Linear Friction Weld Characterization of In-Service INC 718 Nickel-Based Superalloy

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Neutron beam diffraction experiments were conducted to provide residual stress measurements as part of a collaborative research project on the characterization of linear friction welded (LFW) in-service and virgin INC 718 superalloy. This project is a part of a collaboration between the University of British Columbia (Kelowna, BC), the National Research Council of Canada–Aerospace (Montreal, PQ) and industry partner StandardAero Ltd. (Winnipeg, MB).

Nickel based superalloy INC 718 (a.k.a. Alloy 718) is commonly used in high temperature applications due to its excellent high temperature strength and corrosion resistance. This material is commonly used for compressor blade, turbine blade, hot liner cowling and vane/disk material in jet engines. More recently this material is being experimented for used to create BLISK (blade + disk) components, where the blade and disk are integrated into a single part, thereby reducing the material and overall engine weight. BLISKs are fabricated from a single forged part or by welding blades directly onto the disk material. Traditionally, welding of blades was done using conventional methods (TIG, electron beam etc.), however more recent developments have trended towards the use of solid-state welding techniques such as inertia friction or linear friction welding in an effort to reduce the number of defects associated with traditional welding techniques.

As a part of the certification process considering linear friction welding as a repair technique, proper characterization is necessary to understand the various microstructural changes that occur in the material during welding and post weld heat treatment. As part of this characterization, this study mapped the residual stresses across the weld interface of the linear friction welded material in the as-welded and post weld heat treated conditions for both the virgin-virgin and virgin-in-service welds in three orthogonal directions, as shown in the Figures.

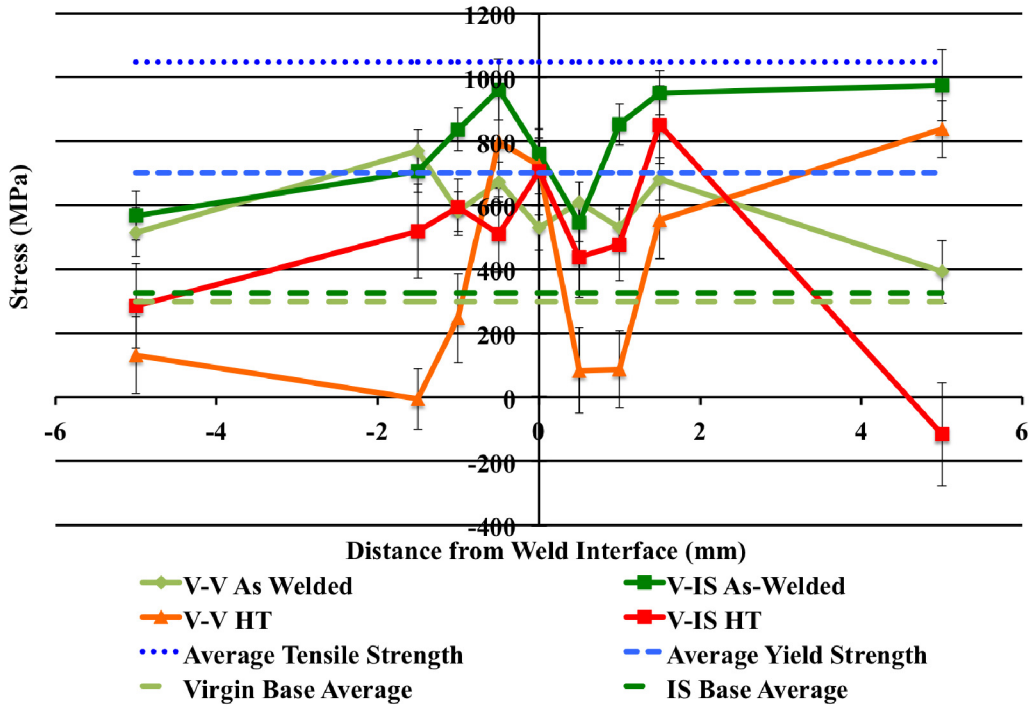

Figure 1: X-direction residual stresses.

