

Common Welding Defects

The defects in the weld can be defined as irregular (non-homogeneous) in the weld metal, that produced due to incorrect welding parameters, wrong welding procedures or wrong combination of filler metal and parent metal. Defects may be on the surface or inside the weld metal. Certain defects such as cracks cannot be tolerated, but other defects may be acceptable within permissible limits. Various welding defects can be classified into types such as cracks, porosity, solid inclusions, lack of fusion and inadequate penetration, imperfect shape and various defects

1. Cracks

Cracks may be of macro size and may appear in the weld metal or base metal or base metal and weld metal boundary. Different types of cracks are longitudinal cracks, transverse cracks or radiating/star cracks and cracks in the weld crater. *Cracks occur when localized stresses exceed the ultimate tensile strength of material. These stresses are developed due to shrinkage during solidification of weld metal. Cracks may be developed due to poor ductility of base metal, high sulphur and carbon contents, high arc travel speeds i.e. fast cooling rates, too concave or convex weld bead and high hydrogen contents in the weld metal.*

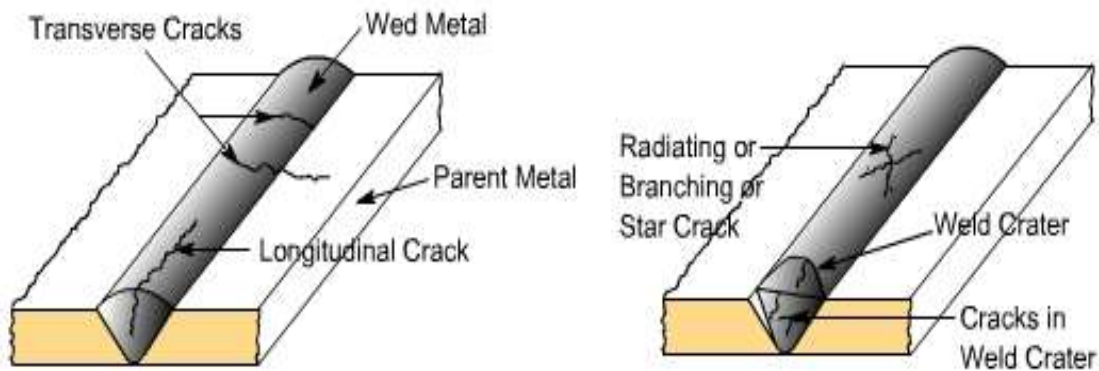


Figure 33 Types of Cracks in Welds

2. Porosity

Porosity results when the gases are remain in the solidifying weld metal. These gases are generated from the flux or coating components of the electrode or shielding gases used during welding or from absorbed moisture in the coating. Rust, dust, oil and grease on the surface of work pieces or on electrodes are also source of gases during welding. Porosity may be easily prevented if work pieces are properly cleaned from rust, dust, oil and grease. Porosity can also be controlled if excessively high welding currents, faster welding speeds and long arc lengths are avoided.

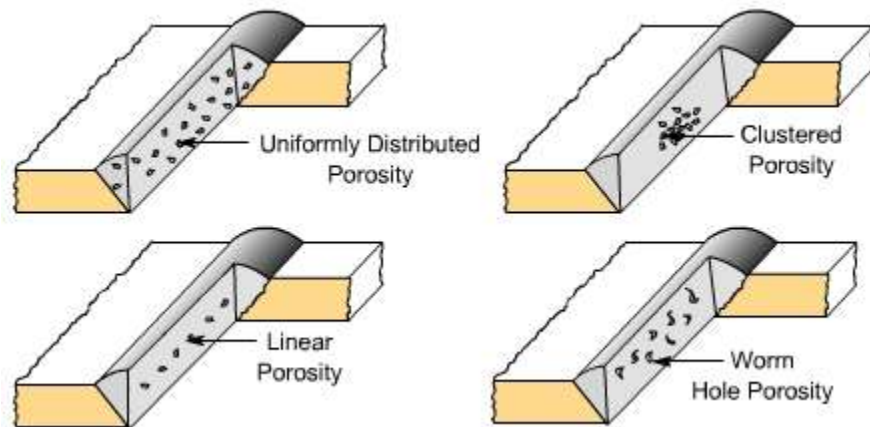


Figure 34 Forms of Porosities

3. Solid Inclusion

Solid inclusions may be in the form of slag or any other non-metallic material in the weld metal as these may not be able to float on the surface of the solidifying weld metal. During arc welding flux either in the form of granules or coating after melting, reacts with the molten weld metal removing oxides and other impurities in the form of slag and it floats on the surface of weld metal due to its low density. However, if the molten weld metal has high viscosity or too low temperature or cools rapidly then the slag may not be leaved from the weld molten and may cause inclusion.

