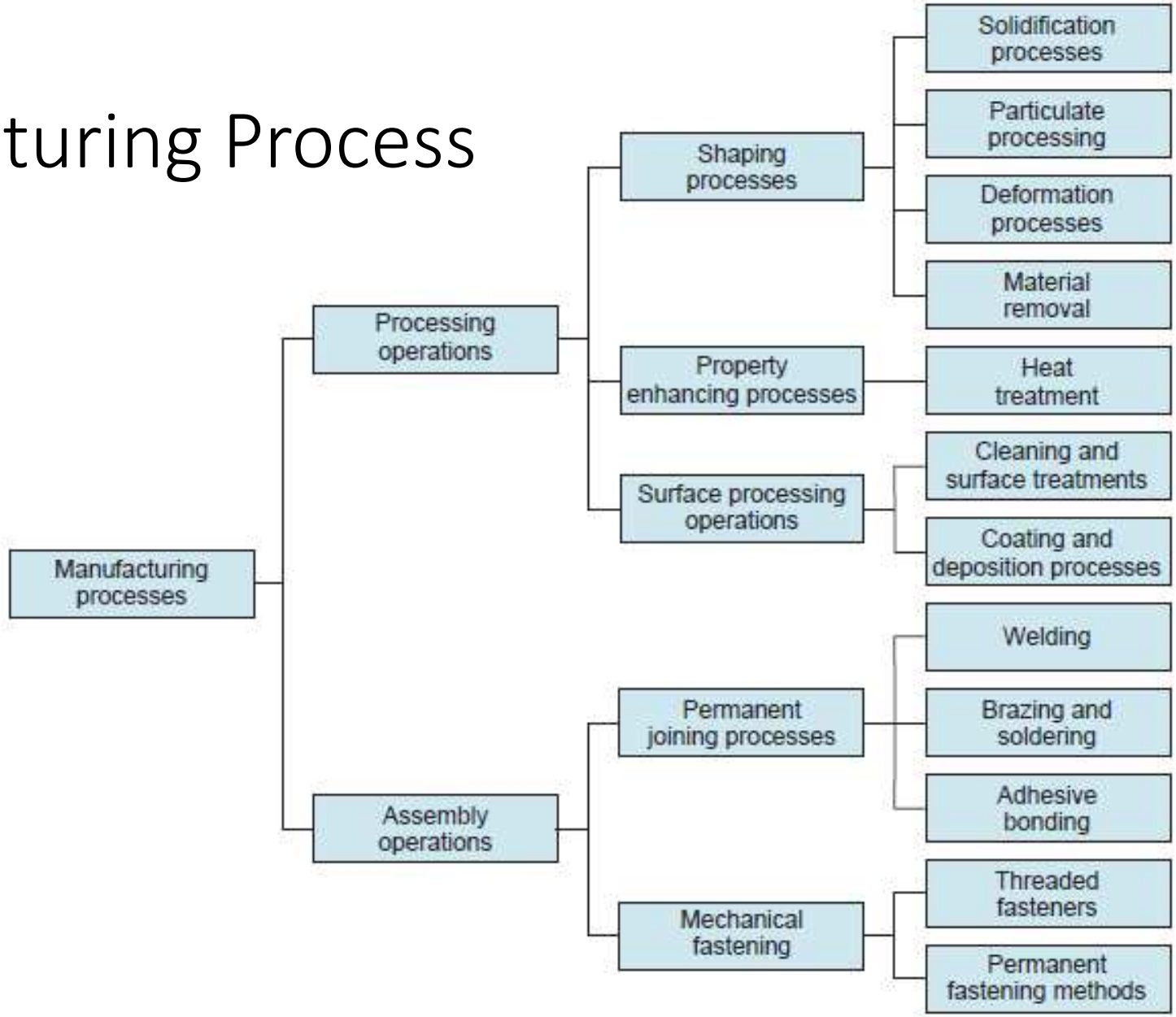
Welding Metallurgy and Joining Processes

Manufacturing Process



What is welding?

