



ABSTRACT OF PAPER

Title of Paper (*limited to 15 words in CAPITALS*):

ASSESSMENT OF OVERHEATED WHEELS FOR INCREASED SERVICEABILITY USING THE ULTRASONIC BIREFRINGENCE RESIDUAL STRESS MEASUREMENT TECHNIQUE

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Nominated Theme:

Rolling Stock

Abstract (*max 350 words*):

As a result of the heat treatment performed during the manufacture of railway wheels, a zone of compressive circumferential residual stress is developed in the outer region of the rim. The compressive residual stress inhibits the propagation of fatigue cracks formed at the contact region of the wheel tread and decreases the likelihood of unstable (brittle) fracture caused by large rolling contact fatigue and heat-induced thermal cracks. The application of repeated friction braking imposes excessive thermal loading which can gradually relax the compressive residual stress and under severe conditions develop tensile circumferential residual stresses which are detrimental to the fatigue performance of the wheels.

Overheated wheels are detected during service by means of discoloration, paint blistering on the wheel plate and also track-side hot wheel detectors. The practice adopted by the majority of railway operators is to withdraw the overheated wheels from the service and scrap them due to their increased risk of failure. However, discoloration and/or the development of short term high temperatures on the wheel plate/rim do not necessarily indicate the extent of thermal damage or detrimental change to the residual stress distribution. Subject to the availability of a reliable non-destructive residual stress measurement method it is possible to return some of these wheels to service if the measured residual stress patterns do not exhibit severe thermal damage. Among different non-destructive measurement methods the ultrasonic birefringence has previously been used to assess overheated wheels and has been adopted as the standard procedure for qualification of wheels at manufacture. This method takes advantage of the reliance of the polarized sound wave velocity on the directional residual stress in the material.



The recent application of this technique in the Rio Tinto Iron Ore railway is presented, which provides an example of how this method can assess and justify the continued service of wheels that were withdrawn from service. The diversity of wheel suppliers and therefore the original residual stress distribution in the rim introduces some complexity into the assessment of wheels. The criteria used to handle these variations are also described in this paper.