The Body (Overview)

The Body

The body shell is a fairly complex assortment of large steel sections. These sections have been stamped into specific shapes which make up the body of your car. These parts are designed to do many jobs at once; protect the occupants from the elements and in collisions, provide solid mounts for all other systems, and to slice through the air with minimal resistance. The body also has one other job which is usually important to the owner... it has to look good!

Although the zillions of parts that make up a car are all very important, it is also important that the car's body be able to make riding in a car bearable for you. Early cars were so uncomfortable to ride in, that the human body could stand it only for short periods of time. Auto bodies have come a long way since then. The body and the suspension system now give us a smooth ride, and cushion us from the jarring of the road. The idea is that the body of the car should go forward with as little up-and-down, and side-to-side movement as possible.

Frame (Chassis)

The frame provides a firm structure for the body, as well a good anchor point for the suspension system. There are two types of frames; integral frames (you've probably heard of them as "unibody") and conventional frames.

A conventional frame is basically a "one-piece" frame, or two "one-piece" frames fastened together. The frame is extremely rigid in order to keep all the other parts of the car in perfect alignment. The manufacturer takes this type of frame and attaches all the other parts of the car to it, like the way a sculptor starts with a wire frame to build his sculpture on and give it shape. To keep things smooth, rubber insulator blocks, or "pads" are placed between the frame and the other car parts. Because the conventional frame is so important to the structure of your car, (without it, your car would be a pile of doors, hoses, seats, wires and metal) it is usually constructed of heavy steel and welded or cold riveted together. Cold riveting keeps the rivets from shrinking after they cool off.

The integral, or unibody, frame is just the opposite. With this type of frame, the body parts are used to structurally strengthen the entire car, and all of the sections are welded into one piece. Sometimes the parts of the body and the suspension system are attached and reinforced. Also, some unibody frames have partial front and rear frames for attaching the engine and suspension members.

Crash / Safety Features

What actually happens in a collision? The first part of that answer is that there are two collisions. The first collision occurs when the vehicle runs into another object. The second collision is when the occupant(s) hit the inside of the car. Neither a seat belt nor an air bag can do anything about the first collision, but they can be a great help to you in the second collision. They can minimize the impact between you and the interior of the car.

Safety belt use is more than a personal right. Injuries and fatalities resulting from motor vehicle accidents are reflected in the rising costs of auto and health insurance, and costs to employers in the form of lost days at work. The taxpayer also loses by having to support emergency medical response teams and social programs for the disabled.

Excuses, excuses!

1. "Seat belts are too uncomfortable."
   Of course, in a car accident -- without your seat belt -- you would smash into the steering column, slam into the dashboard, or crash through the windshield. This too, can be very uncomfortable.
2. "Seat belts wrinkle my clothes."
   Sometimes. Sitting also wrinkles clothes. Wearing clothes wrinkles clothes. Flying through a windshield REALLY wrinkles clothes.
3. "Only nerds wear seat belts."
   Really? It turns out that -- without seat belts -- nerds, jocks, cheerleaders, "A" students and average students would all fly through the windshield at the same rate.
4. "I'm a good driver."
   Nice as that is, good drivers can get hit by bad drivers, drunk drivers, or other good drivers with mechanical failures. Very few people intend to have accidents.
5. "Seat belts restrict my freedom of movement."
   This is true. Without your seat belt, you have all the freedom in the world--to crash into your windshield, to slam into your car's interior, or to be thrown from your car and slide along the pavement. Freedom is great.
6. "It's too embarrassing to ask friends to use their seat belts."

In 1984, 46,000 people died in car accidents. That same year, not one person died of embarrassment.

Safety in car design was recognized as being important even in the earliest cars. In recent years, however, it has become a fundamental subject in its own right. Active safety measures have been designed to reduce the likelihood of a car being involved in an accident in the first place, while passive safety measures assume that a collision is inevitable and then aim to reduce the severity of the injuries to the road users involved.

Until the late 1800's the British had a 2 mph speed limit for cars. There was an excellent reason for this. It was also required, for safety's sake, that each car carry two passengers with a third person walking in front. The job of the third person was to walk in front of the car to warn everyone that it was coming!

Seat Belts and Air Bags

The first federal study of automobile air bags in actual traffic accidents has found that air bags used in conjunction with seat belts are far more effective than seat belts alone. Air bags reduce the risk of death in head-on collisions by 26% and in all serious accidents by 13%.

