Magnetic Barkhausen noise technique for detecting residual stress in 300M steel

Mehrdad Kashefi[1], P. Ross Underhill[2], Julia Milne[2], Thomas Walter Krause[2]

[1]Department of Physics and Space Science, Royal Military College of Canada, Canada, [1]Physics and Space Science, Royal Military College of Canada, Canada

300M steel is a high-strength steel used in aircraft landing gear. Hard landings can cause plastic deformation due to excessive compressive loads that in turn leave tensile residual stresses. These stresses can lead to cracking and failure of the aircraft landing gear component. Techniques to detect the presence of tensile residual stress are limited. Magnetic Barkhausen noise (MBN) is one technique with the potential to detect tensile residual stress, but is also affected by sensitivity to microstructure and the presence of plastic deformation, which can lead to a false negative result. In this study a novel four-point bend testing method was developed to apply tensile and compressive stress on two opposing sides of 300M samples, while simultaneously measuring the MBN signals from both surfaces. The MBN energy was measured at different stress levels in the elastic and plastic regime and a correlation between the degree of plastic deformation and MBN energy signals was established. It was observed that as the degree of plastic deformation increases, the upper side of the samples, which has undergone plastic compressive deformation, exhibit an increase in MBN energy signals due to the formation of residual tensile elastic stress. The underside, which have undergone plastic tensile deformation, on the other hand, displays a decrease in MBN energy levels as residual compressive stress develops. The results indicate that the non-destructive MBN technique can be successfully applied to monitor and detect the formation of plastic deformation and the residual stress level associated with it.