MODULE CONTENT

| Unit of Competency | **DIAGNOSE AND REPAIR CLUTCH SYSTEM** |
| --- | --- |
| Module Title | **DIAGNOSING AND REPAIRING CLUTCH SYSTEM** |
| Module Descriptor | This unit identifies the competence required to perform basic diagnose and repair the clutch system. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and repair clutch system | |
| LO2. Diagnose clutch system | |
| LO3. Repair clutch system | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 1**

**PREPARE TO DIAGNOSE AND REPAIR CLUTCH SYSTEM**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Prepare to diagnose and repair clutch system | If you have some problem on 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 self-check provided in the module. |
| Answer Self-Check 3.1-1 on Prepare to diagnose and repair clutch system | 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 repair clutch system | 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 repair clutch system | Remember the step-by-step procedure the Prepare to diagnose and repair clutch system |
| 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 REPAIR CLUTCH SYSTEM**

**Learning Objectives:**

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

1. Determined job requirements
2. Sourced and interpreted diagnostic information.
3. Verified symptoms.
4. Identified hazards associated with the work and managed risks.
5. Selected and checked tools, equipment, and materials.
6. Reported defective and damaged tools and equipment.
7. Checked and reported availability of materials.
8. Applied safety practices.

**CLUTCH SYSTEM**

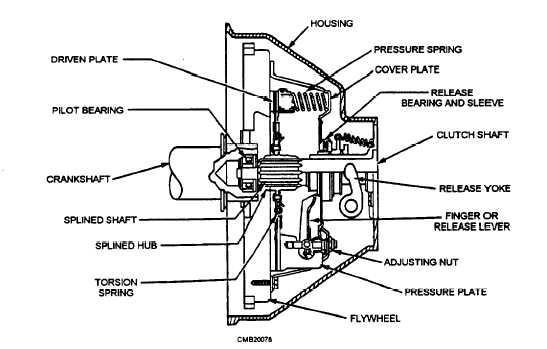
**GENERAL OPERATING PRINCIPLES**

In  a  vehicle,  the  mechanism  that  transmits  the power  developed  by  the  engine  to  the wheels  and/or tracks  and  accessory  equipment  is  called  the  **powertrain.**In  a  simple application,  such  as  a  stationary engine-powered  hoist,  a  set  of  gears  or  a  chain  and sprocket  could  perform  this  task.  However,  auto- motive  and  construction  equipment  are  not  designed for  such  simple  operating  conditions.  They are designed to provide pulling power, to move at high speeds, to travel in reverse as well as forward, and to operate on rough terrain as well as smooth roads. To meet  these  varying  conditions,  vehicle  power  trains are  equipped with  a  variety  of  components.

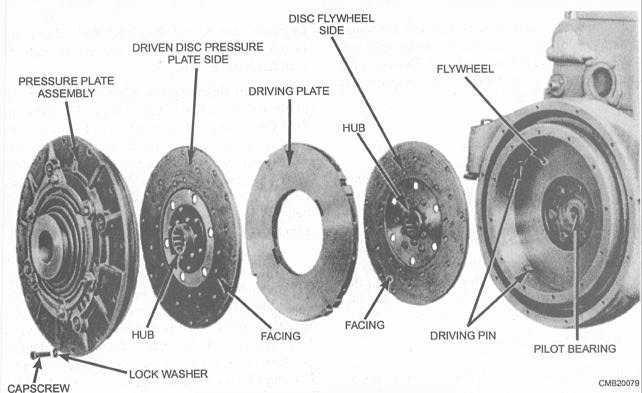
This chapter   discusses   the   basic   automotive   clutch, transmissions (manual and automatic), and transaxles (manual and automatic).

An automotive clutch is used to connect and disconnect   the   engine   and   manual   (hand-shifted) transmission   or transaxle.   The   clutch   is   located between  the  back  of  the  engine  and  the  front  of  the transmission. Type of clutches common are the single-, double-, and multiple-disc types.  The clutch that will be discussed are; the single-disc type, as shown in figure 1, and the double-disc clutch (fig. 2) which is substantially the same as the single disc, except that another driven disc and an intermediate driving plate are added.

