Modern Automotive Technology
Chapter 55
Manual Transmission Fundamentals
Learning Objectives

- Describe gear operating principles.
- Identify & define all the major parts of a transmission.
- Explain the fundamental operation of a manual transmission.
- Trace the power flow through transmission gears.
- Compare the construction of different types of manual transmissions.
- Explain the purpose and operation of a transmission overdrive ratio.
- Acquire knowledge of manual transmission operating principles.
Parts of a Manual Transmission

Manual Transaxle Components

- Differential
- Transmission
- Output to drive axle
- Shift rod assembly
- Housing or case
Manual Transmission Fundamentals

1. Shift Forks are pronged units for moving gears or synchronizers on the shaft rail for gear engagement.

2. The Gear Shift Level control allows the driver to change transmission gears.
Shift Forks

Transfer movement from the gear shift linkage to the sleeves
Shift Linkage

Movement of shift linkage moves the shift fork
Manual Transmission Fundamentals

3. Synchronizers are devices used to mesh (lock) gears into engagement.

4. The Transmission Case houses the transmission shafts, gears, and lubricating oil.
Synchronizer Construction

Hub is splined to the output shaft
Synchronizer Operation
Synchronizer Operation

- Shift fork
- External and internal teeth engaged
- Internal cones
- Spring-loaded ball out of groove
- Input shaft turns hub
- Hub turns outer sleeve
- Sliding outer sleeve turns output gear
- Output gear turns output shaft
Transmission Case

Input shaft gear turns countershaft gears. Countershaft gears turn output shaft gears.
Manual Transmission Fundamentals

5. **Overdrive** is when a larger gear drives a smaller gear.

6. **Overdrive Ratio** provides a way of changing output torque and output shaft speed.
Gear Ratio

Driven gear has 24 teeth

Driving gear has 12 teeth

Driving gear makes one revolution

Driven gear makes 1/2 revolution
If the drive gear has 12 teeth and the driven gear has 24 teeth, the gear ratio is *two-to-one*

\[
\text{Gear Ratio} = \frac{\# \text{ of driven gear teeth}}{\# \text{ of drive gear teeth}} = \frac{24}{12} = 2 \quad \text{or written} \quad 2:1
\]
Five-Speed, Overdrive Transmission

1st Gear Ratio = 4.36:1
Manual Transmission Fundamentals

7. **Shift Linkage** are arms or rods that connect the driver’s shift control to shift the forks.

8. **Gear Reduction** occurs when a small gear drives a larger gear to increase turning force.
External Shift Rod Linkage

- Shift lever mechanism
- 1st–2nd shift rod
- Adjustable swivel
- 3rd overdrive shift rod
- Adjustable swivels
- Reverse shift rod
Internal Shift Rail Linkage

- Spring-loaded detent ball holds mechanism in each position
- Gear shift lever
- Lower end of shift lever acts on gates and shift rail
- Grooves in synchronizer sleeves for shift forks
- Shift rail
- Shift forks
Gear Reduction

Small gear driving a larger gear
Manual Transmission Fundamentals

9. Operated by a clutch, the Transmission Input Shaft turns gears inside transmission.

10. The Output Shaft transfers rotating power out of the transmission.
Input Gear

Machined part of the steel input shaft
Output Shaft

(3rd Gear - 3 Speed Manual Transmission)
Transmission Parts

11. Flywheel
12. Input gear
13. Third gear
14. Synchronizer sleeve
15. Bearing retainer
16. Control shaft
17. Shift fork
18. Reverse idler gear
19. Inspection plate
20. Pressure Plate
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