Chassis

Chassis include the clutch , the transmission, the drive shaft, the final drive assembly, the front suspension, the rear suspension, the steering system ,the brake system, the wheels and tires.

1.clutch

The engine produces the power to drive the vehicle . The drive line or drive train transfer the power of the engine to the wheels . The drive train consists of the parts from the back of the flywheel to the wheels . These parts include the clutch , the transmission ,the drive shaft ,and the final drive assembly .

The clutch which includes the flywheel ,clutch disc , pressure plate , springs , pressure plate cover and the linkage necessary to operate the clutch is a rotating mechanism between the engine and the transmission . It operates through friction which comes from contact between the parts . That is the reason why the clutch is called a friction mechanism . After engagement, the clutch must continue to transmit all engine torque to transmission depending on the friction without slippage . The clutch is also used to disengage the engine from the drive train whenever the gears in the transmission are being shifted from gear ratio to another .

To start the engine or shift the gears , the driver has to depress the clutch pedal with the purpose of disengagement the transmission from the engine . At that time , the driven members connected to the transmission input shaft are either stationary or rotating at a speed that is slower of faster than the driving members connected to engine crankshaft . There is no spring pressure on the clutch assembly parts . So there is no friction between the driving members and driven members . As the driver lets loose the clutch pedal , spring pressure increase on the clutch parts . Friction between the parts also increases . The pressure exerted by the springs on the driven members is controlled by the driver through the clutch pedal and linkage . The positive engagement of the driving and driven members is made possible the friction between the surfaces of the members . When full spring pressure is applied , the speed of the driving and driven members should be the same . At the moment , the clutch must act

as a coupling device and transmit all engine power to the transmission , without slipping .

However , the transmission should be engaged to the engine gradually in order to operate the car smoothly and minimize torsional shock on the drive train because an engine at idle just develop little power . Otherwise , the driving members are connected with the driven members too quickly and the engine would be stalled .

The flywheel is a major part of the clutch . The flywheel mounts to the engine‟s crankshaft and transmits engine torque to the clutch assembly . The flywheel , when coupled with the clutch disc and pressure plate makes and breaks the flow of power the engine to the transmission .

The flywheel provides a mounting location for the clutch assembly as well . When the clutch is applied , the flywheel transfers engine torque to the clutch disc . Because of its weight , the flywheel helps to smooth engine operation . The flywheel also has a large ring gear at its outer edge , which engages with a pinion gear on the starter motor during engine cranking .

The clutch disc fits between the flywheel and the pressure plate . The clutch disc has a splined hub that fits over splines on the transmission input shaft . A splined hub has grooves that match splines on the shaft . These splines fit in the grooves . Thus , the two parts held together . However , back ‐and ‐forth movement of the disc on the shaft is possible . Attached to the input shaft , the disc turns at the speed of the shaft .

The clutch pressure plate is generally made of cast iron . It is round and about the same diameter as the clutch disc . One side of the pressure plate is machined smooth . This side will press the clutch disc facing are against the flywheel . The outer side has shapes to facilitate attachment of spring and release mechanism . The two primary types of pressure plate assemblies are coil spring assembly and diaphragm spring .

In a coil spring clutch the pressure plate is backed by a number of coil springs and housed with them in a pressed ‐steed cover bolted to the flywheel . The spring push against the cover . Neither the driven plate nor the pressure plate is connected rigidly to the flywheel and both can move either towards it o away . When the clutch pedal is depressed a thrust pad riding on a carbon or ball thrust bearing is forced towards the flywheel . Levers pivoted so

that they engage with the thrust pad at one end and the pressure plate tat the other end pull the pressure plate back against its springs . This releases pressure on the driven plate disconnecting the gearbox from the engine .

Diaphragm spring pressure plate assemblies are widely used in most modern cars . The diaphragm spring is a single thin sheet of metal which yields when pressure is applied to it . When pressure is removed the metal spring back to its original shape . The center portion of the diaphragm spring is slit into numerous fingers that act as release levers . When the clutch assembly rotates with the engine these weights are flung outwards by centrifugal plate and cause the levers to press against the pressure plate . During disengagement of the clutch the fingers are moved forward by the release bearing . The spring pivots over the fulcrum ring and its outer rim moves away from the flywheel . The retracting spring pulls the pressure plate away from the clutch plate thus disengaging the clutch .

When engaged the release bearing and the fingers of the diaphragm spring move towards the transmission . As the diaphragm pivots over the pivot ring its outer rim forces the pressure plate against the clutch disc so that the clutch plate is engaged to flywheel .

