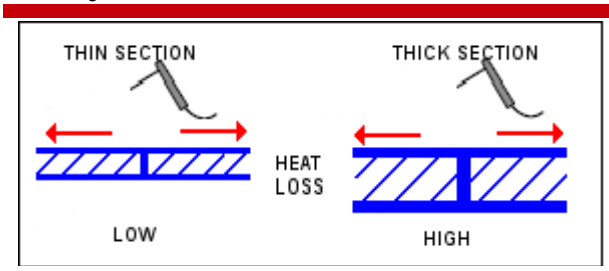
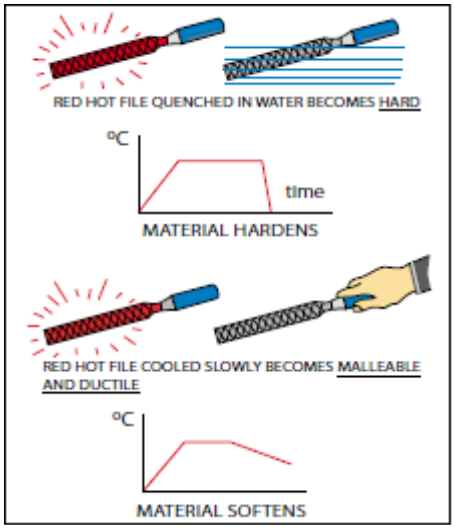
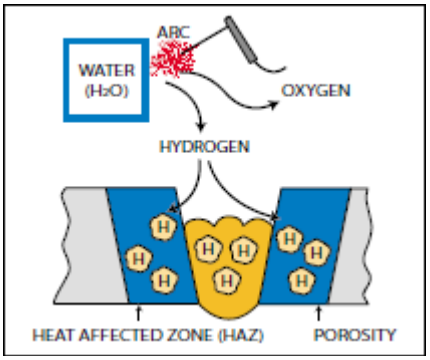
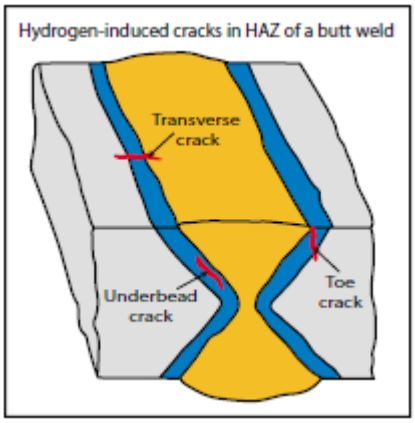
Why Preheat?









Reduce the Level of Thermal Stress:

Thermal stresses are set up as a molten weld pool cools. Cracking can occur both during and after welding when the colder parent metal resists the inevitable contraction of the weld metal. Preheating reduces the temperature differentials between the weld metal and the parent metal, thus minimizing the tendency to crack.

Compensate for High Heat Loss:

Thick-section carbon steel, as well as copper and aluminum alloys having high thermal conductivity, benefit from preheating before welding. The cooling rate of the deposited weld metal is reduced allowing time for the weld metal to fuse properly with the adjacent base metal.

Minimize the Rate of Weld Hardening:

Weld metal and the adjoining heat-affected-zone can harden and crack when rapidly cooled from high temperatures. Preheating the weld and heat-affected-zone generally prevents both from becoming extremely hard by reducing the rate of cooling.

Reduce Porosity:

Water is broken down into its elements, hydrogen and oxygen, by the welding arc. The hydrogen easily dissolves in the weld metal at its high temperatures and can produce weld porosity during solidification. Preheating drives off moisture from the joint surface, eliminating a prim source of water.

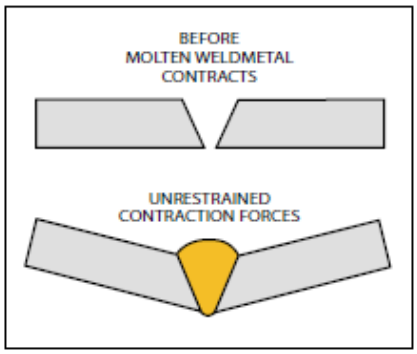
Reduce Hydrogen Cracking:

Electrode coatings and fluxes can often introduce moisture directly to the arc and weld pool. The resulting hydrogen greatly increases the possibility of weld or heat-affected-zone cracking. Preheating slows down the cooling rate allowing the hydrogen to escape.

Improve Microstructure of the Heat-Affected Zone:

Low-alloy steels containing such elements as chromium, nickel, molybdenum, and vanadium are susceptible to cracking in the heat-affected-zone. Preheating improves the microstructure of this zone by reducing the post weld cooling rate, thus leading to formation of more desirable and more ductile microstructures. Cracking by hardening, particularly under the surface, is minimized.

Why Post-Weld Heat Treat?

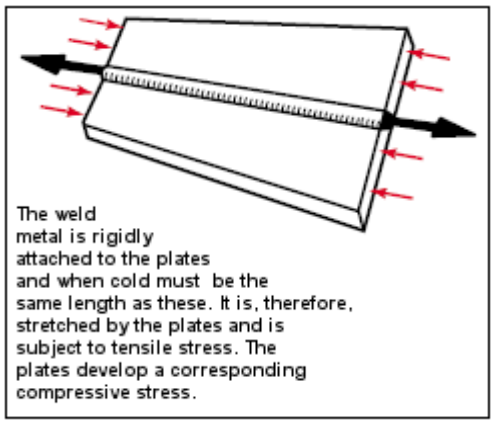


Increase Ductility and Reduce Hardness:

It is generally recognized that postheat typically lowers the tensile and yield strength of carbon-steel and alloy-steel weld metals because softening of the material results. The resultant material is more readily formed and exhibits great resistance to impact loading.

Diminish Brittle Failure:

Structural steel, pressure vessels, and complex welded components can fail catastrophically even under normal loading conditions. Steel normally considered ductile can behave in a brittle fashion in the presence of certain defects, such as notches or stress raisers. This is particularly true of steels operating at low temperatures. Post-weld heat treatment, by relaxing the residual stresses and tempering the metal, can enhance the fracture toughness of the material and prevent brittle failure.



Increase Resistance to Corrosion:

Stress-corrosion cracking and caustic embrittlement can occur in pressure vessels, boilers, petrochemical piping, and other welded construction exposed to certain environments, such as hydroxides, nitrates, and hydrogen sulfides. Postheated welds exhibit reduced levels of residual stress and typically have a higher resistance to attack by corrosive environments than untreated welds.

Improve Machining Stability:

Welding a complex fabrication results in locked-in stresses. If the stresses remain unrelieved, distortion after machining can result because the metal helping to balance the tension and compression forces is removed. Sometimes, intermediate heating is done as the weldment is fabricated, thus reducing excess build-up of stresses. Such heat treatment, therefore, can enable the weldment to be machined after welding without distortion.

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