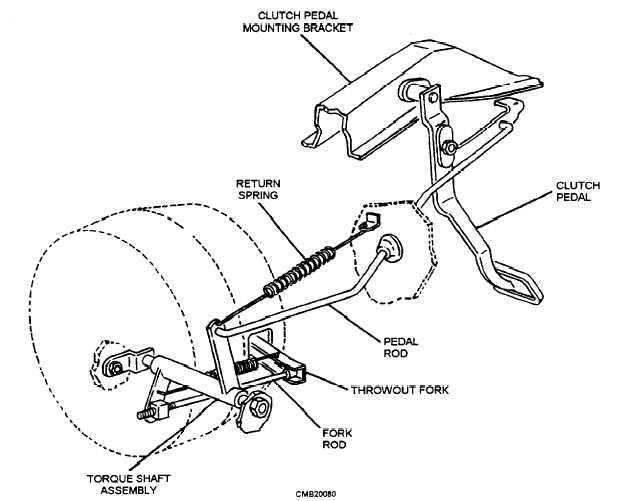
This clutch is used in heavy-duty vehicles and construction equipment.  The multiple-disc clutch is used in the automatic transmission and for the steering clutch used in tracked equipment.



**Figure 1.—Single-disc clutch.**



**Figure 2 – Double Disc clutch, exploded view**



**Figure 3 – Clutch Linkage Mechanism**

The   operating   principles,   component   functions, and maintenance requirements are essentially the same for each of the three clutches mentioned. This being the case, the single-disc clutch will be used to acquaint you with the fundamentals of the clutch.

**CLUTCH   CONSTRUCTION**

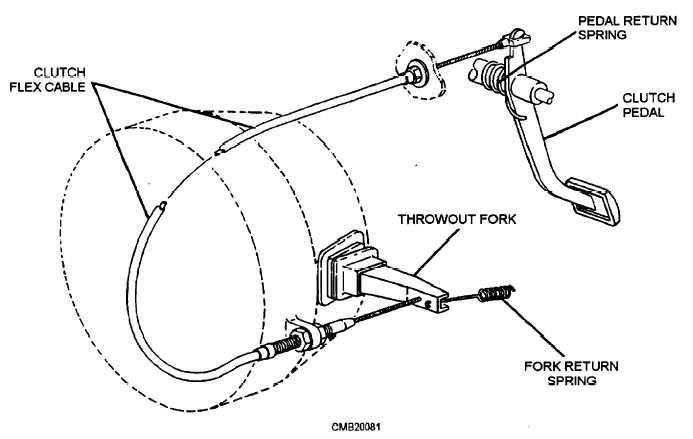
The clutch is the first drive train component powered by the engine crankshaft. The clutch lets the driver control power flow between the engine and the transmission or transaxle.  Before understanding the operation of a clutch, you must first become familiar with the parts and their function.  This  information  is very  useful  when  learning  to  diagnose  and  repair  the clutch  assembly.

**Clutch Release Mechanism**

A clutch release mechanism allows the operator to operate the clutch. Generally, it consists of the clutch pedal assembly, either mechanical linkage, cable, or hydraulic circuit, and the clutch fork.  Some  manufacturers  include  the  release  bearing  as  part  of  the clutch  release  mechanism.

A **clutch linkage mechanism** uses levers and rods to transfer motion from the clutch pedal to the clutch fork. One configuration is shown in figure 3. When the pedal is pressed, a pushrod shoves on the bell crank and  the  bell  crank  reverses  the  forward  movement  of the  clutch  pedal.  The other end of the bell crank is connected to the release rod. The release rod transfers bell crank movement to the clutch fork. It also provides a method of adjustment for the clutch.

The  **clutch  cable  mechanism**uses  a  steel  cable inside  a  flexible  housing  to  transfer  pedal  movement  to the  clutch  fork.  As shown in figure 4, the cable is usually fastened to the upper end of the clutch pedal, with the other end of the cable connecting to the clutch fork.  The cable housing is mounted in a stationary position.  This allows the cable to slide inside the housing whenever the clutch pedal is moved. One end of the clutch cable housing has a threaded sleeve for clutch   adjustment.



**Figure 4 – Clutch Cable Mechanism**

A **hydraulic clutch release mechanism** (fig. 5) uses a simple hydraulic circuit to transfer clutch pedal action to the clutch fork.  It has three basic parts namely; master cylinder, hydraulic lines, and a slave cylinder. Movement  of  the  clutch  pedal  creates  hydraulic pressure  in  the  master  cylinder,  which  actuates  the slave  cylinder.  The slave cylinder then moves the clutch fork.