The advantages of a diaphragm type pressure plate assembly are its compactness , lower weight , fewer moving parts , less effort to engage , reduces rotational imbalance by providing a balanced force around the pressure plate and less chances of clutch slippage .

The clutch pedal is connected to the disengagement mechanism either by a cable or , more commonly , by a hydraulic system . Either way , pushing the pedal down operates the disengagement mechanism which puts pressure on the fingers of the clutch diaphragm via a release bearing and causes the diaphragm to release the clutch plate . With a hydraulic mechanism , the clutch pedal arm operates a piston in the clutch master cylinder . This forces hydraulic fluid through a pipe to the cutch release cylinder where another operates the clutch disengagement mechanism by a cable .

The other parts including the clutch fork , release bearing , bell ‑housing , bell housing cover , and pilot bushing are needed to couple and uncouple the transmission . The clutch fork , which connects to the linkage , actually operates the clutch . The release bearing fits between the clutch fork and the pressure plate assembly . The bell housing covers the clutch

assembly . The bell housing cover fastens to the bottom of the bell housing . This removable cover allows a mechanic to inspect the clutch without removing the transmission and bell housing . A pilot bushing fits into the back of the crankshaft and holds the transmission input shaft .

2.AUTOMATIC TRANSMISSION

The modern automatic transmission is by far , the most complicated mechanical component in today‟s automobile . It is a type of transmission that sifts itself . A fluid coupling or torque converter is used instead of a manually operated clutch to connect the transmission to the engine .

There are two basic types of automatic transmission based on whether the vehicle is rear wheel drive or front wheel drive . On a rear wheel drive car , the transmission is usually mounted to the back of the engine and is located under the hump in the center of the floorboard alongside the gas pedal position . A drive shaft connects the transmission to the final drive which is located in the rear axle and is used to send power to the rear wheels . Power flow on this system is simple and straight forward going from the engine , through the torque converter , then trough the transmission and drive shaft until it reaches the final drive where it is split and sent to the two rear transmission .

On a front wheel drive car , the transmission is usually combined with the final drive to form what is called a transaxle . The engine on a front wheel drive car is usually mounted sideways in the car with the transaxle tucked under it on the side of the engine facing the rear of the car . Front axles are connected directly to the transaxle and provide power to front wheels . In this example , power floes from the engine , through the torque converter to a larger chain that sends the power through a 180 degree turn to the transmission that is along side the engine . From there , the power is routed through the transmission to the final drive where it is split and sent to the two front wheels through the drive axles .

There are a number of other arrangements including front drive vehicles where the engine is mounted front to back instead of sideways and there are other systems that drive all four wheels but the two systems described here are by far the most popular . A much less

popular rear and is connected by a drive shaft to the torque converter which is still mounted on the engine . This system is found on the new Corvette and is used in order to balance the weight evenly between the front and rear wheels for improved performance and handling . Another rear drive system mounts everything , the engine , transmission and final drive in the rear . This rear engine arrangement is popular on the Porsche.

The modern automatic transmission consists of many components and systems that designed to work together in a symphony of planetary gear sets , the hydraulic system, seals and gaskets , the torque converter , the governor and the modulator or throttle cable and computer controls that has evolved over the years into what many mechanical inclined individuals consider to be an art from . Here try to used simple , generic explanation where possible to describe these systems .

1）Planetary gear sets

Automatic transmission contain many gears in various combinations . In a manual transmission , gears slide along shafts as you move the shift lever from one position to another , engaging various sizes gears as required in order to provide the correct gear ratio . In an automatic transmission , how ever , the gears are never physically moved and are always engaged to the same gears . This is accomplished through the use of planetary gear sets .

The basic planetary gear set consists of a sun gear , a ring and two or more planet gears , all remaining in constant mesh . The planet gears are connected to each other through a common carrier which allows the gears to spin on shafts called “pinions” which are attached to the carrier .

One example of a way that this system can be used is by connecting the ring gear to the input shaft coming from the engine , connecting the planet carrier to the output shaft , and locking the sun gear so that it can‟t move . In this scenario , when we turn the ring gear , the planets will “walk” along the sun gear (which is held stationary) causing the planet carrier to turn the output shaft in the same direction as the input shaft but at a slower speed causing gear reduction (similar to a car in first gear) .

If we unlock the sun gear and lock any two elements together , this will cause all three elements to turn at the same speed so that to output shaft will turn at the same rate of speed as

the input shaft . This is like a car that is third or high gear . Another way we can use a planetary gear set is by locking the planet carrier from moving , then applying power to the ring gear which will cause the sun gear to turn in opposite direction giving us reverse gear .

