



Ministry of Higher Education and Scientific Research  
AL Mustansiriyah University - Faculty of Engineering  
Department of mechanical engineering



# The principles of production processes

## FUNDAMENTALS OF **WELDING**

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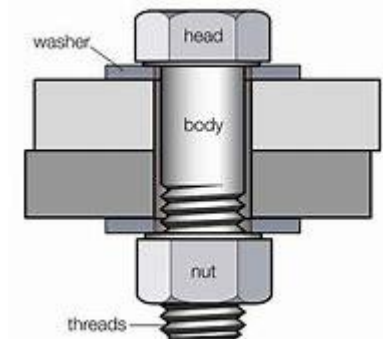
# The introduction of welding processes:

Term **joining** الربط is used for welding, brazing, soldering, and adhesive bonding, which form a permanent joint between the parts—a joint that cannot easily be separated.

The **term assembly** التجميع usually refers to mechanical methods of fastening parts together. Some of these methods allow for easy disassembly, while others do not, (By Screw or Rivet).

**Welding** is a materials joining process in which two or more parts are joined at their contacting surfaces by a suitable application of heat and/or pressure.

Many welding processes are accomplished by heat alone, with no pressure applied; others by a combination of heat and pressure; and still others by pressure alone, with no external heat supplied. In some welding processes a filler material is added to facilitate joining. **The assemblage of parts that are joined by welding is called a WELDMENT.** Welding is most commonly associated with metal parts, but the process is also used for joining plastics.



## Its commercial and technological importance derives from the following:

- ❑ Welding provides a permanent joint.
- ❑ The welded joint can be stronger than the parent materials مواد الأصل if a filler metal حشو المعادن is used that has strength properties superior العليا to those of the parents.
- ❑ Welding is usually the most economical way to join components in terms of material usage استخدام المواد and fabrication costs تكاليف التصنيع.
- ❑ Alternative mechanical methods of assembly require more complex shape alterations التعديلات (e.g., drilling of holes) and addition of fasteners (e.g., rivets or bolts).
- ❑ Welding is not restricted مقيد to the factory environment. It can be accomplished إنجاز "in the field" في الميدان.

## It also has certain **limitations and drawbacks:**

- ❑ Most welding operations are performed manually, and
- ❑ Are expensive in terms of labor cost.
- ❑ Many welding operations are considered "skilled trades," مهارة الحرفة.
- ❑ The labor to perform these operations may be scarce النادرة.
- ❑ Most welding processes are dangerous because they involve the use of high energy.
- ❑ It does not allow for convenient disassembly.
- ❑ The welded joint can suffer from certain quality defects that are difficult to detect.
- ❑ The defects can reduce the strength of the joint.

# Welding as a commercial operation

The principal applications of welding are:

Construction, (buildings and bridges); piping, pressure vessels, boilers, and storage tanks; ship building; air craft and aerospace; and automotive and railroad.



Welding is performed in a variety of locations and industries مواقع  
وصناعات مختلف

Its versatility متعددة الاستعمالات as an assembly technique for commercial products, many welding operations are performed in factories. However, several of the traditional processes, such as arc welding and oxy-fuel gas welding, use equipment that can be readily moved.

# Most welding operations are labor intensive العمالة المكثفة

**Welder**, whom controls the path or placement of the weld to join individual parts into a larger unit.



In the factory, the welder often works with a second worker, called a **fitter**. It is the fitter's job to arrange the individual components for the welder prior to making the weld.





## Welding fixtures and positioners مثبتات اللحام ومواقعها

**A welding fixture** مثبت اللحام is a device for clamping and holding the components in fixed position for welding. It is custom fabricated for the particular geometry of the weldment and economically justified on the basis of the quantities of assemblies التجميعات to be produced.



**A welding positioner** مبضعه اللحام is a device that holds the parts and also moves the collection to the desired position for welding. This differs from a welding fixture that only holds the parts in a single fixed position.



# Types of welding processes

The welding processes can be divided into two major groups:

## 1) Fusion welding

Fusion-welding processes use heat to melt the base metals. In many fusion welding operations, a filler metal is added to the molten pool to facilitate the process and provide bulk الجزء الرئيسي and strength قوة to the welded joint.

A fusion-welding operation in which no filler metal is added is referred to as an autogenous weld.

