MANUFACTURING PROCESSES

Soldering & Brazing

Soldering & Brazing

- In brazing and soldering, the surfaces to be joined are first cleaned, the components assembled or fixtured, and a **low-melting-point *nonferrous metal [Aluminum-silicon, Copper, Copper-silver, Copper-zinc (brass), Copper-tin (bronze), Gold-silver]*** is then melted, drawn into the space between the two solids by ***capillary action***, and allowed to solidify.

Brazing

Source: https://qphs.fs.quoracdn.net/main-qimg-9fcaa4b47839d57b306a2613972ada02.webp

Brazing

- Brazing is the ***permanent joining*** of ***similar or dissimilar metals*** or ceramics (or composites based on those two materials) through the use of heat and a filler metal whose melting temperature (actually, liquidus temperature) ***is above 450°C but below the melting point*** (or solidus temperature) of the materials being joined.

Brazing Advantages

1. A wide range of metallic and non-metallic materials can be brazed. The process is ideally suited for ***joining dissimilar*** materials, such as ***ferrous metal to nonferrous metal***, cast metal to wrought metal, metals with widely different melting points, or even metal to ceramic.
2. Since ***less heating*** is required than for welding, the process can be performed quickly and economically.

Brazing Advantages

3. The lower temperatures ***reduce problems*** associated with ***heat-affected zones*** (or other material property alteration), warping, and distortion.
4. Assembly tolerances are closer than for most welding processes, and joint appearance is usually quite neat.

Brazing Advantages

5. Brazing is highly adaptable to automation and performs well when mass-producing complex or delicate assemblies. Complex products can also be brazed in several steps using filler metals with progressively lower melting temperatures.
6. A strong permanent joint is formed.

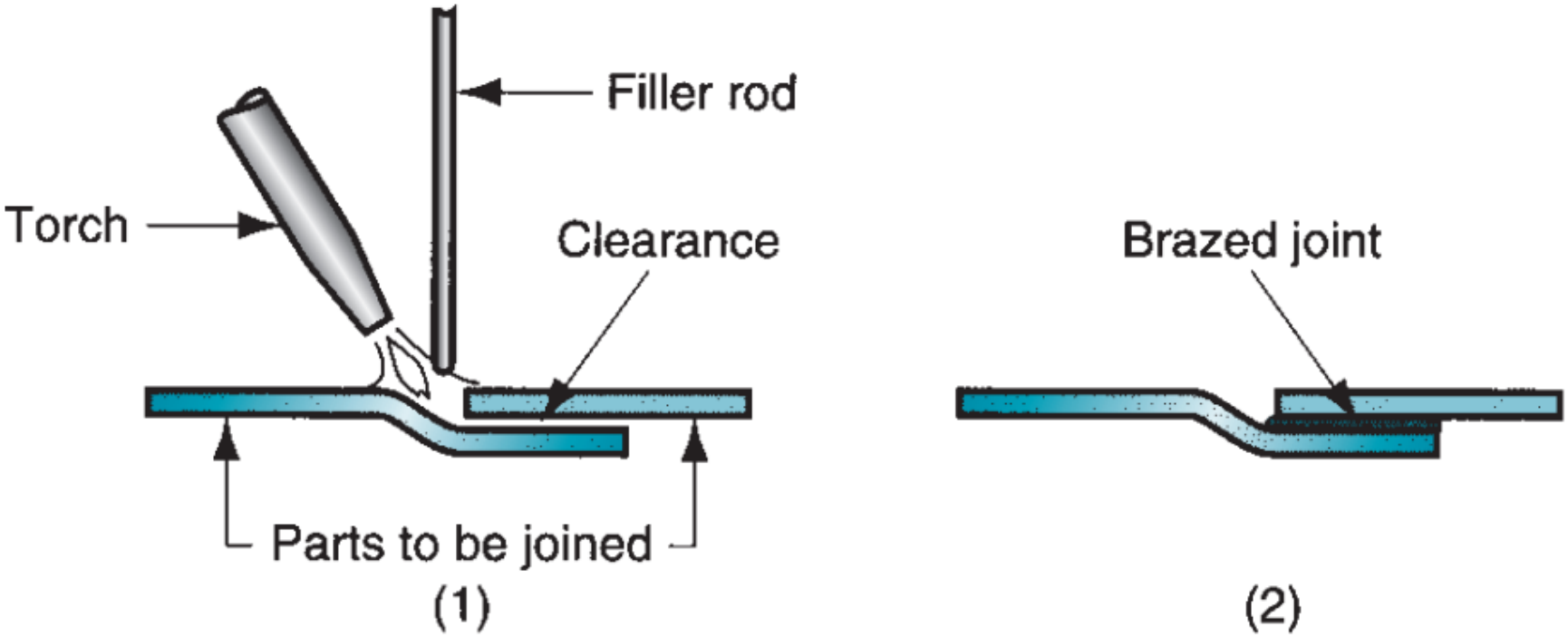
Brazing Disadvantages

- Joint ***strength*** is generally ***less*** than that of a welded joint;
- Although strength of a good brazed joint is greater than that of the filler metal, it is likely to be less than that of the base metals;
- High service temperatures may weaken a brazed joint; and
- The colour of the metal in the brazed joint may not match the colour of the base metal parts, a possible aesthetic disadvantage.

