

## Advanced multi-speed transmissions and their effect on fuel economy, durability and reliability

As of late, many automotive manufacturers offer transmissions with eight to ten different gear ratio combinations. This has been a major change in the past decade where four, five and six speed transmissions dominated the market. The addition to transmission gearing is mainly due to increased demand for fuel economy, where the automotive manufacturers are challenged to have a corporate average fuel economy (CAFE) of 54.5 mpg by 2025. The combined CAFE rating in 2011 was 24.1mpg. There is an advanced formula for calculating CAFE for 2012 through 2025 vehicles which involve the vehicle's actual fuel economy and its "footprint," or size. Nevertheless, this fuel economy requirement has automotive manufacturers designing transmissions that have the ability to place the engine at the most efficient speed for maximum fuel economy. To address this demand, automotive manufacturers are utilizing continuously variable transmissions, dual clutch transmissions, and transmissions with many available gear ratios. This study and oral presentation addresses how much the increase in gearing has impacted the vehicle's overall fuel economy. Also, the study looks at how the increased gearing has the potential to affect the reliability and stress of the internal transmission components. The study looks at published fuel economy data provided by the Environmental Protection Agency on vehicles where the only significant change was the automatic transmission. The automotive manufacturers included in the study include General Motors, Fiat Chrysler Automobiles, Honda, and Toyota vehicle lines. The presentation also compares a typical five-speed and six-speed transmission to the late model eight, nine, and ten-speed transmissions regarding internal components, clutch element cycling, electronics and hydraulic valve activity. Across the life of a vehicle equipped with an advanced transmission, the amount of clutch and valve cycling can be substantially increased when compared to a typical five or six speed transmission. This information will provide an outlook to how much the additional transmission shifting will have on the wear of transmission internal components.