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ABSTRACT

This study focuses on thermo-mechanical fatigue (TMF) behaviors of nickel-based 23Cr-45Ni-7W alloy for pipes and tubes in high-efficiency power boilers. TMF tests (maximum temperature = 700 °C; minimum temperature = 100 °C) were conducted under in-phase (IP) and out-of-phase (OP) conditions. The lives under the IP condition is 0.30–0.44 times of that under the OP condition when same total strain range, $\Delta\varepsilon_t$, is applied. The TMF properties obtained via the tests are compared with the results of isothermal fatigue (ITF) tests conducted at 700 °C and bithermal fatigue (BTF) tests with maximum and minimum temperatures of 700 °C and 100 °C, respectively. The fracture morphology for each type of TMF, ITF, and BTF is similar under the test conditions of this study. Intergranular cracking is predominant under application of cyclic tensile creep strain during the fatigue tests, and transgranular cracking is predominant under application of cyclic compressive creep strain during the fatigue tests. The inelastic strain range–fatigue life ($\Delta\varepsilon_{in}$–N_f) relation in the TMF test and the inelastic strain range