

Residual stresses in a machined and shrink fitted assemblies

Bin Su, Foroogh Hossainzadeh, David Smith and Chris Truman,

¹ Department of Mechanical Engineering, University of Bristol, Queen's Building, University Walk, Bristol BS8 1TR, UK

Abstract

A shrink-fit is a semi-permanent assembly system, widely used in industry, which is designed to resist the relative movement or transmit torque between two components. This done by creating high radial pressures at the interface of the constituent parts. Examples include fitting of gears to shafts to transmit torque and shrink fitted hard wearing sleeves to shafts for steel rolling mills. This paper presents measured and predicted residual stresses from a variety of shrink fitted assemblies, including aluminium alloys, stainless steel and cast irons. In a number of cases the sleeves shrink fitted to the shaft were subjected to prior machining or prior quenching to introduce initial residual stresses in the sleeve.

Residual stresses were measured using a combination of deep-hole drilling (DHD) and incremental centre hole drilling (ICHD) techniques. The ICHD method provided near surface residual stress measurements to depths up to about 1mm. The DHD method measured through thickness residual stresses along radial lines through the outer sleeve and into the shaft up to depths of 400mm. Results are shown for a variety of assemblies and reveal residual stress that are significantly different from both simple analysis and finite element studies. For example, prior machining introduced near surface compressive residual stresses, that is then expected to be counteracted by the near surface tensile shrink fit residual stresses. However, measurements reveal that this is not the case.