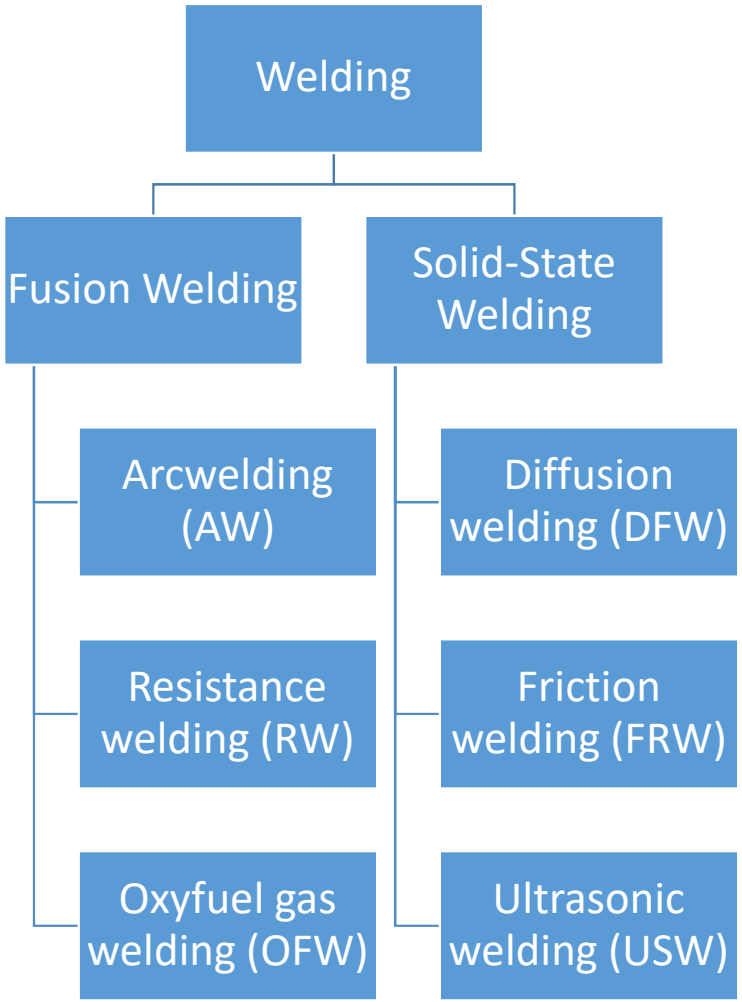
- Welding is a materials joining process in which two or more parts are coalesced at their contacting surfaces by a suitable application of heat and/or pressure.
- The assemblage of parts that are joined by welding is called a weldment

Advantages of welding

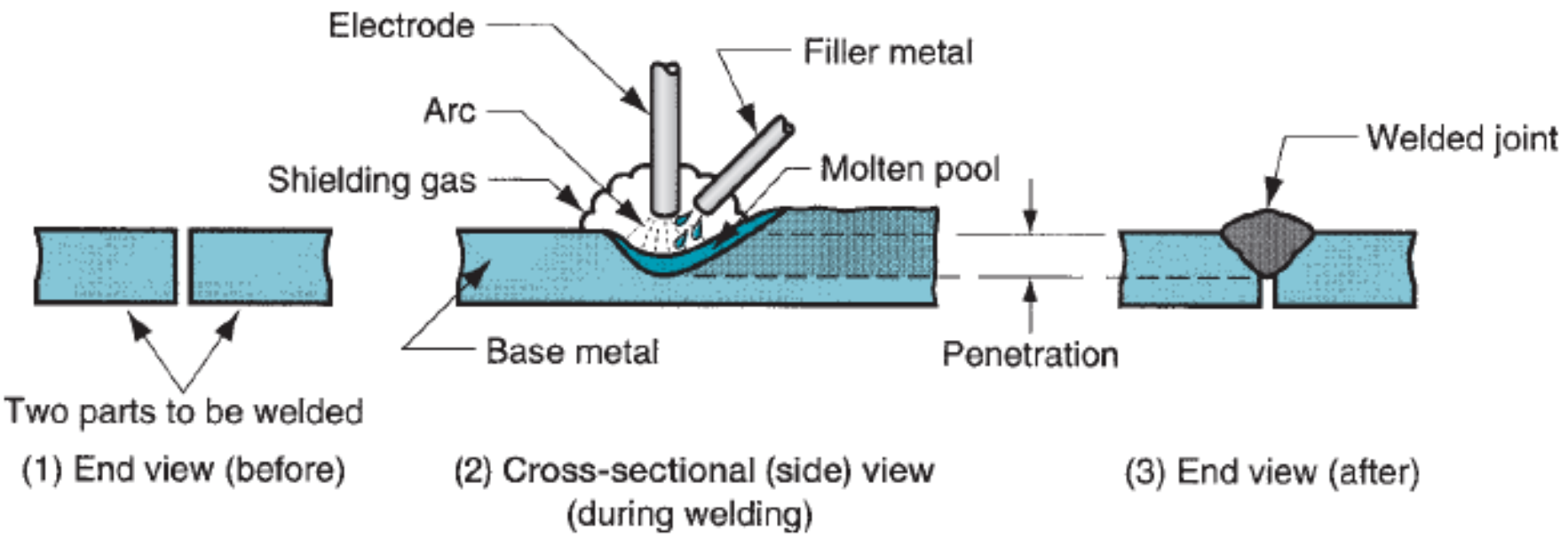
- Welding provides a permanent joint. The welded parts become a single entity.
- The welded joint can be stronger than the parent materials if a filler metal is used that has strength properties superior to those of the parents, and if proper welding techniques are used.
- Welding is usually the most economical way to join components in terms of material usage and fabrication costs. Alternative mechanical methods of assembly require more complex shape alterations (e.g., drilling of holes) and addition of fasteners (e.g., rivets or bolts). The resulting mechanical assembly is usually heavier than a corresponding weldment.
- Welding is not restricted to the factory environment. It can be accomplished ‘‘in the field.’’

