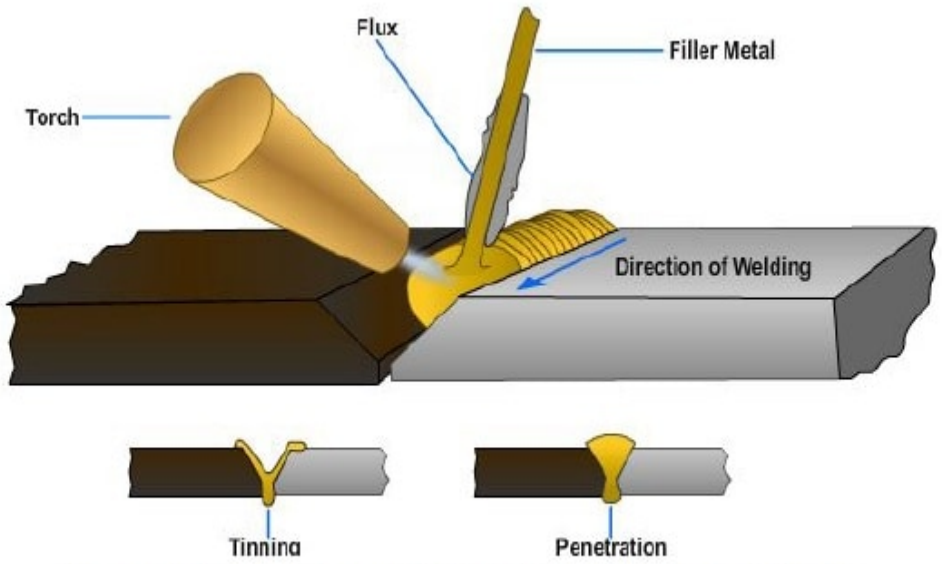
The filler metal used in brazing is an alloy of copper and zinc. This copper-zinc alloy, known as brass, melts around 900-950°F (480-510° C). When heated to its melting point, brass flows into the gap between two pieces of metal that need to be joined, creating a strong bond between them. In addition to brass alloys, some brazing filler metals are also made with silver or nickel for special applications.

When it comes to selecting a filler metal for brazing, several factors need to be considered:

- ✔ These include the materials being joined, joint design and clearance, application temperatures and environmental conditions, cost considerations, corrosion resistance, and strength requirements. The type of filler metal chosen should match all these requirements to ensure a successful joint.
- ✔ Filler metals must achieve proper wetting conditions in order to create strong bonds.



FLUX APPLICATION



Braze welding cast iron and nickel alloy using the backhand method.

WHAT IS FLUX ?

- A flux is a chemical compound to dissolve oxides formed on surface of the metal or filler rod.
- Any form of the oxides on the surface of the metal when heated will prevent the uniform flow of the brazing metals. For this reason, flux is necessary to eliminate the oxide.

