TVET CERTIFICATE IV in AUTOMOBILE TRANSMISSION AND CONTROL SYSTEMS TECHNOLOGY

Module Title: CLUTCH SYSTEM REPAIRING

Code: ATCCR401 REPAIR CLUTCH SYSTEM

Competence

Competence: repair clutch system

Credits: 9

Learning hours: 90

Sector: **Transports and Logistics**

Sub-sector: Automobile

Module Note Issue date: August, 2020

Purpose statement

This module will allow the Learner to identify, describe, maintain and repair clutch system. The learner will be able to dismount clutch system components, disassemble, inspect, clean, replace, adjust and reassemble components of a clutch system. Also the learner should be able to test clutch system.

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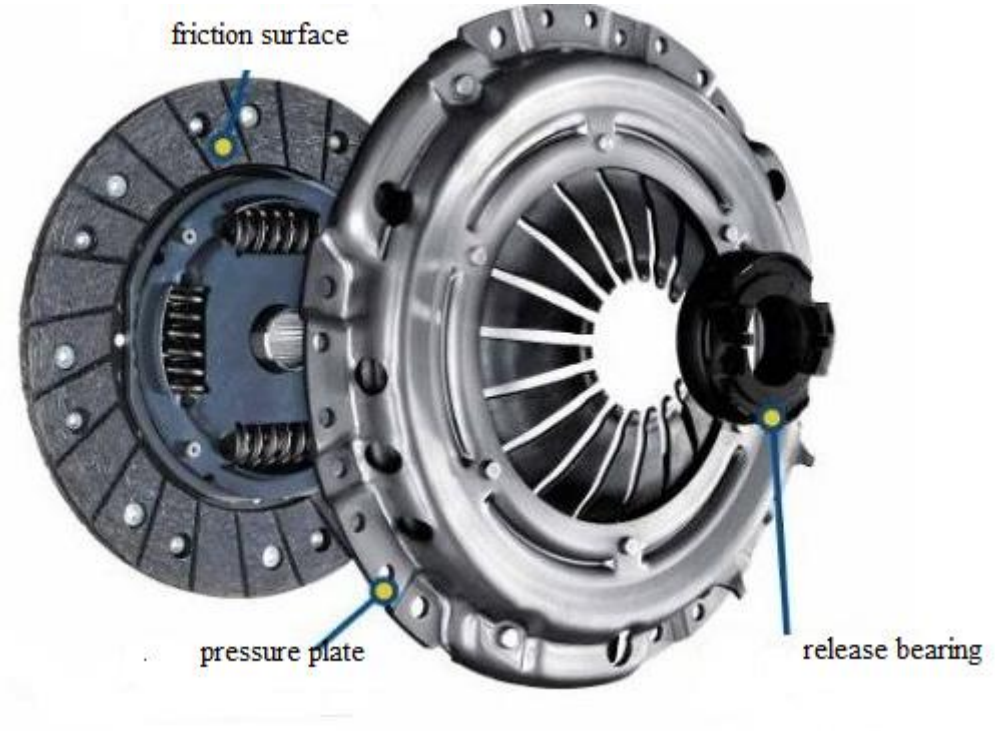
L U.1. IDENTIFY CLUTCH SYSTEM

L O 1.1: Adequate identification of clutch system

- Content/Topic1: Definition and purpose of clutch system

Clutch is a mechanical device used in the transmission system of a vehicle. It engages and disengages the transmission system from the engine. It is fixed between the engine and the transmission.



- **When the clutch is engaged**, the power is transmitted from the engine to the driving wheels through the transmission system and the vehicle starts moving.
- **When the clutch is disengaged,** the power is not transmitted to the rear or driving wheels and the vehicle stops while the engine is still running.
- **The clutch is disengaged** when starting the engine, when stopping the vehicle, when shifting the gears and when idling the engine.
- **The clutch is engaged** when the vehicle is to move and is kept engaged when the vehicle is moving. Clutch also allows the continuous taking up of the load

- Content/Topic 2: Major components of clutch system

The clutch assembly consists of the following components:

- Clutch disc
- Flywheel
- Clutch cover assembly
- Clutch release bearing
- Clutch release fork

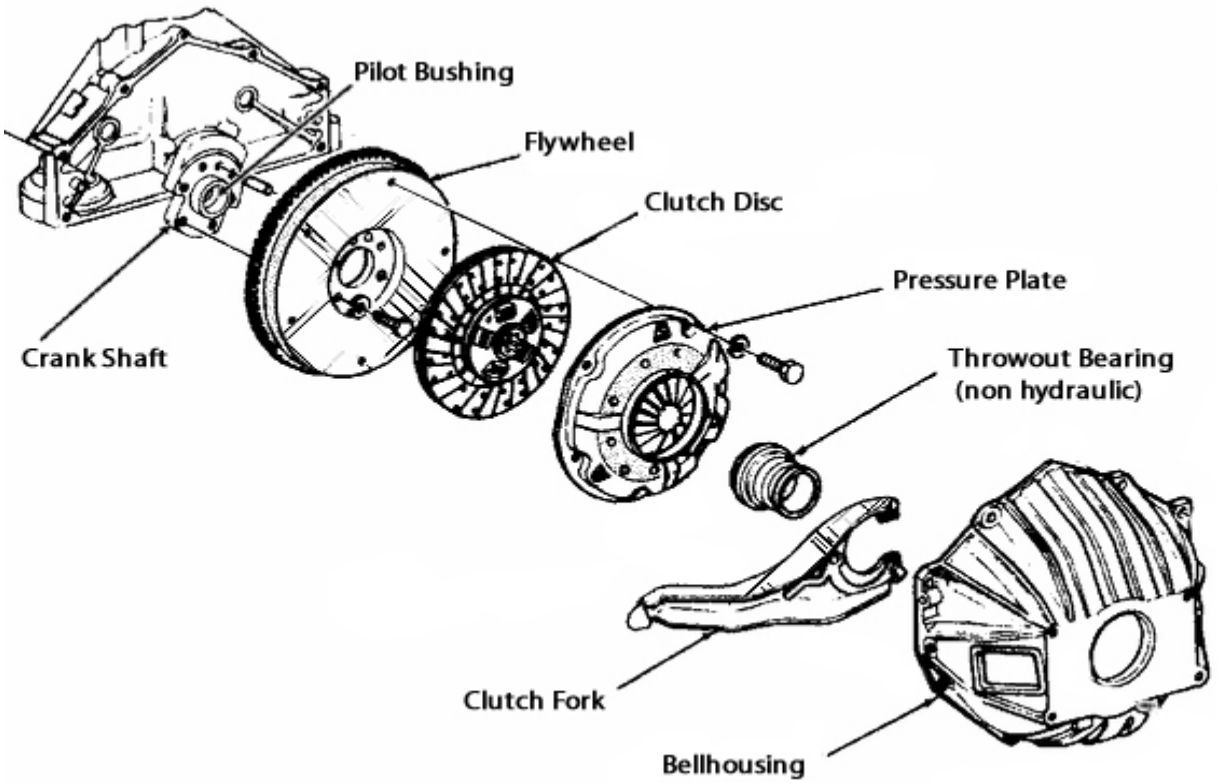


Figure: clutch components

The clutch disc is connected to the input shaft of the transmission, and is located between the flywheel and clutch cover assembly. The flywheel is connected to the engine crankshaft and the clutch cover assembly is attached to the flywheel. The clutch release fork forces the clutch release bearing against the diaphragm spring of the clutch cover assembly.

- **Fly wheel**

The flywheel is connected to the engines crankshaft. A flywheel is very similar to a brake rotor in appearance. It is a large metal disc that stores and releases energy pulses from the crankshaft.

It drives the clutch by providing a friction surface for the clutch disc. In addition, the flywheel provides a mounting surface for the clutch cover, and also dissipates heat.

- **Clutch disc**

The clutch disc is the connecting link between the engine and the transmission. A clutch disc provides a large surface area made of friction material on both sides. In the center, a damper assembly absorbs torsional vibration.

The facing, or friction material is riveted to the cushion plate on both sides and is similar to the composition of brake lining. The cushion plate has a wave design that allows the facings to compress when the pressure plate is engaged. This provides a smooth engagement of engine and transmission.

- **Clutch cover assembly/ pressure plate**

The clutch cover assembly is bolted to the flywheel and provides the pressure needed to hold the clutch disc to the flywheel for proper power transmission.
It is important that the assembly be well balanced and able to radiate the heat generated when the clutch disc is engaged.

- **Clutch Release Bearing & Clutch Release Fork**

The purpose of the clutch release bearing is to transfer the movement of the clutch release fork into the rotating diaphragm spring and clutch cover to disengage the clutch disc.

- **Hydraulic Clutch System**

In a hydraulic clutch system, there are three major components:
Master cylinder
Release cylinder
Clutch pedal

The **master cylinder** stores hydraulic fluid in the **reservoi**r and provides pressure for system operation. When the **clutch pedal** is depressed, pressure is built up in the master cylinder forcing fluid into the **release cylinder**, which causes the clutch release fork to move. The release fork and release bearing compress the diaphragm spring of the clutch cover to disengage the clutch disc.

- **Mechanical Clutch System**

The mechanical clutch system consists of:
Clutch pedal and release lever
Clutch release cable
Release fork
Release bearing

The **clutch pedal** is mechanically connected to the release fork through a cable.

Clutch pedal free play is indicated by the amount of clearance between the release bearing and diaphragm fingers. In a mechanical system, disc wear causes the diaphragm spring fingers to move closer to the release bearing, which reduces free play. As normal disc wear continues, the clutch may begin to slip when there is no free play. **Free play adjustment** is accomplished by changing the length of the cable housing. Shortening the cable housing increases clutch pedal free play.

L O 1.2 Classify friction clutch

- Content/Topic 1: Definition and purpose of friction clutch

Clutch is defined as a mechanism for connecting and disconnecting an engine and the transmission system in a vehicle or the working parts of any machine

The purpose of the clutch is to transfer torque from the engine to the transmission in a controlled manner. In order to make this possible, a friction clutch system that transfers power by pressing two or more surfaces together is used. Depending on friction between those surfaces the kinetic energy is either converted to movement or heat.