## 2) Solid-State

Welding Solid-state welding refers to joining processes in which coalescence results نتائج التلاحم from application of pressure alone or a combination of heat and pressure. If heat is used, the temperature in the process is below the melting point of the metals being welded. No filler metal is utilized. Representative welding processes include.



# Types of Fusion-welding processes

## □ Arc welding (AW):

refers to a group of welding processes in which heating of the metals is accomplished by an electric arc. Some arc welding operations also apply pressure during the process and most utilize a filler metal.



## □ Resistance welding (RW):

achieves joining using heat from electrical resistance to the flow of a current passing between the faying surfaces of two parts held together under pressure.

## □ Oxyfuel gas welding (OFW):

use an oxyfuel gas, such as a mixture of oxygen and acetylene, to produce a hot flame for melting the base metal and filler metal, if one is used.



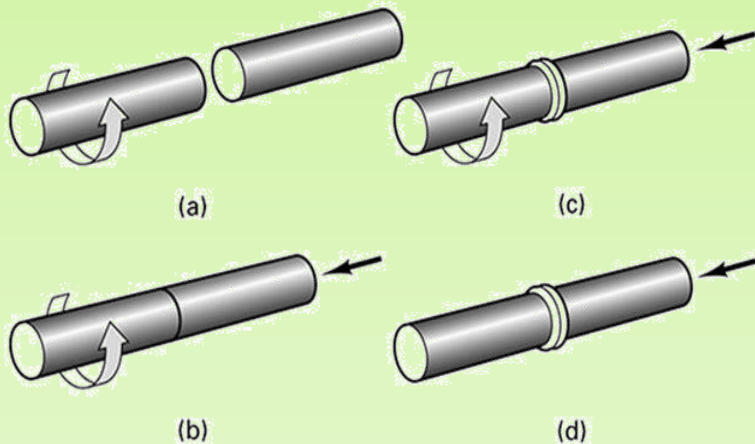
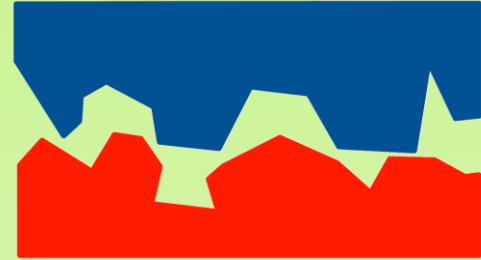
Other welding processes:

**electron beam welding** and **laser beam welding**.

# Types of Solid State-welding processes

## □ Diffusion welding (DFW):

Two surfaces are held together under pressure at an elevated temperature *درجة حرارة مرتفعة* and the parts coalesce by solid-state diffusion.

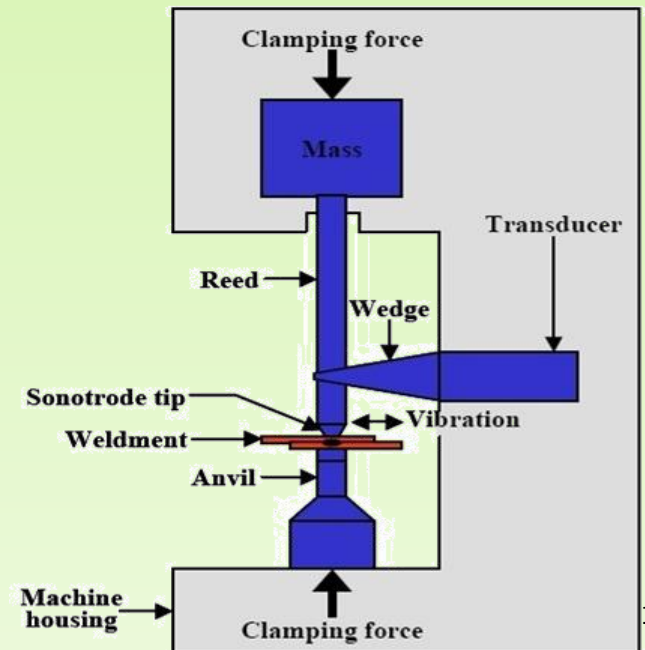


## □ Friction welding (FRW):

Coalescence is achieved by the heat of friction between two surfaces.

## □ Ultrasonic welding (USW):

Coalescence is by ultrasonic oscillating motion in a direction parallel to contacting surface of two parts held together under pressure.