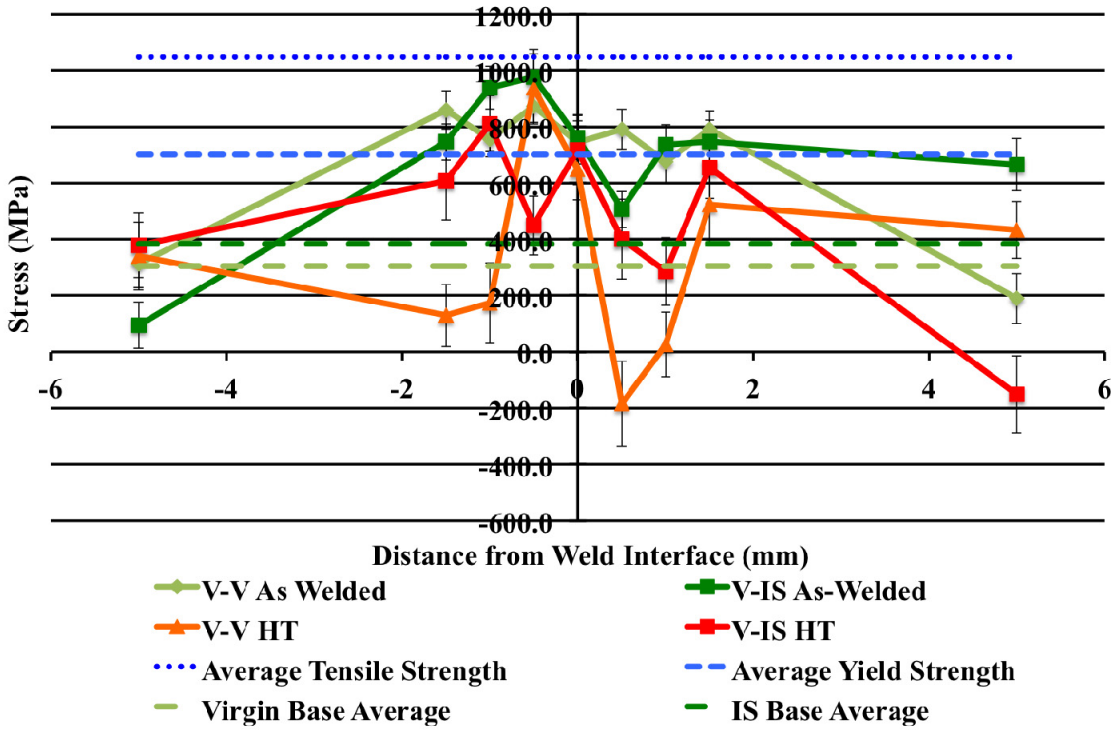

Figure 2: Y-direction residual stresses.

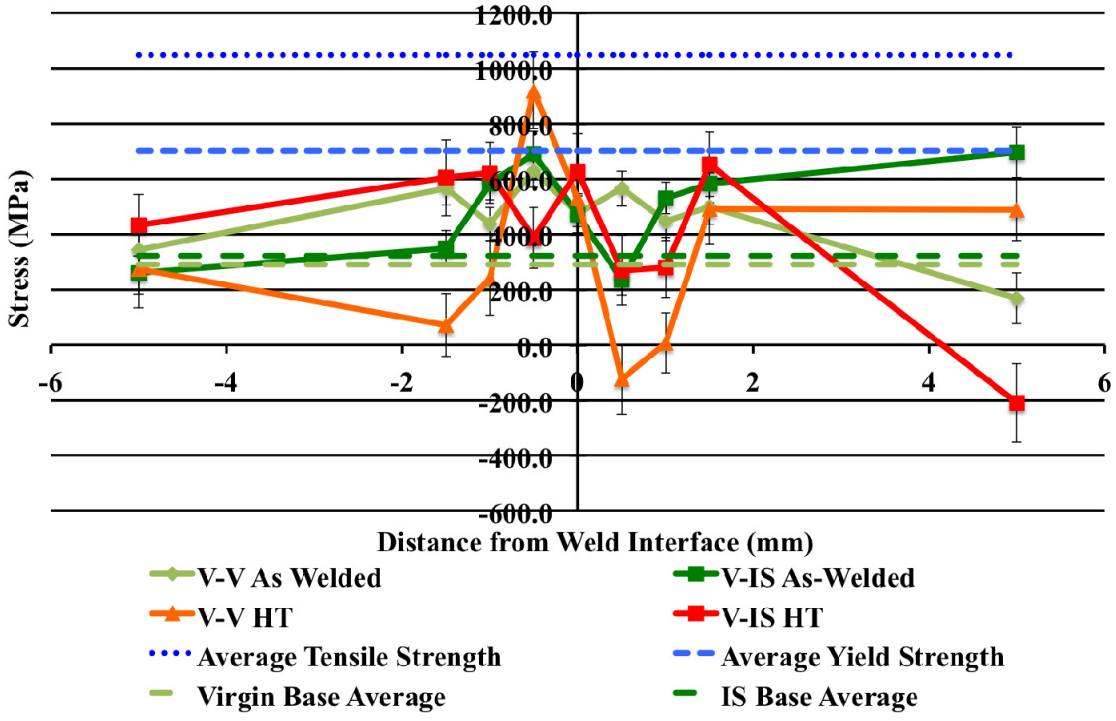

Figure 3: Z-direction residual stresses.