

# On the foreign object damage based fatigue mechanism of high-speed railway axles

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**Abstract:** Railway axles are one of the most important safety critical components. However foreign object damage (FOD) happens on the axle surface with the increased speed especially at the ballast track, thus leading to a primary life limiting factors. To evaluate the residual life and resulting inspection interval of high-speed railway axles, steel indenters were specially designed and employed to produce the notches with different shapes on 25CrMo4 specimens. Rotary bending fatigue testing was then conducted to acquire the fatigue endurance. Meanwhile, residual stresses at the bottom of representative notches were examined every constant fatigue cycles for a comparison with theoretical solutions. The detailed dimensions of the notches were statistically identified from the fractography of fatigue cycled specimens. The fatigue limit related with different sized notches was defined for an important reference to the modified Kitagawa-Takahashi diagram. Furthermore, a damage tolerance evaluation was carried out for the fatigue crack growth. Finally, fatigue damage evolution and the performance were tentatively postulated in terms of foreign object damage.

**Keywords:** Damage tolerance; foreign object damage; Fatigue life; Residual stress; High-speed railway.

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