## The Strict safety pre-cautions must be practiced by those who perform these operations.

- ❑ The high temperatures الحرارة of the molten metals in welding are an obvious danger.
- ❑ In gas welding, the fuels (e.g., acetylene) are a fire hazard خطر الحريق.
- ❑ The processes use high energy to cause melting of the part surfaces to be joined.
- ❑ In many welding processes, electrical power is the source of thermal energy, so there is the hazard of electrical shock to the worker مخاطر الصدمة الكهربائية للعامل.
- ❑ Certain welding processes have the iron particular perils مخاطر خاصة أيرون. In arc welding, for example, ultra violet radiation الإشعاع is emitted تنبعث that is injurious الضارة to human vision.
- ❑ Sparks, splatters رش of molten metal, smoke, and fumes أبخرة add to the risks associated with welding operations.

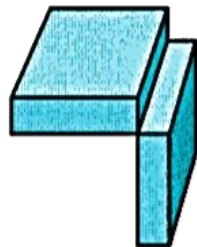
# The weld joint

**1) TYPES OF JOINTS** نوع الربط, There are five basic types of joints:

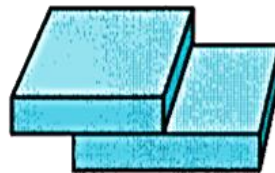
- ❑ Butt joint. The parts lie in the same plane and are joined at their edges. (Fig. 2(a))
- ❑ Corner joint. The parts in a corner joint form a right angle and are joined at the corner of the angle. (Fig. 2(b))
- ❑ Lap joint. This joint consists of two overlapping parts. (Fig. 2(c))
- ❑ Tee joint. One part is perpendicular to the other in the approximate shape of the letter "T." (Fig. 2(d))
- ❑ Edge joint. The parts in an edge joint are parallel with at least one of their edges in common, and the joint is made at the common edge(s). (Fig. 2(e))



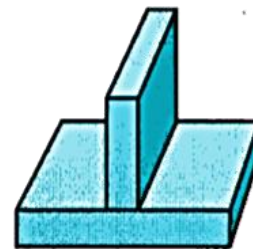
(a)



(b)



(c)



(d)



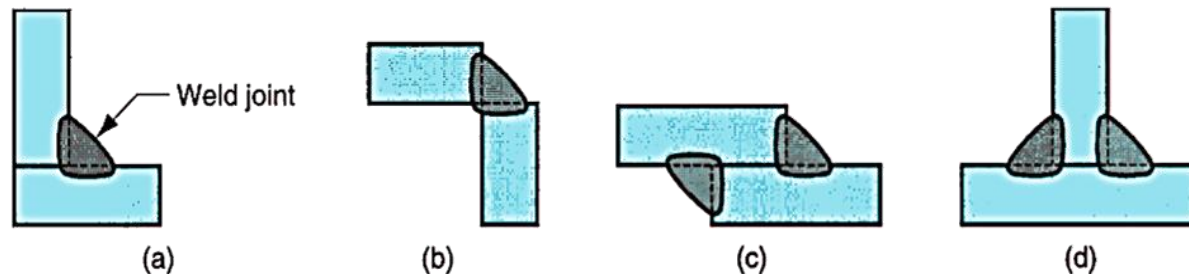
(e)

# The weld joint

**2) TYPES OF WELDS** نوع اللحامات, There are five basic types of joints:

**A fillet weld** لحام التعبئة is used to fill in the edges of plates created by corner, lap, and tee joints.

- ❑ Filler metal is used to provide a cross section approximately the shape of a right triangle.
- ❑ The most common weld type in arc and oxy-fuel welding because it requires minimum edge preparation.
- ❑ Fillet welds can be single or double (i.e., welded on one side or both) and can be continuous or intermittent (i.e., welded along the entire length of the joint or with un-welded spaces along the length).