Contrasting earlier findings that did not involve actual road conditions, the study showed that air bags protected occupants in ways that seat belts alone, did not. The air bag spread out the violent impact of a crash and kept occupants from smashing against the steering wheel, dashboard or windshield.

Having an air bag and wearing an effective seat belt offers the best protection of all. Not only are you protected from frontal crashes by the air bag -- you are also protected by the seat belt in all other types of crashes.

Studies show that 60% of the people killed or injured in automobile accidents would have been saved from serious injury by safety belts. Unfortunately, many people choose not to wear them.

With an "effective" safety belt (one that is worn and operating correctly), your body will stop, in a crash, before you have a chance to hit or go through the windshield and parts of your car.

Seat belts are especially important in small cars, because your chances of being killed or badly hurt in a collision with a big car is eight times greater. Wearing your belt will greatly improve your chances of survival.

In a Department of Transportation study made public on June 26, 1992, it was announced that air bags are far more effective than seat belts alone. Air bags can reduce the risk of death in a head-on collision by 26% and in all serious accidents by 13%. However, the DOT cautioned that air bags work this well ONLY when occupants were wearing a properly buckled seat belt over lap and shoulder. Other studies have shown that WITHOUT A BELT, AIR BAGS ARE OF SLIGHT BENEFIT.

Air bags are only useful in frontal crashes, so it is not a good idea to skip your seat belt because you have an air bag. Air bags provide very effective protection in frontal crashes, inflating instantly to protect the driver or passenger that has a air bag. They spread the impact of the crash over the individual's head and chest and protect fragile body parts from the car's hard surfaces.

More than 6 million cars (about 4% of cars on the road today) have air bags, but the majority of them have air bags on the driver's side only. Federal officials estimate that air bags have inflated in more than 57,000 accidents since they were introduced, six years prior to 1992, and saved about 300 lives.

This report came out in the middle of the most sweeping safety overhaul since the introduction of the seat belt almost 30 years ago. For the first time, most new cars sold in the US in 1992 have driver's side airbags. Within 6 years, federal law will require that every new car, light truck and van have air bags on both sides.

The main concern of car safety research in the last few years has been the development of passive safety design features, where the aim is to improve the "crash-worthiness" of vehicles. The fundamental aim of good passive safety design is to ensure that only tolerable loads are applied to a car occupant's body during a crash. This is done first by restraining the occupant within the passenger compartment by means of a seat belt or other device, so that chances of making contact with the interior parts of the car are reduced. Secondly, when contacts

cannot be avoided, the structures which are likely to be hit by the occupants must be designed to collapse and cushion them.

It is important for the designers to have some knowledge of the forces that the human body can withstand, but as yet this branch of biomechanics has not been fully researched. Work is done at low impact energy levels using volunteers, but for high speed crashes it is necessary to use dummies.

The relationship between dummy performance and that of a real person in a crash is complex, and it may be that these differences are very considerable. To reduce this problem, some work is currently being done using human cadavers.

In spite of the difficulties in this area, many basic improvements have been introduced into cars in recent years. These include anti-burst door latches, safety glass, energy-absorbing steering wheels and columns, head restraints and various seat belt systems.

The benefits of the three-point seat belts have been firmly established: over 50% of fatal and serious injuries to car occupants would be avoided if all occupants wore their seat belts. Most states now have a law that both passengers and driver must have seat belts buckled while in motion. Those states which do not enforce a seat belt law for all passengers have an effective law for children under five years of age to be strapped in.

Rust Prevention

Rust is very bad for your car. It will also depreciate the value of your car more than any other problem. It is the most difficult and expensive problem to fix.

The best way to protect your car against rust is to keep the body clean and check it regularly. If you see a light brown stain, don't ignore it, have it fixed before it gets worse. Although most rust problems can be repaired, if it involves chrome parts, you will need to replace them.

The major cause of rust is salt on the roads. The salt carries moisture into every nook and cranny of your car. Rising temperatures bring on salt-caused oxidation. This makes the salt already in your car worse in the spring. Heat in your garage will also bring out the worst in the salt. Acid rain is also bad for your car's body; it ruins the paint that protects the metal of the body.

Undercoating is not rustproofing. Its job is to deaden sound. If any salt or moisture gets into the undercoating, it aids in the rusting process.

