5 Matching Engine and Transmission

Apart from design, the main factors affecting the market success of a vehicle are performance, fuel consumption, emissions and comfort.

Chapter 3 dealt with the available and the required power. Chapter 4 then elaborated the principles for selecting overall gear ratios. The purpose of this chapter is now to consider matching the transmission to the engine and the vehicle. This is a task in the field of vehicle longitudinal dynamics. The powertrain and its components are optimised by means of computer driving simulation and road and bench tests. The powertrain components – engine, moving-off element, selector gearbox, final drive etc. – must be “harmoniously” combined. This matching process is called “powertrain matching”. The main optimisation criteria in this process are

- performance,
- fuel consumption,
- emissions and
- comfort.

This adaptation process has to be tackled from both sides, matching the engine to the transmission and vice versa. In practice, the characteristics of the engine dominate, and the characteristics of the transmission have to be “adapted” to match.

![Diagram illustrating the combined action of “engine spread” and overall gear ratio.](image)

**Fig. 5.1.** Combined action of “engine spread” and overall gear ratio

The transmission mediates between the engine and the road surface; it adapts the traction available to the power required, ensuring the desired performance. For this purpose, the speed range of the engine is mapped to a wheel speed range or a road speed range. Similarly, the torque range of the engine is mapped to a torque or traction range at the wheels. The speed and torque range of the engine should be referred to as the “engine spread” as discussed in Section 3.3.2. Engine spread and the overall gear ratio together form a field of possible traction at the wheels (Figure 5.1). The transmission enables the most fuel-efficient operating regions of the engine to be exploited (Figure 5.2).

Fuel consumption is influenced greatly by the gear ratio and the final ratio specified, as well as the gearshift points selected. During unaccelerated driving on a level surface, there can be “discrete” operating curves (with geared transmissions), or a whole operating map (with continuously variable transmissions), between the driving resistance lines, $T_B$, for the minimum and maximum powertrain ratios. With geared transmissions the operating points lie at the intersections of the