Vehicle Servicing and Repairing Level II

Learning Guide-#35

Unit of Competence: - Carry out Wheel Alignment

Module Title: - Carrying out Wheel Alignment

LG Code: EIS VSR2 M010 LO1-LG-35

TTLM Code: EIS VSR2 TTLM 0919v1

LO1: Carry out wheel alignment pre-checks

Instruction Sheet	Carry out wheel alignment pre-checks

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Identify nature and scope of work
- Obtain procedures and information
- Operating principles of steering geometry and wheel alignment
- Use of measuring tools and testing equipment
- Wheel alignment procedure
- Perform vehicle/equipment tests
- Carry outing vehicle wheel alignment pre-checks

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, *upon completion of this Learning Guide, you will be able to:*

- Carry out wheel alignment pre-checks
- Perform vehicle wheel alignment
- Complete documentation and service history documents
- Clean up work area and maintain equipment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4” , Self-check 5, Self-check 6, and 7Self-check **in page -6, 9, 12 and 14** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -43.**
6. Do the “LAP test” **in page – 16** (if you are ready).

Information Sheet-1	Identify nature and scope of work

1.1 . Identify nature and scope of work

Scope Planning

You always want to know exactly what work has to be done before you start it. You have a collection of team members, and you need to know exactly what they're going to do to meet the project's objectives. The scope planning process is the very first thing you do to manage your scope. Project scope planning is concerned with the definition of all the work needed to successfully meet the project objectives. The whole idea here is that when you start the project, you need to have a clear picture of all the work that needs to happen on your project, and as the project progresses, you need to keep that scope up to date and written down in the project's scope management plan.

Defining the Scope

You already have a head start on refining the project's objectives in quantifiable terms, but now you need to plan further and write down all the intermediate and final deliverables that you and your team will produce over the course of the project. The deliverables for your project include all of the products or services that you and your team are performing for the client, customer, or sponsor. Project deliverables are tangible outcomes, measurable results, or specific items that must be produced to consider either the project or the project phase completed. Intermediate deliverables, like the objectives, must be specific and verifiable.

All deliverables must be described in a sufficient level of detail so that they can be differentiated from related deliverables. For example:

- A twin engine plane versus a single engine plane
- A red marker versus a green marker
- A daily report versus a weekly report
- A departmental solution versus an enterprise solution

One of the project manager's primary functions is to accurately document the deliverables of the project and then manage the project so that they are produced according to the agreed-on criteria. Deliverables are the output of each development phase, described in a quantifiable way.

Project Requirements

After all the deliverables are identified, the project manager needs to document all the requirements of the project. Requirements describe the characteristics of the final deliverable, whether it is a product or a service. They describe the required functionality that the final deliverable must have or specific conditions the final deliverable must meet in order to satisfy the objectives of the project. A requirement is an objective that must

be met. The project's requirements, defined in the scope plan, describe what a project is supposed to accomplish and how the project is supposed to be created and implemented.

Requirements may include attributes like dimensions, ease of use, colour, specific ingredients, and so on. If we go back to the example of the company producing holiday eggnog, one of the major deliverables is the cartons that hold the eggnog. The requirements for that deliverable may include carton design, photographs that will appear on the carton, color choices, etc.

Requirements specify what the final project deliverable should look like and what it should do. Requirements must be measurable, testable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design. They can be divided into six basic categories: functional, non-functional, technical, business, user, and regulatory requirements.

Functional Requirements

Functional requirements describe the characteristics of the final deliverable in ordinary non-technical language. They should be understandable to the customers, and the customers should play a direct role in their development. Functional requirements are what you want the deliverable to do.

Vehicle Example

If you were buying vehicles for a business, your functional requirement might be: "The vehicles should be able to take up to a one ton load from a warehouse to a shop."

Using the vehicle example, the functional requirement is for a vehicle to take a load from a warehouse to a shop. Without any constraints, the solutions being offered might result in anything from a small to a large truck. Non-functional requirements can be split into two types: performance and development.

To restrict the types of solutions, you might include these performance constraints:

- The purchased trucks should be American-made trucks due to government incentives.
- The load area must be covered.
- The load area must have a height of at least 10 feet.Similarly, for the computer system example, you might specify values for the generic types of performance constraints:

- The response time for information is displayed on the screen for the user.
- The number of hours a system should be available.
- The number of records a system should be able to hold.
- The capacity for growth of the system should be built in.
- The length of time a record should be held for auditing purposes.

For the customer records example, the constraints might be:

- The system should be available from 9 a.m. to 5 p.m.Monday to Friday.
- The system should be able to hold 100,000 customer records initially.

- The system should be able to add 10,000 records a year for 10 years.
- A record should be fully available on the system for at least seven years.

One important point with these examples is that they restrict the number of solution options that are offered to you by the developer. In addition to the performance constraints, you may include some development constraints.

There are three general types of non-functional development constraints:

- **Time**: When a deliverable should be delivered
- **Resource**: How much money is available to develop the deliverable
- **Quality**: Any standards that are used to develop the deliverable, development methods, etc.

Technical Requirements

Technical requirements emerge from the functional requirements to answer the questions: how will the problem be solved this time and will it be solved technologically and/or procedurally? They specify how the system needs to be designed and implemented to provide required functionality and fulfill required operational characteristics.

For example, in a software project, the functional requirements may stipulate that a database system will be developed to allow access to financial data through a remote terminal. The corresponding technical requirements would spell out the required data elements, the language in which the database management system will be written (due to existing knowledge in-house), the hardware on which the system will run (due to existing infrastructure), telecommunication protocols that should be used, and so forth.

Business Requirements

Business requirements are the needs of the sponsoring organization, always from a management perspective. Business requirements are statements of the business rationale for the project. They are usually expressed in broad outcomes, satisfying the business needs, rather than specific functions the system must perform. These requirements grow out of the vision for the product that, in turn, is driven by mission (or business) goals and objectives.

User Requirements

User requirements describe what the users need to do with the system or product. The focus is on the user experience with the system under all scenarios. These requirements are the input for the next development phases: user-interface design and system test cases design.

Regulatory requirements

Regulatory requirements can be internal or external and are usually **non-negotiable**. They are the restrictions, licenses, and laws applicable to a product or business that are imposed by the government.

Software Requirements Fundamentals

This section refers to requirements of “software” because it is concerned with problems to be addressed by software. A software requirement is a property that must be exhibited by software developed or adapted to solve a particular problem. The problem may be to automate part of a task of someone who will use the software, to support the business processes of the organization that has commissioned the software, to correct short comings of existing software, to control a device, etc. The functioning of users, business processes, and devices is typically complex.

An essential property of all software requirements is that they be verifiable. It may be difficult or costly to verify certain software requirements. For example, verification of the throughput requirement on a call centre may necessitate the development of simulation software. Both the software requirements and software quality personnel must ensure that the requirements can be verified within the available resource constraints. Requirements have other attributes in addition to the behavioral properties that they express.

Measuring Requirements

As a practical matter, it is typically useful to have some concept of the volume of the requirements for a particular software product. This number is useful in evaluating the size of a change in requirements, in estimating the cost of a development or maintenance task, or simply in using it as the denominator in other measurements (see Table 9.1).