- Content/Topic 2: Types of friction clutch

Single plate

Single plate clutch is a type of friction **clutch** in which power is transmitted by means of friction between the contact surface usually called **clutch plates**. As name suggest a this **clutch** consists of only one **clutch plate** with both side friction lining

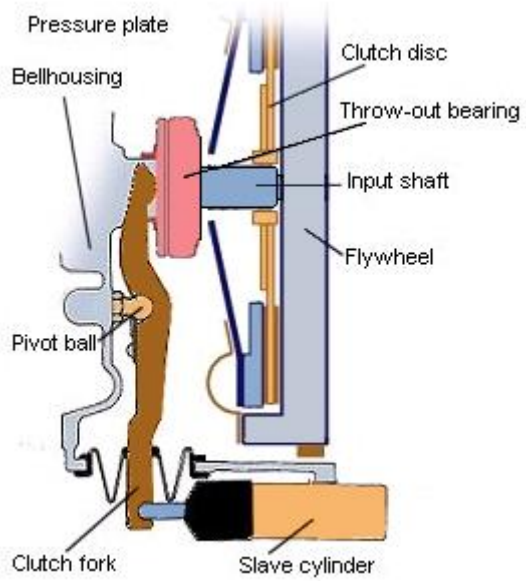


Figure: single plate clutch

Multi-plate

Multi-Plate Clutch consists of a number of clutch plates instead of only one clutch plate like in the Single plate clutch. Friction surface also increased because of a number of clutch plates. Because of a number of friction surfaces, the capacity of the clutch to transmit torque is also increased

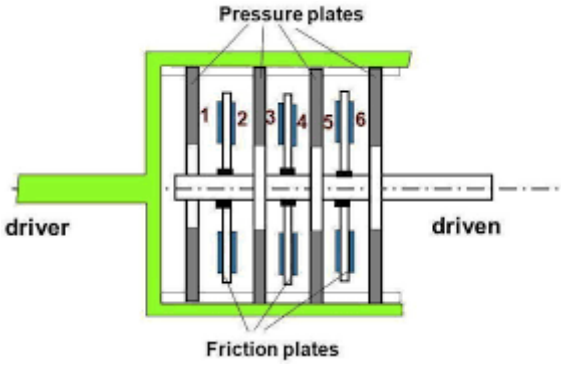


Figure: multi-plate clutc

Magnetic particle

A magnetic particle clutch is a special type of electromagnetic clutch which does not use friction plates. Instead, it uses a fine powder of magnetically susceptible material (typically stainless steel) to mechanically link an otherwise free-wheeling disc attached to one shaft, to a rotor attached to the other shaft

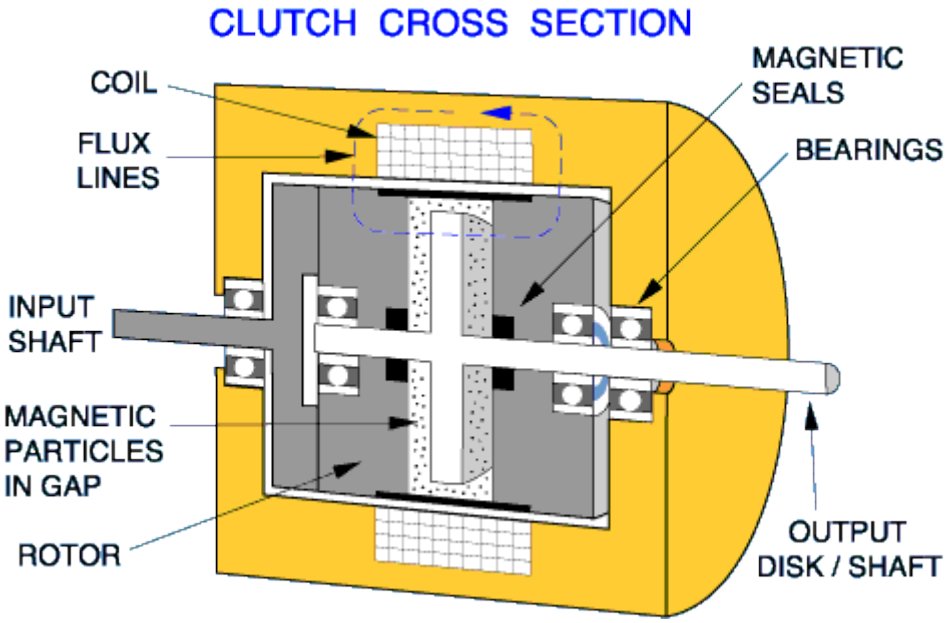


Figure: magnetic clutch

- Content/Topic 3: Clutch control

➢ **Hydraulic clutch controls** use hydraulic pressure to move the release bearing against the release fingers of the clutch. Similar to a brake system, the hydraulic clutch has a master cylinder, hydraulic tubing, and a release cylinder.

When the driver presses the clutch pedal, a linkage arm connected to the master cylinder forces the master cylinder piston down its bore. Thus, pressure is applied to the brake fluid contained in the master cylinder, which transfers this pressure to the release cylinder. The piston in the release cylinder changes this pressure into mechanical force by moving outward. This mechanical action forces the release bearing

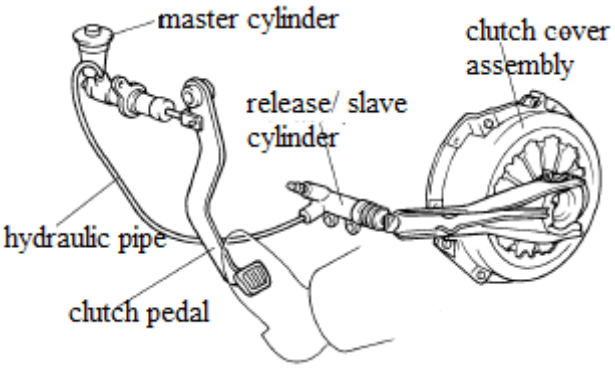


Figure: hydraulic clutch control

➢ **The mechanical clutch control system** the clutch pedal is mechanically connected to the release fork through a cable.

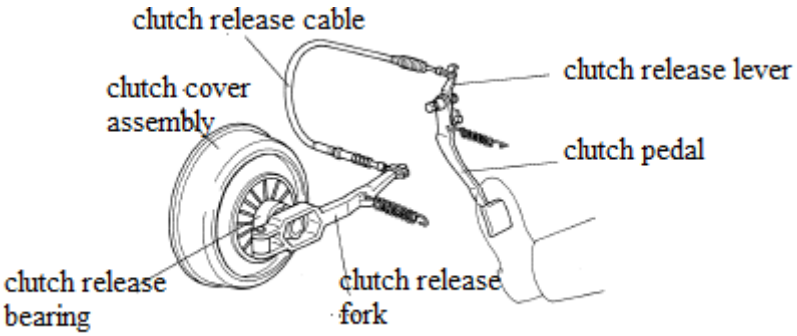


Figure: mechanical clutch control

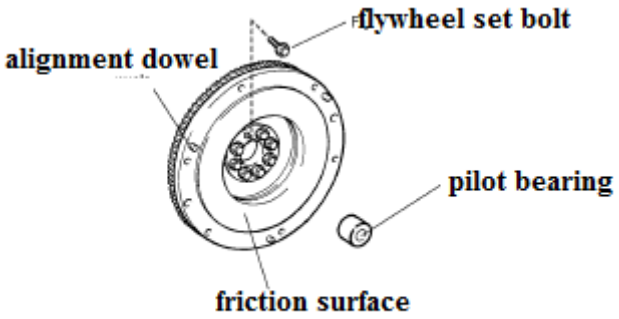
L O 1.3: Describe clutch components

- Content/Topic1 Clutch system components description

- **Fly wheel**

The flywheel is connected to the engines crankshaft. A flywheel is very similar to a brake rotor in appearance. It is a large metal disc that stores and releases energy pulses from the crankshaft.

It drives the clutch by providing a friction surface for the clutch disc. In addition, the flywheel provides a mounting surface for the clutch cover, and also dissipates heat.

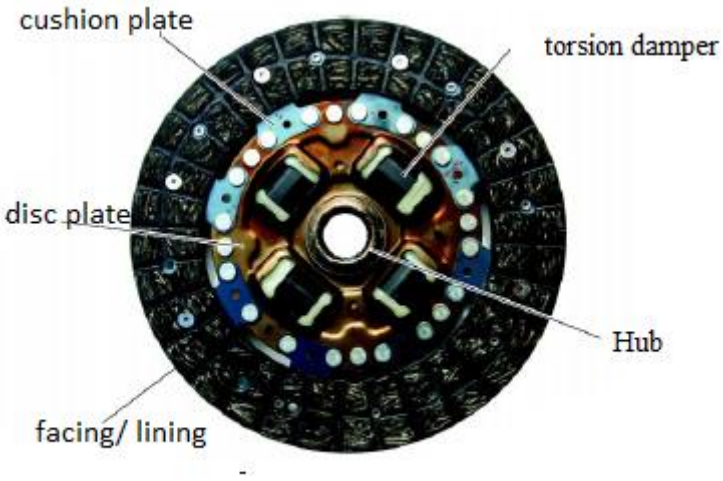


- **Pilot Bearing**: Pilot bearing supports the engine side of the input shaft. The pilot bearing used on most vehicles is a ball bearing located in a bore in the end of the crankshaft. The pilot bearing only turns when the clutch is disengaged.

- **Clutch disc**

The clutch disc is the connecting link between the engine and the transmission. A clutch disc provides a large surface area made of friction material on both sides. In the center, a damper assembly absorbs torsional vibration.

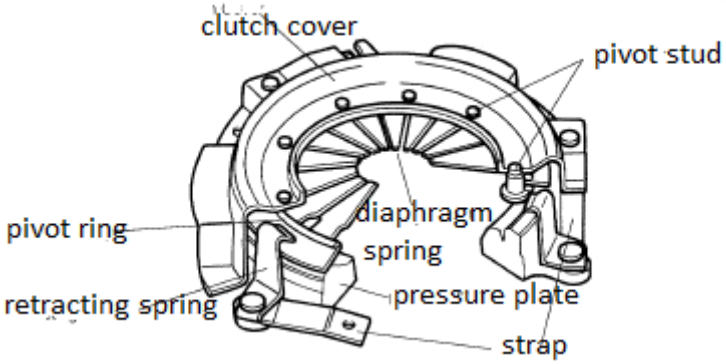
The facing or friction material is riveted to the cushion plate on both sides and is similar to the composition of brake lining. The cushion plate has a wave design that allows the facings to compress when the pressure plate is engaged. This provides a smooth engagement of engine and transmission.



- **Clutch Hub & Damper Assembly:** The internal splines of the clutch hub fit over the external splines of the transmission input shaft allowing the clutch hub to move back and forth smoothly. Most clutch discs include a **damper assembly** to reduce or eliminate torsional vibrations that occur from uneven engine and drivetrain power pulses.

- **Clutch cover assembly/ pressure plate**

The clutch cover assembly is bolted to the flywheel and provides the pressure needed to hold the clutch disc to the flywheel for proper power transmission.
It is important that the assembly be well balanced and able to radiate the heat generated when the clutch disc is engaged.

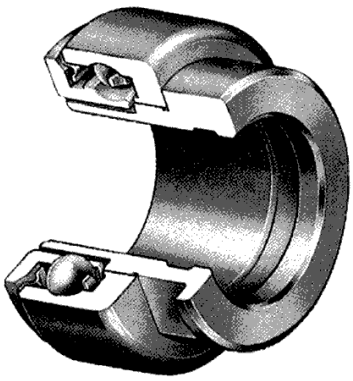


The diaphragm spring is a round, conical shaped spring that provides the clamping force against the pressure plate.

- **Clutch Release Bearing & Clutch Release Fork**

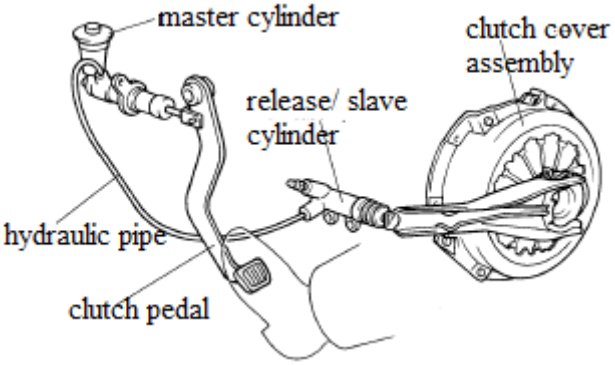
The purpose of the clutch release bearing is to transfer the movement of the clutch release fork into the rotating diaphragm spring and clutch cover to disengage the clutch disc.