The illustration in Figure shows how the simple system described above would look in an actual transmission . The input shaft is connected to the ring gear , the output shaft is connected to the planet carrier which is also connected to a “Multi –disk” clutch pack . The sun gear is connected to drum which is also connected to the other half of the clutch pack . Surrounding the outside of the drum is a band that can be tightened around the drum when required to prevent the drum with the attached sun gear from turning .

The clutch pack is used , in this instance , to lock the planet carrier with the sun gear forcing both to turn at the same speed . If both the clutch pack and the band were released , the system would be in neutral . Turning the input shaft would turn the planet gears against the sun gear , but since noting is holding the sun gear , it will just spin free and have no effect on the output shaft . To place the unit in first gear , the band is applied to hold the sun gear from moving . To shift from first to high gear , the band is released and the clutch is applied causing the output shaft to turn at the same speed as the input shaft .

Many more combinations are possible using two or more planetary sets connected in various way to provide the different forward speeds and reverse that are found in modern automatic transmission .

2）Clutch pack

A clutch pack consists of alternating disks that fit inside a clutch drum . Half of the disks are steel and have splines that fit into groves on the inside of the drum . The other half have a friction material bonded to their surface and have splines on the inside edge that fit groves on the outer surface of the adjoining hub . There is a piston inside the drum that is activated by oil pressure at the appropriate time to squeeze the clutch pack together so that the two components become locked and turn as one .

3）One-way Clutch

A one-way clutch (also known as a “sprag” clutch) is a device that will allow a component such as ring gear to turn freely in one direction but not in the other . This effect is just like that

bicycle , where the pedals will turn the wheel when pedaling forward , but will spin free when pedaling backward .

A common place where a one-way clutch is used is in first gear when the shifter is in the drive position . When you begin to accelerate from a stop , the transmission starts out in first gear . But have you ever noticed what happens if you release the gas while it is still in first gear ? The vehicle continues to coast as if you were in neutral . Now , shift into Low gear instead of Drive . When you let go of the gas in this case , you will feel the engine slow you down just like a standard shift car . The reason for this is that in Drive , one-way clutch is used whereas in Low , a clutch pack or a band is used .

4）Torque Converter

On automatic transmission , the torque converter takes the place of the clutch found on standard shift vehicles . It is there to allow the engine to continue running when the vehicle comes to a stop . The principle behind a torque converter is like taking a fan that is plugged into the wall and blowing air into another fan which is unplugged . If you grab the blade on the unplugged fan , you are able to hold it from turning but as soon as you let go , it will begin to speed up until it comes close to speed of the powered fan . The difference with a torque converter is that instead of using air it used oil or transmission fluid , to be more precise .

A torque converter is a lager doughnut shaped device that is mounted between the engine and the transmission . It consists of three internal elements that work together to transmit power to the transmission . The three elements of the torque converter are the pump , the Turbine , and the Stator . The pump is mounted directly to the torque housing which in turn is bolted directly to the engine‟s crankshaft and turns at engine speed . The turbine is inside the housing and is connected directly to the input shaft of the transmission providing power to move the vehicle . The stator is mounted to a one-way clutch so that it can spin freely in one direction but not in the other . Each of the three elements has fins mounted in them to precisely direct the flow of oil through the converter .

With the engine running , transmission fluid is pulled into the pump section and is pushed outward by centrifugal force until it reaches the turbine section which stars it running . The fluid continues in a circular motion back towards the center of the turbine where it enters

the stator . If the turbine is moving considerably slower than the pump , the fluid will make contact with the front of the stator fins which push the stator into the one way clutch and prevent it from turning . With the stator stopped , the fluid is directed by the stator fins to re-enter the pump at a “help” angle providing a torque increase . As the speed of the turbine catches up with the pump , the fluid starts hitting the stator blades on the back-side causing the stator to turn in the same direction as the pump and turbine . As the speed increase , all three elements begin to turn at approximately the same speed . Sine the „80s , in order to improve fuel economy , torque converters have been equipped with a lockup clutch which locks the turbine to the pump as the vehicle reaches approximately 40-50 mph . This lockup is controlled by computer and usually won‟t engage unless the transmission is in 3rd or 4th gear .

5）Hydraulic System

The hydraulic system is a complex maze of passage and tubes that sends that sends transmission fluid and under pressure to all parts of the transmission and torque converter and . Transmission fluid serves a number of purpose including : shift control ,general lubrication and transmission cooling . Unlike the engine ,which uses oil primary for lubrication ,every aspect of a transmission „s function is dependant on a constant supply of fluid is send pressure . In order to keep the transmission at normal operating temperature , a portion of the fluid is send to through one of two steel tubes to a special chamber that is submerged in anti-freeze in the radiator . Fluid passing through this chamber is cooled and then returned to the transmission through the other steel tube . A typical transmission has an avenge of ten quarts of fluid between the transmission , torque converter , and cooler tank , In fact , most of the components of a transmission are constantly submerged in fluid including the clutch packs and bands . The friction surfaces on these parts are designed to operate properly only when they are submerged in oil .