To prevent rust:

1. Keep your car clean and well waxed.
2. Rinse the underside with water when salt is in use or if you live in a salty area.
3. Keep your wheel wells clean and free from material that holds moisture, such as dirt or leaves.

4. Make sure that all drain holes in the frame, floor and bottoms of doors are clear.
5. After you wash your car, open the doors to let the water drain out.

Rust proofing is a treatment of waxy paste sprayed inside the body panels by an "after market" specialist. The specialist drills holes in hidden areas, sprays in the paste, and plugs the holes. Another type of rustproofing is a clear silicon-based spray that is applied to your paint to protect it from chemicals and pollution. Modern cars come with good built-in corrosion protection and warranties against corrosion. You might wind up sealing in the corrosives you are trying to protect against. Also, many car manufacturers void your corrosion warranty if you have your car rustproofed. The best course is to take the rust preventative measures listed above.

Door Locks

Door locks must keep the door from opening in a crash situation and resist break-ins, but it should also be possible to open them if you lose the key. The door handle acts as a lever that pulls on a rod. The rod rotates the door latch. The various types of lock mechanisms interrupt the action of the door latch. The "striker" is a mechanism attached to the door post, or part of the car body. It holds the door shut or allows it to be opened when the door handle rotates the latch. The striker's job is to keep the door closed under normal conditions, or to hold the door closed if the door post starts to bend away from the door in a crash.

Power door lock mechanisms are operated by electric solenoids. Anti-burst door locks are a relatively cheap development, that have proven to be one of the most successful but unrecognized benefits of crash protective design.

Studies have shown that it is much better to remain in a car than to be thrown out, because if a person is thrown out, serious injury may result from contact with the road surface, and there is a great risk of being run over by one's own or another vehicle. It is, therefore, important that the doors should stay shut during a collision, and the design of a latch to do this has been perfected and introduced into almost all cars in the world.

An anti-burst latch provides resistance to tension forces of up to 3000 lb. (1360 kg) in all directions, by having a lock striker on the door which completely encircles a ring or plate mounted on the door frame. The system is designed so that it resists the forces generated in a collision both by the occupant striking the door on the inside and by the force of the impact on the outside. The result is that ejection, which was established as a leading cause of death to car occupants in 1956, has now been reduced until it has relatively little importance.

Window Winding Mechanisms

There are two types of window winding mechanisms; hand cranked and power.

Hand cranks work two ways. With "window winders," the crank turns a "sector gear" that pivots a pair of arms. The arms raise the "window carrier" and the glass. Some cars have fixed glazing in the rear doors so that the window cannot go up or down. The other type of window crank is a tape mechanism. It winds up a ladder-like tape

made of plastic links. The plastic links are wound on to or off a spool to raise or lower the glass. The tape mechanism was introduced in 1980 GM cars. It saves weight and space. Its parts will not corrode when rainwater gets into the door, and it needs no lubrication.

First introduced in 1946, power windows use a small electric motor inside the door. The motor turns the crank that raises the window.

Door and vent windows are made of laminated "safety" plate glass, which is a sandwich of glass and clear plastic. The plastic acts as a soft, protective barrier, keeping the glass in place, if it is struck during a collision. The glass sticks to the plastic even when shattered.

Side Beam

The door's inner panel has crossbars, or heavy metal beams to provide strength to the door, and to protect the passenger from injury in the event of a collision.

Door

A door consists of an inner and an outer panel. The inner panel provides strength. The outer panel is just a metal cover, or "skin." The inner panel has a variety of holes and stems for the attachment to the window mechanisms and locks. The upper part of the door is the window glass that rides in grooves on two sides of the door frame.

Door Hinges

The door hinge is a jointed, flexible device on which the door opens and closes. Its foundation is the center body pillar. The door is attached to the center body pillar by the hinge.

Seats

There are basically two types of seats; bench seats or bucket seats.

A bucket seat is a low, separate seat for one person. Although we think of them as relatively new, it is interesting to note that in 1905 Henry Ford's first model A had bucket seats.

Bench seats are a continuous cushion and backrest across the width of the car (although some vans might have them running along the length of the van). Bucket seats are single units with a separation between the left and right seats.

Usually vinyl leather and fabric are used for upholstery. "Flatsprings" are used for comfort. A flatspring is a piece of wire that is bent into a zigzag pattern. Both ends of the wire are attached to the seat frame, with additional lengths added every six inches. Foam padding is used to cover the flatsprings.