The release bearing is mounted on the sleeve of the gearbox front cover on which it can slide in axial direction or it is mounted as combined component with the release cylinder directly to the clutch housing

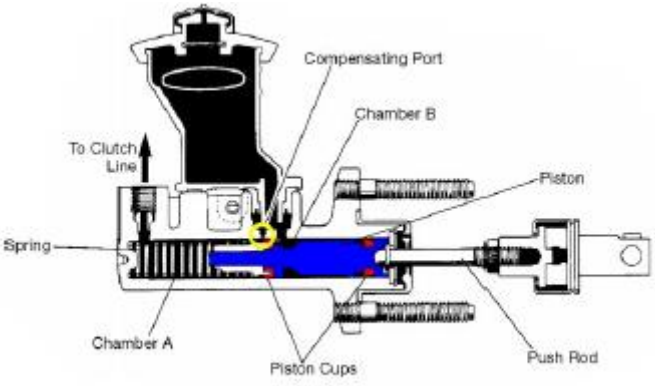


- **Hydraulic Clutch System**

In a hydraulic clutch system, there are major components:

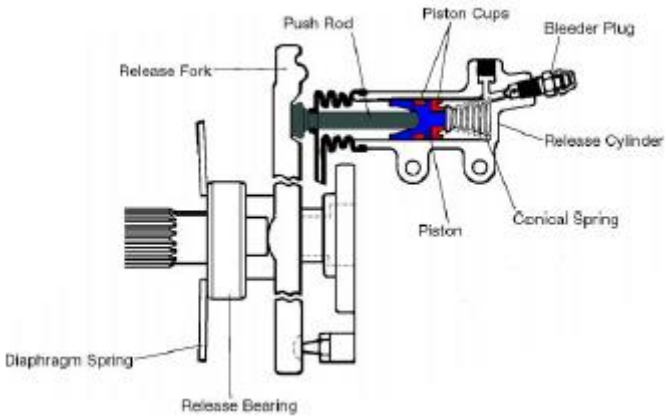


Master cylinder When force is applied to the pushrod, the piston displaces hydraulic fluid in chamber A of the master cylinder. During initial piston travel, the compensating port in the master cylinder is closed by the piston. Further piston travel allows fluid to be displaced, transmitting force through the clutch line to the release cylinder located at the transmission.



When the pushrod is released, the piston is returned to its initial position by a spring

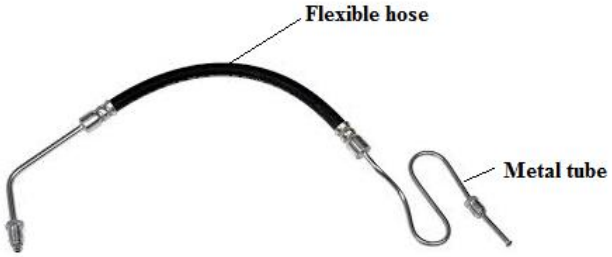
Release cylinder When the master cylinder directs fluid to the release cylinder, the piston in the release cylinder moves the push rod out against the release fork. Since the release bearing is connected to the release fork, the force is transmitted to the diaphragm spring of the clutch cover. The clutch disc is then disengaged.



When the clutch pedal is released, the diaphragm spring in the clutch cover moves the push rod and piston back in the bore of the release cylinder.

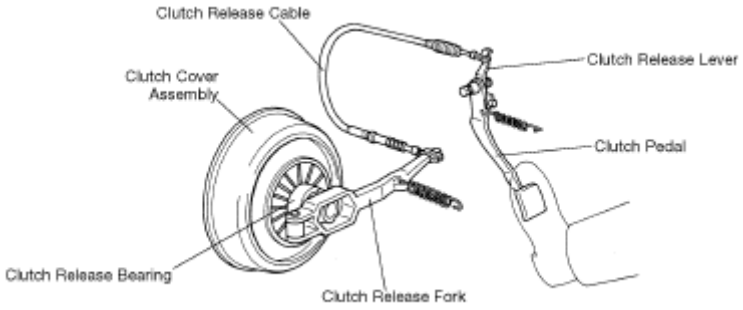
Hydraulic clutch hoses

Hydraulic clutch system is a flexible clutch hose. The purpose of this hose is to send fluid from master cylinder to release cylinder of clutch,



- **Mechanical Clutch System**

The mechanical clutch system consists of:



The **clutch pedal** is mechanically connected to the release fork through a cable.

Clutch pedal free play is indicated by the amount of clearance between the release bearing and diaphragm fingers. In a mechanical system, disc wear causes the diaphragm spring fingers to move closer to the release bearing, which reduces free play. As normal disc wear continues, the clutch may begin to slip when there is no free play. **Free play adjustment** is accomplished by changing the length of the cable housing. Shortening the cable housing increases clutch pedal free play.

L U 2 DISMOUNT CLUTCH COMPONENTS

L O 2.1: select tools, materials and equipment

- Content/Topic 1: introduction on tools

Tools: a handheld device that aids in accomplishing a task, something (such as an instrument or apparatus) used in performing an operation or necessary in the practice of a vocation or profession

- Content/Topic 2: Definition and function of materials

M aterial: the elements, constituents, or substances of which something is composed or can be made, matter that has qualities which give it individuality and by which it may be categorized

- Content/Topic 3 : Definition and function of equipment

Tangible property (other than land or buildings) that is used in the operations of a business.

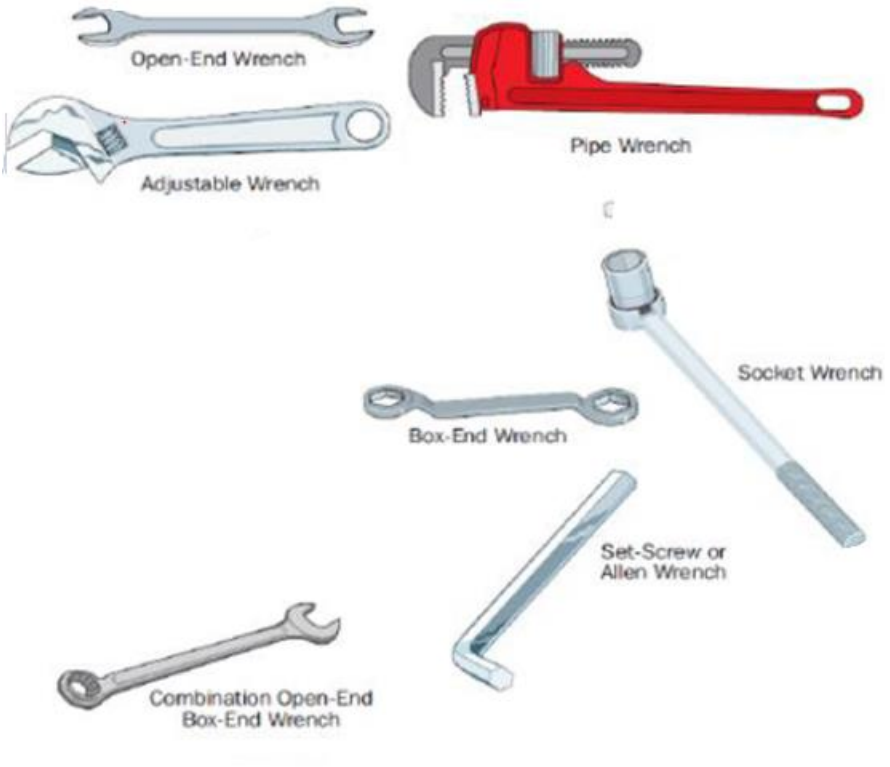
Examples of equipment include devices, machines, tools, and vehicles

- Content/Topic 4: Types of tools
- **Hand tools**

  Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches

- **Wrenches:**

A wrench is a tool for twisting and/or holding bolt heads or nuts



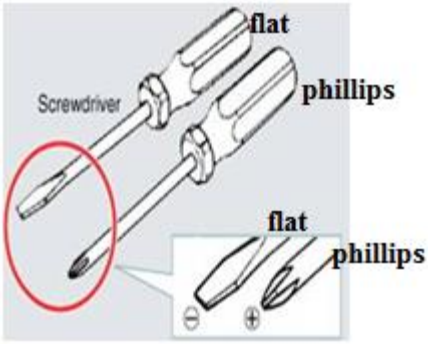
- **Screwdrivers**

A screwdriver drives a variety of threaded fasteners used in the automotive industry

Standard Tip Screwdriver: A slotted screw accepts a screwdriver with a standard or blade-type tip

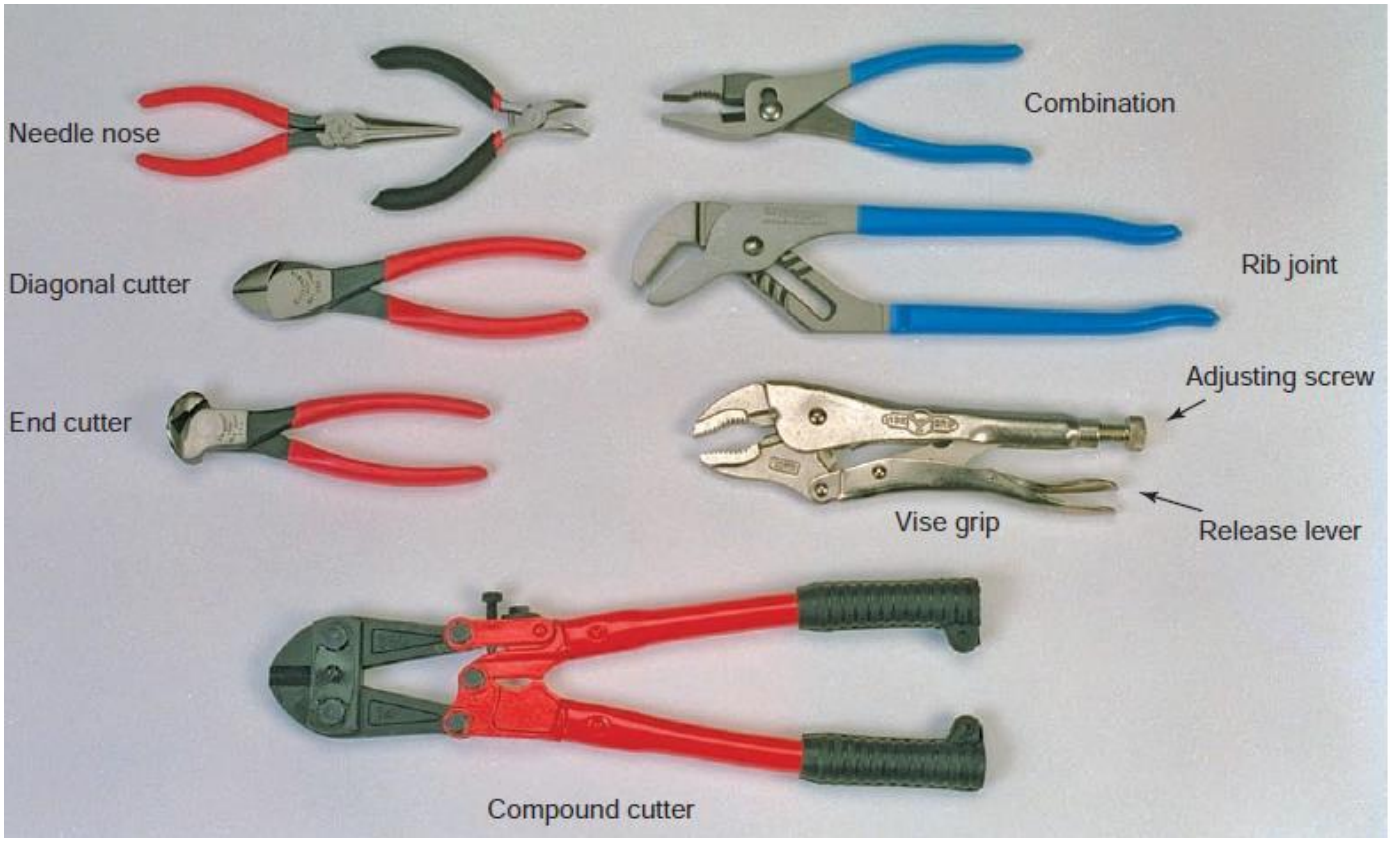
Phillips Screwdriver: The tip of a **Phillips screwdriver** has four prongs that fit the four slots in a Phillips head screw

Pozidriv® Screwdriver: The **Pozidriv screwdriver** is like a Phillips but its tip is flatter and blunter.



