Magnetic Treatment of Steel Parts with High Retained Austenite

G. Muralidharan and Bruce Bunting (Oak Ridge National Laboratory)

Introduction
Hardened steel parts with high accuracy requirements must be stabilized before final machining in order to remove or reduce retained austenite (RA), since the slow conversion of RA over useful life will result in dimensional changes and could lead to machine failure. Two common examples of parts running with tight enough clearances for this problem to occur are fuel injectors and piston pins for heavy duty diesel engines. The reduction of RA is commonly done with liquid nitrogen treatment during heat-treatment and must be done within a narrow time window after quench in order to be effective. There is evidence in the literature that high magnetic fields may enhance this conversion process; however, it was not clear if the same restrictions regarding time after quench was applicable to magnetic field induced RA transformation. The purpose of this work was to study the effect of high magnetic fields on the RA levels in fuel injector body and piston pins.

Experimental
A fuel injector body comprising of 52100 steel and a plunger made of M2 steel were used for this study. Retained austenite contents in these components were evaluated by AMERICAN STRESS TECHNOLOGIES, INC, Cheswick, PA, using X-ray diffraction techniques. Following these measurements, the steel components were exposed to high magnetic fields at the NHMFL facility. Special equipment was fabricated to hold these specimens in a high (20 Tesla) magnetic field. Effect of different field strengths and time varying magnetic fields on the retained austenite levels were the subject of the study. Retained austenite levels were measured in the same identified locations on each of the components after the conclusion of the high magnetic field exposure. In each case, the specimens were quenched at least six months before exposure to the magnetic field.

Results and Discussion
Figure 1 shows a summary of results obtained on the retained austenite levels in these components. Results show that in one of the steels very little difference before and after exposure to the magnetic field while in the M2 piston some small difference can be observed.

Conclusions
Stabilization of retained austenite may be affected by large magnetic fields and merits further careful, statistical evaluation.

Acknowledgements
Research sponsored by the U.S. Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Vehicle Technologies, as part of the Propulsion Materials Program, under contract DE-AC05-00OR22725 with UT-Battelle LLC.

References