The front seats ride on rails that are bolted to the floor. This arrangement allows the seats to move backwards and forwards to suit the driver or passenger. The seat adjustment lever is attached to a latch that fits into teeth along the rail. Moving the lever releases the seat, and allows the seat to move. At any point of the seat's movement, releasing the lever engages the latch with one of the teeth. Usually there is also a pull-spring; this draws the seat forward when the latch is released.

The rear seat usually doesn't move, because it is secured to the floor of the car. It's backrest is attached to the partition between the passenger compartment and trunk.

Door Handle

The door handle is used to open the door, and as a way to release the door latch. It mates with a toothed wheel at the side panel of the door, called a rotor. When the door is closed, one of the teeth contacts the striker and causes the rotor to turn one tooth. If the door is completely closed, the rotor engages with the striker. The door can't open because the rotor is locked. When you unlock the door, the rotor can rotate and the door opens.

Windshield

Up until 1935 many cars had hinged windshields that could be folded on the hood of the car or opened up. Today, most windshields are stationary. They are fixed in place with a weather-strip made of rubber. The strip has a groove on the inside and a groove on the outside. The inside groove holds the glass; the outside groove holds the metal rim of the windshield opening in place. The glass "floats" in a plastic sealant that is spread out between the edge of the glass and the frame of the windshield.

Windshields are made of laminated safety plate glass, which is a sandwich of glass and clear plastic. The plastic acts as a soft, protective barrier, keeping the glass in place, if it is struck during a collision. The glass sticks to the plastic to eliminate glass from flying around the interior and injuring someone.

Safety glass for windscreens was one of the first passive safety devices introduced into cars in the 1930s, but its use remains a controversial question. North America and Scandinavia favor a laminated glass, which consists of two sheets of annealed glass, separated by a layer of transparent plastic. The rest of Europe and Japan favor toughened glass because it is cheaper. This type is a single sheet of glass which is heat strengthened, and which on impact fractures into small cubic fragments without very sharp edges. In recent years, laminated glass has been improved by changes in the properties of the plastic interlayer. Research has demonstrated that this new laminated glass is about 4 times safer than toughened glass, but because it is more expensive, controversy continues as to whether or not toughened glass windscreens should be banned by legislative action and replaced by laminated glass.

Recent developments have combined the benefits of both laminated and toughened material in that a laminated construction is used, but the sheet next to the inside of the car is made of toughened glass.

Spoiler

A spoiler is a kind of wing that is mounted on the rear of the car in a horizontal position. Its function is to provide high speed stability. For most cars, the spoiler is purely cosmetic; a car has to be going over 100 mph to take advantage of the aerodynamics of the spoiler.

Some mini-vans also make use of a spoiler, but it's upside down, and angled. The purpose of this type of spoiler is simply to keep the rain off the rear window.

Air Dam

An air dam is a projection of the body shell underneath the front of the chassis. Its function is to reduce the amount of air turbulence and drag underneath the car, and to channel air to the radiator.

Floor Pan

The floor pan is at the bottom of the car assembly. This is the foundation of the body shell. The floor pan is stamped with bulges and curves to accommodate the spatial requirements of the engine, transmission and rear axle, as well as the passenger compartment. A second floor pan is often used for the trunk of the car. If the car has a separate frame, the floor pan is bolted to the side rails buffered by large rubber cushions. With unibody construction, the floor pan is attached to the several metal pieces that make up the chassis center section.

Firewall and "A" Pillars

The firewall separates the passenger and engine sections of the car. It's a flat piece of steel stamped with curves and punched with holes and openings for wires, tubes, and levers that extend into the passenger compartment. It goes up both sides of the dashboard and stops where it meets the roof panel. These pillars formed by the firewall provide the frame for the windshield and are called "A" pillars.

Rear Quarter Panel

The rear quarter panel is the body skin, or sheet metal, that runs from the rearmost part of the rear door edge, around the back and to the rear door on the other side of the car. On many cars, the rear quarter panels are integral with the roof.

The rear quarter panel is composed of an outer skin and inner panels. The inner panels are reinforcements for the rear of the passenger compartment, the trunk, and the wheel housings. Without the inner panels, there would be severe vibration and weak construction in the back of the car.

Bumpers

Bumpers are made of heavy sheet metal and are mounted on the front and rear of the car. Bumpers are bent and formed into specific shapes in order to absorb and deliver momentum during a collision. In the event of a collision, the bumper absorbs some of the impact, which decreases damage to the car and its occupants. It also

protects the front of the car by diverting all of the car's momentum to the object with which it has collided.