- **Pliers**

Pliers are gripping tools used for working with wires, clips, and pins.



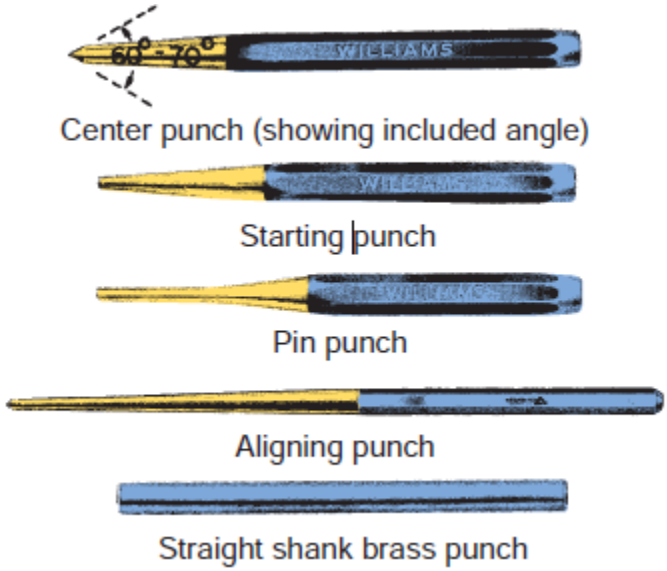
- **Hammers**

Hammers are identified by the material and weight of the head. There are two groups of hammer heads: steel and soft faced

- **Chisels and Punches**

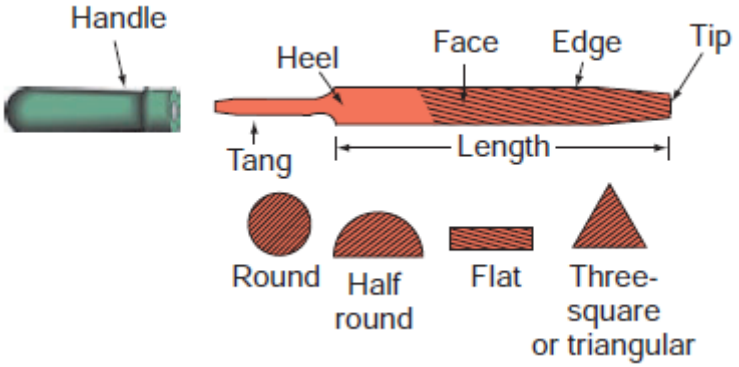
Chisels are used to cut metal by driving them with a hammer.

Punches are used for driving out pins, rivets, or shafts; aligning holes in parts during assembly; and marking the starting point for drilling a hole.



- **Files**

Files are commonly used to shape or smooth metal edges. Files typically have square, triangular, rectangular (flat), round, or half-round shapes



- **Gear and Bearing Pullers**

Many precision gears and bearings have a slight interference fit (**press fit**) when installed on a shaft or housing.

- **power tools**

They operate faster and with more torque than hand tools. However, power tools require greater safety measures.

Power tools do not stop unless they are turned off. Power is furnished by air (pneumatic), electricity, or hydraulic fluid.

- **Impact Wrench**

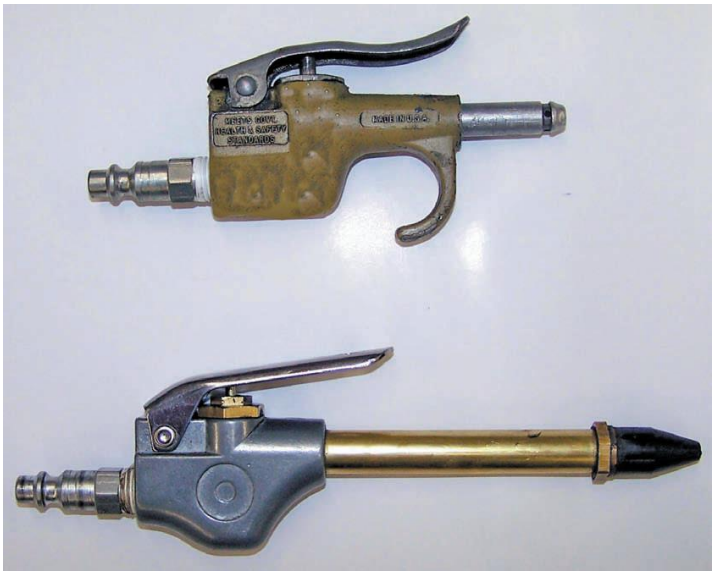
An **impact wrench** is a portable handheld reversible wrench

- **Air Ratchet**

An air ratchet, like the hand ratchet, has a special ability to work in hard-to-reach places. Its angle drive reaches in and loosens or tightens where other hand or power wrenches just cannot work

- **Blowgun**

Blowguns are used for blowing off parts during cleaning.



Special tools for clutch work

- Clutch alignment tool
- Brake and clutch fluid
- Brake and clutch bleeder
- Various screwdrivers
- Various size 6-point sockets
- Ratchet
- Breaker bar
- Trolley jack
- Jack stands or ramps
- Wheel chocks

Tool safety

General safety tips for hand and power tools:

- Buy quality tools. Many tools, including cutters and hammers, should be made of steel and should be heat-treated.
- Regularly inspect tools to make sure they are in good shape and fit for use.
- Be sure to maintain your tools by performing regular maintenance, like grinding or sharpening. Always follow the manufacturer's instructions.
- Dress for the job by avoiding loose clothing or articles that can get caught in a tool's moving parts, like jewelry.
- Wear appropriate personal protective equipment, like leather gloves.
- Use the right tool for the job. In other words, don't try to use a wrench as a hammer.
- Make sure that your feet are planted on a stable surface.
- Be aware of the people around you and make sure they stay clear of the tools you are using.
- Never carry tools up a ladder by hand. Instead, use a bucket or bag to hoist tools from the ground to the worker.
- When working at heights, never leave tools lying out in the areas where they could present a hazard to workers below.
- When appropriate, secure work with a clamp or vise to keep it from slipping.
- Never carry pointed tools in your pocket. Carry them in a toolbox or cart instead.
- Inspect your tools on a regular basis, checking for damage. Report damaged tools to your supervisor.
- Make sure to keep extra tools handy in case the tool you had planned to use is damaged.
- Make sure tools are stored in a safe place.

Safety tips for electric power tools:

- Keep floors dry and clean to avoid slipping while working with or around dangerous tools.
- Keep cords from presenting a tripping hazard.
- Never carry a power tool by its cord.
- Use tools that are double-insulated or have a three-pronged cord and are plugged into a grounded receptacle.
- Do not use electric tools in wet conditions unless they are approved for that use.
- Use a ground fault circuit interrupter or an assured grounding program.
- Use appropriate Personal protective equipment (PPE)

Safety tips for pneumatic tools:

- Verify that all parts of the tool are fastened securely before use.
- Never point a compressed air gun at yourself or another person.
- When you are finished using the tool, make sure that the pressure is released before you break the hose connections.
- Use a safety clip or retainer to prevent attachments from being ejected during operation, and use a chip guard when using high-pressure compressed air for cleaning. Be sure to limit the nozzle pressure to 30 pounds per square inch.
- Always wear eye protection.
- Use screens to protect nearby workers from flying fragments.
- Never leave your tool unattended.
- Never store a loaded air gun.

- Content/Topic 5: Using of tools

Use tools that are the right size & right type for the job
Follow the correct procedure for **using** every **tool**

- Content/Topic 6: Storing and maintaining tools

Keep tools in a dry place with low humidity away from clothes dryers, laundries, etc.

Store power tools in their original boxes or cases, and hang garden tools off the floor.
If you use a toolbox or drawers, use silica gel packs to absorb moisture, or invest in anti-trust drawer liners.

L O 2.2 Drain gear box oil and clutch fluid

- Content/Topic 1: Introduction to gear box oil and clutch fluid

Hydraulic Clutch fluid
Clutch and brake fluid is not the by-product of petroleum. Typically it is made up of glycols, ethers and esters. A brake fluid should have a high boiling point to prevent from vapour lock. A clutch fluid should have a property not to react with rubbers and metals and it should have a viscosity that doesn't vary with temperature gradient. Basically, there are four types of brake fluid, DOT 3, DOT 4, DOT 5, depending on the boiling point and other factors.

(DOT: Department of transport)

Transmission Lubrication
To prevent overheating, the lower transmission gears run in a bath of lubricant. As they spin, their motion spreads the lubricant throughout the case.

- Content/Topic 2: Definition and function of fluid

Floating gears on the main shaft or counter shaft transmissions have oil passages drilled to get lubricant into critical areas. Some transmissions use scoops, troughs, or oiling funnels as lubrication paths. Each transmission includes a vent at the top, to relieve internal pressure (heat) during operation.
The transmission gears are lubricated to:

1. Reduce friction
2. Transfer heat away from gears and bearings
3. Reduce corrosion and rust
4. Remove dirt and wear particles from moving parts

- Content/Topic 3: Types of oil and fluid

The manual transmissions use the following gear lubrication types:
Gear oil (most likely 75-90 or 80-90, check owner's manual)
75W-90 GL4/GL5
80W-90 GL4/GL5

- Content/Topic 4. Vehicle positioning

Park the vehicle on level and smooth surface
Engage the parking brake
Locking the wheel using wheel stopper

- Content/Topic 5 Transmission oil Draining procedures

- **Gathering tools**

tools needed:

- Jack and Axle stands or tire ramps to get your car off the ground
- Set of wrenches and ratchet set (depending on your vehicle.)
- Torque wrench
- oil drain bucket of some type
- Fluid pump
- rags

- WD - 40 or a penetrating oil
- Gear oil (most likely 75-90 or 80-90, check owner's manual)

- **Filer bolt location and removal**


First Jack your vehicle up by the jack points and secure the vehicle with the axle/jack stands. Never go under a vehicle supported only by the jack.

Next we will locate and remove the filler bolt. In some cases the filler bolt will become completely siezed that heating it won't even work. Or the filler bolt may become stripped. If this happens to you, you don't want to this to happen with an empty transmission

- **Drain bolts removal**


Figure: gearbox drain bolt removal

Use the same process you used to remove the filler bolt to remove the drain bolt. Loosen the drain, place the drain pan under the transmission and then remove the drain bolt allowing the oil to drain.

- **Clean the Magnet and Remove the Filler Bolt**


The drain bolt usually has a magnet on it that catches the metal shavings. Clean them off really well. When the oil are fully drained, tighten it on provided torque

- **Fill the Oil. Close the Filler Bolt.**

Add gear oil back into the gearbox using the oil pump. Fill the oil into the filler until the oil reaches the level of the filler and then tighten the filler bolt.