**Clutch Fork**

The clutch fork, also called a clutch arm or release arm, transfers motion from the release mechanism to the release bearing and pressure plate. The clutch fork sticks through a square hole in the bell housing and mounts on a pivot. When the clutch fork is moved by the release mechanism, it PRIES on the release bearing to disengage the clutch. A rubber boot fits over the clutch fork. This boot is designed to keep road dirt, rocks, oil, water, and other debris from entering the clutch housing assembly, with the manual transmission bolted to the back of the housing. The lower front of the housing has a metal cover that can be removed for fly-wheel ring gear inspection or when the engine must be separated from the clutch assembly. A hole is provided in the side of the housing for the clutch fork.  It can be made of aluminium, magnesium, or cast iron.

**Release Bearing**

The   release   bearing,   also   called   the   throw-out bearing,   is   a   ball   bearing   and   collar   assembly.   It reduces friction between the pressure plate levers and the release fork.  The release bearing is a sealed unit pack with a lubricant.  It  slides  on  a  hub  sleeve extending  out  from  the  front  of  the  manual transmission or transaxle. The release bearing snaps over the end of the clutch fork. Small spring clips hold the bearing on the fork. Then fork movement in either direction slides the release bearing along the transmission hub sleeve.

**Pressure Plate** **Clutch Housing**

The clutch housing is also called the bell housing. It bolts to the rear of the engine, enclosing the clutch. The pressure plate is a spring-loaded device that can either engage or disengage the clutch disc and the flywheel. It bolts to the flywheel.

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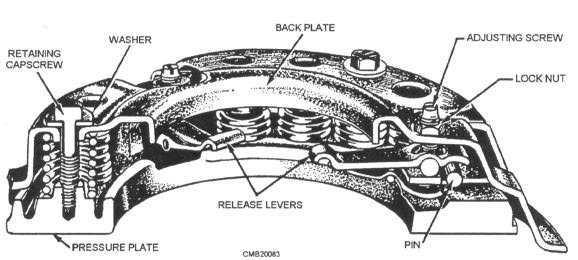
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**Figure 4.5 – Hydraulic Clutch Release Mechanism**

The clutch disc fits between the flywheel and the pressure plate. There are two types of pressure plates—the coil spring type and the diaphragm type. Coil spring pressure plate uses small coil springs similar to valve springs (fig.  4-6).  The  face  of  the pressure  plate  is  a  large,  flat  ring  that  contacts  the clutch disc during clutch engagement. The backside of the pressure plate has pockets for the coil springs and brackets for hinging the release levers. During clutch action, the pressure plate moves back and forth inside the clutch cover. The release levers are hinged inside the pressure plate to pry on and move the pressure plate face away from the clutch disc and flywheel.  Small clip-type springs fit around the release levers to keep them rattling when fully released.  The pressure plate cover fits over the springs, the release levers, and the pressure plate face.  Its main purpose is to hold the assembly together. Holes around the outer edge of the cover are for bolting the pressure plate to the flywheel. Diaphragm pressure plate (fig. 4-7) uses a single diaphragm spring instead of coil springs. This type of pressure  plate  functions  similar  to  that  of  the  coil spring  type.  The diaphragm spring is a large, round disc of spring steel. The spring is bent or dished and has pie-shaped segments running from the outer edge to the center.  The diaphragm spring is mounted in the pressure plate with the outer edge touching the back of the pressure plate face. The outer rim of the diaphragm is secured to the pressure plate and is pivoted on rings (pivot rings) approximately 1 inch from the outer edge.



**Figure 6 – Coil Spring pressure plate**

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**Figure 7 – Diaphragm Pressure Plate Operation**

Application of pressure at the inner section of the diaphragm will cause the outer rim to move away from the flywheel and draw the pressure plate away from the clutch disc, disengaging the clutch.

**Clutch Disc**

The clutch disc, also called friction lining, consists of a splined hub and a round metal plate covered with friction material (lining).  The splines in the center of the clutch disc mesh with the splines on the input shaft of the manual transmission. This makes the input shaft and disc turn together.

