Vehicle Gearbox Noise and Vibration: Measurement, Signal Analysis, Signal Processing and Noise Reduction Measures
Jiri Tuma
Wiley, Hoboken, NJ (2014), 260 pages, 120 USD,
ISBN: 978-1-118-35941-9

Vehicle Gearbox Noise and Vibration is a book aimed for practicing engineers who are involved in the development and testing of manual transmissions.

This book consists of seven (7) chapters and an index:

Chapter 1—Introduction
Chapter 2—Tools for Gearbox Noise and Vibration Frequency Analysis
Chapter 3—Gearbox Frequency Spectrum
Chapter 4—Harmonics and Sidebands
Chapter 5—Order Analysis
Chapter 6—Tracking Filters
Chapter 7—Reducing Noise of Automobile Transmissions.

Each chapter of this book contains diagrams, figures, tables and references.

The first chapter begins by describing pass-by noise legislation as being one of the major problems that an OEM will encounter while developing a vehicle. One of the most significant sources of noise is the radiated noise levels emitted by the transmission gearbox. Unfortunately, axle whine noise, while important for both pass-by noise and interior cabin noise, is not addressed.

Chapter 2 describes the fundamentals of signal processing, the FFT, zoom FFT, windowing and a brief introduction to filters. Chapter 3 introduces the reader to noise signatures of gears, gear mesh frequency, sidebands, gear rattle, periodicity of planetary gears and signatures from bearings. Chapter 4 discusses sidebands from a mathematical point of view, amplitude and phase modulation, the Hilbert transform and Cepstrum analysis. Chapter 5 treats Order Analysis. In Chapter 6, the author reviews both the Kalman and the Vold–Kalman filters. In Chapter 7 the author provides the reader guidelines in how to make a quieted transmission and further discusses pass-by noise testing.

A topic that the author should have emphasized in the writing of this book is that the transmission error (TE) of a gear mesh that is a major source of gear noise. The only of hint of TE is given in the final chapter. He briefly describes ways of measuring the TE in the development of a gear set. However, if the reader is not familiar with the practical aspects of this measurement approach, they will not find help here. Also, planetary gears typically found in automatic transmissions are briefly mentioned but omitted are the types of noise signatures that this type of gear emits.

There is no doubt that the author is competent in the subject of gears and the signal processing that is involved in analyzing these gear noise signatures, but he loses the reader by not adequately presenting the material. There are very little practical examples included and he spends a considerable amount of time covering advanced signal processing topics that in general are not part of everyday testing and development of a "gearbox." The bridge between designing a quieted transmission, to the vehicle cabin noise, and pass-by noise and legislature are not presented coherently in this book.

Charles D. Glynn
Ford Motor Company,
Vehicle Acoustics and Vibrations, USA
cglynn5@ford.com