Slag inclusion can be prevented if proper groove is selected, all the slag from the previously deposited bead is removed, too high or too low welding currents and long arcs are avoided.

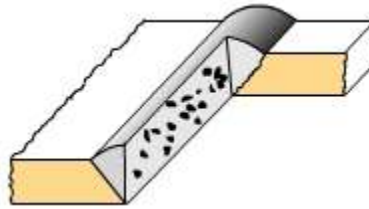


Figure 35 Slag Inclusion in Weldments

4. Lack of Fusion

Lack of fusion is the failure to fuse together either the base metal and weld metal or subsequent beads in multipass welding because of failure to raise the temperature of base metal or previously deposited weld layer to melting point during welding. Lack of fusion can be avoided by properly cleaning of surfaces to be welded, selecting proper current, proper welding technique and correct size of electrode.

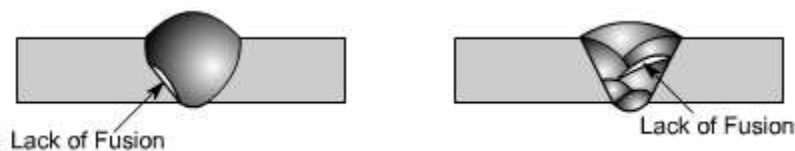


Figure 36 Types of Lack of Fusion

5. Imperfect Shape

Imperfect shape means the variation from the desired shape and size of the weld bead. During undercutting a notch is formed either on one side of the weld bead or both sides in which stresses tend to concentrate and it can result in the early failure of the joint. Main reasons for undercutting are the excessive welding currents, long arc lengths and fast travel speeds.

*Underfilling may be due to low currents, fast travel speeds and small size of electrodes.
Overlap may occur due to low currents, longer arc lengths and slower welding speeds.*

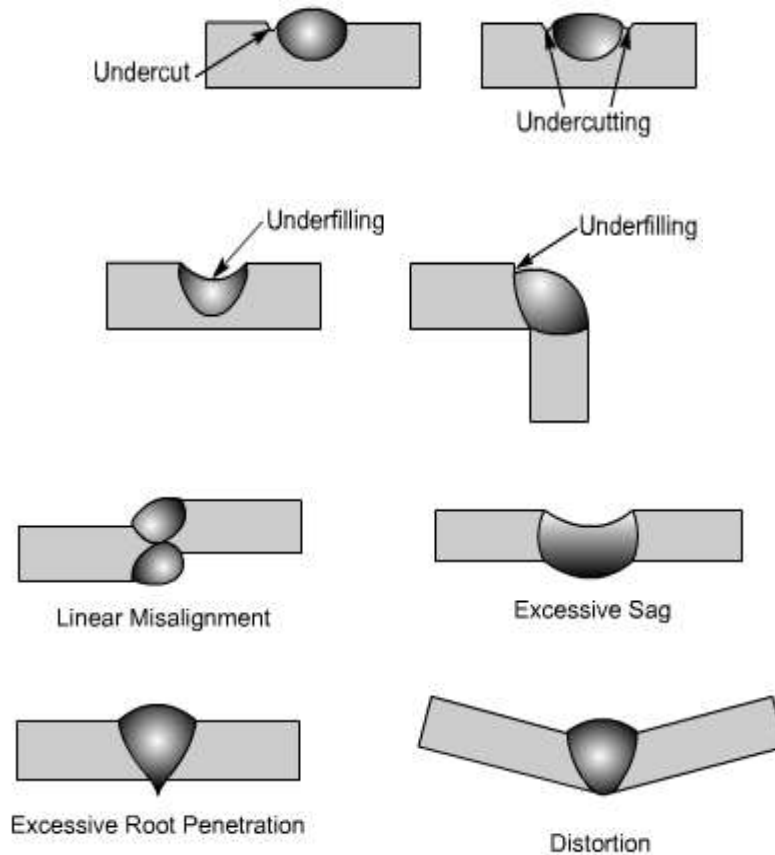


Figure 37 Various Imperfect Shapes of Welds

Excessive reinforcement is formed if high currents, low voltages, slow travel speeds and large size electrodes are used. Excessive root penetration and sag occur if excessive high currents and slow travel speeds are used for relatively thinner members. Distortion is caused because of shrinkage occurring due to large heat input during welding.

