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Present Paper at SAE 2016 Brake Colloquium & Exhibition

We presented a paper at SAE 2016 Brake Colloquium & Exhibition on September 27, 2016. This paper will be published in SAE International's scholarly journal.

1. TITLE

Interactive Effects of Thermal Deformation and Wear on Lateral Runout and Thickness Variation of Brake Disc Rotors

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3. ABSTRACT

Brake judder is one of the most serious problems in automotive-brake systems. It is basically a forced vibration caused by the friction-surface geometry of a brake disc, and therefore, disc rotors play a significant role in judder. There are two types of judder: cold and hot. Hot judder is caused by the thermo-mechanical deformation of a brake disc due to high-speed braking. There are several shapes of deformation, e.g., coning and circumferential waviness. Circumferential waviness is caused by thermo-mechanical buckling and typically found as a butterfly shape in a 2nd rotational-order and hot-spotting. In a previous paper, two groups of disc castings with different material homogeneity were machined intentionally to have two kinds of dimensional variations. From repetitive high-speed braking tests of these discs, both the material and dimensional homogeneity were found to affect the wave-like deformation of discs in the 1st and 2nd rotational-orders with different significance between the two casting groups. There are many mechanisms affecting disc geometry during braking. Plastic deformation and wear cause permanent effects, while thermal expansion and elastic deformation are reversible. A disc's initial shape before braking affects its geometry both transiently and permanently. Considering these effects, the previous test results were reanalyzed in the present paper. Some discs exhibited large transient runout and DTV but small permanent DTV, while others behaved differently. The thermal deformation and differential wear were confirmed to interactively affect the transient and permanent geometry of operating brake discs.

5. CONTACT

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