MODULE CONTENT

| Unit of Competency | **DIAGNOSE AND OVERHAUL MANUAL TRANSMISSION/TRANSAXLE** |
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| Module Title | **DIAGNOSING AND OVERHAULING MANUAL TRANSMISSION/TRANSAXLE** |
| Module Descriptor | This unit identifies the competence required to diagnose, overhaul and assemble the manual transmission/transaxle. Overhaul includes knowledge, skills and attitude in disassembly and replacement of components of manual transmission/transaxle. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and overhaul manual transmission/ transaxle | |
| LO2. Diagnose manual transmission/ transaxle | |
| LO3. Disassemble and evaluate manual transmission/ transaxle and components | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 1**

**PREPARE TO DIAGNOSE AND OVERHAUL MANUAL TRANSMISSION/ TRANSAXLE**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Prepare to diagnose and overhaul manual transmission/ transaxle | If you have some problem with the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer the self-check provided in the module. |
| Answer Self-Check 3.1-1 on Prepare to diagnose and overhaul manual transmission/ transaxle | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Prepare to diagnose and overhaul manual transmission/ transaxle | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 on Prepare to diagnose and overhaul manual transmission/ transaxle | Remember the step-by-step procedure the Prepare to diagnose and overhaul manual transmission/ transaxle |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**PREPARE TO DIAGNOSE AND OVERHAUL MANUAL TRANSMISSION/ TRANSAXLE**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Determined job requirements.
2. Sourced and interpreted diagnostic and dismantling information.
3. Verified symptoms.
4. Analyzed and selected disassembly options.
5. Identified hazards associated with the work and managed risks.
6. Selected and checked tools and equipment.
7. Reported defective tools and equipment.
8. Checked and reported availability of materials..

**MANUAL TRANSMISSION/ TRANSAXLE**

**PURPOSE OF TRANSMISSION OR TRANSAXLES**

There are three reasons for having a transmission or transaxle in the automotive power train or drive train. The transmission or transaxle can:

1. Provide the torque needed to move the vehicle under a variety of road and load conditions. It does this by changing the gear ratio between the engine crankshaft and vehicle drive wheels.

2. Be shifted into reverse so the vehicle can move backward.

3. Be shifted into neutral for starting the engine and running it without turning the drive wheels. There are two basic types of transmissions and transaxles: manual and automatic. Manual transmissions and transaxles are shifted manually, or by hand. Automatic transmission and transaxles shift automatically with no help from the driver

**Difference between transmissions and transaxles**

The manual transmission is an assembly of gears, shifts and related parts. These are contained in a metal case or housing filled with lubricant. A manual transmission is used in sole front-wheel-drive vehicles and in front-engine rear wheel-drive vehicles. It is positioned between the clutch and the driveshaft that carries engine power to the drive wheels. The engine, clutch, transmission and driveshaft are all in a single line.

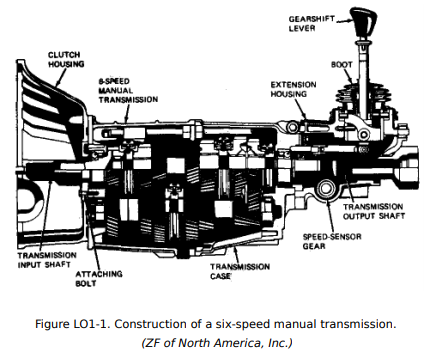
The manual transaxle is also an assembly of gears and shafts. It attaches to a front-mounted transverse engine and drives the front wheels. Rear-engine cars can use an engine-mounted transaxle to drive the rear wheels. A few front-engine cars drive the rear wheels through a rear-mounted transaxle.

The transaxle includes a final drive and a differential (front differential). These devices are not found in the transmission. The final drive is a set of gears that provides the final speed reduction or gear ratio between the transmission and the drive wheels. The differential permits the drive wheels to rotate at different speeds when the vehicle turns from straight ahead.