The bumper is mounted to the car's chassis with special impact absorbers. These shock absorbers are often spring loaded. In slow speed collisions, this allows the bumper to compress, and then extend back to its original position.

All bumpers are designed to absorb the energy of the impact. They do this through a series of valves and air chambers. Some car bumpers have hydraulic chambers. In the event of a collision, the absorption unit allows air and/or hydraulic fluid to pass through small openings. Forcing the air/fluid through the valve openings absorbs the energy from the collision.

The bumper's job is to minimize damage, primarily to the occupants of the vehicle and to the vehicle itself. US law requires cars to pass special crash tests at various speeds. In order to pass, the car's damage level during the crash must be below a specific dollar level. This protects the consumer and is also very important for keeping the cost of automobile insurance to a minimum.

Sometimes bumpers are constructed with built-in "crumple zones." Crumple zones are designed to absorb impact; they will flex on impact. As the metal flexes, the action of the bending metal converts the kinetic energy of the car into heat. Kinetic energy is the energy an object possesses while it is in motion.

Hood

The car's hood is another type of door. It also consists of an inner and an outer panel. The inner panel provides strength. The outer panel is just a metal cover, or "skin". The underside of the hood is often covered with a sound-absorbing material. Some high performance cars have openings in the hood to allow the engine to "breathe" easier. "Hood scoops" are used to channel outside air directly to the air filter, which gives improved performance and efficiency.

Trunk Lid

The trunk lid is another type of door. It consists of an inner and an outer panel. The inner panel provides strength. The outer panel is just a metal cover, or "skin".

Radiator Grille

The radiator grille is the part of the body shell on the front of your car that covers the area where the air enters. The radiator grille can also be part of the bumper on some cars.

The radiator is connected to the shroud for the radiator. The shroud directs the air that comes in through the radiator grille to the radiator only. This prevents the air from escaping around the radiator and failing to cool the engine.

On newer cars, the radiator grille has been lowered to take advantage of lower hood lines, brought about by an effort to increase fuel efficiency. Older cars had massive grilles, whereas the cars now produced have smaller more aerodynamic grilles.

Driver's Side Mirror

The driver's side mirror is connected to the driver's side of the car's body. This mirror is a very important device, not for adjusting your make-up. It enables you, with a slight glance of the eye, to see places that you can't otherwise see without taking your eyes off the road.

The mirror is adjusted by the driver to suit the necessary visibility position (position of the head). Sometimes the mirror must be manually adjusted outside the car.

The mirror is also often controlled from the inside of car by a series of cables. The cables are connected to a "joystick" that allows you to tilt the mirror manually, or to an electrical motor that allows you to tilt the mirror by pushing a button.

So if your mom, husband, wife, etc., is displeased with you for re-adjusting all the mirrors, remind them that you're just being a safe driver!

Rear View Mirror

The rear view mirror is a wide rectangular mirror that you (the driver) use to view anything behind the car. You don't have to take your eyes off the road to turn your head around.

On most cars, the rear view mirror has a "day/night" selection switch that tilts the mirror inside its glass housing without tilting the exterior glass housing itself. The switch tilts the mirror upward, about five degrees, to divert the majority of the light striking the mirror up on to the headliner of the car. The light that you see when the mirror is on the "night" setting is actually bouncing off the glass housing (a good reason to keep it clean). The percentage of light reflected into your eyes in the night position, is very small compared to the amount that would normally be reflected into your eyes in its normal position.

Headrests

Headrests are a safety device and enhancement. If a headrest is properly positioned behind your head, it can protect you from injury during a collision. Some safety conscious car manufacturers have headrests for both front and rear seats.

Headrests can also be safety hazards if they are positioned improperly. A headrest that is adjusted too high can obscure the driver's rear view. If a headrest is adjusted too low, during the event of a collision, it can "chop" the driver or passengers in the neck, rather than protect the head.

Rear-impact accidents occur frequently and are increasing with the greater density of today's traffic. In rear end collisions, the car is suddenly accelerated forward, with the result that the head of an occupant is snapped backwards over the seat back.