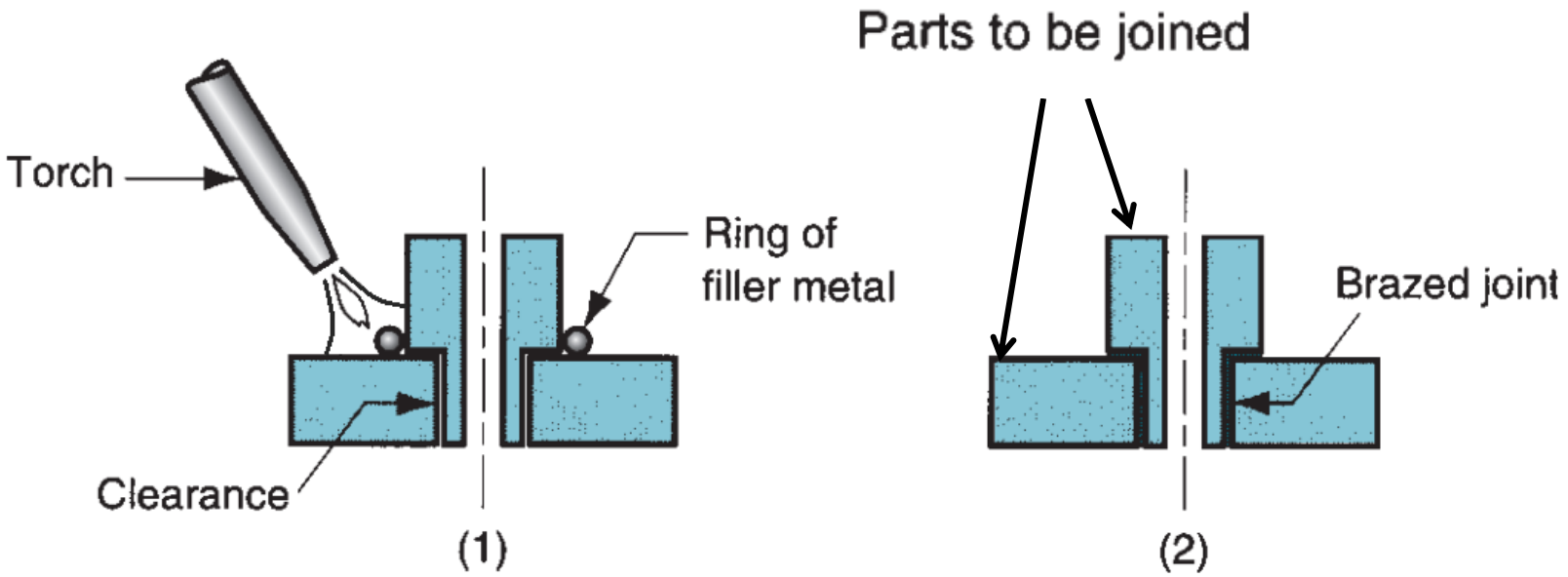
Brazing Applications

- Brazing as a production process is widely used in a variety of industries, including
  - automotive (e.g., joining tubes and pipes),
  - electrical equipment (e.g., joining wires and cables),
  - cutting tools (e.g., brazing cemented carbide inserts to shanks), and
  - Jewellry making.
- In addition, the chemical processing industry and plumbing and heating contractors join metal pipes and tubes by brazing.
- The process is used extensively for repair and maintenance work in nearly all industries