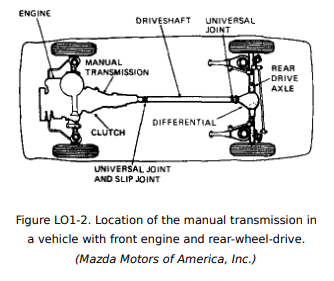
Some transaxles include a viscous coupling and a center differential. These are used in four-wheel-drive and all-wheel-drive power trains.

**Manual transmissions and transaxles**

Older transmissions are three-speed units. They have three forward gear ratios or speeds. These are first or low, second and third or high. They also have reverse and neutral. Four-speed transmission and transaxles have been widely used. They provide first, second, third and fourth. They also have reverse and neutral. Many transmissions and transaxles are five speeds with a fifth forward gear.

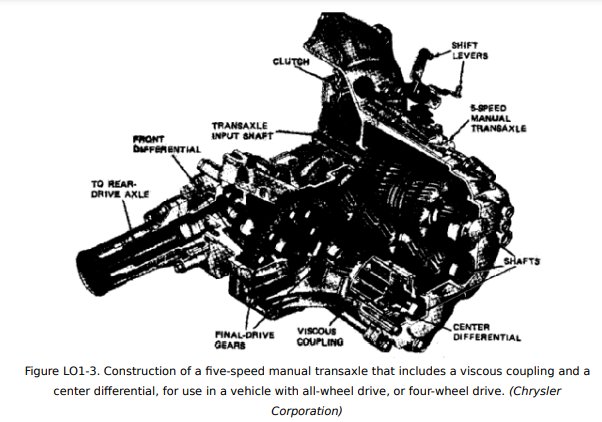
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Fourth gear in some four-speed units and fifth gear in five-speed units is overdrive. The output shaft turns faster than, or overdrives the input shaft. This allows a lower engine speed to keep the vehicle moving at its desired road speed. Better fuel economy and reduced engine wear result, with less noise and vibration. Some cars have a six-speed manual transmission or transaxle. Both fifth and sixth-gear are overdrive ratios. However, these may not be usable during city driving in heavy traffic.

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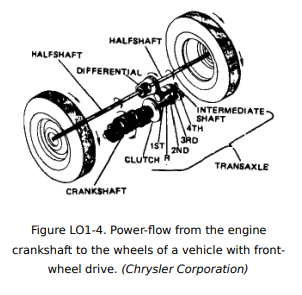
The different gear ratios are necessary because the engine develops relatively little power at low engine speeds.

The engine must be turning at a fairly high speed before it can deliver enough torque to start the vehicle moving. This means the transmission or transaxle must be in first gear to start out. After the vehicle is moving, progressively higher gears are selected (second, third, fourth, fifth) to suit operating conditions. Usually, the vehicle is in top gear after reaching highway speed. Moving the gearshift lever makes the shift which changes the gear ratio. In some vehicles, the gearshift lever is on the steering column. In others, it is on the floor or in a center console.

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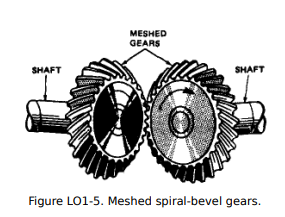
**Gears and Gearing**

Gears are wheels with teeth that transmit power between shafts. The teeth may be on the edge of the wheel, on the side, or inside. To transmit power, a gear on one shaft is “meshed” with a gear on another shaft. To mesh means that the teeth of a gear fit into the spaces between the teeth of another gear. When one gear turns, its teeth then force the other gear to turn. The gear that is forced to turn is the drive gear.

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The relative speed of two meshed gears is determined by the number of teeth in each gear. This is the gear ratio.