Table 9.1: Measuring Requirement

Property	**Measure**
Speed	Processed transactions/second User/Event response time Screen refresh time
Size	K Bytes Number of RAM chips
Ease of use	Training time Number of help frames
Reliability	Mean time to failure Probability of unavailability Rate of failure occurrence Availability
Robustness	Time to restart after failure Percentage of events causing failure Probability of data corruption on failure

Portability	Percentage of target dependent statements Number of target systems

Techniques certainly being a seasoned project manager broadens the repertoire of one's scope planning techniques. An experienced project manager can draw on past experiences with like projects to determine the work that is realistically doable, given time and cost constraints, for a current project. Project managers need to educate stakeholders about the project impacts of some requirements. It may also have an impact on project quality. Some aspects of the project may be unfeasible – stakeholders need to know this so they can adjust their vision or prepare for future challenges.

Gathering requirements is part of scope definition, and it can be done using one or more of following techniques:

- Interviews
- Focus groups
- Observation
- Questions and surveys
- Group decision-making techniques: unanimity, majority, plurality, dictatorship

Requirements Traceability Matrix

The requirements traceability matrix is a table that links requirements to their origin and traces them throughout the project life cycle.. It provides a means to track requirements throughout the project life cycle, helping to ensure that requirements approved in the requirements documentation are delivered at the end of the project. Finally, it provides a structure for managing changes to the product scope. This process includes, but is not limited to, tracking:

- Requirements to business needs, opportunities, goals, and objectives
- Requirements to project objectives
- Requirements to project scope/work breakdown structure deliverables

Attributes associated with each requirement can be recorded in the requirements traceability matrix. These attributes help to define key information about the requirement. The term local resources (or community resources similar term) are assets in a community that help meet certain needs for those around them.

Self-Check 1	Written Test

1 , who, what, where, when, how much, and how does a business process work?

2 , For a computer system you may define what the system is to do:?

Information Sheet-2	**Obtain procedures and information**

. **Obtain procedures and information**

The vehicle must have proper straight- line performance for stable *driving, cornering performance* for *driving around curves*, *recovery force for returning to the straight-line condition*, the capacity to soften the shock transmitted to the suspension when the tires are impacted, etc.

Therefore, the wheels of a vehicle are mounted at specific angles to the ground and specific suspensions for each purpose.

Wheel alignment - is the adjustment of the suspension and steering to ensure proper vehicle handling with minimum tire wear.

When a vehicle is *new*, the alignment angles are set at the *factory*. After many miles and/or months of driving, the alignment angles can change slightly.

By adjusting the suspension and steering components, proper alignment angles can be restored. An alignment includes *checking and adjusting*, if necessary, both front and rear wheels.
The main purpose of wheel alignment is to make the tires roll without *scuffing, slipping*, or *dragging* under all operating conditions Wheel balancing procedure

Clean all dirt and foreign matter from the wheels and remove all wheel weights.

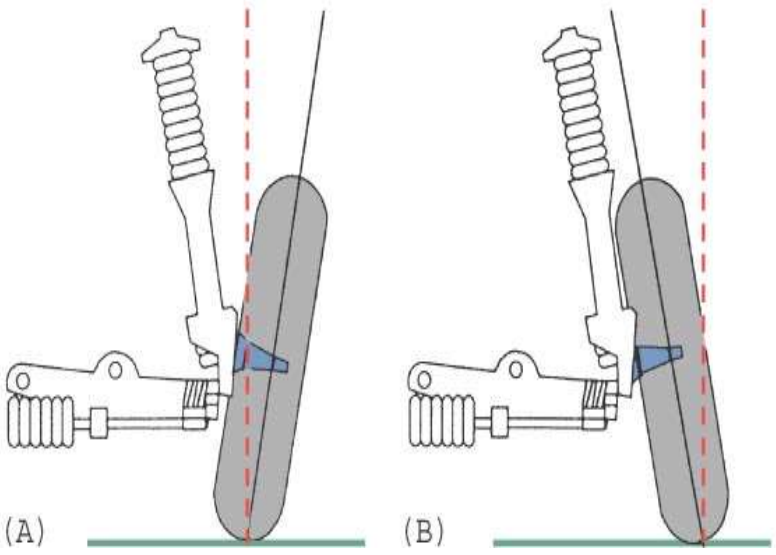
1. Clean larger stones from the tire tread.
2. Check and correct tire and wheel run out in ex
3. Cases of specifications.
4. Correct the tire inflation pressure.
5. Operating principles of steering geometry and wheel alignment

Steering Geometry Steering geometry is the term manufacturers use to describe steering and wheel alignment. The six fundamental angles or specifications that are required for a proper wheel alignment are caster Wheel alignment geometry describes the positioning of the wheels, tires, and suspension components in relation to each other and to the vehicle as a whole. Proper relationships between these elements are necessary for safe, responsive handling, and maximum tire life. Listed below are the primary elements that comprise a vehicle's wheel alignment geometry Wheel Alignment

The purpose of these adjustments is maximum tire life and a vehicle that tracks straight and true when driving along a straight and level road.

Wheel Alignment is often confused with Wheel Balancing. The two really have nothing to do with each other except for the fact that they affect ride and handling. If a wheel is out of balance, it will cause a vibration at highway speeds that can be felt in the steering wheel and/or the seat. If the alignment is out, it can cause excessive tire wear and steering or tracking problems If you know anything about wheel alignment, you've probably heard the terms Camber, Caster and Toe-in.

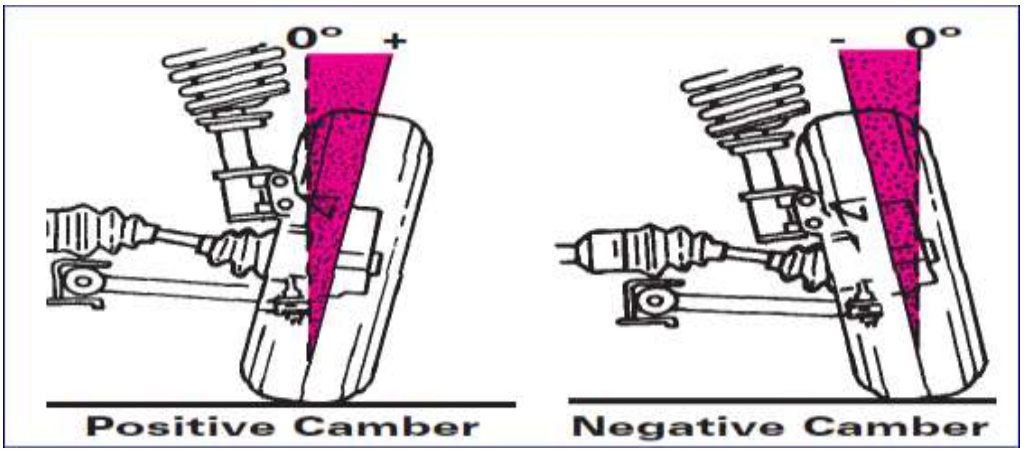
Camber



Camber is the angle of the wheel, measured in degrees, when viewed from the front of the vehicle. If the top of the wheel is leaning out from the centre of the car, then the camber is positive, if it's leaning in, then the camber is negative. If the camber is out of adjustment, it will cause tire wear on one side of the tire's tread. If the camber is too far negative, for instance, then the tire will wear on the inside of the tread.

Camber wear pattern

If the camber is different from side to side it can cause a pulling problem. The vehicle will pull to the side with the more positive camber.