Clean up and take the car for a test drive

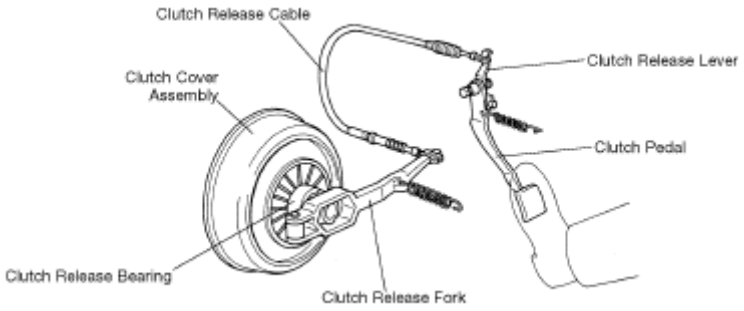
L O 2.3 Dismount clutch control

- Content/Topic1.Friction clutch control types

There are two mostly common type :

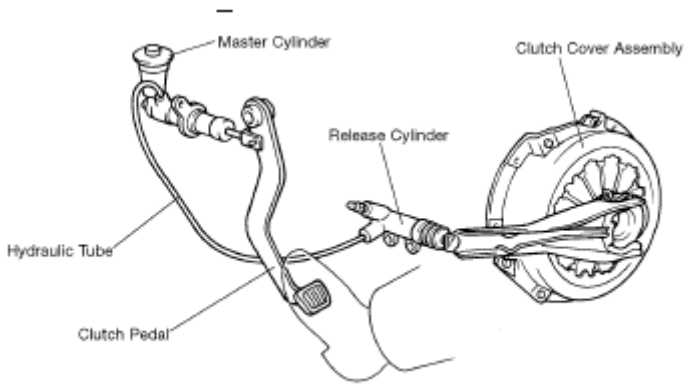
- Hydraulic clutch control
- Mechanical clutch control

➢ **The mechanical clutch control system** The clutch pedal is mechanically connected to the release fork through a cable.



➢ **Hydraulic clutch controls** use hydraulic pressure to move the release bearing against the release fingers of the clutch. Similar to a brake system, the hydraulic clutch has a master cylinder, hydraulic tubing, and a release cylinder.

When the driver presses the clutch pedal, a linkage arm connected to the master cylinder forces the master cylinder piston down its bore. Thus, pressure is applied to the brake fluid contained in the master cylinder, which transfers this pressure to the release cylinder. The piston in the release cylinder changes this pressure into mechanical force by moving outward. This mechanical action forces the release bearing into the clutch cover release fingers, disengaging the clutch.



Content/ topic2. Clutch control dismounting

First steps involve disconnecting the battery, unbolting the shifter lever within the cabin (two bolts), and with the car off the ground, undoing the clutch cable from the fork lever within the dust cover on

the side of the gearbox. The clutch cable needs to be slackened by loosening the adjustment nuts at the firewall in the engine bay

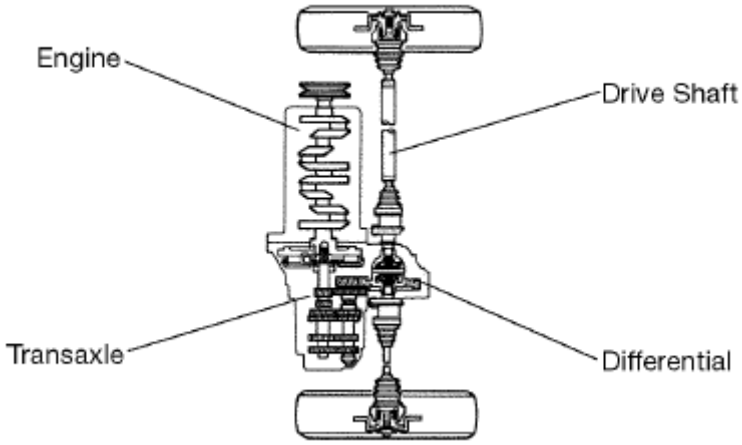
L O 2.4: Dismount tires, propeller shaft, drive shafts and joints

- Content/Topic1.Introduction to the type of drive

Energy produced in the engine is transmitted to the drive wheels through the drive train. The components that make up the drive train include: a clutch mechanism, transmission, and propeller shaft, differential and axles. The drive train allows the driver to control power flow using engine torque and allows the vehicle to move from a stop to cruising speed while maintaining engine speed within it's most efficient power band.

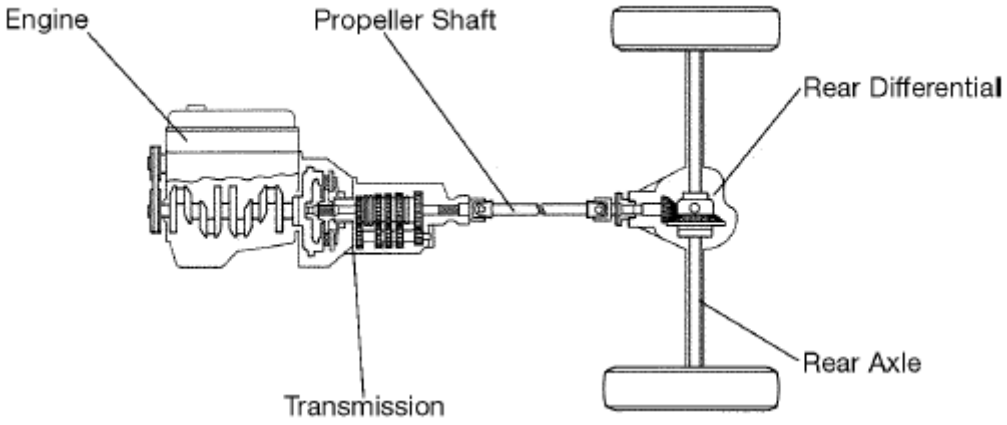
- **Front wheel drive**

Front-wheel-drive (FWD) vehicles are propelled by the front wheels.
A front engine front drive (FR) drive train delivers power from a front engine through the transaxle and differential to the front wheels. (This configuration is essentially the same for a rear mounted engine with rear wheel driver)



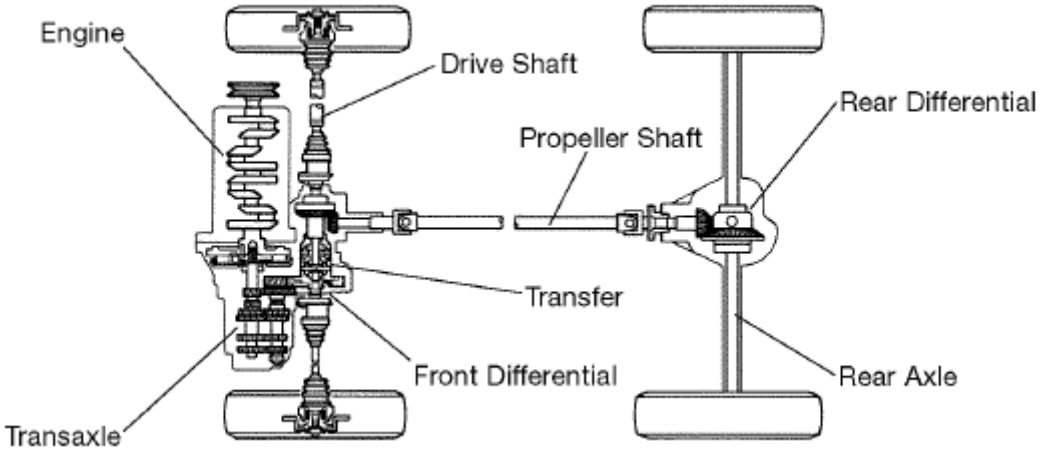
- **Rear wheel drive**

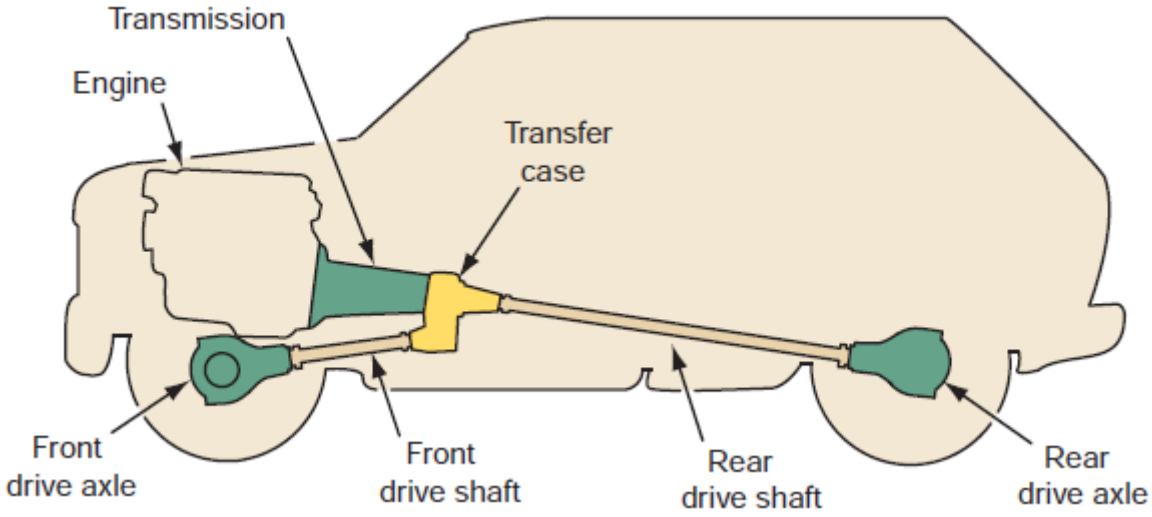
A front engine rear drive (FR) drive train delivers power from a front mounted engine through the transmission and rear differential to the rear wheels



- **All-wheel drive**

A four wheel drive (4WD) drive train delivers power from a front mounted engine through either a transaxle to the front wheels and a transfer and a rear differential to the rear wheels; or through a transmission to the rear differential and rear wheels, and a transfer to a front differential and front wheels





- Content/Topic2. Definition and function of propeller shaft, drive shafts and joints

The propeller shaft connected between the gearbox and the differential with a universal joint at each end. It transmits the rotary motion of the gearbox output shaft to the differential
drive axle assembly transmits torque from the engine and transmission to drive the vehicle's wheels.

Front-**wheel-drive (FWD) axles**, also called **axle shafts**, typically transfer engine torque from the transaxle's differential to the front wheels. One of the most important components of FWD axles is the **constant velocity (CV) joint**. These joints are used to transfer uniform torque at a constant speed, while operating through a wide range of angles.

The **U-joint** allows two rotating shafts to operate at a slight angle to each other.

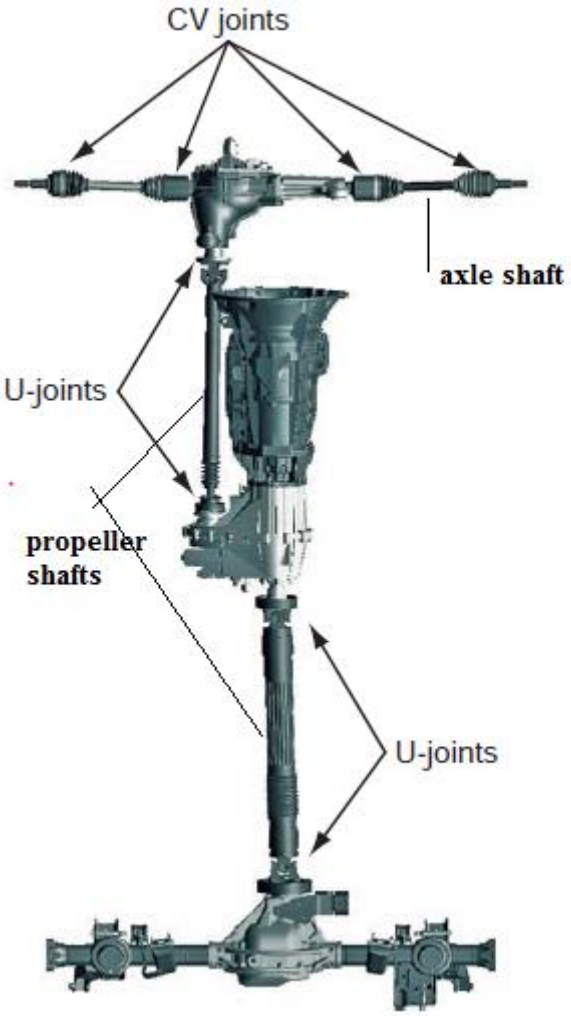


Figure: The location of propeller shaft, drive axle the CV joints and U-joints on a typical 4WD vehicle.