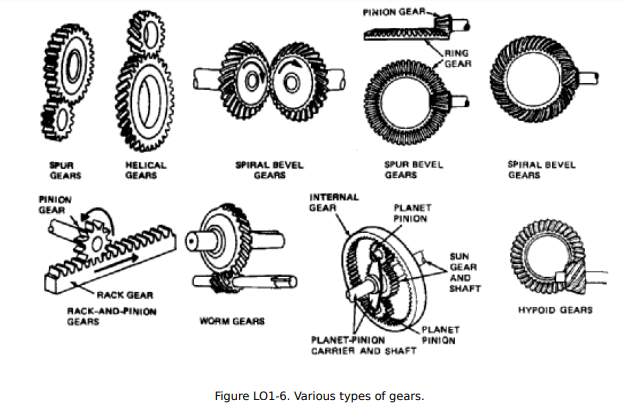
If two meshing gears have the same number of teeth, both will turn at the same speed. When the driven gear has more teeth than the driving gear, the driven gear turns more slowly than the driving gear. For example, if the driving gear has 12 teeth and the driven gear has 24 teeth, the driving gear must turn two times to turn the driven gear once. The gear ratio between the two gears is two-to one. This is written as 2:1.

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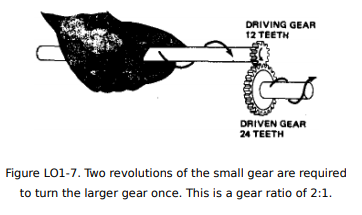
If a 12-tooth gear is meshed with a 36-tooth gear, the 12-tooth gear turns three times for every revolution of the 36-tooth gear. The gear ratio is 3:1.

**Gear Ratio and Torque**

The gear ratio changes as the number of teeth is the meshing gears change. At the same time, torque also changes. Torque is a twisting or turning force that may or may not result in motion. It is measured in pound-feet (lb-ft) and Newton-meters (N-m).

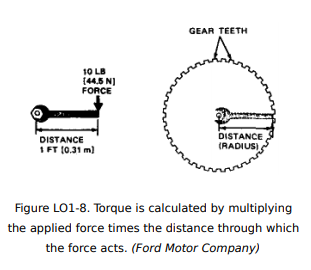
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To loosen and remove the top from a screw-top jar, you must apply torque to the top. To calculate torque, multiply the applied force times the distance through which the force sets. The torque on a gear is the force on a tooth multiplied by the distance from the tooth to the center of the gear. This distance is the radius of a gear or circle.

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Two or more meshed gears make a gearset or a gear train. In a gear system, speed reduction means torque increase.

Also, speed increase means torque reduction. An example of torque increase is a car that has a gear reduction of 12:1 from the transmission or transaxle to the drive wheels. The crankshaft turns 12 times to turn the drive wheels once. If the engine is producing a torque of 100 lb-ft [135.6 N-m], then a torque of 1200 lb-ft [1627 N-m] is applied to the drive wheels.

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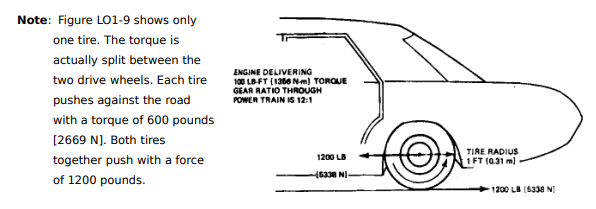
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Figure LO1-9. How torque at the drive wheels pushes the vehicle forward. The tire is turned with a torque of 1200 lb-ft [1637 N-m]. Since the tire radius is 1 foot [0.31 m], the push of the tire against the ground is 1200 lb-ft. As a result, the vehicle is pushed forward with a force of 1200 pounds [5338 N].

The radius of the tire in Figure LO1-9 is 1 foot [0.31 m]. With the torque acting on the ground at a distance of 1 foot, the force of the tire pushing against the road is 1200 pounds [5338 N].

**MANUAL TRANSMISSIONS CONSTRUCTION**

Manual transmissions, manual transaxles, and transfer cases are all various types of gearboxes. A gearbox has:

1. Gears that transmit power.

2. Splined shafts that rotate while other parts slide on them.

3. Bearings that support the shafts and transfer the load to the case or housing.

In a gearbox, the gear teeth and other moving metal parts must not touch. They must be continuously separated by a thin film of lubricant. This prevents excessive wear and early failure. Therefore, a gearbox runs partially filled with a lubricant or gear oil. Oil seals prevent loss of lubricant from between the case and the rotating shafts.