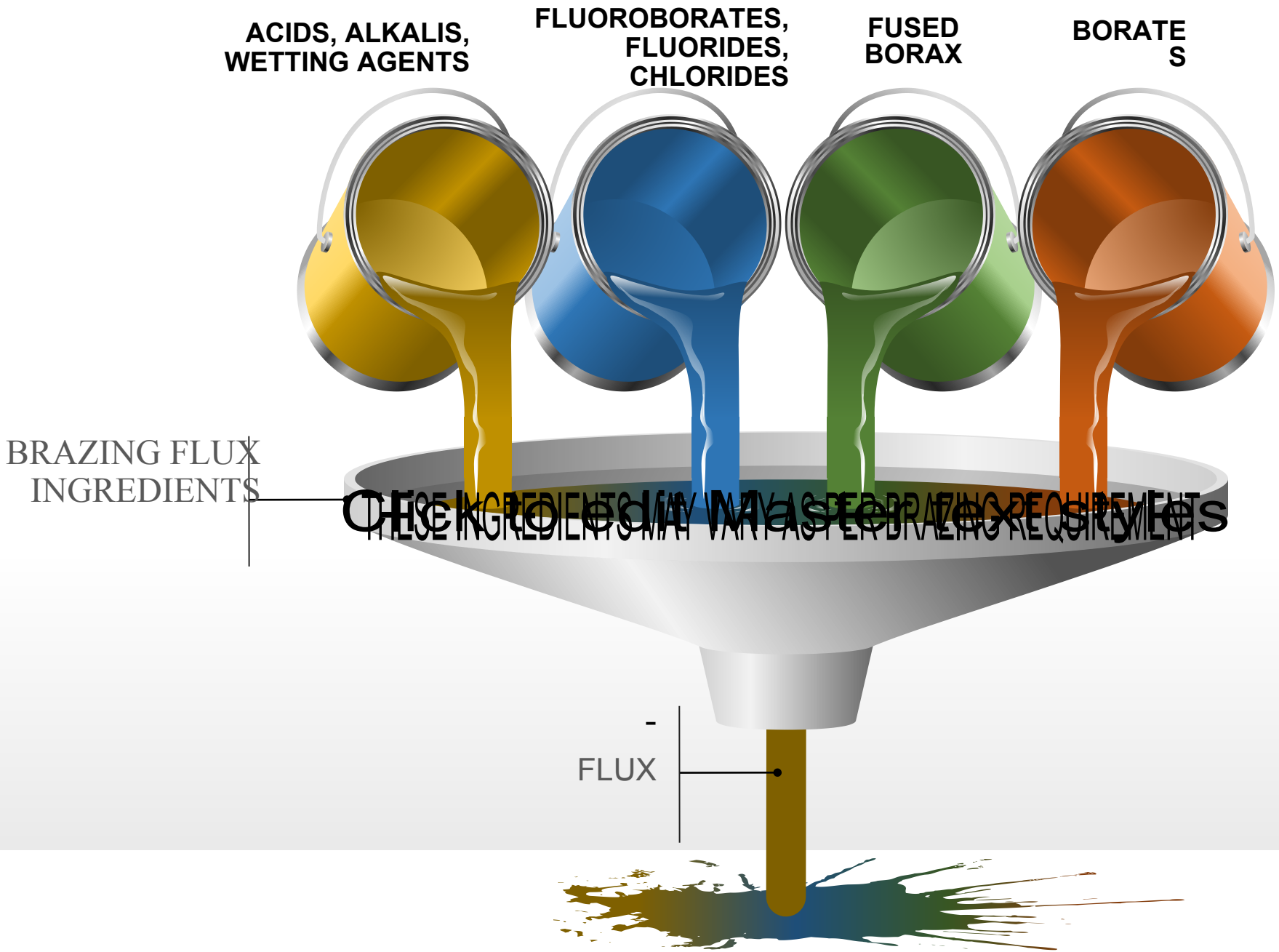
HOW TO APPLY FLUX TO JOINTS?

✔ Typically you apply the flux just before brazing, if possible. That way the flux has least chance to dry out and flake off, or get knocked off the parts in handling.

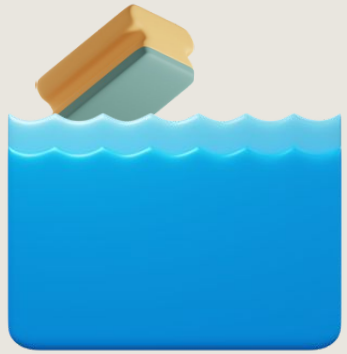
✔ As for the how, apply the flux any way you can as long as you cover the surfaces completely.

✔ Since flux is conventionally made in a paste consistency, it's usually most convenient to brush it on.

✔ But as production quantities increase, it may be more efficient to apply the flux by dipping or dispensing a pre-measured deposit of high viscosity dispensable flux from an applicator gun


ACIDS, ALKALIS, WETTING AGENTS
FLUOROBORATES, FLUORIDES, CHLORIDES
FUSED BORAX
BORATE S
BRAZING FLUX INGREDIENTS
FLUX

CLEARING AFTER BRAZING



WHY TO CLEAR BRAZING RESIDUE ?

- FLUX RESIDUES ARE CHEMICALLY CORROSIVE AND, IF NOT REMOVED, COULD WEAKEN CERTAIN JOINTS.

SOME WAYS OF POST-BRAZING CLEARING:

- Soaking/wetting - Use hot water with agitation in a soak tank to remove excess flux immediately following the braze operation, and then dry the assembly. When soaking is not possible, use a wire brush along with a spray bottle or wet towel.