This can cause a serious "whiplash" injury to the neck. To prevent such injuries, some seats are fitted with head restraints. Many of these, however, are not used as designed, because the user has to adjust his own head restraint so that it is in the right position to protect them in a collision. In the United States, for example, where nearly all head restraints are adjustable, field surveys have shown that 80% of the head restraints are in the fully down position all the time. As a result, head restraints are of hardly any benefit in an accident.

Roll Bar

The purpose of the roll bar is to protect driver and passengers from injury if the car rolls over onto its roof. A series of tubes that are welded together into a contoured shape, and then bolted directly to the frame members, or rails. Since frame members are located differently on different types of cars, a roll bar is very unique to an individual car, and must be designed for a specific car.

Although a roll bar is a very nice feature, it is not always practical, because there isn't a place to mount it. Roll bars are usually put on convertibles as an aftermarket add-on piece. A convertible provides no protection if it overturns.

Some cars have built-in "targa" roll bars. These are roll bars that are covered up by body work; they appear to be part of the body. Targa roll bars are generally flat and wide, instead of round like normal roll bars. Because they are wider, they are able to hold up the overturned car. They also look nice, because they look like a body panel. They do reduce rear visibility because of their greater width. Some targa roll bars are purely cosmetic, because they have no frame inside. This type of roll bar affords you about as much protection as the windshield, and so is not really a roll bar.

Most cars don't come with roll bars, but all race cars have roll bars. Roll bars themselves are relatively inexpensive, but they usually require quite a bit of expensive installation work. Some roll bars provide better protection than others.

If you have a tendency to exceed the speed limit along winding roads or go off roading, you really ought to have a roll bar.

Rocker Panels

A rocker panel is a three or four inch piece of metal that runs along the bottom of the car body underneath the doors. Rocker panels are usually coated with a rock proof protectant which rubberizes the exterior surface before the car is painted. If you have mud flaps behind your wheels, this protects your rocker panels, as well as your fenders and your doors. Rocker panels are often made of chrome plating, and enhance the car.

Wheel Well

The wheel well is either plastic or metal. Metal wheel wells are usually part of the body shell. Metal wheel wells strengthen the structure of the car because of their shape, and because they are strongly welded to the body shell. Most rear wheel wells are made of metal.

Wheel wells are coated with a rock-proof, rubberized coating underneath, in order to prevent the rocks kicked up by the wheels from damaging the metal and making a lot of noise when they hit.

Often the front wheel wells are made of plastic. This is because it is harder to mount the engine with the front wheel wells in place. Plastic wheel wells can be removed, and make it easier to mount the engine during the manufacturing of the car.

Front Quarter Panel

The front quarter panel is composed of the body skin, or sheet metal, that runs from the front corner of the hood to the front of the door. It is usually a separate piece that is welded on in a few places. This makes it easy to replace if you get in a "fender bender." Front quarter panels can usually be replaced relatively inexpensively.

Some newer vehicles use a rubber-like plastic for the fenders, which allows small impacts to be absorbed without damage.

Chassis Cross Member

The chassis cross member is usually a heavy gauge piece of sheet metal that is bent into a convoluted channel shape. It is mounted onto the bottom of the chassis, and keeps the transmission firmly secured at the end where the drive shaft begins. On some cars, the cross member is removable. On other cars, it is part of the body shell.

Drive Shaft Clearance Tube

The drive shaft clearance tube is a section of the floor pan. It is actually shaped more like a tunnel than a tube. It provides clearance for the drive shaft, the universal joints, and the rear of the transmission. The underside of the drive shaft clearance tube is coated with a rubberized sound absorption coating that reduces road noise.

Only rear-wheel drive vehicles have drive shaft clearance tubes.

Transmission Tunnel

The transmission tunnel is a cone-shaped formation in the front of the floor pan. Its shape duplicates the transmission, but it is a little bit bigger and provides about two inches of clearance around the transmission. You won't find the transmission tunnel in front wheel drive cars, because the transmission is on the side of the engine completely under the hood. Only rear-wheel drive cars have transmission tunnels.

A manual transmission tunnel has a hole in it to allow the shift linkage to be worked from inside the car. The shifter linkage goes through the transmission tunnel. A rubber boot on the shifter linkage stops dirt, dust and exhaust fumes from entering the passenger compartment. The rubber boot is mounted onto the transmission tunnel and fastened securely around the gearshift linkage. This arrangement is not

necessary with an automatic transmission, because the shift linkage does not usually go through the transmission tunnel. The shift linkage in automatic transmission usually goes in front of the firewall from the base of the steering column.