The manual transmission and transaxle in passenger cars have from four to six forward speeds. A few vehicles with three-speed transmissions are still being driven. Many older vehicles and some new ones have four speeds. However, a five-speed transmission or transaxle is used in most cars today. Trucks and buses use bigger transmissions with 4 to 16 forward speeds. Regardless of type, most manual transmissions and transaxles are similar. One difference is the size and heaviness of construction. Another is that transmissions and transaxles with more speeds have more gears and shafts.

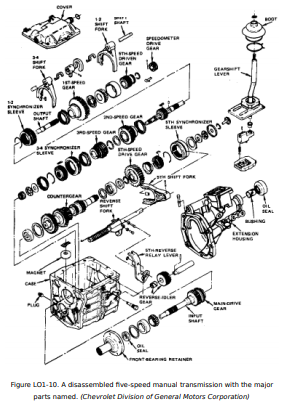
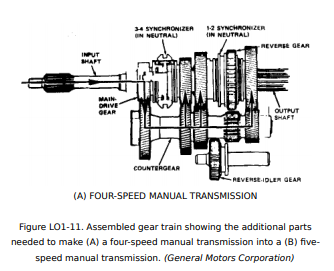


Figure LO1- 10 shows a disassemble d five-speed manual transmission with the major parts named. Figure LO1- 11 shows the assembled gear train of this transmission . It is made as a fourspeed and with additional parts as a five-speed. The maindrive gear or clutch gear drives the one-piece cluster gear or counter gear.

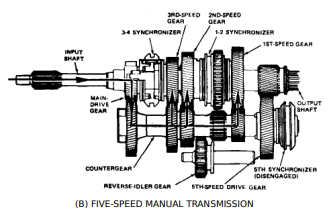
The gears on the output shaft (except for the reverse gear) mesh with the gears on the countershaft. If the countershaft turns, the gears on the output shaft also turn.

No power flows through if the transmission is in neutral. Then none of the outputshaft gears are locked to it. The gears have bushings or bearings that permit them to rotate freely on the output shaft. During gear shifting, the gears themselves are not moved. The gears are locked to the shaft by synchronizer action. Synchronizers are connecting devices that are splined to the output shaft and rotate with it.



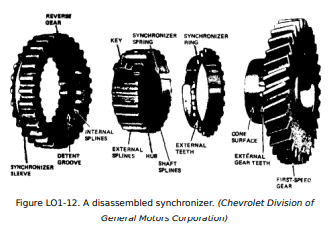
Shift forks fit into grooves in the synchronizer sleeves. When the driver moves the gearshift lever, linkage carries the movement to a shift fork. The fork moves the sleeve which then locks the selected gear to the shaft. In figure LO1- 11a, two synchronizers lock gears to the transmission output shaft. The five-speed transmission has an additional synchronizer (5th synchronizer). It locks the fifth-speed drive gear to the countergear.

The only gear that actually moves into mesh and in many other transmissions is the reverse-idler gear. It slides on its shaft to engage the reverse gear on the countergear (the spur gear). It also engages reverse gear on the output shaft. This causes the output shaft to turn in the opposite direction of input-shaft rotation.

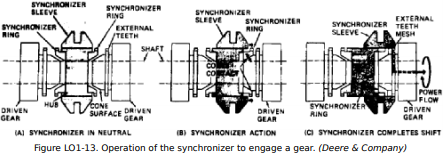


**Synchronizer Action**

Synchronizers are used in manual transmissions and transaxles to prevent gear clash during gear shifting. These devices ensure that gears and sliding sleeves about to mesh rotate at the same speed. The result is a smooth engagement.

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The synchronizer used in the transmission shown in figures LO1-10 and LO1-11 has synchronizing cones on the gears and in the synchronizer rings

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