6）Oil Pump

The transmission oil pump（not to confused with the pump element inside the torque converter) is responsible for producing all the oil pressure that is required in the transmission . The oil pump is mounted to front of the transmission case and is directly connected to a

flange on the engine crankshaft , the pump will produce pressure whenever the engine is running as there is a sufficient amount of transmission fluid available . The oil enters the pump through a filter that is located at bottom of the transmission oil pan and travels up a pickup tube directly to the oil pump . The oil is then sent , under pressure to the pressure regulator , the valve body and the rest of the components , as required .

7）Valve Body

The valve body is the control center of the automatic transmission . It contains a maze of channels and passages that direct hydraulic fluid to the numerous valves which when activate the appropriate clutch pack of band servo to smoothly shift to the appropriate gear for each driving situation . Each of the many valves in the valve body has a specific purpose and is named for that function . For example the 2-3 shift valve activates the 2nd gear up-shift or the 3-2 shift timing valve which determines when a downshift should occur .

The most important valve and the one that you have direct control over is the manual valve. The manual valve is directly connected to the gear shift handle and covers and uncovers various passages depending on what position the gear shift is paced in . When you place the gear shift in Drive , for instance , the manual valve directs fluid to the clutch pack (s) that activates 1st gear . It also sets up to monitor vehicle speed and throttle position so that it can determine the optimal time and the force for the 1-2 shift . On computer controlled transmission , you will also have electrical solenoids that are mounted in the valve body to direct fluid to the appropriate clutch packs or bands under computer control to more precisely control shift points .

8）Seals and Gaskets

An automatic transmission has many seals and gaskets to control the flow of hydraulic fluid and to keep it from leaking out . There are two main external seals : the front seal and the rear seal . The front seal seals the point where the torque converter mounts to the transmission case . This seal allows fluid to freely move from the converter to the transmission but keeps the fluid from leaking out . The rear seal keeps fluid from leaking past the output shaft .

A seal is usually made of rubber (similar to the rubber in a windshield wiper blade)

and is used to keep oil from leaking past a moving part such as a spinning shaft . In some cases , the rubber is assisted by a spring that holds he rubber in close contact with the spinning shaft .

A gasket is a type of seal used to seal two stationary parts that are fasted together . Some common gasket materials are : paper , cork , rubber , silicone and soft metal .

Aside from the main seals , there are also a number of other seals and gasket that vary from transmission to transmission . A common example is the rubber O-ring that seals the shaft for the shift control lever . This is the shaft that you move when you manipulate the gear shifter . Another example that is common to most transmission is the oil pan gasket . In fact , seals are required anywhere that a device needs to pass through the transmission case with each one being a potential source for leaks .

9 Computer Controls

The computer uses sensors on the engine and transmission to detect such things as throttle position , vehicle speed , engine speed , engine load , stop light switch position , etc . to control exact shift points as well as how soft or firm the shift should be . Some computerized transmission even learn your driving style and constantly adapt to it so that every shift is timed precisely when you would need it .

Because of computer controls , sports models are coming out with the ability to take manual control of the transmission as through it were a stick shift lever through a special gate , then tapping it in one direction or the other in order to up-shift at will . The computer monitors this activity to make sure that the driver dose not select a gear that could over speed the engine and damage it .

mode which can detect a problem early on and warn you with an indicator light on the dash . A technician can then plug test equipment in and retrieve a list of trouble codes that will help pinpoint where the problem is .

3. The Differential System

When a vehicle is cornered the inner wheel moves through a shorter distance than the

outer wheel . This means that the inner wheel must slow down and the outer wheel must speed up . During this period it is desirable that each driving maintains its driving action . The differential performs these two tasks . The principle of the bevel type differential can be seen if the unit is considered as two discs and a lever .

When the vehicle is traveling straight , the lever will divide the diving force equally and both discs will move the same amount .

When the vehicle corners , the driving will still be divided equally but the inner disc will now move through a smaller distance ;this will cause the lever to pivot about its center which will prize forward the outer disc to give it a greater movement . This action shows that the torque applied to each driving wheel is always equal hence the differential is sometimes called a torque equalizer .