Rear End Tunnel

The rear end tunnel is a tube with a pumpkin shaped indentation in the center which provides clearance for the drive shaft and the housing of the differential. It allows the rear end to travel up and down with suspension motion; it clears the differential housing by a maximum of three or four inches when the suspension is fully compressed. The rear end tunnel often forms the front of the trunk floor. It is attached to the wheel wells on each side as well as the floor pan and the trunk floor.

Springs

Springs all have one thing in common; they are made of specially formulated steel which is tempered to prevent it from loosing the shape it is bent into when "sprung." For this reason, a spring will compress or extend and then return almost entirely to it original shape. There are two kinds of springs, leaf springs and coil springs.

Springs have life spans that are determined by the number of cycles they can withstand over a certain period of time. Occasionally a spring will break on a car while it is being driven. This doesn't usually lead to a collision, but if a spring breaks while you are driving , the car will suddenly lurch downward-- you've got yourself a low-rider! The bottom of the car might be damaged, or you might lose your muffler!

Leaf springs are made of individual springs, or plates. If you break one plate of your leaf-spring, it won't be noticeable, but your car might begin to lean to one side or the other.

Coil springs, if they break, will suddenly drop the front or rear end of your car and impair driving under the normal conditions of full suspension travel.

Usually the springs surround the shock absorbers, because space can be saved by putting the shock absorber inside the spring. The spring on a MacPherson strut suspension rotates along with the strut body itself; it pivots on a bearing mounted to the wheel well.

Some springs have adjustment dials mounted between them and their mounting points. This allows the mechanic to increase the spring tension and the ride height, you desire. This type of spring is usually used only in high performance cars, because it allows the raising and lowering of suspension system's height. The suspension system is lowered for competitive events and then raised afterwards. This way, the car can be driven normally and deal with road hazards such as speed bumps.

Nuts and Bolts

Nuts are hexagon shaped metal objects with a threaded hole through them so that they can be attached to bolts. Bolts are cylindrical objects with "threads" on the

outside of them which enable them to be threaded into nuts. The hexagon shaped end classifies a "bolt". A "bolt" without an end is classified as a "lug" or "stud."

Most bolts have what is termed as a "right-handed" thread. This is a spiraling thread. If you were inserting a right-handed threaded bolt into a threaded hole, you would turn it clockwise. Some bolts have "left-handed" threads. When inserting this type of bolt, you turn it counter clockwise.

There are many "grades" of nuts and bolts. Grades depend on the quality of the materials and the tolerances observed during the manufacture of the nuts and bolts. The ends of bolts and the faces of nuts are almost always marked with symbols denoting their quality standards. Unfortunately, in recent years it has become apparent through various government investigations, that unscrupulous individuals have been importing nuts and bolts with symbols printed on them that falsely denote a higher quality bolt. In other words, these individuals import and sell lead with gold stamped on it. This doesn't sound particularly dangerous, but in the cases of certain airplane and amusement park incidents, it has been proven that such a business deal, in conjunction with an innocuous object such as a nut or a bolt, can lead to tragedy.

Nuts and bolts are often separated by washers. Washers have many shapes and sizes, but serve one purpose. This purpose is to give the nut and the bolt a firm hardened surface for bedding against. The parts that you put together with nuts and bolts are usually not as strong as the nuts and bolts themselves. The washers allow the nuts and bolts to be fully tightened down, providing a wider area to spread out the force of the tightening. Washers keep the nuts and bolts from digging into the material when they are tightened. Washers shaped like a broken section of a coil are called "lock washers." They are designed to prevent the nut from rattling loose.

"Allen" bolts have socket heads, or a recessed hexagon shaped hole in the top. You need Allen keys or wrenches to tighten or loosen the Allen bolts.

Glove Box

The glove box, or glove compartment, is a small storage cabinet in the dashboard of an automobile. It is used to store small parts which fall off the interior, and usually a few forgotten parking tickets. The smart motorist also keeps the following in the glove box: a flashlight, an air pressure gauge, and a few paper towels.

Hood Release

The hood release is a small lever which is usually mounted under the dash. It is connected to the hood latch by a cable. The hood latch has a safety feature which requires a second latch to be released before the hood will open. This is to prevent accidental opening while driving.

Visor

The visor is a flat sunshade, usually movable. It is attached to the interior of the car at the top of the windshield. Visors protect the eyes of the driver and passengers from the sun's glare.