AUTOMOTIVE TRANSMISSION EFFICIENCIES V/S NVH CHARACTERISTICS- AN EXPERIMENTAL STUDY

R Chaudhary, Prashant Kumar, Sarita Seth, R Mahapatra, Ajay K Harinarain*, Sarita Garg, Deepak Saxena, SSV Ramakumar

*kumarajay@indianoil.in

[a] Indian Oil Corporation Ltd, R&D Centre, Sector 13, Faridabad-121007, INDIA

KEYWORDS

Fluid Lubrication, Lubricant Additives, Experiments in Tribology, Noise-Vibration-Harshness study.

ABSTRACT

This paper presents an experimental study on the influence of lubricant formulations to strike a balance between transmission efficiencies and their Noise Vibration and Harshness (NVH) characteristics. There is increasing trend to reduce lubricant friction and viscous drag to achieve high transmission efficiencies of automotive gear boxes. Discerning vehicle customers besides asking for good fuel economy also look for refined NVH performance. This would mean the absence of transmission rattle and gear whine noise emanating from the vehicular gear transmissions.

It has been reported by Mohammadpour et all [1] that conditions which correspond to reduced friction and increase in efficiencies promote increased residual vibratory energy leading to noisy transmissions and poor NVH performance. This would reflect, if NVH performance was assessed as part of standard protocol of the driving cycle which focusses on fuel efficiencies and reduced emissions. Baumann et al [2] indicated that gear rattle noise reduction can be achieved by avoiding meshing impacts, using low traction gear lubricants. Theodossiades et al [3] reports that lubricant behaves like a non-linear spring damper, which significantly affects the response of idle gears during the meshing cycle altering the system NVH performance.

Transmission oils with different viscometrics and FMs were selected for this study. The transmission efficiency was studied using bench tests for film thickness and traction coefficients. The oils were then evaluated for their NVH performance on a vehicular gear transmission in a chassis dynamometer. Viscosity of the oils @40^0 C and comparative test results of EHD film thickness, traction coefficient in MTM and NVH at a given test conditions are shown in Table 1. Comparative traces of EHD Film thickness and NVH performance of the different oils are given in Fig. 1 and Fig. 2 respectively.

Sound level measurements inside the cabin were measured using a FFT(Fast Fourier Transform) sound spectrum level analyser on the driver side and the front passenger side. The key attributes studied were the gear whine while ramping to high speeds and the gear rattle when running at low speeds. FFT Spectrums for the range of 20Hz to 1 KHz were compared for different oils. Based on these studies, oils offering optimum transmission efficiencies and improved NVH characteristics were selected. Based on the above results, it may be inferred that Oil B has given best NVH performance.

Table 1 comparative properties of different oils

Name of oil	KV @ 40^0 C (Cst)	EHD film thickness @ 30N,40^0C, 4m/s (nm)	Traction coeff.@ 40^0C, 10% SRR, 3 m/s, 0.95GPa	NVH sound level @ 1kHz (dB)
Oil A	91.5	623	0.035	25
Oil B	116.5	785	0.045	15
Oil C	116.9	753	0.042	18

Fig. 1: EHD Film thickness of oils @30, 40^0C

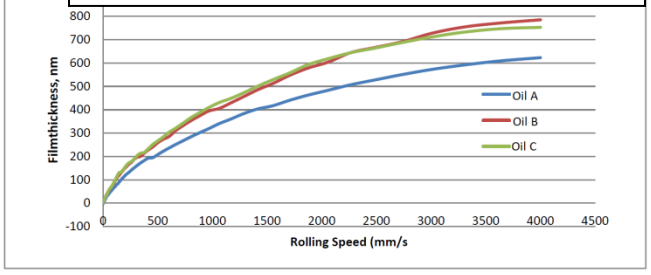
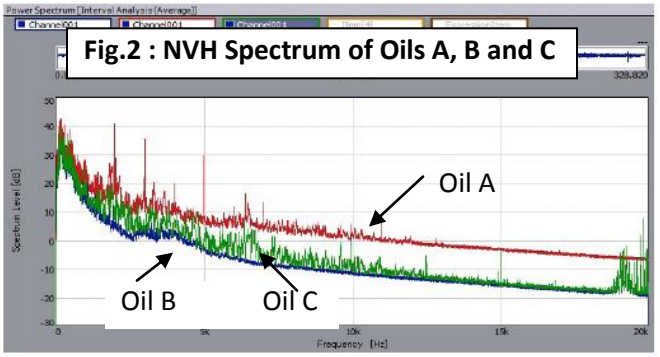


Fig.2 : NVH Spectrum of Oils A, B and C



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