

HOT CRACKING

Hot cracking is a term used to describe cracks that occur in the fusion zone or heat affected zone of a welded joint at elevated temperatures. Its occurrence is dependent on the existence of a relatively high tensile stress, developed by contraction of the welded joint, and lack of ductility due to the presence of a discontinuous intergranular liquid film.

There are two approaches to reducing the incidence of hot cracking:

1. Minimizing restraint and hence contraction stress, achieved by good design practice.
2. Control of chemical composition
 - a. Carbon and low alloy steels - Not usually a problem except with some steels containing greater than 1% nickel or where there are unusually high levels of sulphur, phosphorus or lead, such as the free machining steels.
 - b. CSEF (Creep Strength enhanced Ferritic) Steels: Since these are modified with vanadium, nickel, aluminum, niobium and nitrogen, it develops very high hardness. Tramp residual elements in this steel, such as phosphorous, sulfur, lead, tin, copper, antimony and other elements will segregate to the grain boundaries during solidification of the weld, and, since the weld metal is very hard, it will crack quite easily. It is, therefore, very important to use low residual filler metal.
 - c. Stainless steel and combinations of stainless steel, low alloy steels and nickels alloys - There can be a problem with certain compositions of weld metal. It is necessary to avoid the fully austenitic microstructures and the presence of elements such as sulphur, phosphorus (which should be less than 0.025% to minimize risk) and copper which promote cracking. On the other hand molybdenum tends to make the weld deposit more crack resistant and the 18Cr-8Ni-3Mo filler metal is sometimes used for welding the more difficult alloys.