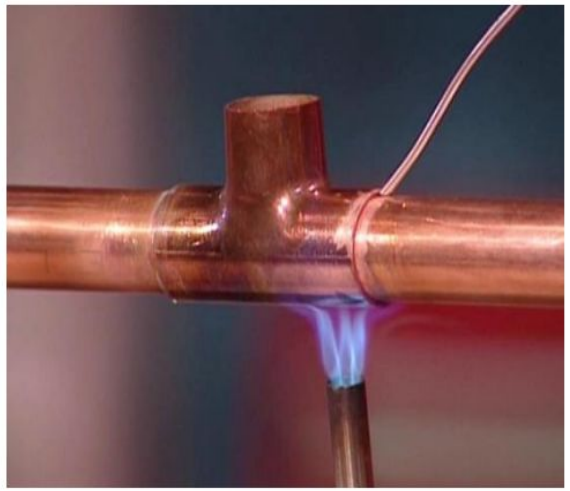
- Quenching - This process induces a thermal shock that cracks off residual flux. When quenching a brazed part in hot water, take care to avoid compromising the braze joint. Quench only after the braze filler metal has solidified to avoid cracks or rough braze joints. Note that quenching can affect base material mechanical properties. Do not quench materials with large differences in coefficients of thermal expansion to avoid cracks in the base materials and tears within the braze alloy.

- Steam lance cleaning - This process employs super-heated steam under pressure to dissolve and blast away flux residue.
- Mechanical cleaning - Clean residue from brazed joints with a wire brush or by sandblasting. Be advised that soft metals-including aluminium-require extra care, as they are vulnerable to the embedding of particles.

- Chemical cleaning - You can use an acidic or basic solution, generally with short soak times to avoid deteriorating the base materials.

SOLDERING

INTRODUCTION



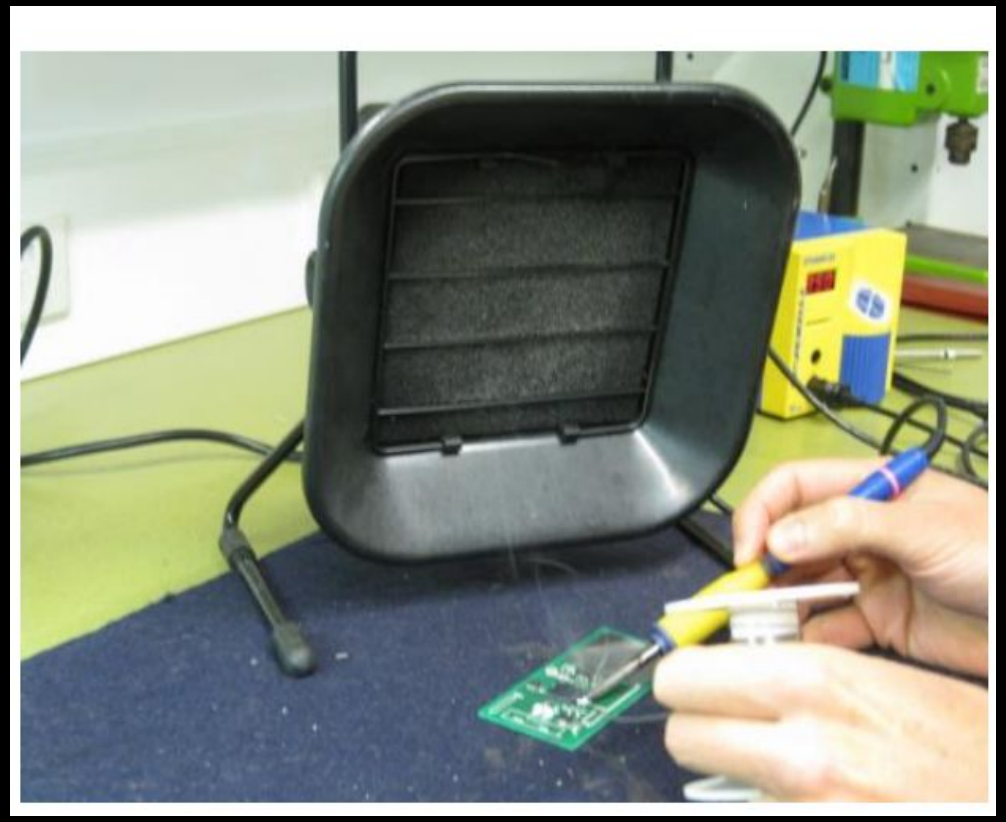
Soldering copper pipe

Sheet metal fabrication

Figure 1 – Different Types of Soldering

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined. It is different to welding in that the parts being joined are not melted and are usually not the same material as the solder. Soldering is a common practice for assembling electrical components and wiring. Although it can be used for plumbing too.

