HEI Tech Sheet #138
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MAXIMUM ALLOWABLE RESIDUAL STRESSES ON AUSTENITIC FEEDWATER HEATER TUBES

The intent of this "Tech Sheet" is to provide guidance for specifying residual stresses on feedwater heater tubes.

Overview of Stress Corrosion Cracking (SCC):

Stress Corrosion Cracking (SCC) is the environmentally-corrosive assisted form of cracking in susceptible alloys such as the 300 series stainless steel under tensile stress. Material, environment (including temperature), and high stresses are the three main factors that impact SCC. Under various combinations of these three factors, SCC can occur.

In high pressure feedwater heaters, most of the SCC failures emanate from the steam side of the tube, but there have been a limited number of SCC failures reported in the water side. In both cases, failure occurs where the stresses are high enough to promote cracking.

As one of the key factors that promote SCC, high stresses may come from different sources. Residual stresses from the tube fabrication process, thermal and pressure induced stresses, and dynamic stresses imposed under all modes of operations must be considered. The combination of these stress sources is what promotes cracking when exposed to corrosive media, but residual stress in the tube can be the primary source, unless controlled.

Undesirable residual stress from metal working of the tube during the tube manufacturing process may be reduced using several methods. Tubes for high pressure application should be subjected to residual hoop stress testing. The Electric Power Research Institute (EPRI) provides guidelines for the maximum residual stresses of austenitic stainless steel tubes: "Unless otherwise agreed, the maximum hoop stress in straight lengths of tubing shall be 5000 psi."[(1)]

(1) EPRI GS-6913 Feedwater Heaters: Replacement Specification Guidelines