Disadvantages of welding

- Most welding operations are performed manually and are expensive in terms of labor cost. Many welding operations are considered ‘‘skilled trades,’’ and the labor to perform these operations may be scarce.
- Most welding processes are inherently dangerous because they involve the use of high energy.
- Since welding accomplishes a permanent bond between the components, it does not allow for convenient disassembly. If the product must occasionally be disassembled (e.g., for repair or maintenance), then welding should not be used as the assembly method.
- The welded joint can suffer from certain quality defects that are difficult to detect. The defects can reduce the strength of the joint.

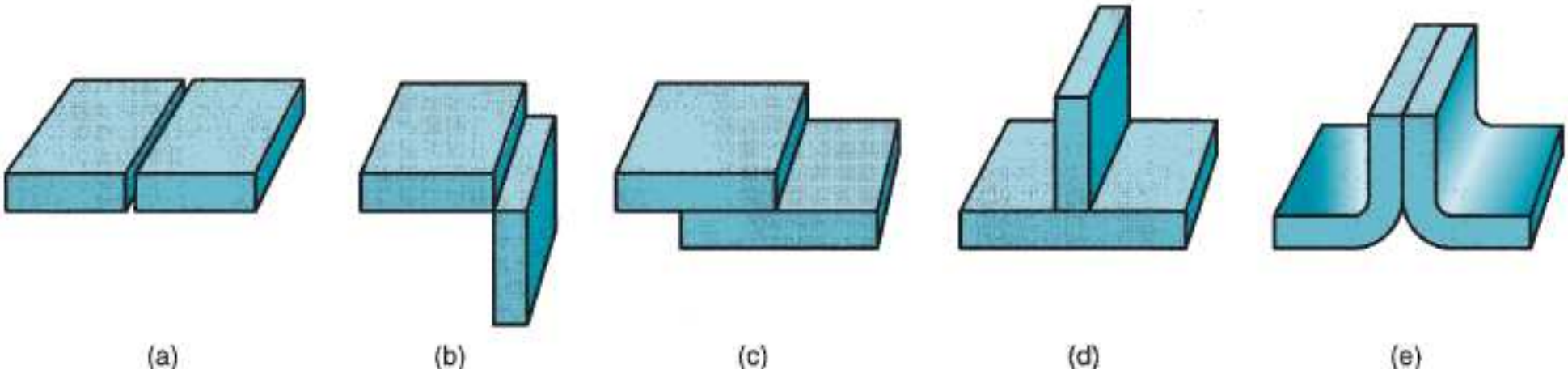


We can divide the welding processes into two major groups



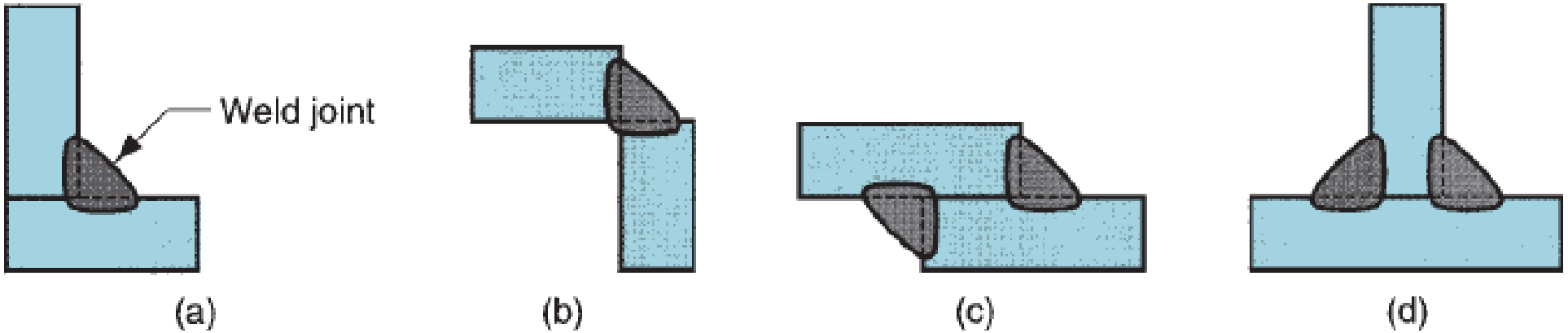
Basics of arc welding: (1) before the weld; (2) during the weld (the base metal is melted and filler metal is added to the molten pool); and (3) the completed weldment. There are many variations of the arc-welding process.

TYPES OF JOINTS



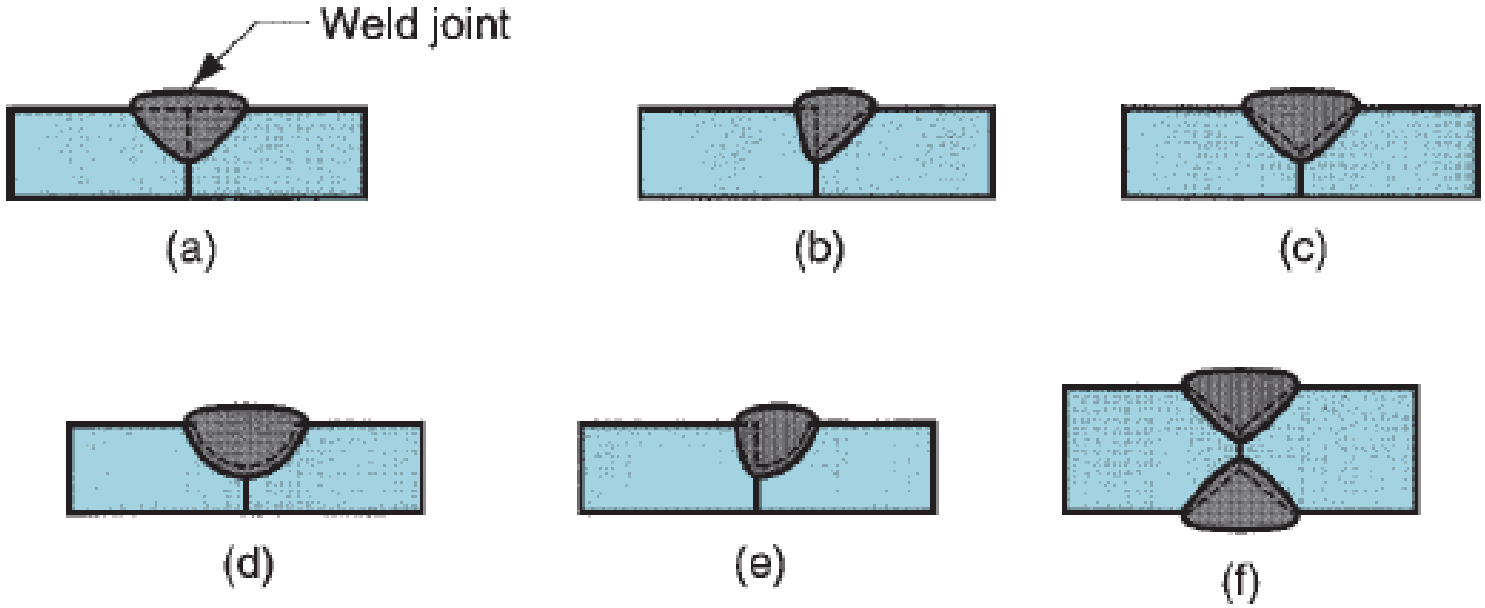
Five basic types of joints: (a) butt, (b) corner, (c) lap, (d) tee, and (e) edge.