SOLDERING CIRCUIT BOARDS



- Soldering may be used to join wires or attached components to a circuit board.

MOST COMMON TYPE OF SOLDER

There are different types of solder used for electrical work. They are broadly classified as tin/lead solders or lead free solders. Tin/lead solders have been used for many years because of their ease of use however they have been phased out of commercial use due to the harmful effects on humans and the environment. Tin/lead solder is still available and in use.

SOLDERING IRONS

A soldering iron is a hand tool used in soldering. It supplies heat to melt solder so that it can flow into the joint between two workpieces.

Soldering irons are designed to reach a temperature range of 200 to 480 °C (392 to 896 °F).

Soldering irons are most often used for installation, repairs, and limited production work in electronics assembly.

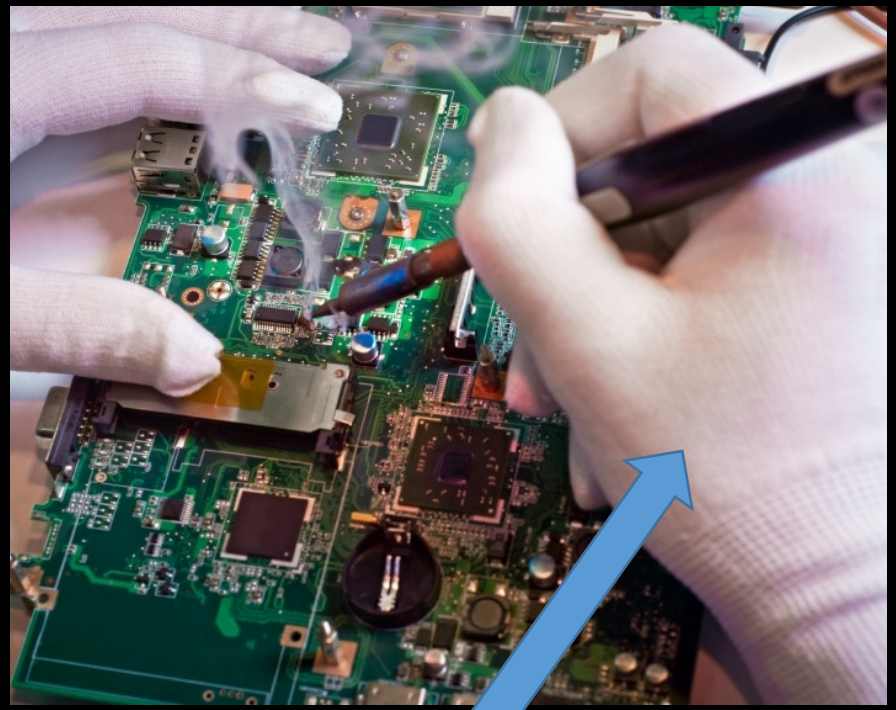
Electric soldering iron

A gas-fired soldering iron

DESOLDERING

- If a part that has been soldered needs to be replaced it needs to be “de-soldered”. Depending on the part and type of joint it may be possible to simply re-melt the solder and remove the part, or it may be necessary to remove the solder from the joint so the part can be freed. Some methods for removing solder are solder wick, solder sucker or de-soldering tool.

ELECTRICAL SAFETY



Use of rubber gloves

Electric soldering irons are plugin appliances and must have a current safety test tag. The test will confirm that the soldering iron conforms to electrical safety standards and has not been damaged at the time of the test. Before use you should visually check that the soldering iron does not have damage such as melted insulation on the lead, broken or cracked handle.

YOUR PATIENCE AND UNDERSTANDING ARE GREATLY APPRECIATED !

WE HOPE YOU HAVE UNDERSTOOD THE TOPIC “BRAZING AND SOLDERING”.

THANK YOU !