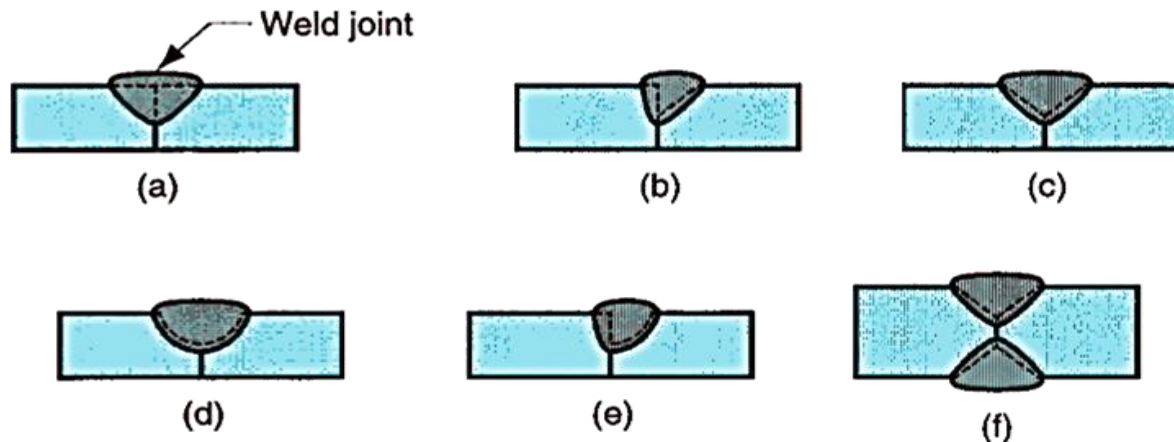


(a) inside single fillet corner joint; (b) outside single fillet corner joint;  
(c) double fillet lap joint; and (d) double fillet tee joint.

# The weld joint

**Groove welds** الأخدود اللحامات usually require that the edges of the parts be shaped into a groove to facilitate weld penetration تسهيل تغلغل اللحام.

Preparation of the part edges beyond the basic square edge is often done to increase the strength of the welded joint or where thicker parts are to be welded.



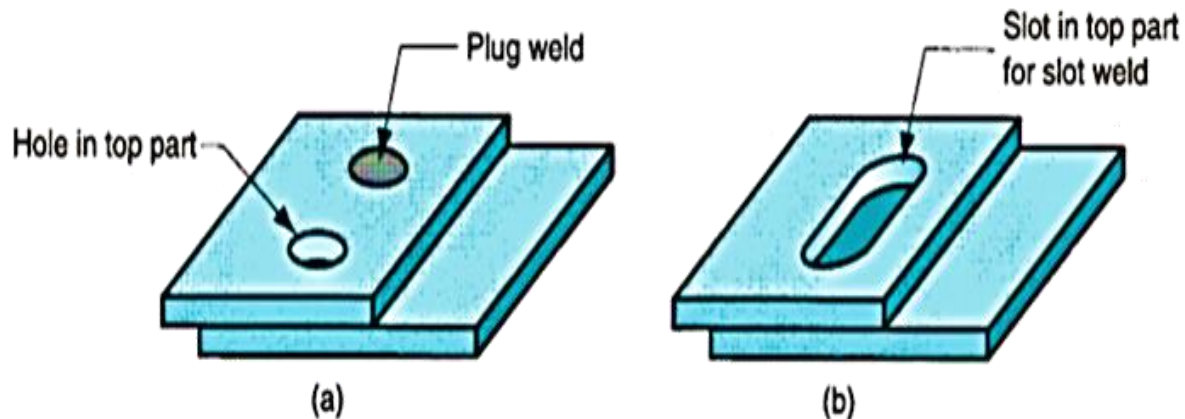
(a) square groove weld, one side; (b) single bevel groove weld; (c) single V-groove weld; (d) single U-groove weld; (e) single J-groove weld; (f) double V-groove weld.



# The weld joint

Although most closely associated with a butt joint, groove welds are used on all joint types except lap.

**Plug welds and slot welds** are used for attaching flat plates, as shown in Figure 5, using one or more holes or slots in the top part and then filling with filler metal to fuse the two parts together.