Nonconventional welding (hybrid welding)

The aim of nonconventional welding is increasing of joining process efficiency. Welding is today a key manufacturing process, present practically in all industrial sectors. One of the principal directions for the progress of the welding is the development of hybrid welding processes. These are created by combination of two conventional welding processes and through effects of the advantages to each individual welding process, first of all an increase of the process stability and efficiency.

Hybrid welding processes combines two welding processes to improve or increasing of joining process efficiency. The first hybrid welding process was the plasma – MIG welding which represents a combination between plasma welding and shielded gas welding with fusible electrode (MIG welding). At present over 20 hybrids welding processes are known, the most important as the following:-

Laser arc hybrid welding which combines the laser welding with a TIG (Tungsten Inert Gas) or MIG (Metal Inert Gas) shielded gas electric arc welding process;

- MIG welding combined with submerged arc welding.
- Resistance spot welding combined with brazing.
- Laser activated friction stir welding
- A-TIG welding (chemically activated TIG welding).
- Ultrasonically activated TIG welding.

PLASMA – MIG HYBRID WELDING

The plasma – MIG welding process is a combination between the plasma welding and the MIG welding. The electric arc produced between a fusible electrode (wire), that is situated in the hot ionized gas current of a plasma arc. The process principle is illustrated in figure 38. Usually, the plasma arc is supplied in direct current direct polarity and the MIG arc in direct current reversed polarity.

The MIG arc ignites in the interior of the plasma stream which assures a contraction effect. Two operating modes are possible. In the case of a MIG current having a reduced value, the electric arc is narrow, this technological version can be used for thin plates at high speed welding. But with welding thick plates at reduced welding speed, and a high intensity MIG current, in this case the wire melting rate increased.

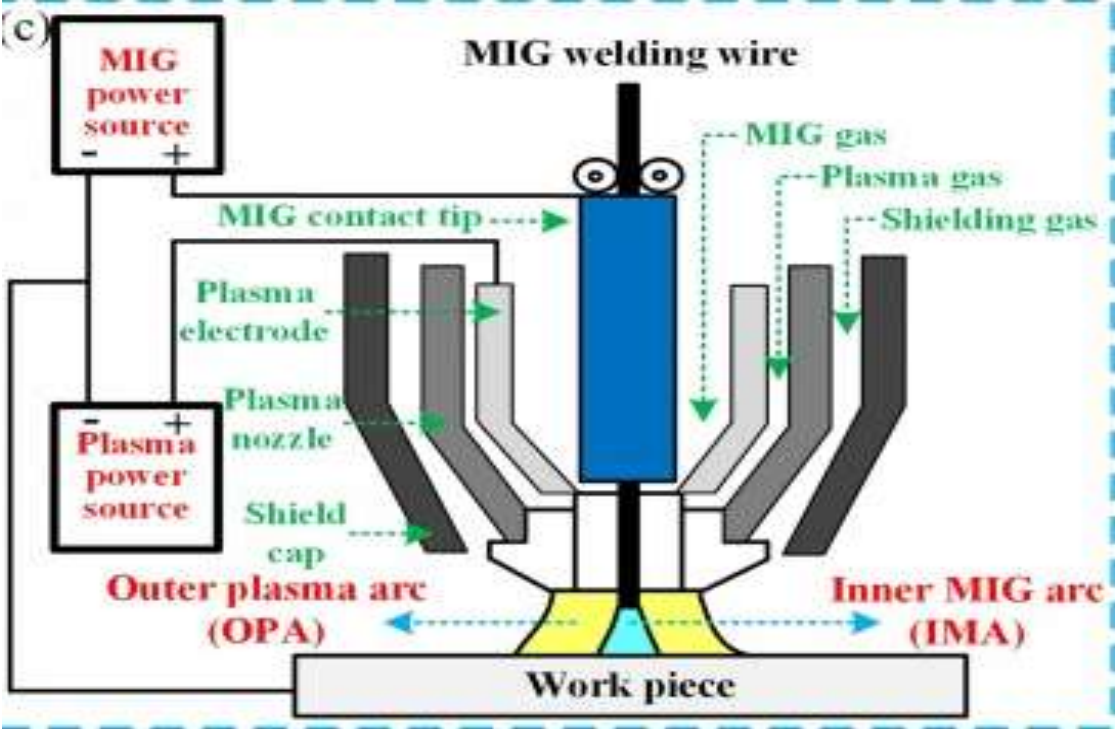


Figure 38 Principle of plasma – MIG hybrid