Caster

Caster Is the forward or rearward tilt of the steering axis in reference to a vertical line as viewed from the side of the vehicle. The steering axis is defined as the line drawn through the upper and lower steering pivot points. Zero caster means the steering axis is straight up and down. This is also called 0 degrees or perfectly vertical, as shown.

Caster - is the angle between an imaginary line drawn through the upper and lower steering pivots and a line perpendicular to the road surface (viewed from side of vehicle). If the top of the line tilts rearward, the vehicle is said to have “POSITIVE” caster. If the top of the line tilts forward, the vehicle is said to have “NEGATIVE” caster. By setting the caster angle on the driver’s side ½ degree less than the passenger side for positive caster specifications or 1/2 degree more for negative caster specifications, the road crown should not cause vehicle pull in either direction.

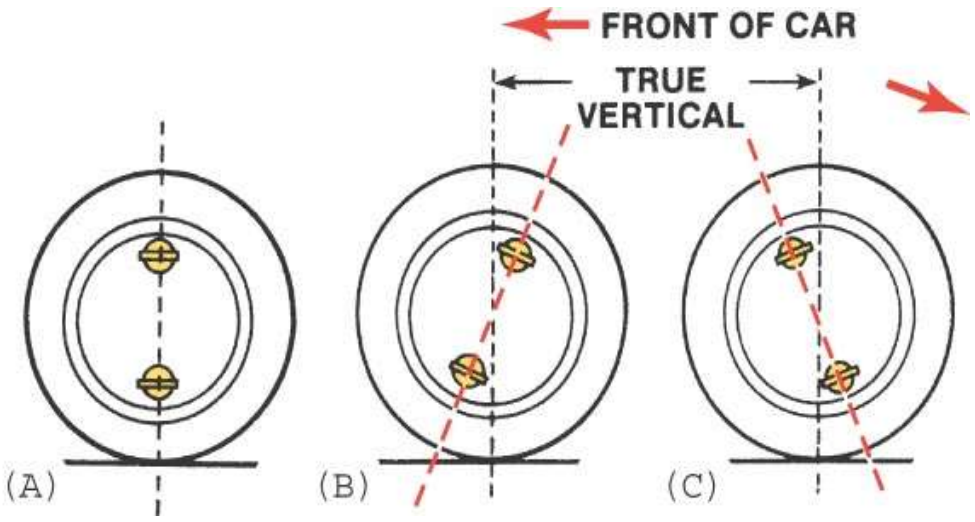
Caster is designed to provide steering stability. The caster angle for each wheel on an axle should be equal. Caster is affected by worn or loose ball joints, strut rods, and control arm bushings.

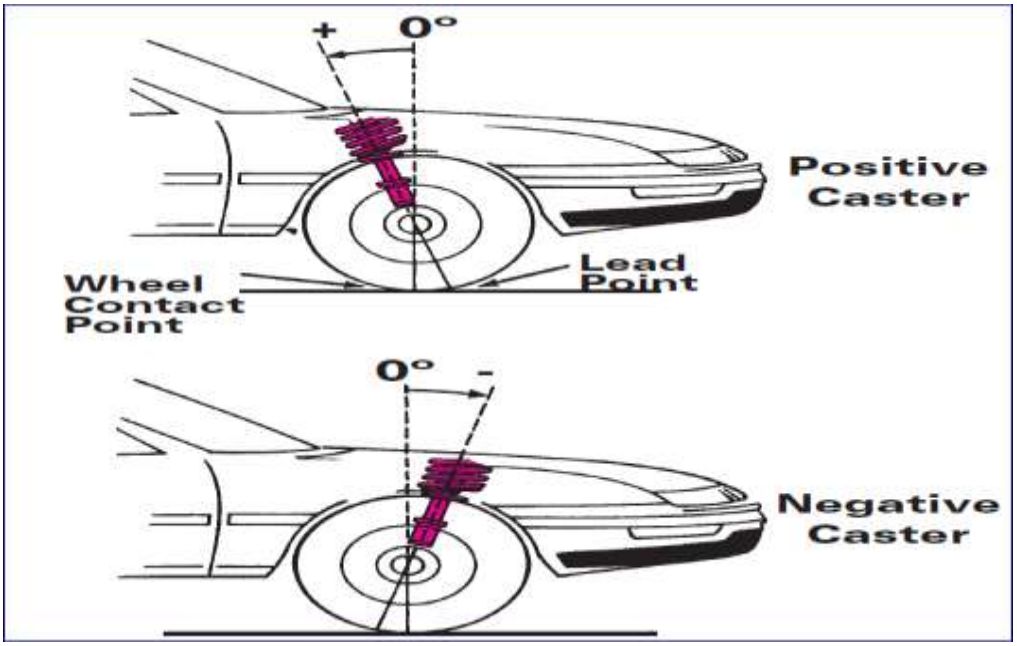
Purpose of Positive Caster: Tilts the top of the steering knuckle toward the rear of the vehicle. Most common on vehicles with power steering.

Camber is designed into the vehicle to compensate for road crown, passenger weight, and vehicle weight. Camber is usually set equally for each wheel. Equal camber means each wheel is tilted outward or inward the same amount. Unequal camber causes tire wear and causes the vehicle to pull toward the side that is more positive.

Is the inward or outward tilt of the wheels from true vertical as viewed from the front of the vehicle? If the wheel is true vertical, camber is zero (0 degrees). When you turn the steering wheel, the front wheels respond by turning on a pivot attached to the suspension system. Caster is the angle of this steering pivot, measured in degrees, when viewed from the side of the vehicle. If the top of the pivot is leaning toward the rear of the car, then the caster is positive, if it is leaning toward the front, it is negative. If the caster is out of adjustment, it can cause problems in straight line tracking. If the caster is different from side to side, the vehicle will pull to the side with the less positive caster. If the caster is equal but too negative, the steering will be light and the vehicle will wander and be difficult to keep in a straight line. If the caster is equal but too positive, the steering will be heavy and the steering wheel may kick when you hit a bump. Caster has little affected on tire wear.

The best way to visualize caster is to picture a shopping cart caster. When the wheel is behind the pivot at the point where it contacts the ground, it is in positive caster. Picture yourself trying to push the cart and keep the wheel ahead of the pivot. The wheel will continually try to turn from straight ahead. That is what happens when a car has the caster set too far negative. Like camber, on many front wheel-drive vehicles, caster is not adjustable. If the caster is out on these cars, indicates that something is worn or bent, possibly from an accident, and must be repaired **Caster**





Toe-in

The toe measurement is the difference in the distance between the front of the tires and the back of the tires. It is measured in fractions of an inch in the US and is usually set close to zero which means that the wheels are parallel with each other. Toe-in means that the fronts of the tires are closer to each other than the rears. Toe-out is just the opposite. An incorrect toe in will cause rapid tire wear to both tires equally. This type of tire wear is called a saw-tooth wear pattern as shown in this illustration.

If the sharp edges of the tread sections are pointing to the centre of the car, then there is too much toe-in. If they are pointed to the outside of the car then there is too much toe-out. Toe is always adjustable on the front wheels and on some cars, is also adjustable for the rear wheels.

