

# Speed Dependence of the Vehicle Vibration and the Tire Force in Cleat Testing

Shun Horiuchi<sup>1)</sup> Yasuyuki Iino<sup>1)</sup> Tatsuya Sasaki<sup>1)</sup>

1) 1-1, 2-chome, Tsutsui-cho, Chuo-ku, Kobe 651-0071, Japan  
(E-mail: shun-horiuchi.az@srigroup.co.jp)

**KEY WORDS:** vibration, noise, and ride comfort, harshness, test and analysis technology, tire/wheel [B3]

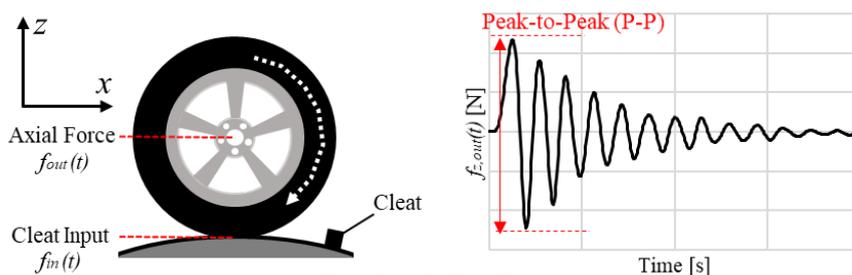


Fig.1 Bench Cleat Test

Tires are a vibration source contributing to overall vehicle vibration phenomena, which affect ride comfort for passengers.

Cleat testing is a type of bench test that is typically employed in laboratory evaluations of tire characteristics relating to ride comfort, measuring peak-to-peak axial force response (hereinafter, “Axial P-P”) as an indicator thereof (Fig.1). When vertical Axial P-P is measured at varying velocities, the maximum Axial P-P value can be found at a velocity in the vicinity of 30km/h. This phenomenon occurs due to the enveloping characteristics of tires, which cause cleat input frequency to approach the 1st radial mode frequency of tires at this velocity, resulting in tire resonance excitation.

In the research described in this paper, the authors investigated the impact of tires on overall vehicle vibration by means of performing cleat testing of tires mounted on a vehicle. The authors mounted accelerometers to the floor and knuckle of the test vehicle and then performed cleat testing at varying velocities within the range of 8-80km/h, measuring the acceleration peak-to-peak (hereinafter, “Acceleration P-P”) at each velocity. As the result of subsequent frequency analysis of knuckle acceleration at the point of cleat contact at each velocity, the authors found that vibration attributable to tires fell within the 60-110Hz frequency band. Using a bandpass filter to extract vibration data in this frequency band, the authors next compared Acceleration P-P and Axial P-P at each velocity, verifying that maximum P-P values occur within the 30-50km/h velocity range in vehicle cleat testing as well as bench testing. The authors also found that low-pressure P-P values exceed high-pressure P-P values at points coinciding with maximum values (Fig.2).

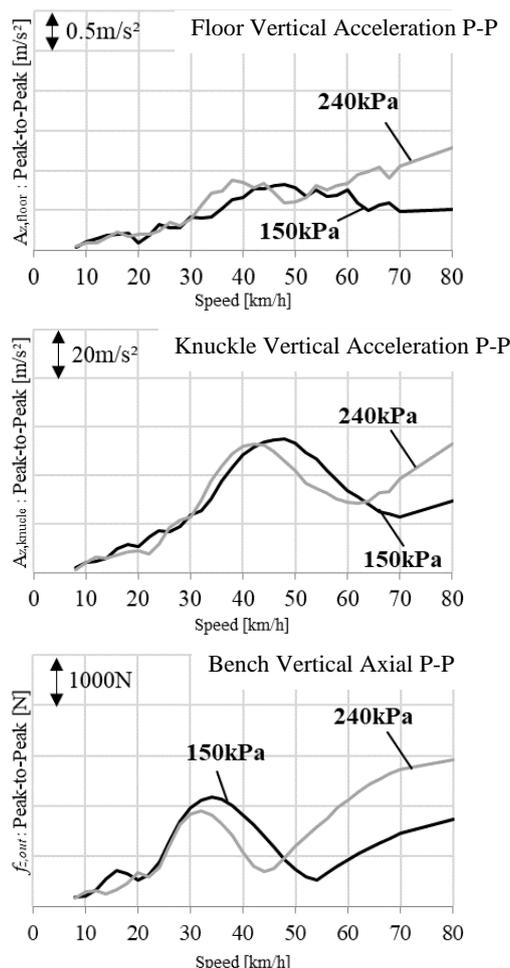


Fig.2 Comparison of Cleat Test Results: Vehicle and Bench