

Lecture: 3

Classification of Welding Processes II

Apart from technical factors, welding processes can also be classified on the fundamental approaches used for deposition of materials for developing a joint. This chapter presents the classification of welding processes as welding processes and allied process used for developing a joint

Keywords: Welding and allied processes, approach of classification, cast weld, resistance weld, fusion weld, solid state weld

3.1 Classification of welding processes

There is another way of classifying welding and allied processes which is commonly reported in literature. Various positive processes involving addition or deposition of metal are first broadly grouped as welding process and allied welding processes as under:

1. Welding processes
 - i. Cast weld processes
 - ii. Fusion weld processes
 - iii. Resistance weld processes
 - iv. Solid state weld processes
2. Allied welding processes
 - i. Metal depositing processes
 - ii. Soldering
 - iii. Brazing
 - iv. Adhesive bonding
 - v. Weld surfacing
 - vi. Metal spraying

This approach of classifying the welding process is primarily based on the way metallic pieces are united together during welding such as

- Availability and solidification of molten weld metal between components being joined are similar to that of casting: Cast weld process.

- Fusion of faying surfaces for developing a weld: Fusion weld process
- Heating of metal only to plasticize then applying pressure to forge them together: Resistance weld process
- Use pressure to produce a weld joint in solid state only: Solid state weld process

3.2 Cast welding process

Those welding processes in which either molten weld metal is supplied from external source or melted and solidified at very low rate during solidification like castings. Following are two common welding processes that are grouped under cast welding processes:

- Cast weld processes
 - Thermite welding
 - Electroslag welding

In case of thermite welding, weld metal is melted externally using exothermic heat generated by chemical reactions and the melt is supplied between the components to be joined while in electroslag welding weld metal is melted by electrical resistance heating and then it is allowed to cool very slowly for solidification similar to that of casting.

Comments on classification based on cast weld processes

This classification is true for thermite welding where like casting melt is supplied from external source but in case of electroslag welding, weld metal obtained by melting of both electrode and base metal and is not supplied from the external source. Therefore, this classification is not perfect.

3.3 Fusion Weld Processes

Those welding processes in which faying surfaces of plates to be welded are brought to the molten state by applying heat and cooling rate experienced by weld metal in these processes are much higher than that of casting. The heat required for melting can be produced using electric arc, plasma, laser and

electron beam and combustion of fuel gases. Probably this is un-disputed way of classifying few welding processes. Common fusion welding processes are given below:

- Fusion Weld Processes
 - Carbon arc welding
 - Shielded metal arc welding
 - Submerged arc welding
 - Gas metal arc welding
 - Gas tungsten arc welding
 - Plasma arc welding
 - Electrode gas welding
 - Laser beam welding
 - Electron beam welding
 - Oxy-fuel gas welding

3.4 Resistance welding processes

Welding processes in which heat required for softening or partial melting of base metal is generated by electrical resistance heating followed by application of pressure for developing a weld joint. However, flash butt welding begins with sparks between components during welding instead of heat generation by resistance heating.

- Resistance welding processes
 - Spot welding
 - Projection welding
 - Seam welding
 - High frequency resistance welding
 - High frequency induction welding
 - Resistance butt welding
 - Flash butt welding
 - Stud welding