, camber, toe, steering axis incrimination, toe-out on turns, tracking, and scrub radius. **6.1.1** Caster Caster is the steering angle that uses the weight and momentum of the vehicle's chassis to lead the front wheels in a straight path (Figure 14-45). Caster is the backward or forward tilt of the steering axis that tends to stabilize steering in a straight direction by placing the weight of the vehicle either ahead or behind the area of tire-to-road contact. Caster controls where the tire touches the road in relation to an imaginary centre line drawn through the spindle support. It is NOT a tire wear angle. The basic purposes for caster are as follows:

- To aid directional control of the vehicle.
- To cause the wheels to return to the straight ahead position.

• To offset road crown pull (steering wheel pull caused by the slope of the road surface). Caster is measured in DEGREES starting at the true vertical (plumb line). Manufacturers give specifications for caster as a specific number of degrees positive or negative. Typically, specifications list more positive caster for vehicles with power steering and more negative caster for vehicles with manual steering (to ease steering effort). Depending upon the vehicle manufacturer and type of suspension, caster may be adjusted by using wedges or shims, eccentric cams, or adjustable struts. Negative caster tilts the top of the steering knuckle toward the front of the vehicle. With negative caster, the wheels will be easier to turn. Positive caster tilts the top of the steering knuckle towards the rear of the vehicle. Positive caster helps keep the wheels of the vehicle travelling in a straight line. When you turn the wheels, it lifts the vehicle. Since this takes extra turning effort, the wheels resist turning and try to return to the straight-ahead position. Figure 14-45 — Caster angle.

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Camber is the inward and outward tilt of the wheel and tire assembly when viewed from the front of the vehicle. It controls whether the tire tread touches the road surface evenly. Camber is a tire-wearing angle measured in degrees. The purposes for camber are as follows:

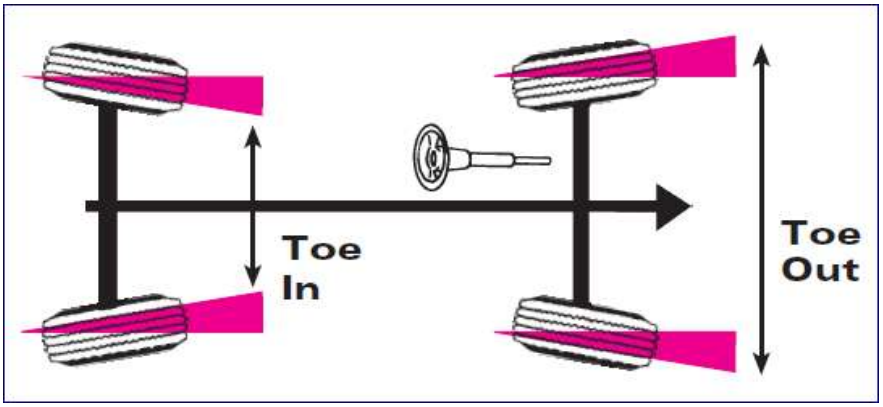
• To aid steering by placing vehicle weight on the inner end of the spindle.

• To prevent tire wear on the outer or inner tread.

• To load the larger inner wheel bearing. Positive and negative camber is measured from the true vertical (plumb line) (Figure 14-46). If the wheel is aligned with the plumb line, camber is zero.

With positive camber, the tops of the wheels tilt outward when viewed from the front. With negative camber, the tops of the wheels tilt inward when viewed from the front. Most vehicle manufacturers suggest a slight positive camber setting from a 1/4 to a 1/2 degree.

1.1 Toe-in is produced when the front wheels are closer together in the front than at the rear when measured at the hub height**. Toe-in** causes the wheels to point inward at the front. Toe-out results when the front of the wheels is farther apart than the rear. Toe-out causes the front of the wheels to point away from each other. The type of drive (rear or front wheel) determines the toe settings. Rear-wheel drive vehicles are usually set to have toe-in at the front wheels. This design is due to the front Figure 14-46 — Camber angle. Figure 14-47 — Toe-in and out



Self check-2	Written

1 Is the inward or outward tilt of the wheels from true vertical as viewed from the front of the vehicle?

Operation Sheet-2	Obtain procedures and information

Operation Title: installing new wheels Purpose: After inspection to replace the wheel and there components

Equipment, Tools and Materials: all the above

Procedure

1. using a torque wrench, tighten the lug nuts in a crises-cross pattern to specifications.
2. If so equipped, install the wheel cover or hub cap. Make sure the valve stem protrudes through the proper opening before tapping the wheel cover into position.
3. If equipped, install the lug nut trim caps by pushing them or screwing them on, as applicable.

4. Remove the jack from under the vehicle. If you have just finished changing a flat, place the jack and tire iron/wrench in their storage compartments.

5. Remove the wheel chock(s).

6.If you have removed a flat or damaged tire, place it in the storage compartment of the vehicle and take it to your local repair station to have it fixed or replaced as soon as possible.

7. Tightening wheel lug nuts.

Information Sheet-3	**Use of measuring tools and testing equipment**

Use of measuring tools and testing equipment

NI Test and Measurement Equipment create better performance at lower cost. Design Systems Faster. Low Obsolescence. Open Architecture. Decrease Test Costs. Industry Leading Testing. Modular Hardware. Unmatched Versatility. Global Service & Support. A measuring instrument is a device for measuring a physical quantity. In the physical sciences, quality assurance, and engineering, measurement is the activity of obtaining and comparing physical quantities of real-world objects and events. Use these invaluable tools to measure twice and cut once.

- 1 Tape Measure. A well-worn tape measure signifies a builder who takes their work seriously. ...

- 2 Speed Square. A speed square can be found on the hip of carpenters and DIYers everywhere. ...
- 3 Protractors. ...
- 4 Mechanical Carpenter's Pencil. ...

5 Laser Measure.

Use these invaluable tools to measure twice and cut once.