- Content/Topic3. Procedures of removing propeller shaft and joints

1. Mark propeller shaft
2. Remove propeller shaft bolts
3. Remove propeller shaft flange
4. Propeller shaft removal

- Content/Topic4. Procedures of removing half shaft

-1 Removing the axle from the car begins with the removal of the wheel cover and wheel hub cover. The hub nut should be loosened before raising the car and removing the wheel.

-2 After the car is raised and the wheel is removed, the hub nut can be unscrewed from the axle shaft.

-3 The brake line holding clamp must be loosened from the suspension.

-4 The ball joint must be separated from the steering knuckle assembly. To do this, first remove the ball joint retaining bolt. Then pry down on the control arm until the ball joint is free.

-5 The inboard joint can be pulled free from the transaxle.

-6 A special tool is normally needed to separate the axle shaft from the hub allowing the axle to be removed from the car. Never hit the end of the axle with a hammer.

-7 The axle shaft should be mounted in a soft-jawed vise for work on the joint. Pieces of wood on either side of the axle work well to secure the axle without damaging it.

-8 Begin boot removal by cutting and discarding the boot clamps.

-9 Scribe a mark around the axle to indicate the boot's position on the shaft. Then move the boot off the joint.

L O 2.5: Dismount gear box mountings and attachments

- Content/Topic1.Introduction to the gear box

The manual transmission transfers power from the engine to the propeller shaft. It converts and multiplies rotational speed, allowing engine RPM to remain in it's limited optimal power range while providing a wide range of RPM to the propeller shaft; which, in turn, controls vehicle speed.

Multiple gear sets within the transmission provide gear ratios to best utilize the engine's torque. A gear ratio of about 4:1 in first gear provides high torque to begin moving the vehicle. In contrast, a higher

- Content/Topic2. Location of gear box

Gear box is located between clutch and propeller shaft for manual transmission and between torque converter and propeller shaft for automatic transmission, it's a power train component next to clutch or torque converter

- Content/Topic3. Function of gear box

The manual transmission transfers power from the engine to the propeller shaft.
It converts and multiplies rotational speed,
allowing engine RPM to remain in it's limited optimal power range while providing a wide range of RPM to the propeller shaft; which, in turn, controls vehicle speed.
It provide permanent neutral position
It permit vehicle to move backward (reversing)

- Content/Topic4. Dismounting attachments and mountings

On front-wheel-drive vehicles with transaxles, any parts that interfere with transaxle removal must be removed first. These parts might include drive axles, parts of the engine, brake and suspension system, or body parts. Check the service manual for specific instructions.

On rear-wheel-drive vehicles, remove the driveline and transmission because the engine is somewhat supported by the transmission mounts. It may be necessary to support the engine with a tall jack stand

Then disconnect and remove the clutch linkage. Cable systems need to be disconnected at the transmission.

L O 2.6: Dismount clutch housing with gear box

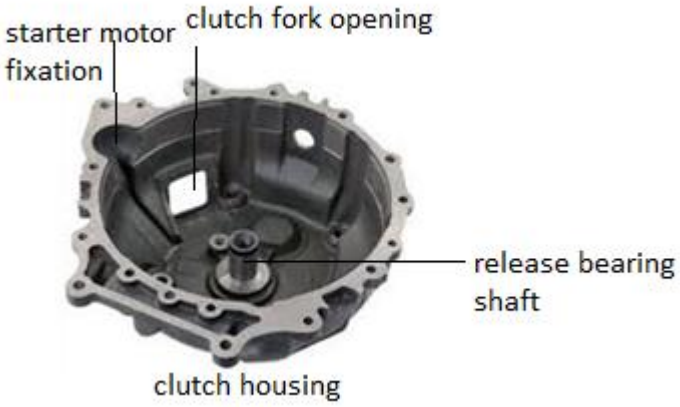
- Content/Topic1. Location of clutch housing

The clutch housing is attached to the engine cylinder block and located between engine and gearbox

- Content/Topic2. Function of clutch housing

It house and support the clutch components
It provides starter motor fixation

It is connected to either a cable or a hydraulic master cylinder. The gearbox input shaft is splined to carry the driven plate. The release bearing is operated by a fork. The clutch cover plate is bolted to the flywheel, and its diaphragm spring clamps the driven plate to the flywheel.



- Content/Topic3.Clutch housing dismount

In some cases, the bell housing is removed with the transmission. In other cases, it is removed after the transmission is removed

Step one

First steps involve disconnecting the battery, unbolting the shifter lever within the cabin (two bolts), and with the car off the ground, undoing the clutch release cylinder/ cable from the fork lever within the dust cover on the side of the gearbox. The clutch cable needs to be slackened by loosening the adjustment nuts at the firewall in the engine bay

Next, disconnect the sensor wires from the gearbox and loosen and then disconnect handbrake cable so the gearbox can be removed.

Figure: disconnect battery and all transmission wires

Step two

The tail shaft and propeller shaft has to come out, which is a straightforward removal of four nuts and bolts

Figure: tail shaft and propeller removal

Step three

A section of the exhaust has to come out to help with access. Bolts located on the exhaust are generally difficult to remove due to dirt, rust and the constant expanding and contracting of the hot exhaust pipe. A penetrate oil, such as WD40, can help loosen difficult bolts.

Figure: exhaust removal

Step four

With everything out of the way, remove the starter motor and begin removing the bellhousing bolts. Some bolts may be difficult to access and require extra tools such as long extensions, swivel joints and breaker bars

Figure: bell housing bolt removal

Step five

Next remove the gearbox.

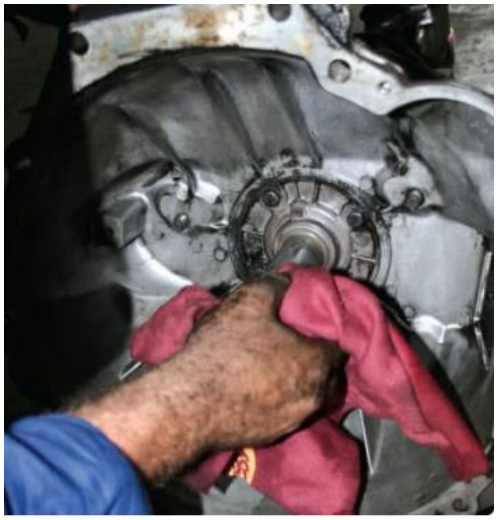
Then you could use a gearbox jack or similar, or if you are on the ground, then you could also use a trolley jack. It really is a job for more than two person

Figure: gearbox removal

Step six

Remove the old pressure plate, clutch disc and flywheel. To keep the engine from rotating while removing the flywheel bolts, use a large screwdriver slotted into the teeth and locked against the body.

Figure: pressure plate, clutch disc and flywheel removal



Clean the inside of the bellhousing throughly.

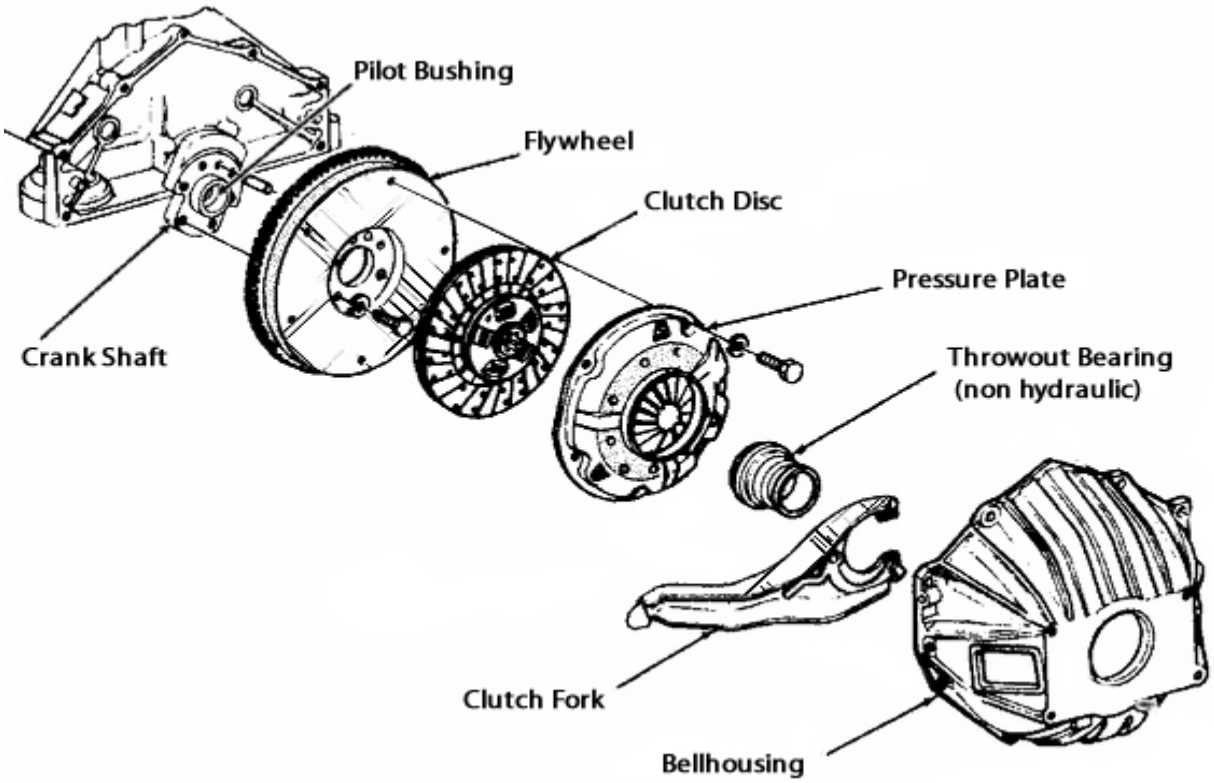
Fit the new flywheel and pressure plate and tightened to the manufacturers specified torque.

Note the use of the clutch alignment tool

Refitting the gearbox is largely a reverse process including reconnecting all the cables and wires.

