

A Study on the Effect of Piston Stiffness on Piston Pin Rotation in a Diesel Engine

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In commercial diesel engines, full-floating piston pins are required to rotate appropriately within their bearings due to friction exerted by both the con-rod small end bearing and the piston pin boss bearings. In this research, rotational force (hereafter RF) acting on the piston pin was measured by a newly developed apparatus, and effect of piston stiffness on RF was investigated.

Fig.1 shows measuring apparatus structure. A torsion bar was installed in the piston pin, and one end was fixed to the piston, and the other end was fixed to the piston pin. Therefore, when the piston pin rotated by RF, torsional stress occurred in the torsion bar. The stress was detected by the strain gauges attached to the bar. In addition, a clearance was provided between the piston and piston pin—specifically between torsion bar and the torque transmission part so as not to impede the vertical and lateral movement of the piston pin.

Figure 2 shows RF and con-rod angular velocity at 1000 rpm on high stiffness piston. RF showed a correlation with con-rod angular velocity. Additionally, the higher the load, the greater the RF at the firing top dead center (360°). It suggested that the friction force at con-rod bearing was the main cause of RF.

Figure 3 shows the effect of piston stiffness on RF. It was found that RF for high stiffness piston showed larger value at the firing top dead center than that for low stiffness piston. It was suggested that pin rotation might be inhibited by friction force at the pin boss bearing of low stiffness piston. It was assumed that larger deformation of pin boss bearing in low stiffness piston caused greater friction force.

In this research, measured RF by newly developed measurement apparatus clarified that low-stiffness piston generates less rotational force, and that uneven contact caused by bearings deformation hinders rotation.

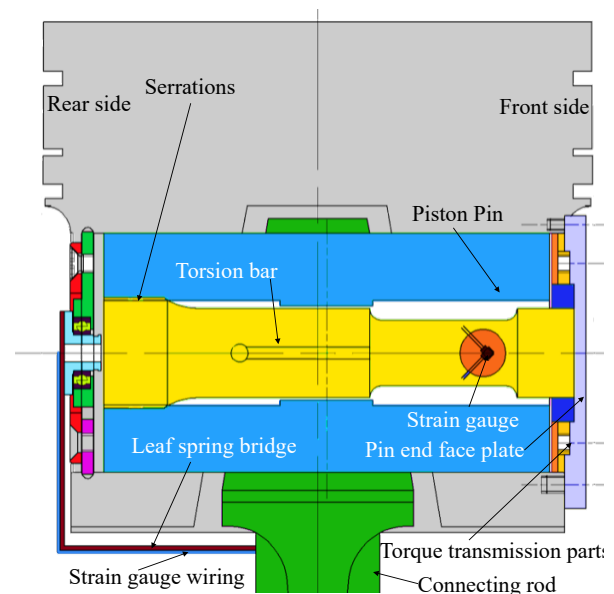


Fig. 1 Measuring apparatus

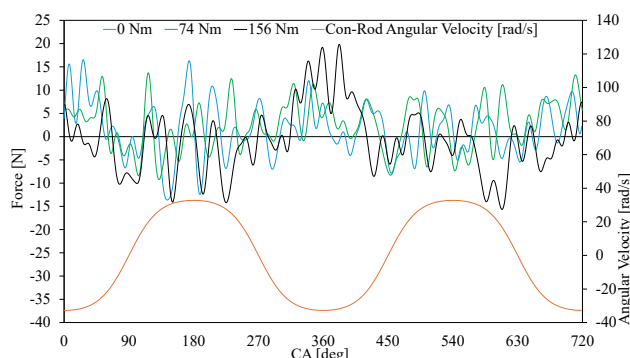


Fig. 2 RF and Con-Rod Angular Velocity measured for high stiffness piston at 1000rpm

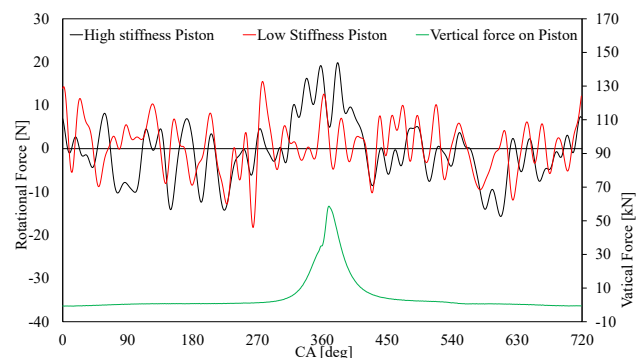


Fig. 3 The effect of piston stiffness on RF at 1000 rpm at 156 Nm