However, the disc is free to slide back and forth on the shaft. Clutch disc **torsion springs,** also termed **damping** **springs,**absorb  some  of  the  vibration  and  shock produced  by  clutch  engagement.  They  are  small  coil springs  located  between  the  clutch  disc  splined  hub and  the  friction  disc  assembly.  When  the  clutch  is engaged,  the  pressure  plate  jams  the  stationary  disc against   the   spinning   flywheel.   The   torsion   springs compress and soften, as the disc first begins to turn with the flywheel. Clutch   disc **facing   springs,** also   called   the **cushioning   springs,**are   flat   metal   springs   located under the friction lining of the disc. These springs have a  slight  wave  or  curve,  allowing  the  lining  to  flex inward  slightly  during  initial  engagement.  This also allows for smooth engagement.

The clutch disc **friction material,** also called **disc** l**ining**or **facing,**is made of heat-resistant asbestos, cotton   fibers,   and   copper   wires   woven   or   molded together. Grooves are cut into the friction material to aid cooling and release of the clutch disc.  Rivets are used to bond the friction material to both sides of the metal body of the disc.

**Flywheel**

The   flywheel   is   the   mounting   surface   for   the clutch.  The pressure plate bolts to the flywheel face. The clutch disc is clamped and held against the flywheel by the spring action of the pressure plate. The face of the flywheel is precision machined to a smooth surface.  The face of the flywheel that touches the clutch disc is made of iron. Even if the flywheel were aluminium, the face is iron because it wears well and dissipates heat better.

**Pilot Bearing**

The pilot bearing or bushing is pressed into the end of the crankshaft to support the end of the transmission input shaft. The pilot bearing is a solid bronze bushing, but it also may be a roller or ball bearing. The end of the transmission input shaft has a small journal machined on its end. This journal slides inside the pilot bearing.  The  pilot  bearing  prevents  the transmission  shaft  and  clutch  disc  from  wobbling  up and down when the clutch is released. It also assists the input shaft center the disc on the flywheel.

**CLUTCH OPERATION**

When  the  operator  presses  the  clutch  pedal,  the clutch  release  mechanism  pulls  or  pushes on  the  clutch release  lever  or  fork  (fig.  4-8).  The  fork  moves  the release  bearing  into  the  center  of  the  pressure  plate, causing the pressure plate to pull away from the clutch disc releasing the disc from the flywheel. The engine crankshaft can then turn without turning the clutch disc and transmission input shaft. When  the  operator  releases  the  clutch  pedal,  spring pressure  inside  the  pressure  plate  pushes  forward  on the   clutch   disc   (fig.  8).

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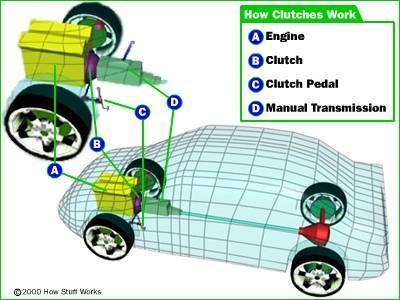
**Figure 8 – Clutch Operation**

This  action   locks   the flywheel,  the  clutch  disc,  the  pressure  plate,  and  the transmission  input  shaft  together.  The engine again rotates the transmission input shaft the transmission gears, the drive train, and the wheels of the vehicle.

**CLUTCH START SWITCH**

Many  of  the  newer  vehicles  incorporate  a  clutch start  switch  into  the  starting  system.  The clutch start switch is mounted on the clutch pedal assembly. The clutch start switch prevents the engine from cranking unless the clutch pedal is depressed fully. This serves as a safety device that keeps the engine from possibly starting while in gear. Wires from the ignition switch feeds starter solenoid current through the switch. Unless  the  switch  is  closed  (clutch  pedal  depressed), the  switch  prevents  current  from  reaching  the  starter solenoid.  With  the  transmission  in  neutral,  the  clutch start  switch  is  bypassed  so  the  engine  will  crank  and start.

**Diagram of a Car showing Clutch Location**

[](http://auto.howstuffworks.com/transmission-pictures.htm)

If you drive a [manual transmission](http://auto.howstuffworks.com/transmission.htm) [car](http://auto.howstuffworks.com/car.htm), you may be surprised to find out that it has more than one clutch. And it turns out that folks with [automatic transmission](http://auto.howstuffworks.com/automatic-transmission.htm) cars have clutches, too. In fact, there are clutches in many things you probably see or use every day: Many cordless [drills](http://home.howstuffworks.com/drills.htm) have a clutch, [chain saws](http://home.howstuffworks.com/chainsaw.htm) have a centrifugal clutch and even some [yo-yos](http://entertainment.howstuffworks.com/question158.htm) have a clutch.