Brazing FILLER METALS



Brazing FILLER METALS



SOLDERING

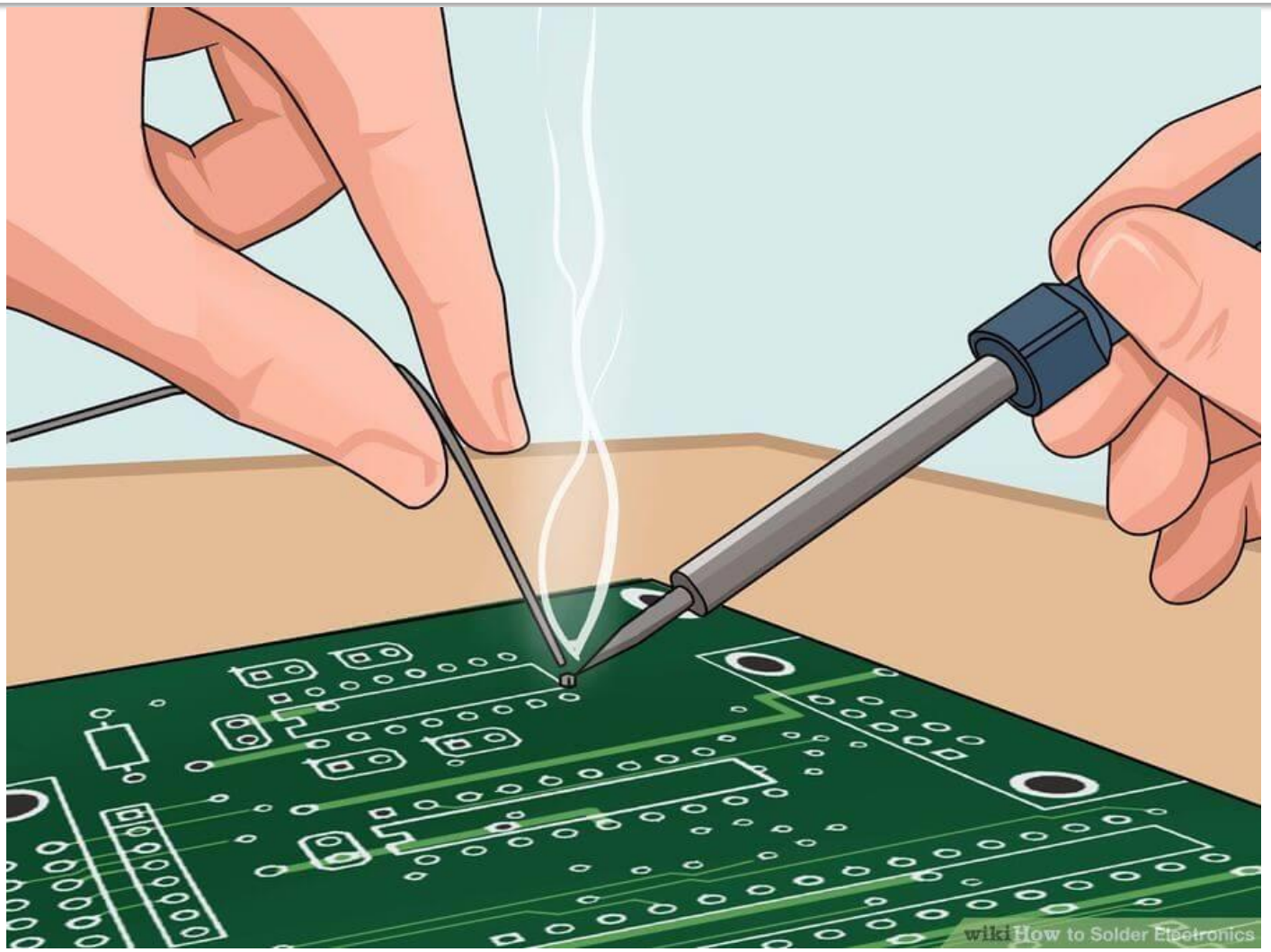


Image source: http://epcb2016.blogspot.com/2017/01/common-soldering-mistakes.html

SOLDERING

- Soldering is a brazing-type operation where the filler metal has a melting temperature (or liquidus temperature if the alloy has a freezing range) ***below 450°C.***
- It is typically used for joining thin metals, connecting electronic components, joining metals while avoiding exposure to high elevated temperatures, and filling surface flaws and defects.
- Details of soldering are similar to those of brazing, and many of the heating methods are the same.

SOLDERING

- Surfaces to be soldered must be pre-cleaned so they are free of oxides, oils, and so on.
- An appropriate flux must be applied to the faying surfaces, and the surfaces are heated.
- Filler metal, called solder, is added to the joint, which distributes itself between the closely fitting parts.

SOLDERING

- As an industrial process, soldering is most closely associated with electronics assembly.
- It is also used for mechanical joints, but not for joints subjected to elevated stresses or temperatures.

ADVANTAGES

- Advantages attributed to soldering include
  - (1) low energy input relative to brazing and fusion welding,
  - (2) variety of heating methods available,
  - (3) good electrical and thermal conductivity in the joint,
  - (4) capability to make air-tight and liquid-tight seams for containers, and
  - (5) easy to repair and rework.

DISADVANTAGES

- The biggest disadvantages of soldering are
  - (1) low joint strength unless reinforced by mechanically means and
  - (2) possible weakening or melting of the joint in elevated temperature service.

ELECTRONICS APPLICATIONS

- Principal function of the soldered joint is to provide an electrically conductive path between two parts being joined.
- Other design considerations include heat generation (from the electrical resistance of the joint) and vibration.
- Mechanical strength in a soldered electrical connection is often achieved by deforming one or both of the metal parts to accomplish a mechanical joint between them,
- or By making the surface area larger to provide maximum support by the solder.

COMMONLY USED SOLDERING ALLOY

Some common solder alloy compositions with their melting temperatures and applications.

Filler Metal	Approximate Melting Temperature °C	Approximate Melting Temperature °F	Principal Applications
Lead–silver	305	580	Elevated temperature joints
Tin–antimony	238	460	Plumbing and heating
Tin–lead	183	361	Electrical/electronics
	188	370	Electrical/electronics
	199	390	General purpose
	207	405	Automobile radiators
Tin–silver	221	430	Food containers
Tin–zinc	199	390	Aluminum joining
Tin–silver–copper	217	423	Electronics: surface mount technology