4 Brake System

The breaking system is the most important system in cars . If the brakes fail , the result can be disastrous . Brakes are actually energy conversion devices , which convert the kinetic energy (momentum) of the vehicle into thermal (heat) . When stepping on the brakes , the driver commands a stopping force ten times as powerful as the force that puts the car in motion . The braking system can exert thousands of pounds of pressure on each of the four brakes .

The brake system is composed of the following basic components : the “master cylinder” which is located under the hood , and is directly connected to the brake pedal , converts driver foot‟s mechanical pressure into hydraulic pressure . Steel “brake lines” and flexible “brake hoses” connect the master cylinder to the “slave cylinders” located at each wheel . Brake fluid , specially designed to work in extreme condition , fills the system . “Shoes” and “Pads” are pushed by the salve cylinders to contact the “drum” and “rotors” thus causing drag , which (hopefully) slows the car .

The typical brake system consists of disk brakes in front and either disk or drum brakes in the rear connected by a system of tubes and hoses that link the brake at each wheel to the master cylinder .

Stepping on the brake pedal , a plunger is actually been pushing against in the master cylinder which forces hydraulic oil (brake fluid) through a series of tubes and hoses to the braking unit at each wheel . Since hydraulic fluid (or any fluid for that matter) cannot be compressed , pushing fluid through a pipe is just like pushing a steel bar through pipe . Unlike a steel bar , however , fluid can be directed through many twists and turns on its way to its destination , arriving with the exact same motion and pressure that it started with . It is very important that the fluid is pure liquid and that there are no air bubbles in it . Air can compress , which causes a sponginess to the pedal and severely reduced braking efficiency . If air is remove the air . There are “bleeder screws” at each wheel and caliper for this purpose .

On a disk brakes , the fluid from the master cylinder is forced into a caliper where it pressure against a piston . The piton , in-turn , squeezes two brake pads against the disk （rotor ）which is attached to the wheel , forcing it to slow down or stop . This process is similar to the wheel ,causing the wheel to stop . In either case , the friction surface of the pads on a disk brake system , on the shoes on a drum brake convert the forward motion of the vehicle into heat . Heat is what causes the friction surfaces (lining) of the pads and shoes to eventually wear out and require replacement .

Brake fluid is a special oil that has specifics properties . It is designed to withstand cold temperatures without thickening as well as very high temperatures without boiling . (If the brake fluid should boil , it will cause you to have a spongy pedal and the car will be hard to stop) .

The brake fluid reservoir is on top of the master cylinder . Most cars today have a transparent reservoir so that you can see the level without opening the cover . The brake fluid lever will drop slightly as the brake pads wear . This is a normal condition and no cause for concern . If the lever drops noticeably over a short period of time or goes down to about two thirds full , have your brakes checked as soon as possible . Keep the reservoir covered expect for the amount of time you need to fill it and never leave a can of brake fluid uncovered . Brake fluid must maintain a very high boiling point . Exposure to air will cause the fluid to absorb moisture which will lower that boiling point .

The brake fluid travels from the master cylinder to the wheels through a series of steel tubes and reinforced rubber hoses . Rubber hoses are only used in places that require flexibility , such as at the front wheels , which move up and down as well as steer . The rest of the system uses non-corrosive seamless steel tubing with special fittings at attachment points . If a steel line requires a repair , the best procedure is to replace the complete line . If this is nit practical , a line can be repaired using special splice fittings that are made for brake system

You must never use brass “compression” fittings or copper tubing repair a brake system . They are dangerous and illegal .

Other Components in the Hydraulic System

1　Proportioning Valve or Equalizer Valve

These valves are mounted between the master cylinder and the rear wheels . They are designed to adjust the pressure between the front and the rear brakes depending on how hard you are stopping . The shorter you stop , the more of the vehicle‟s weight is transferred to the front wheels , in some cases , causing the rear to lift and the front to dive . These valves are designed to direct more pressure to the front and less pressure to the harder you stop . This minimizes the chance of premature lockup at the rear wheels .

2）Pressure Differential Valve

This valve is usually mounted just below the master and is responsible for turning the brake warning light on when it detects a malfunction . It measures the pressure from the two sections of the master cylinder and compares them . Since it is mounted ahead of the proportioning or equalizer valve , the two pressure it detects should be equal . If it detects a difference , it means that there is probably a brake fluid leak somewhere in the system .

3）Combination Valve

The Combination valve is simply a proportioning valve and a pressure differential valve that is combine into one unit .

The parking brake system controls the rear brakes through a series of steel cables that are connected to either a hand lever or a foot pedal . The ideal is that the system is fully mechanical and completely bypasses the hydraulic system so that the vehicle can be brought to a stop even if there is a total brake failure .