You will learn why you need a clutch, how the clutch in your car works and find out some interesting, and perhaps surprising, places where clutches can be found.

Clutches are useful in devices that have two rotating shafts. In these devices, one of the shafts is typically driven by a motor or pulley, and the other shaft drives another device. In a drill, for instance, one shaft is driven by a motor and the other drives a drill chuck. The clutch connects the two shafts so that they can either be locked together and spin at the same speed, or be decoupled and spin at different speeds.

In a car, you need a clutch because the [engine](http://auto.howstuffworks.com/engine.htm) spins all the time, but the car's wheels do not. In order for a car to stop without killing the engine, the wheels need to be disconnected from the engine somehow. The clutch allows us to smoothly engage a spinning engine to a non-spinning transmission by controlling the slippage between them.

To understand how a clutch works, it helps to know a little bit about **friction**, which is a measure of how hard it is to slide one object over another. Friction is caused by the peaks and valleys that are part of every surface -- even very smooth surfaces still have microscopic peaks and valleys. The larger these peaks and valleys are, the harder it is to slide the object. You can learn more about friction in [How Brakes Work](http://auto.howstuffworks.com/auto-parts/brakes/brake-types/brake.htm).

A clutch works because of friction between a clutch plate and a flywheel.

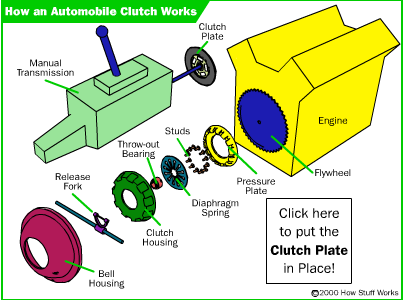


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*Press “CTRL” on your computer, pint the mouse to the picture and “CLICK” to see the VIDEO on how clutch works.*

**Fly Wheels, Clutch Plates and Friction**

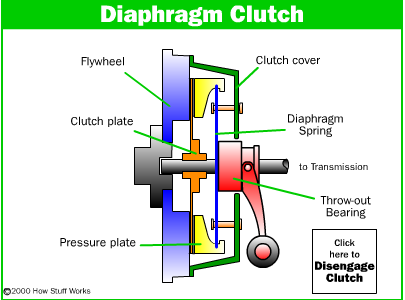
In a [car's](http://auto.howstuffworks.com/car.htm) clutch, a flywheel connects to the [engine](http://auto.howstuffworks.com/engine.htm), and a clutch plate connects to the [transmission](http://auto.howstuffworks.com/transmission.htm). You can see what this looks like in the figure below.



**Exploded view of a clutch**

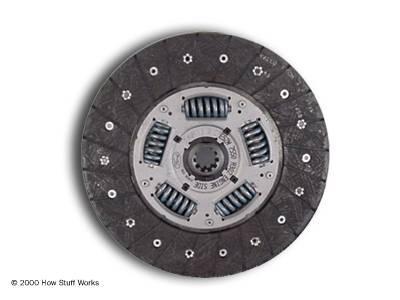
When your foot is off the pedal, the springs push the pressure plate against the clutch disc, which in turn presses against the flywheel. This locks the engine to the transmission input shaft, causing them to spin at the same speed.

The amount of force the clutch can hold depends on the friction between the clutch plate and the flywheel, and how much force the spring puts on the pressure plate. The friction force in the clutch works just like the blocks described in the friction section Information Sheet “[How Brakes Work](http://auto.howstuffworks.com/auto-parts/brakes/brake-types/brake.htm)”, except that the spring presses on the clutch plate instead of weight pressing the block into the ground.



**How a clutch engages and releases**

When the clutch pedal is pressed, a cable or hydraulic piston pushes on the release fork, which presses the throw-out bearing against the middle of the diaphragm spring. As the middle of the diaphragm spring is pushed in, a series of pins near the outside of the spring causes the spring to pull the pressure plate away from the clutch disc (see below). This releases the clutch from the spinning engine.



**Clutch plate**