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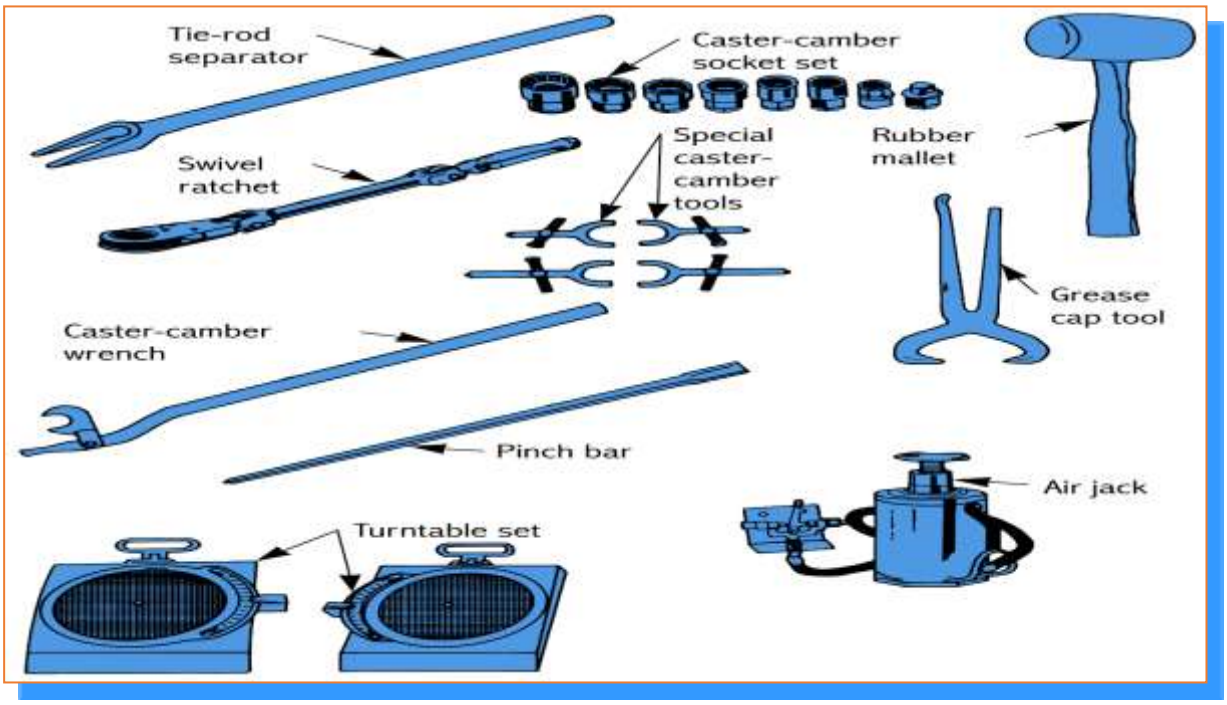
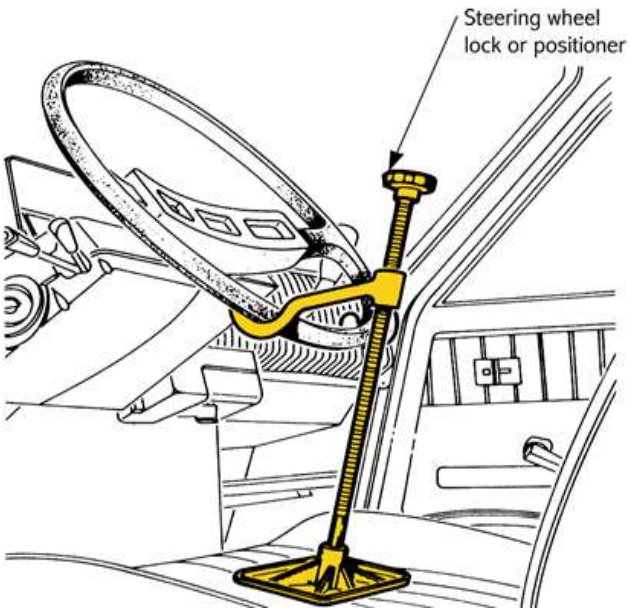
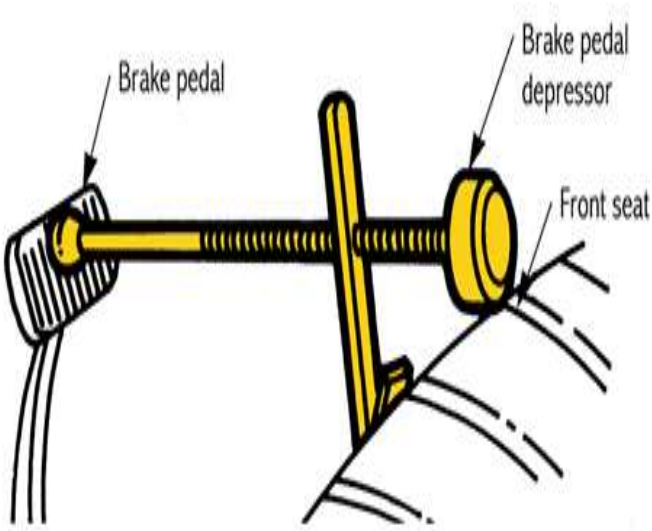
3 Protractors. ...
4 Mechanical Carpenter's Pencil. ...
5 Laser Measure. List of measuring device

	Device	Quantity measured
1	Magnetometer	strength of magnetic fields
2	Manometer	pressure of gas
3	mass flow meter	mass flow rate of a fluid travelling through a tube
4	mass spectrometer	masses of ions, used to identify chemical substances through their mass spectra

