Temperature Control and Heat Treatment of Weldments

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Preheating of HASTELLOY® and HAYNES® alloys is generally not required. Ambient or room temperature is generally considered a sufficient preheat temperature. However, the alloy base material may require warming to raise the temperature above freezing or to prevent condensation of moisture. For example, condensation may occur if the alloy is brought into a warm shop from cold outdoor storage. In this case, any metal near the weld should be warmed slightly above room temperature to prevent the formation of condensate, which could cause weld metal porosity. Warming should be accomplished by indirect heating if possible, e.g. infrared heaters or natural warming to room temperature. If oxyacetylene warming is used, the heat should be applied evenly over the base metal rather than in the weld zone. The torch should be adjusted so that the flame is not carburizing. A "rosebud" tip, which distributes the flame evenly, is suggested. Care should be taken to avoid local or incipient melting as a result of the warming process.

Interpass temperature refers to the temperature of the weldment just prior to the deposition of an additional weld pass. It is suggested that the maximum interpass temperature be 200°F (93°C). Auxiliary cooling methods may be used to control the interpass temperature; water quenching and rapid air cooling are acceptable. Care must be taken to ensure that the weld zone is not contaminated with traces of oil from air lines, grease/dirt, or mineral deposits from hard water used to cool the weld joint. When attaching hardware to the outside of a thin-walled vessel, it is good practice to provide auxiliary cooling to the inside (process side) of the vessel to minimize the extent of the heat-affected zone.

Under the vast majority of service environments, corrosion-resistant alloys and solid-solution-strengthened high-temperature alloys are used in the as-welded condition, and postweld heat treatment (PWHT) of these alloys is generally not required to assure good weldability. Postweld heat treatment may be required, or advantageous in certain situations, such as to relieve weld residual stresses. However, stress relief heat-treatments at temperatures commonly used for carbon steels are normally ineffective for these alloys. If PWHT is conducted at these intermediate temperatures, it may result in the precipitation of secondary phases in the microstructure which can have a detrimental effect on material properties, such as corrosion resistance. For most alloys, PWHT in the 1000 to 1500ºF (538 to 816ºC) temperature range should be avoided. If stress relief heat treatment of attendant carbon steel components is required, contact Haynes International for guidance. In general, the only acceptable PWHT for solid-solution strengthened alloys is a full solution-anneal. The heat treatment guidelines should be consulted to determine the appropriate solution-annealing temperature for an alloy. Annealing time is normally commensurate with weld joint thickness.

For precipitation-strengthened alloys, PWHT is normally required in order to develop appropriate material/weldment properties. In almost all cases, this involves a full solution-anneal followed by an age hardening heat treatment. Consult the heat treatment guidelines to determine the appropriate annealing and age-hardening heat-treatment schedule for an alloy.

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