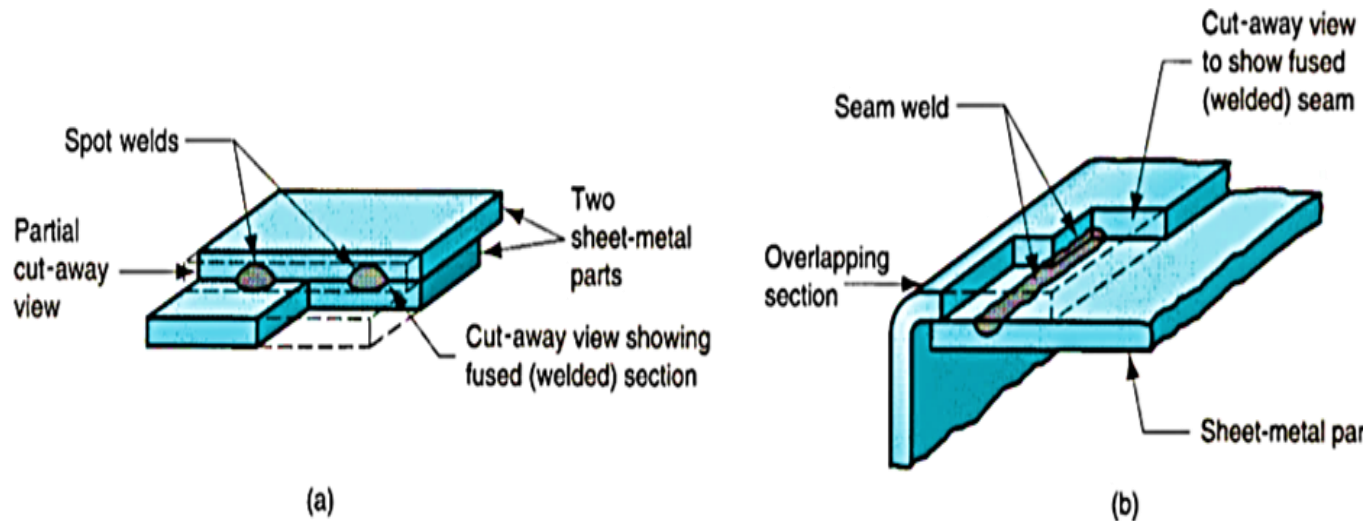


(a) Plug weld; and (b) Slot weld.

# The weld joint

**Spot welds and seam welds**, used for lap joints:

- A spot weld is a small fused section between the surfaces of two sheets or plates. Multiple spot welds are typically required to join the parts. It is most closely associated with resistance welding.
- A seam weld is similar to a spot weld except it consists of a more or less continuously fused section between the two sheets or plates.

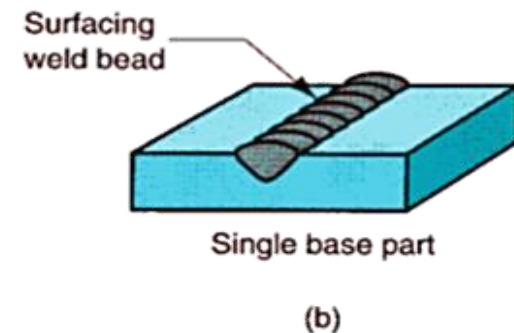
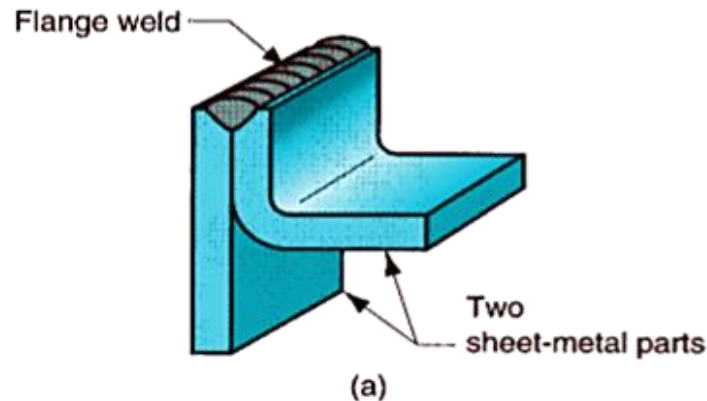


(a) Spot weld; and (b) seam weld.

# The weld joint

## Flange welds and surfacing welds

- A flange weld is made on the edges of two (or more) parts, usually sheet metal or thin plate, at least one of the parts being flanged.
- A surfacing weld is used to deposit لترسيب filler metal onto the surface of a base part in one or more weld beads. The weld beads can be made in a series of overlapping parallel passes, thereby covering large areas of the base part. The purpose is to increase the thickness of the plate or to provide a protective coating on the surface.



(a) Flange weld; and (b) surfacing weld.

Thanks  
for your attention