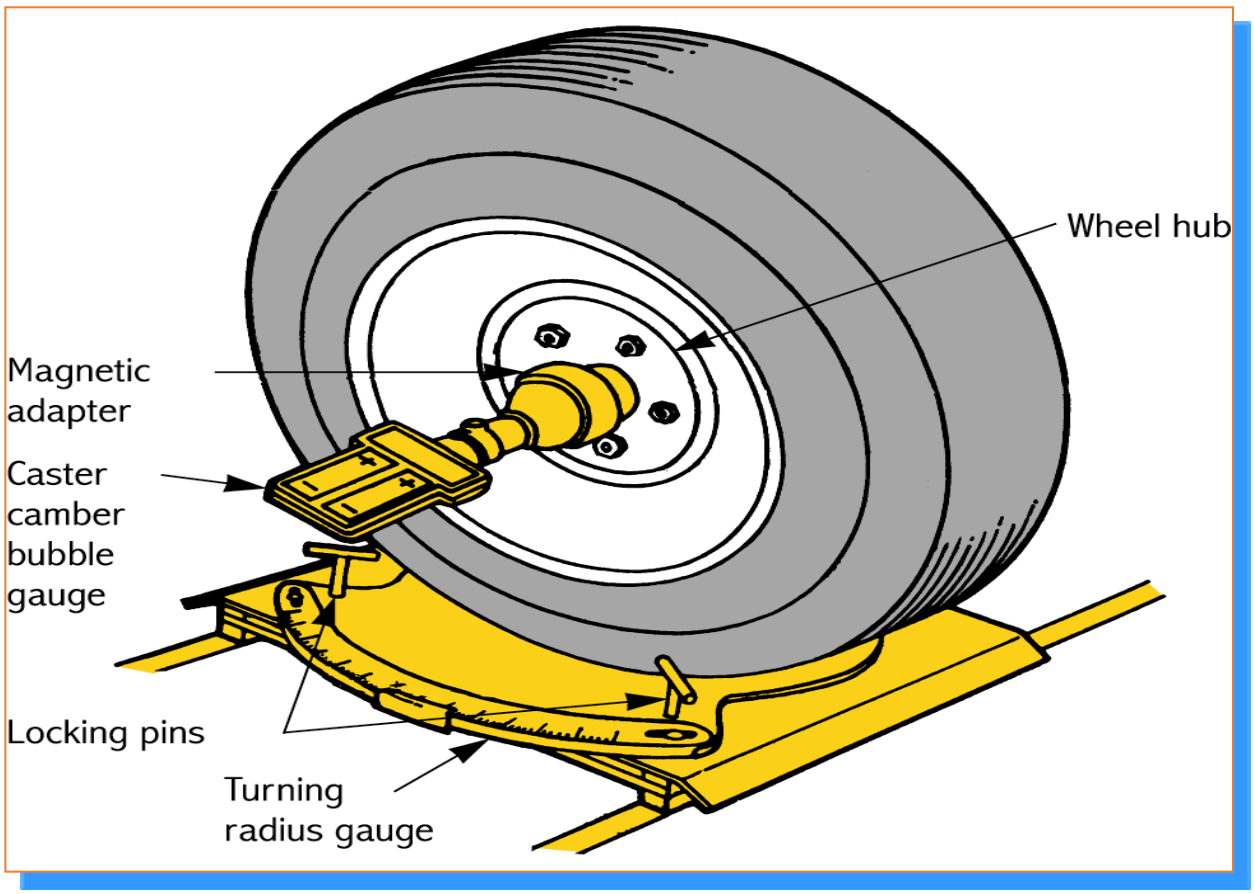






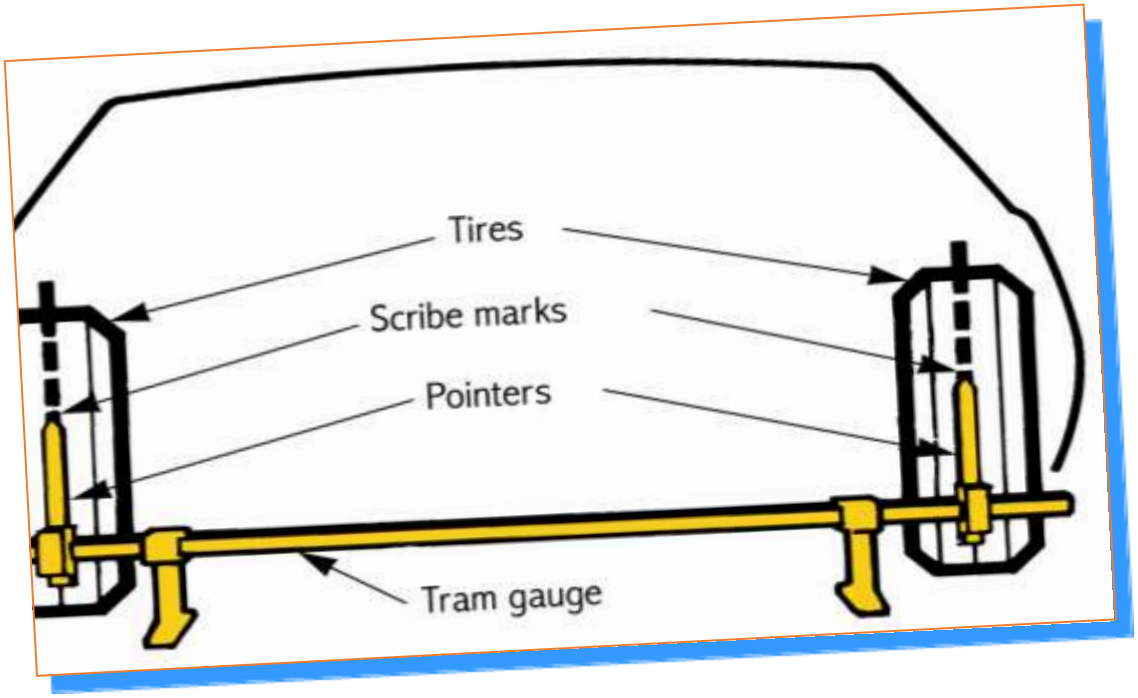
Caster-Camber Gauge

- ❑ Used with the turning radius gauge to measure caster and camber in degrees
- ❑ Secured on the wheel hub magnetically or it may fasten on the wheel rim
- ❑ Caster and camber are adjusted together since one adjustment may affect the other



Tram Gauge

- ✓ Used to compare the distance between the front and rear of a vehicle's tires for checking toe adjustment.



- Wheel alignment procedure
- The order of adjustment – caster, camber, and then toe – is recommended for all vehicles
- Refer to the manufacturer's service manual for details
- Mount the alignment equipment, following the equipment manufacturer's instructions
- Check steering and axis inclination and camber, caster, turning radius and toe
- Document your readings and adjustment value after removing the tire from the rim probe repairable tire injuries in order to remove a nail or other damaging material. Take care not to damage the liner or expose any cords. Lubricate the injury by pushing the snout of the vulcanizing fluid can into the injury from both sides of the tire. Also pour vulcanizing fluid on the insertion tool and push it through with a twisting motion until it can be inserted and withdrawn easily. Using a head-type or head less straight plug slightly larger than the size of the injury, place it in the eye of the insertion tool. When a headless straight plug is used, always back it up with a patch. Always pour directly from the can so as not to contaminate the can's contents.

Self check	**Written**

5. Without bumping the tram gauge pointers, reposition the gauge to the front of the tires.

Identify type of wheel alignment check functionally and (Normal (30m)

Operation sheet	**measuring tools and testing equipment**

Equipment; Magnetometer, mass flow meter mass spectrometer, Magnetometer, Manometer, Caster-Camber Gauge and Tram Gauge

Procedure; for using a tram gauge for measuring toe are as follows:

1. Raise the front wheels of the vehicle and rub a chalk line all the way around the center rib on each tire.
2. With a scribing tool, rotate each tire and scribe a fine line on the chalk line. This will give you a very thin reference line for measuring the distance between the tires.
3. Lower the vehicle back on the turning radius gauges.
4. Position the tram gauge at the back of the tires. Move the pointers until they line up with the scribe marks on the tires.

Identify type of wheel alignment check functionally and (Normal (30m

Information Sheet-3	Perform, vehicle/equipment test

Perform, vehicle/equipment test

Modern systems are computerized; many use LEDs and CCD cameras to determine wheel position. Alignment information is displayed on screen and can be printed for the customer. Alignment equipment and racks need maintenance and care to provide reliable service.

Autonomous driving and ADAS have a huge impact on vehicle networking architectures. Increasing data volume and the centralization of ECUs are not only a challenge for architectures – they also require a new generation of testing equipment for automotive data logging that offers sufficient bandwidth, provides a rich number of interfaces and is able to deal with the amount of communication happening within a multicourse ECU. The logger PM-200 and its extensions can be individually combined to fit any automotive data logging use case.

1.3.1 Check condition of suspension

Removal of chemical waste

Always read the material safety data sheet (MSDS). This should have directions for correct disposal of chemical waste Follow these instructions exactly Some chemicals should not be flushed down the drain as they could be corrosive or impact on the environment Use a registered accredited commercial chemical waste disposal company. Items that should be professionally disposed of:

Acids Alkalis Aerosols Waxes Paint cans Paint thinners Solvents.

1.3.2 **Damage**

that is generally caused by hitting a curb or median at high speeds, resulting in one corner or side of the vehicle being higher than another; typically detected by a low or sagging corner, as if the suspension were broken

A. *Road hazards, including, without limitation: Puncture,*

. Improper use or operation, including, without limitation:

B. *Improper use or operation, including, without limitation***:**

Improper inflation pressure, overloading, tire/wheel spinning, use of an improper wheel, tire chain damage, Misuse, misapplication, negligence, tire alteration, or for Racing or competition purposes.

C. *Insufficient or improper maintenance, including, without*

Limitation: Failure to rotate tires as recommended in this manual, wheel misalignment, worn suspension components, improper tire mounting or demounting,

Tire/wheel assembly imbalance, or other vehicle.

1.3.3 **Corrosion and ageing**

. Ageing treatment This alloy rod was machined into 12 mm diameter and 10 mm length for corrosion samples. These samples are used for Heat treatment process. First, we did solution treatment (ST) of all samples at 545°C for three hours and subsequent quenched in water medium in room temperature and then ageing was done at two temperatures .The corrosion behavior of alloys was explored foe as received and after ageing treatment samples.

