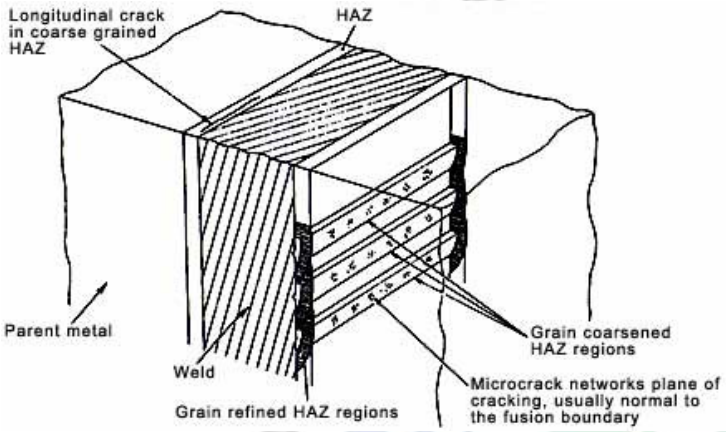
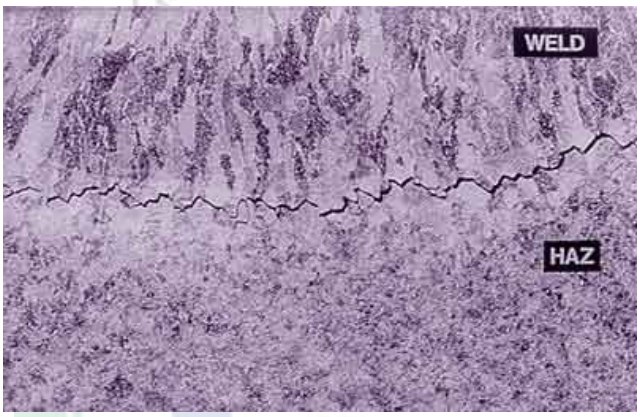
Reheating Cracking

Reheat cracking normally occurs in low alloy steels containing additions of chromium and molybdenum or chromium, molybdenum and vanadium when the welded component is being subjected to post weld heat treatment, such as stress relief heat treatment, or has been subjected to high temperature service (in the range 350 to 550°C).
Cracking is almost exclusively found in the coarse grained regions of the heat affected zone (HAZ) beneath the weld and in the coarse grained regions within the weld metal.
Cracking may occur in the form of macro-cracks or colonies of micro-cracks.





The principal cause to this cracking is that, when heat treating susceptible steels, the grain interior becomes strengthened by carbide precipitation, forcing the relaxation of residual stresses by creep deformation at the grain boundaries.

Factors

- Temperature between 350ºC and 550ºC
- Chromium, molybdenum and vanadium

Prevention Modes

In a material level:

- The choice of steel must be done adopting steel that isn't susceptible to reheat cracking and that has the mechanical characteristics necessary to perform a function.

Regardless of the steel choice, it's important to buy steels specified to have low levels of impurity elements (antimony, arsenic, tin, sulphur and phosphorus).

In a process level:

- Refinement of the HAZ can be promoted by first buttering the surface of the susceptible plate with a thin weld metal layer using a small diameter (3.2mm) electrode. The joint is then completed using a larger diameter (4 - 4.8mm) electrode, which is intended to generate sufficient heat to refine any remaining coarse grained HAZ under the buttered layer.
- The degree of austenite grain growth can be restricted by using a low heat input. However, reducing the heat input will almost certainly require a higher preheat temperature to avoid hydrogen-assisted cracking.
- To avoid the stress concentration, it's essential to grind the weld toes with the preheat maintained.