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OPTIMIZING THE DEVELOPMENT AND MANUFACTURING OF 56SiCr7 LEAF SPRINGS

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ABSTRACT

This study investigates the microstructure, surface mechanical properties, and fatigue life of 56SiCr7 leaf specimens produced under serial conditions. The investigation occurs at different stages of the manufacturing process of the leaf springs; mainly heat treatment and surface treatment by shot peening. Macro-hardness and micro-hardness measurements, at the Rockwell C and Vickers scales, respectively, are taken following the thermal treatment and surface shot peening treatment steps of the manufacturing process. Residual stress measurements accurately show the induction depth of the residual stresses in the material. The above measurements are used to determine how heat treatment and shot peening affect the mechanical properties of the surface and core of the spring material. Though the performed micro-hardness measurements clearly indicate surface decarburization effects and quantify the decrease in strength, they do not reveal the insufficient martensitic transformation during the thermal treatment of selected specimens (protocol 1). The macro-hardness measurements are completely insensitive in revealing the surface decarburization and phase transformation phenomena that take place in the investigated case. Solely the microstructural investigations with the aid of a metallographic optical microscope revealed the degree of phase transformation achieved by the thermal treatment. The effect of the individual manufacturing processes, of thermal treatment and shot peening, on the fatigue life of the leaf springs is demonstrated by experimental Wöhler curves at stress amplitudes between 250 MPa and 600 MPa. Two stress ratios are examined, $R=0$ and $R=0.4$, which reflect the stress ratios recommended by the automotive industry. The corresponding Haigh diagrams and mean stress sensitivity factors can be applied for fatigue life assessments of new leaf spring products produced using the suggested protocols.

Keywords: *hardness; microstructure; fatigue life; residual stresses; leaf springs.*

INTRODUCTION

Load carrying-applications, such as in axle suspension springs in the automotive industry, will typically use components made of high strength steel. The formation of nucleation sites, often

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