After cloth polishing samples were etched with Keller's reagent for 30 seconds and washed. 1. The entire sample was cleaned in ethanol before the corrosion test. These cleaned sample were attached in the flat cell and the was filled with 250ml of electrolyte solution. After filling electrolyte solution in flat cell, working electrode, counter electrode and reface electrode were connected respectively with the corrosion testing sample, platinum mesh electrode and reference electrode tube. The potential dynamic polarization test were performed with 1 mV/s scan rate.

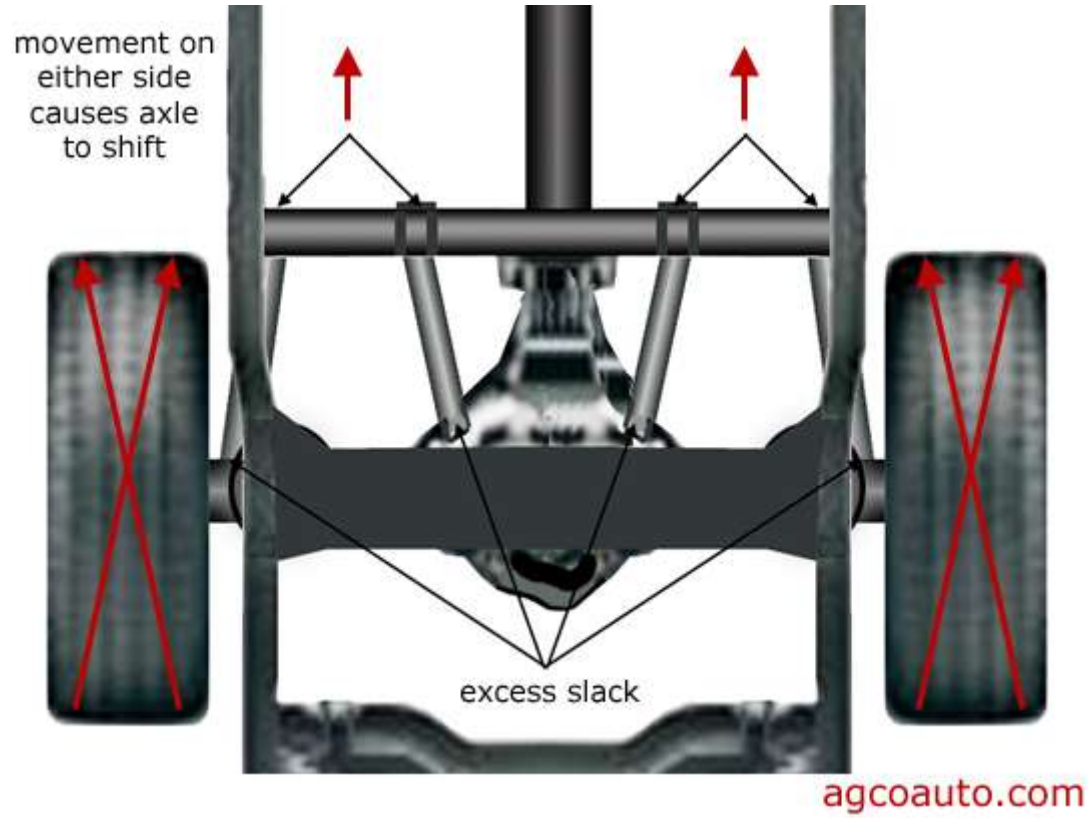
After corrosion test corrode surface structure study was carried out on Zeist microscope.

1.3.4 Excessive slackness and excessive wear

Because of the rigorous routine the front suspension must endure, the front tires have to work much harder than the rear tires. Even when the suspension is in good condition and the alignment is set correctly, the front tires will wear faster than the rear tires in most cases. This is the reason for tire rotation at regular intervals.

When an abnormal condition develops in the suspension system, it will usually affect the tires and ride. When this happens, one or even both tires can be affected and begin a wear pattern characteristic of the problem. If a vehicle has a suspension malfunction, the wear pattern of the tire should readily show what the problem is. Typically where multiple malfunctions have existed for many miles, attempting to get an accurate

diagnosis can be difficult or impossible.



1.3.5 Excessive clearance,

❖ Condition Possible Cause Camber

Not Adjustable Control arm bent. Frame bent. Hub and bearings not properly seated. Sagging sprig

❖ Front End Shimmy

Excessive wheel/rim runs out. Power steering reaction bracket loose. Steering gear box(rack) mount loose. Steering gear adjustment loose. Tires out of balance. Tires out of round. Wheel bearings worn o r loose. Worn steering/suspension components.

❖ Hard Steering Ball joint tight or seized.

Bent steering knuckle or supports. Damaged suspension components. Front tire pressure low. Idler arm bushing too tight. Power steering fluid low or belt loose. Power steering pump defective. Steering gear out of adjustment.

1.3.6 Proper fitting

The tires for automotive use have many tough functions to perform, for which they must possess some desirable properties. It is seen that some of these properties are conflicting with others, so that the final tire design must incorporate an optimum combination of all these. The desirable properties are:

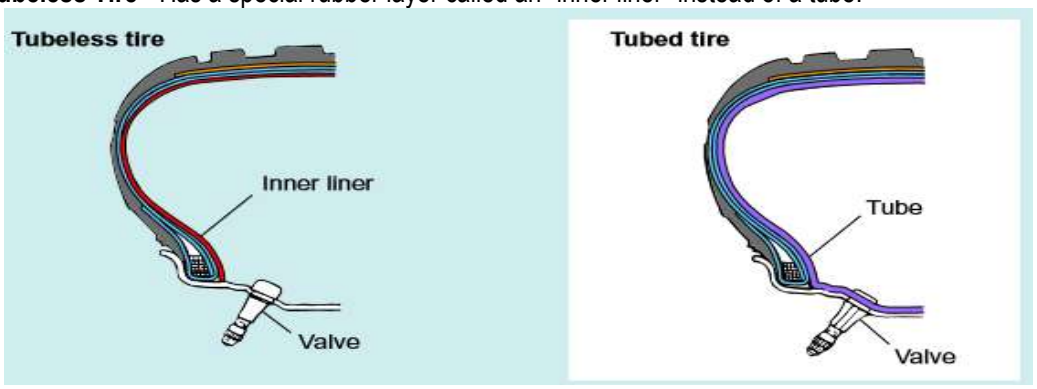
1. Load carrying: The tire should be able to carry the weight of the vehicle and its occupants without distortion. The tire material should resist bending, tensile, compressive and tensional stresses some of which come up during steering and braking.
2. Cushioning: It should absorb the shock loads caused due to road irregularities and damp the vibrations fast.
3. Uniform Wear: The tire should not develop skidding even on wet roads. Uniform wear reduces tire skid and vibrations due to road irregularities.