TYPES OF WELDS



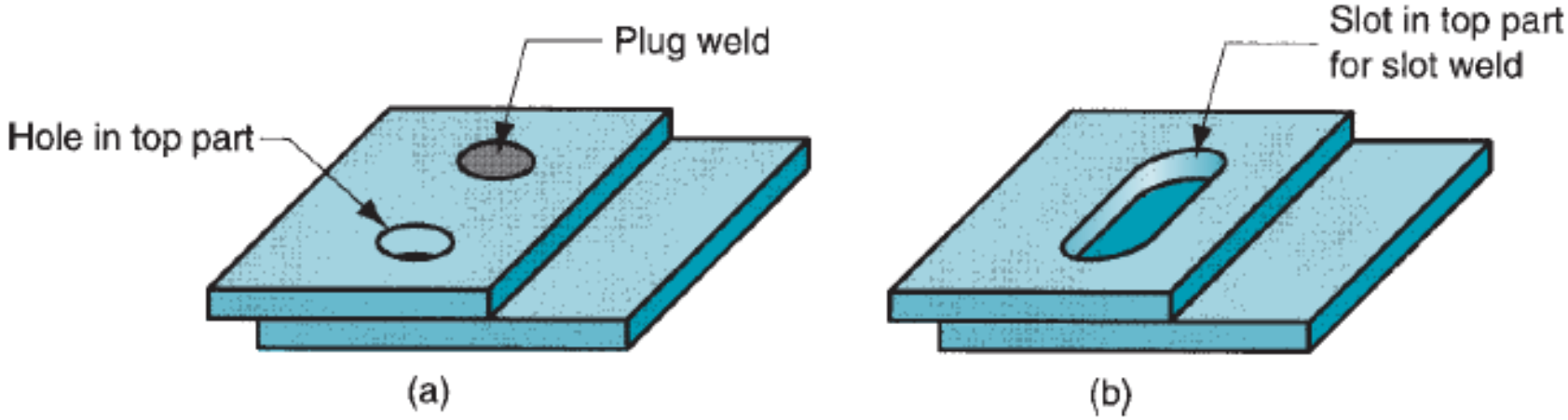
Various forms of **fillet welds**: (a) inside single fillet corner joint; (b) outside single fillet corner joint; (c) double fillet lap joint; and (d) double fillet tee joint. Dashed lines show the original part edges.

TYPES OF WELDS



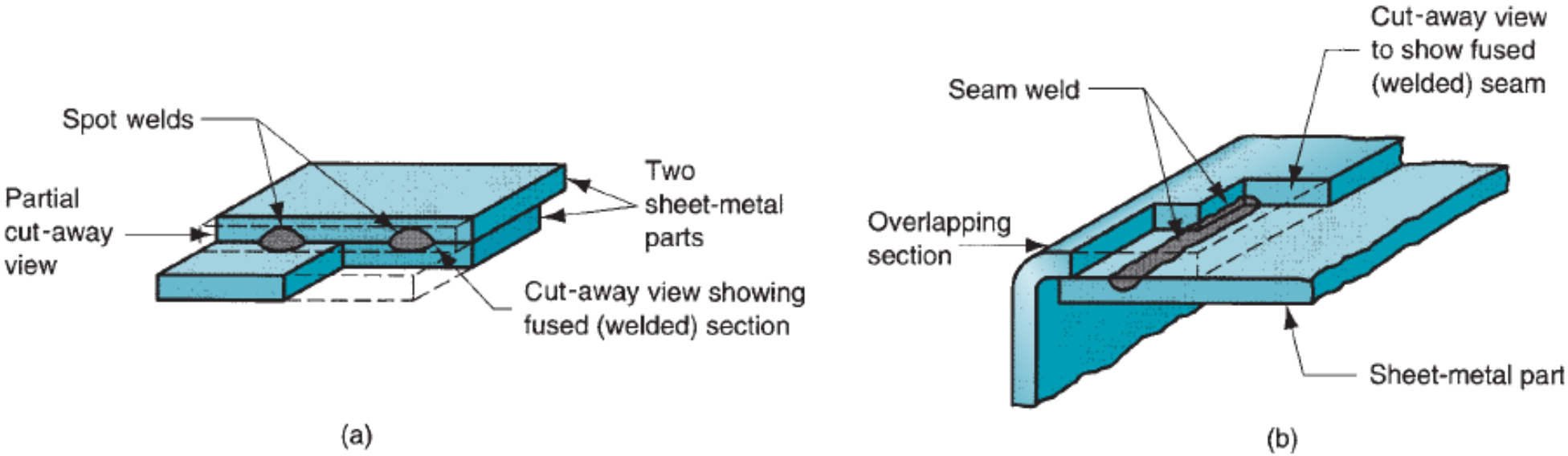
Some typical **groove welds**: (a) square groove weld, one side; (b) single bevel groove weld; (c) single V-groove weld; (d) single U-groove weld; (e) single J-groove weld; (f) double V-groove weld for thicker sections. Dashed lines show the original part edges.