L O 2.7: Dismount clutch mechanism

- Content/Topic1 Identification of clutch components



- Content/Topic2.Functions of friction clutch

- Provide link between engine and transmission system
- Allow smooth take up of drive
- Clutch allows for brief separation between engine and gearbox
- Transmit torque
- Provides temporary disconnection when vehicle stopped in gear

- Content/Topic3. Friction clutch types

1. Friction clutch
    - Single plate clutch
    - Multi plate clutch(Wet, Dry)
    - Cone clutch (External, Internal)
2. Centrifugal Clutch
3. Semi-centrifugal clutch
    - Conical spring clutch or Diaphragm clutch (Tapered finger type, Crown spring type)
4. Positive clutch (Dog clutch ,Spline Clutch)

5. Hydraulic clutch
6. Electromagnetic clutch
7. Vacuum clutch
8. Overrunning clutch or freewheel unit

- Content/Topic4. Dismantle clutch mechanism

Unbolting the shifter lever within the cabin (two bolts), and with the car off the ground, undoing the clutch release cylinder/ cable from the fork lever within the dust cover on the side of the gearbox. The clutch cable needs to be slackened by loosening the adjustment nuts at the firewall in the engine bay

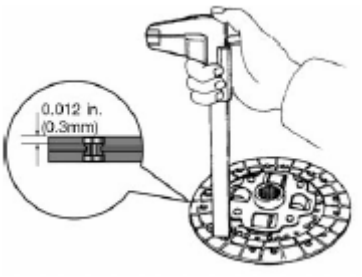
Next, disconnect the sensor wires from the gearbox and loosen and then disconnect handbrake cable so the gearbox can be removed

LU3. INSPECT CLUTCH COMPONENTS

L O 3.1: Inspect clutch components

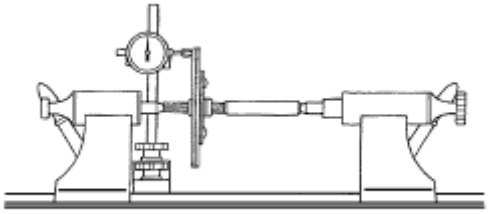
- Content/Topic1 Clutch disc inspection

Always check a used clutch disc for facing thickness, damper spring condition, hub spline wear, and warpage or axial runout by measuring the height of the facing surface above the rivets. The minimum depth should be 0.012 in. (0.3mm)..



To check facing thickness, measure the height of the facing surface above the rivets. The minimum depth should be 0.012 in. (0.3mm).

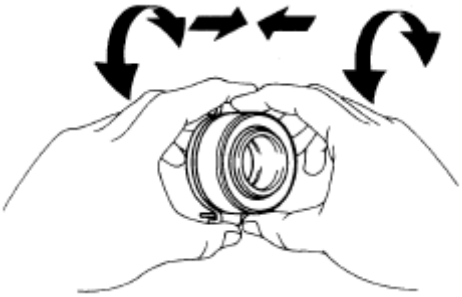
Lining surface, Grease adhesion, Torsion spring for weakness, Rivet for looseness
Depth between the lining surface and the rivet head
Run-out t he disc is rotated while watching for wobbling (runout) of the facing surfaces. More than 0.031 in. (0.8mm) is excessive, and the disc should be replaced.



Oil face

- Content/Topic2 Release bearing inspection

Release bearings are checked by feeling for roughness and visually checked for obvious wear. They are normally replaced with the disc and clutch cover.

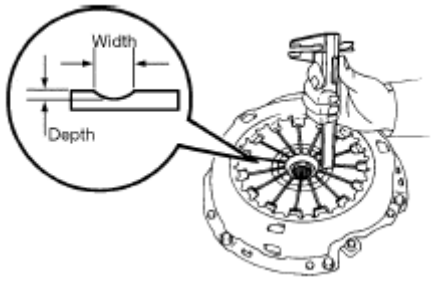


Noise Worn out

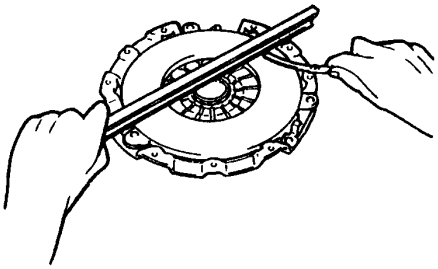
- Content/Topic3. Pressure plate inspection

A used clutch cover assembly should be visually inspected for cover distortion and friction surface damage. The friction surface of the clutch cover assembly tends to polish or glaze from normal use. Excessive slippage can cause grooves, heat checks, and warping.

Measure the width and depth of the wear to determine if it is within tolerable limits. For diaphragm springs

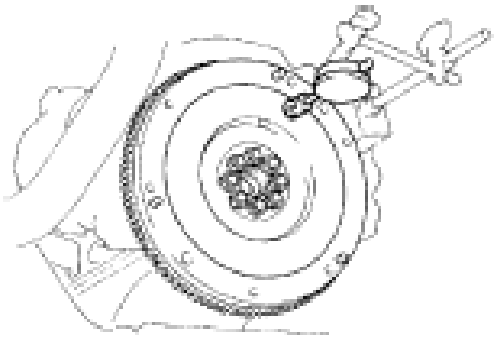


Measure the flatness of the pressure plate with a straight edge and a feeler gauge. If not as specified, replace the clutch cover



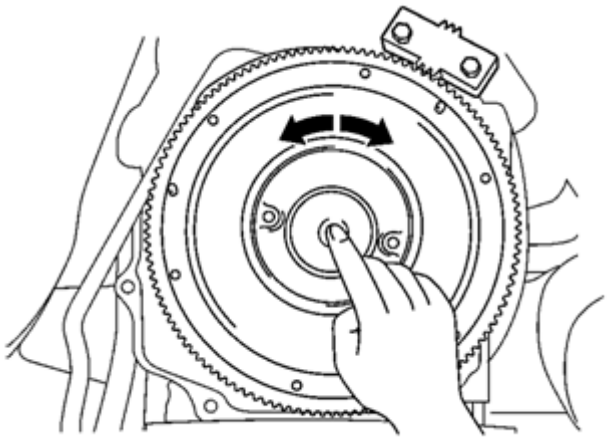
- Content/Topic4 Flywheel inspection

The flywheel must have a flat surface to prevent chatter, and the proper surface finish to provide the necessary coefficient of friction. The wear of the friction surface is usually concave. The new flat clutch disc will not seat completely against a worn flywheel. This can cause premature clutch wear, chatter or even clutch disc failure. Grooves, heat checks, and warping can occur if there is excessive slippage,



Excess warn of surface
Looseness
Oil face

Inspect the pilot bearing for damage, wear, and proper rotation. If there is any malfunction, replace the pilot bearing.



- Content/Topic5. Splines inspection

The hub splines and damper springs should be visually checked for rust and shiny worn areas, and broken or missing springs

Place the new clutch disc over the transmission clutch shaft and ensure that it slides freely over the splines.
.

- Content/Topic 6 Misalignment

Misalignment is commonly caused by damaged or missing dowels or damaged dowel locating holes between the engine and gearbox, with the result that the engine and gearbox are no longer correctly centralized
Misalignment is also caused by bell housing distortion or cracking, welding repairs to a damaged bell housing, and engine or gearbox conversions where the adaptor plate or conversion bell housing has missing or inaccurately-positioned dowel locations. Misalignment can also be caused by fitment errors such as trapping a wire, pipe or bracket between the engine and gearbox when fitting the gearbox, distortion of the sheet metal cover plate on the rear engine flange, or failure to clean old hardened dirt or sealant from the mating surfaces of the engine and gearbox flanges before fitting the gearbox

L O 3.2 Clean clutch components

- Content/Topic 1. Methods of cleaning

Dry cleaning
Air blowing
Solvents

Purpose of cleaning:

- Removes oil, grease and other dirt from metal parts.
- Eliminates dust from brake and clutch parts.
- Restores the friction of brake and clutch lining material.
- Avoids airborne asbestos dust.
- Leaves no residue

- Content/Topic 2. Cleaning mediums

The clutch assembly is accessible after the bell housing has been removed. Use an approved vacuum collection system or an approved liquid cleaning system to remove asbestos dust and dirt from the clutch assembly.

- Cloth rags
- Sand paper

L O 3.3.Diagnose clutch system faults

- Content/Topic 1 Diagnosing clutch problems

- **Clutch slipping**

Occurs when engine speed increases but road speed does not. Most noticeable when driving up hill or when moving from standstill. Occurs when clutch plate slips between flywheel and pressure plate.

Can be due to:

- ✓ Worn clutch plate
- ✓ Oil contamination
- ✓ Insufficient free play
- ✓ Worn or seized operating mechanism

- **Clutch chattering or Clutch grabbing**

Recognized by vibrations as clutch pedal is released from standstill

Typical causes are:

- ✓ Broken/defective engine mount or track rod
- ✓ Oil contamination on clutch plate

- ✓ Faulty pressure plate
- ✓ Worn or seized operating mechanism.
- ✓ Misaligned friction faces

- **Clutch dragging/ Clutch disengagement problems**

Occurring when difficult to engage gears, or vehicle moves forward when clutch pedal fully depressed and gear selected
Clutch plate in continuous contact with flywheel, pressure plate or both can be caused by:

- ✓ Warped clutch plate, pressure plate or flywheel
- ✓ Corrosion or contamination on clutch plate
- ✓ Excessive free play
- ✓ Worn or seized operating mechanism

- **Clutch abnormal noise**

Noises may be due to many reasons and the first step is to determine when the noise occurs:

- ✓ When clutch is disengaged or engaged - due to worn or dry release bearing
- ✓ As clutch is engaged - due to worn friction surfaces or torsion springs
- ✓ As clutch pedal is moved up or down - due to worn or dry release bearing or linkage problems
- ✓ When vehicle is in neutral - generally a problem in worn manual transmission system or pilot bearing and not clutch system

- **Clutch pedal pulsation**

Pulsating Clutch Pedal – Pedal pulsation is a rapid up-and-down pumping movement of the clutch pedal as the clutch engages and disengages. The movement of the pedal is normally slight but can be felt through the pedal.

To test for pulsations, start the engine and slowly depress the clutch pedal. Pay close attention to the pedal as it is being depressed. Very slight pulsations are normal, however if the pulsations are quite noticeable or severe, the clutch assembly needs to be disassembled and inspected.
Pedal pulsation is normally caused by :

- ✓ broken, bent or warped release levers,
- ✓ a misaligned bell housing, or
- ✓ a warped pressure plate, flywheel, or clutch disc

LU 4. REMOUNT CLUTCH COMPONENTS

L O4.1: Mount and fix clutch mechanism

- Content/Topic 1Clutch disc centralization

  - Check the flywheel bolts to make sure they are torqued to specifications. Also check the pilot bearing recess to ensure it is clean. Using the appropriate driver tool against the outer race, drive the new pilot bearing into the crankshaft recess.

  - Place the new clutch disc over the transmission clutch shaft and ensure that it slides freely over the splines. Make sure the correct side of the disc is placed against the flywheel. If the damper assembly is not marked flywheel side", it normally goes to the pressure plate side.

  - Place the disc alignment tool through the disc and into the pilot bearing so that they are centered to each other.

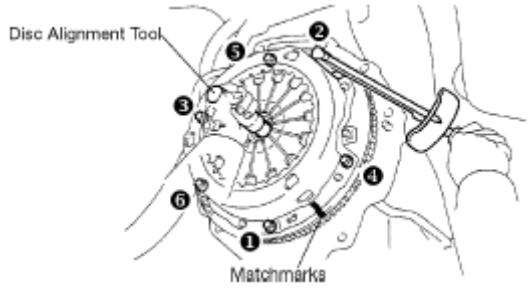
  - Centralize with clutch disc aligner

Make sure the correct side of the clutch disc is placed against the flywheel. Place the disc alignment tool through the disc and into the pilot bearing so that they are centered to each other.

  - Centralize with used input shaft

- Content/Topic 2. Pressure plate tightening

  - Install the clutch cover over the disc, by properly aligning it with the dowel pins and mounting bolt holes. Install the mounting bolts.
  - Tighten the mounting bolts in an alternating fashion, two turns at a time across the clutch cover.
  - Pressure plate tightening using torque wrench



  - Pressure plate tightening using hand

- Content/Topic 3. Grease release bearing, release fork and drive shaft

  - Apply high temperature molybdenum disulphide grease to the fork pivot and the fork contact areas. Fill the groove inside of the release bearing collar with grease.

  - Place the release bearing over the transmission bearing retainer and check for smooth movement of the bearing collar.

