Predicting the Effect of Gearbox Preconditioning on Vehicle Efficiency

R. Gillot* A. Picarelli* M. Dempsey*

*Claytex Services Ltd. Edmund House, Rugby Road, Leamington Spa, CV32 6EL
{romain.gillot, alessandro.picarelli, mike.dempsey} @claytex.com,

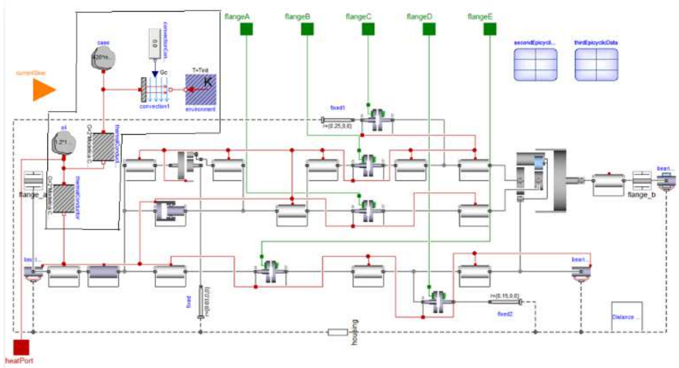

Figure 1. 6-speed automatic transmission gear set with thermal mass and heat dissipation network

Responding to the ever growing need to reduce vehicle fuel consumption and pollutant emissions, new technologies have been developed and successfully implemented in a large number of vehicles over the last few years. However, if engine efficiency has recently dramatically increased thanks to ongoing design improvements and new technologies, the question is how much further we can push the limits to improve efficiency in use and at what price.

One way to achieve better performance from the powertrain is to improve its efficiency. To do so, we have to keep in mind that our vehicles are rarely operated in their optimal efficiency region due mainly to the road layouts, road traffic, driver behaviour, short range operation and the climatic conditions. We can at least seek to counteract the effects of the latter on vehicle efficiency. Vehicle transmission oil viscosity increases exponentially at low temperatures, affecting the vehicle transmission efficiency. Until the oil has fully warmed-up, which can take a rather long time under extreme cold weather conditions, the transmission losses are high due to drag on the gears, clutches and bearings caused by the viscous oil. Poor range and fuel economy can result in customer dissatisfaction compounded by the fact that the vehicle is only being used exploiting a small percentage of its certified power. The idea is then to put the transmission (and in future other subsystems such as engine and traction battery as part of a larger study) in the best conditions whatever the weather is in order to increase its efficiency.

In this paper we build a vehicle model in Dymola using components from the Powertrain Dynamics Library developed by Claytex. We then precondition the transmission lubricant to several temperatures and run the vehicle model over the standard NEDC and ARTEMIS drive cycles. The ARTEMIS drive cycle combines an urban and a highway portion. The models involved in this study are predictive equation based models in order to show how the efficiency would benefit from higher oil temperatures without the constraints of map/empirical based models. The benefits of preconditioning are then highlighted as well as the costs of doing so.