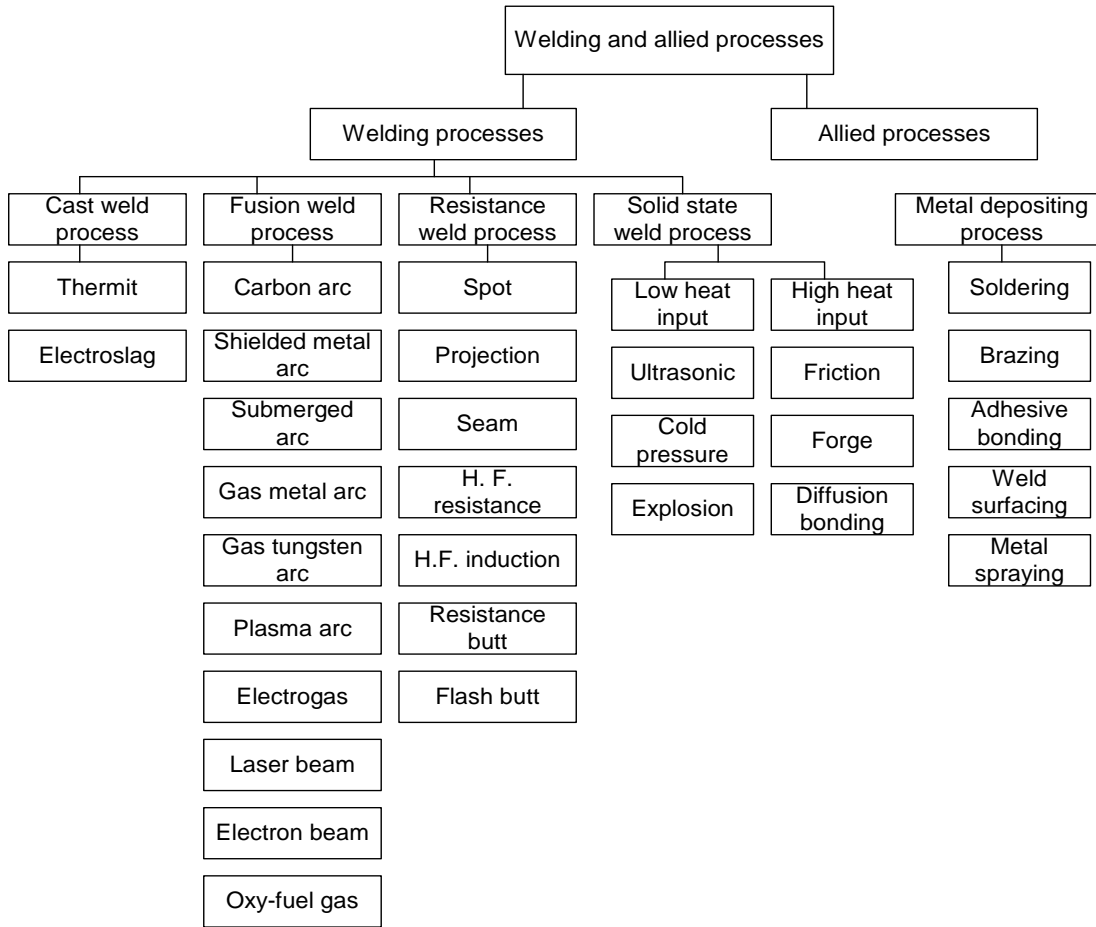
3.5 Solid state welding process

Welding processes in which weld joint is developed mainly by application of pressure and heat through various mechanism such as mechanical interacting, large scale interfacial plastic deformation and diffusion etc.. Depending up on the amount of heat generated during welding these are further categorized as under:

- Solid state welding process
 - Low heat input processes
 - Ultrasonic welding
 - Cold pressure welding
 - Explosion welding
 - High heat input processes
 - Friction welding
 - Forge welding
 - Diffusion welding

There are many ways to classify the welding processes however, fusion welding and pressure welding criterion is the best and most accepted way to classify all the welding processes. The flow chart is showing classification of welding and allied processes for better understanding of nature of a specific process (Chart 3.1).

Chart 3.1 Classification of Welding and Allied Processes



References and books for further reading

- Metals Handbook-Welding, Brazing and Soldering, American Society for Metals, 1993, 10th edition, Volume 6, USA.
- Richard Little, Welding and Welding Technology, McGraw Hill, 2001, 1st edition.
- H Cary, Welding Technology, Prentice Hall, 1988, 2nd edition.
- S V Nadkarni, Modern Arc Welding Technology, Ador Welding Limited, 2010, New Delhi.
- R S Parmar, Welding process and technology, Khanna Publisher, New Delhi
- Welding handbook, American Welding Society, 1987, 8th edition, volume 1 & 2, USA.

- http://www.substech.com/dokuwiki/doku.php?id=classification_of_welding_processes
- <http://www.newagepublishers.com/samplechapter/001469.pdf>
- <http://www.typesofwelding.net>
- http://books.google.co.in/books?id=PSc4AAAAIAAJ&pg=PA1&lpg=PA1&dq=classification+of+welding+processes&source=bl&ots=G9EbFzqzBa&sig=T1EqGIMpChzzqwSZJJeuD9PlaKQ&sa=X&ei=qlsyUO_XCMnZrQfn8oHoCQ&sqi=2&ved=0CCIQ6AEwBA#v=onepage&q=classification%20of%20welding%20processes&f=false
- <http://www.kobelcowelding.com/20100119/handbook2009.pdf>
- http://me.emu.edu.tr/me364/ME364_combining_fusion.pdf