L O 4.2: Mount and fix clutch housing, gear box mountings and attachments

- Content/Topic 1. Cleaning of the clutch housing

Dry cleaning using clothes rags
Wet cleaning of clutch housing
Clutch house washing with water

- Content/Topic 2 Clutch housing with gearbox lifting

  - Place a thin film of high temperature molybdenum disulphide grease on the clutch splines.

  - Support the transmission while it is slid into place. Never let the transmission hang on the clutch splines In order to make this installation easier, use a pair of alignment dowels to support the transmission.

  - Place the transmission in low gear and rotate the output shaft or turn the flywheel to align the input shaft splines with the clutch hub.

  - Push the transmission into position until the front of the transmission is flush against the engine block. Do not force the transmission into place.

  - Install the transmission mounting bolts until lightly seated, and then tighten them to the proper torque.

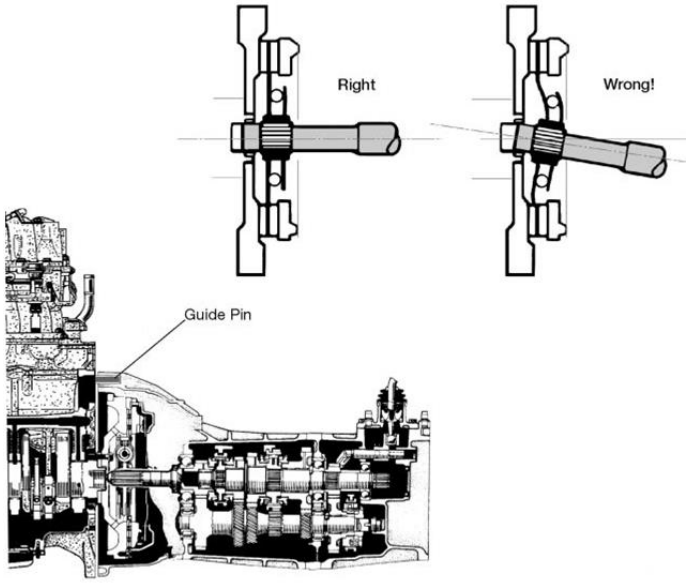


Figure: correct way of install clutch shaft

- Content/Topic 3. Clutch housing tightening

Tighten the mounting bolts in an alternating fashion, crisscross turns at a time across the clutch cover.
Tighten using a specified torque range
Tighten using hand

L O 4.3: Mount and fix propeller shaft, drive shafts and joints

- Content/Topic 1. Procedures of remounting propeller shaft and joints

Align marks on propeller shaft
Remounting of Propeller shaft
Remounting of Propeller shaft flange
Remounting of Propeller shaft bolts

- Content/Topic 2 Procedures of remounting drive shaft

Remount the Brake drums/shock absorber
Remount the Axle shaft
Remount the Axle shaft bolts
Remount Wheels

LU 5. REPAIR CLUTCH CONTROL

L O 5.1: Replace damaged clutch control components

- Content/Topic 1 Identification of clutch control types:

Mechanical clutch control
Hydraulic clutch control

- Content/Topic 1. Function of clutch control types

The function of clutch control is to boost pedal force applied by the driver and transmit this force to the clutch operator

- Content/Topic 2 Replacing damaged clutch control components

Replace all worn or damaged clutch control component includes (Slave cylinder, Release fork, Tubes and hoses, Master cylinder, Return/release spring, Clutch cable, Clutch pedal…)

L O 5.2: Remount and fix clutch control components

- Content/Topic 1 Mechanical clutch control

Remounting of Clutch cable
Remounting of Clutch pedal
Remounting of Release fork
Remounting of Return spring

- Content/Topic 2 Hydraulic clutch control

Remounting of Master cylinder
Remounting of Tubes and hoses
Clutch slave cylinder
Remounting of Clutch pedal
Remounting of Release fork
Remounting of Release spring

L O 5.3: Bleed/fill hydraulic clutch system

- Content/Topic1 Introduction to the clutch fluid

Clutch and brake fluid is not the by-product of petroleum. Typically it is made up of glycols, ethers and esters. A brake fluid should have a high boiling point to prevent from vapour lock. A clutch fluid should

have a property not to react with rubbers and metals and it should have a viscosity that doesn't vary with temperature gradient. Basically, there are four types of brake fluid, DOT 3, DOT 4, DOT 5, depending on the boiling point and other factors.

(DOT: Department of transport)

- Content/Topic 2 Definition and function of clutch fluid

Use hydraulic pressure to move the release bearing against the release fingers of the clutch

- Content/Topic 3 Fluid level and fluid filling

Fill the master cylinder with the approved fluid a and correct level (must be between min& max) indicated on fluid reservoir

- Content/Topic 4 Fluid leakage control

Check the entire hydraulic circuit to make sure there are no leaks and the level of fluid

- Content/Topic 5 Bleeding hydraulic clutch system

Bleeding the System Whenever the hydraulic system is opened, the entire system should be bled. Bleeding may also be necessary if the system has run low on fluid and air is trapped in the lines or cylinders.

- Content/Topic 6 Definition and purpose of bleeding

Bleeding is a process of eliminating air contained in hydraulic system

- Content/Topic 7 Bleeding procedures

  - Check the entire hydraulic circuit to make sure there are no leaks.
  - Check the clutch linkage for wear and repair any defects before continuing.

  - Make sure all mounting points for the master and slave cylinders are solid and do not flex under the pressure of depressing the pedal.
  - Fill the master cylinder with the approved fluid Attach one end of a hose to the end of the bleeder screw and the other end into a catch container. Loosen the bleed screw at the slave cylinder approximately one-half turn.

  - Fully depress the clutch pedal, and then move the pedal through three quick and short strokes. Allow the fluid and air to exit the system and then immediately close the bleeder screw.
  - Release the pedal rapidly.

  - Recheck the fluid level in the master cylinder.
  - Repeat steps 3 and 4 until no air is evident in the fluid leaving the bleeder screw.

- Close the bleeder screw immediately after the last downward movement of the pedal.
- Make sure the bleeder screw is tight after the system has been bled.

L O 5.4: Adjust clutch system

- Content/ topic 1 **Adjust clutch's free play**

Normal service for a clutch includes checking the mechanical linkage systems for clutch pedal height and free play, and checking the hydraulic systems fluid levels

Definition of clutch free play

Free travel is the distance a clutch pedal moves when depressed before the release bearing contacts the clutch release lever or diaphragm spring of the pressure plate.

Values of clutch free play

To check and adjust clutch pedal free play, push the clutch pedal downward by hand until all play is removed and resistance is felt. The distance from this point to the pedal top position is free play

To check pedal play, use a tape measure or ruler. Place the tape measure or ruler beside the clutch pedal and the end against the floor of the vehicle and note the reading. Then depress the clutch pedal just enough to take up the pedal play and note the reading again. The difference between the two readings is the amount of pedal play.

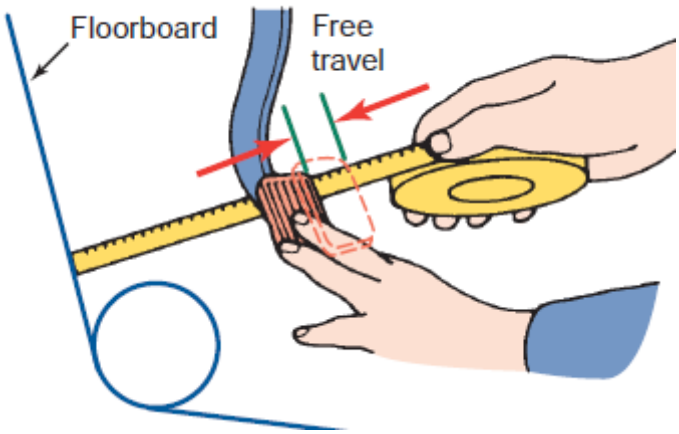


Figure: free travel measuring

- **Types of clutch free play**

Free play at pedal
Release arm free play

- **Clutch free play adjustment**

To adjust clutch pedal play, refer to the manufacturer's service manual for the correct procedure and adjustment point locations. Often pedal play can be increased or decreased by turning a threaded fastener located either under the dash at the clutch pedal or where the linkage attaches to the clutch fork.

L O 5.5: Mount and fix wheels and tires

- Content/ topic 1. Tire remounting

Place tire on wheel hub studs
Fix tyre nuts
Release vehicle from the jack
Tight Tire Nuts

L O 5.6: Test clutch system

- Content / topic 1 Checking for slipping when starting

• Once normal operating temperature is achieved, slowly accelerate to 15 - 20 mph in the highest transmission gear.

• Depress the accelerator completely to make a full throttle acceleration. The engine speed should increase steadily and smoothly as the vehicle speeds up. If engine rpm increases without a corresponding increase in vehicle speed, the clutch is slipping and needs service.

- Content / topic 2 Checking for slipping with hand brake applied

• Start the vehicle and warm up the engine to normal operating temperature, block the wheels, and apply the parking brake.

• Shift the transmission into the highest gear and release the clutch pedal in a smooth, normal motion. If the clutch is engaging correctly, the engine should stall immediately. A delay in engine stalling indicates slow engagement and a slipping clutch condition.

- Content / topic 3 Checking the separation performance

• Start the vehicle and warm up the engine and transmission to operating temperature.

• With the transmission in neutral and the engine running at idle speed, push in the clutch pedal, wait nine seconds, and shift the transmission into reverse.

• Gear clash or grinding indicates a clutch that hasn't completely released.

- Content / topic 4 Checking abnormal noise

• Transmission bearing or noise problem _ noise stops as the pedal is depressed.

• Faulty release bearing _ noise starts as pedal is depressed beyond free play.
• Faulty clutch cover to release bearing contact _ noise and vibration occur at one-fourth to one half pedal travel.

• Faulty pilot bearing _ noise after clutch pedal is fully depressed.

- Content / topic 5 Checking fluid leakage

Check the entire hydraulic circuit to make sure there are no leaks and the level of fluid

- Content / topic 6 Checking free plays

Insufficient free play could cause release bearing to be in constant contact with pressure plate and cause clutch slip
Excessive free play could cause pressure to be exerted on clutch plate even when clutch pedal is fully depressed causing clutch drag

- Content / topic 7 Perform road test

Perform road test in order to verify:

Performance
Noise
Vibrations

- Content / topic 8 **Six-Step Diagnostic Procedure**

To perform a complete diagnostic check, these six steps should be followed:

- **Verify the customer complaint**

Verifying the customer complaint is the single most important step in diagnosis. Check to see that all the information you need to begin is on the work order. If more information is needed, contact the service writer or customer to clarify the complaint and acquire the needed information to begin the diagnostic procedure.

- **Identify the symptoms**

During the test drive and inspection of the vehicle, identify the symptoms. Flow charts are provided to deal with specific problem areas.

- **Isolate the cause**

Check to see what components and/or parts are causing the main complaint. Determine what it will take to make the proper repairs. Look for any related components that could cause a similar complaint or future complaints.

- **List recommended repairs and possible related repairs**

Following the inspection and test drive, you should have all the information you need to discuss the complaint and repairs with the service writer. Be sure to bring up any related repairs you feel may cause similar or future problems. If the customer does not want to do all the repairs at this time, note them on the work order for future reference.

- **Repair the cause**

The technician can now proceed with the necessary repairs. The repair may be as simple as a clutch adjustment or hydraulic component replacement and bleeding, or may require transmission removal and disassembly.

- **Verify proper operation**

When repairs are completed, the technician should verify that the complaint has been corrected. This is accomplished by test driving the vehicle and verifying the operation of the component that has been repaired.

Reference books:

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