TYPES OF WELDS



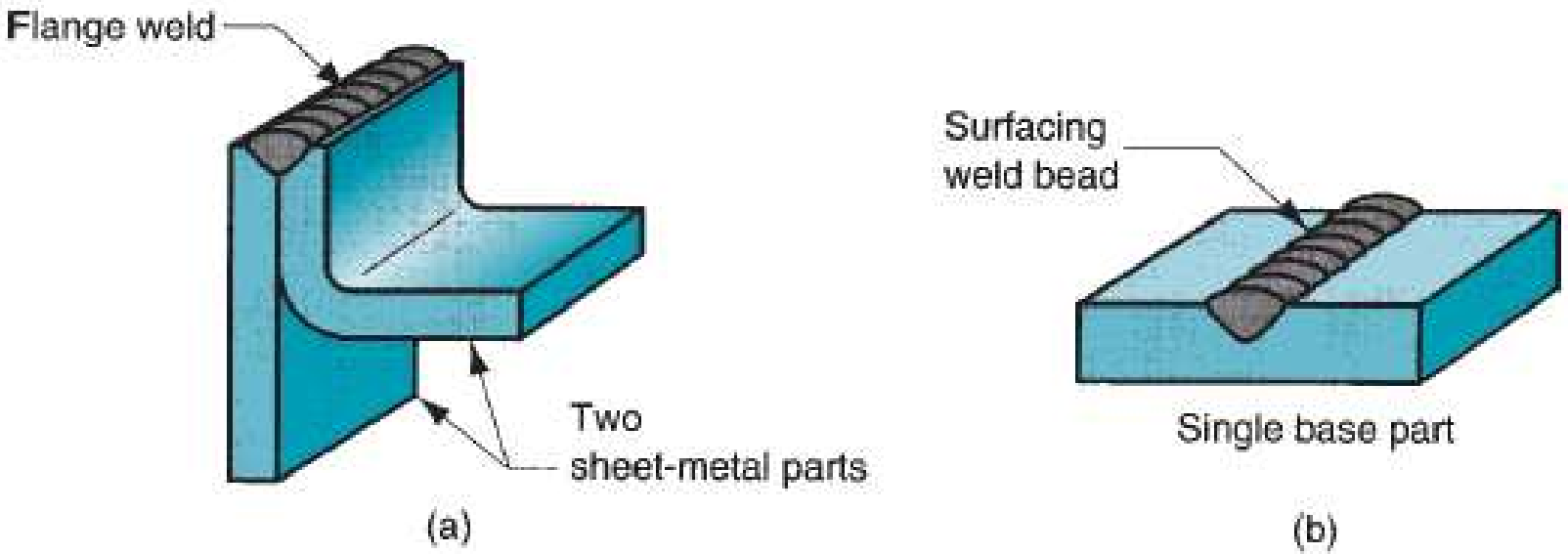
(a) Plug weld; and (b) slot weld.

TYPES OF WELDS



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

TYPES OF WELDS



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

REVIEW QUESTIONS

1. What are the advantages and disadvantages of welding compared to other types of assembly operations?
2. Define the term fusion weld.
3. What are the fundamental differences between a fusion weld and a solid state weld?
4. Discuss the reasons why most welding operations are inherently dangerous.
5. What is the difference between machine welding and automatic welding?
6. Name and sketch the five joint types.
7. Define and sketch a fillet weld.
8. Define and sketch a groove weld.
9. Why is it desirable to use energy sources for welding that have high heat densities?
10. What is the heat-affected zone in a fusion weld? Sketch and descripbe in detail.