Types of Tires

TUBED & TUBELESS TIRE

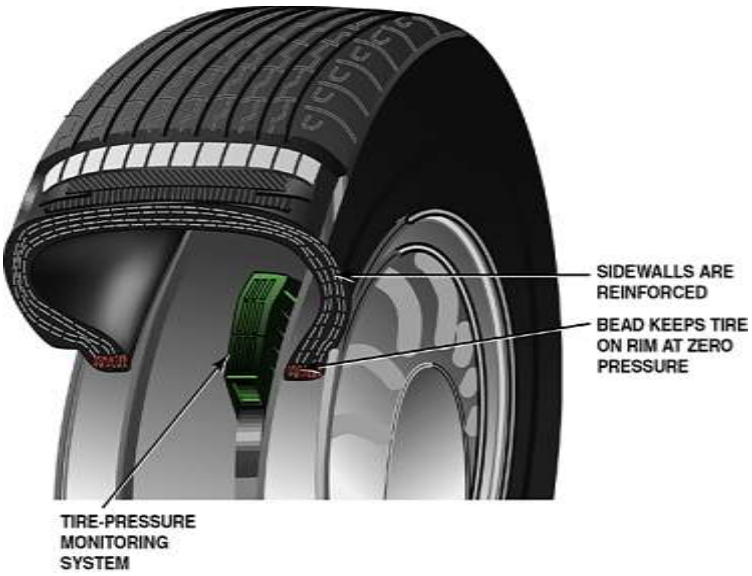
a) **Tubed Tire -** Contains inner tube that is inflated with air.
Inner tube – is a rubber doughnut inflated with air and install inside the tire.

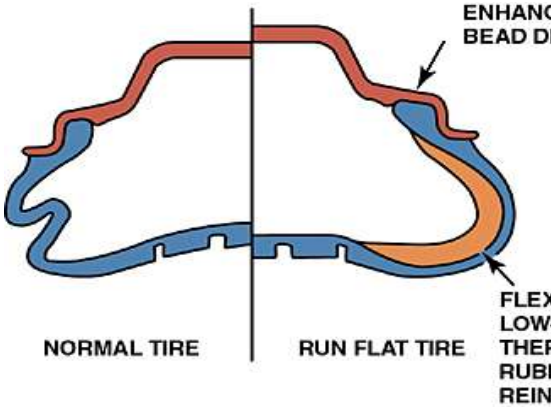
b) **Tubeless Tire** - Has a special rubber layer called an "inner liner" instead of a tube.



1. RUN FLAT TIRE

This tires' sidewalls contain reinforced rubber, so even if a vehicle equipped with this tire has a puncture while driving, and the air pressure drops to zero, it can continue to travel another 100 km (62 mile) at a maximum speed of 60 km/h (37 mph). Run-flat tires *(abbreviated RFT)*. A typical run-flat tire (also called *extended mobility tire* [EMT] or *zero pressure* [ZP] *tire*) requires the use of an *air pressure sensor/transmitter* and a *dash-mounted receiver* to warn the driver that a tire has lost pressure. Due to reinforced sidewalls, the vehicle handles almost the same with or without air pressure.





PAX Run-Flat Tires - Michelin developed a run-flat tire that has three unique components:

- A **special wheel** that has two bead seats that is of different diameters. The outside bead seat is 10 mm smaller in diameter than the inside bead seat. This means that a conventional tire cannot be installed on a PAX-style wheel.
- A **urethane support ring** that is designed to support the weight of the vehicle in the event of a flat tire.
- A **special tire** that is designed to operate without air.

P245/680R 460A 102V

P	= passenger
245	= the cross-section width in millimeters (mm)
680	= the tire diameter in mm (26.77 inches)
R	= radial ply construction
460	= the wheel, diameter in mm (18.1 inches)
A	= asymmetric wheel, meaning that one bead is smaller than the other bead by 10 mm (0.040 in.)
102	= the load index
V	= the speed rating

Tire

The use of solid tires on automobile is now obsolete and only the pneumatic tires are used universally. These pneumatic tires are of two types, i.e., the conventional type with a tube and tubeless tire.

2 **Conventional tube tire**:

It consists of two main parts, i.e., the carcass and the tread.

The carcass is the basic structure taking mainly the various loads and consists of a number of plies wound in a particular fashion from the cords of rayon or any other suitable material. Each cord in each ply is covered with resilient rubber compounds and all the plies are insulated against each other. The term ' ply rating' which is often used in tyre industry does not indicate exact number of plies in the tire. It is only a relative index of tyre strength and load. Carrying capacity. A four ply rating tire, for example, may actually have only two plies.

The tread is the part of the tyre which contacts the road surface when the wheel rolls. It is generally made of synthetic rubber and on the design of the tire tread depend various tyre properties, i.e., the grip, the noise and the wear. Between the bead and tread, outer rubber covering of the carcass is called the side wall.

3Tubeless tire:

The material and design of the carcass and tread remain similar to the tube type of tire. The inside of the casing is lined with a soft rubber lining which forms an air tight seal with the rim. This lining retains the air and seals itself on being punctured.

The tubeless tires posses the following advantages over the conventional tube tires:

\Lesser unsparing weight- Being lighter, unsparing weight is reduced, reducing wheel bounce.

Better cooling- In case of tube tires, heat in the compressed air has to pass through the tube material, i.e., rubber which is not a good conductor of heat. Since there is no tube in the tubeless tires, heat can be passed on to the atmosphere directly resulting in better cooling there by increasing the tire life.

Slower leakage of air – since the liner in the tubeless tires is not stretched like the tube, it retains the air better resulting in its slower leakage.

Simpler Assembly – only the tire has to be fitted over the rim. There is no danger of the tube being punctured during assembly.

Improved safety – In case of any hole being caused in the tire, the same can be repaired simply by plugging, whereas in case of the conventional tires, it takes quite some time to remove the tube for repair.

Thus the chances of sudden tire puncture leading to accident are reduced and any tire damage shows up only as a low leak. Further such tires retain the air pressure by virtue of their perfect seal with the wheel rim

Self check	**Written**

1 What is the difference of tubeless tire and tube tire?

3 what is the advantage of convectional tire ?

4 how can control the Excessive clearance wheel and tire?

5 Sequence of preparing clean and organized service work station

6 Steps to be undertaken to meet work of clean work area for repair?

Operation sheet 3	**vehicle/equipment test**

Equipment ;Tools and Materials: safety stand, hydraulic jack, cross wrench, chalk, and vehicle with wheel

Purpose: to check the condition of the wheel hub and brake system components

Procedure 1. Park the vehicle on a level surface.

2. Remove the jack, tire iron and, if necessary, the spare tire from their storage compartments. 3. Check the owner's manual for the jacking points on your vehicle. Then, place the jack in the proper position.

4. If equipped with lug nut trim caps, remove them by either unscrewing or pulling them off the lug nuts, as appropriate. Consult the owner's manual, if necessary.

5. If equipped, remove the wheel cover or hub cap. In most cases there is a groove along the cover's edge, insert the tapered end of the tire iron in the groove and pry off the cover.

6. Apply the parking brake and block the diagonally opposite wheel with a wheel chock or two.

Note: Use the wheel lug torque specifications from the owner's manual, shop manual, new car dealer or other reliable source. The chart provided below lists typical torque values and should only be used temporarily to move the vehicle from the service area until the proper torque spec can be obtained.

Information Sheet-4	**Carry out vehicle wheel alignment pre-checks**

Carry out vehicle wheel alignment pre-checks

Different car models have different alignment specifications which are determined by the manufacturers. We use a special computerized alignment machine that is pre-loaded with every vehicle's alignment specifications. Once the vehicle type is determined, the high tech and precise measuring begins.

- ✓ Before attempting wheel alignment, make sure all steering-related and suspension-related parts are in good condition.
- ✓ It is impossible to properly align the wheels on a vehicle with worn or damaged parts.
- ✓ Check for the following:
  - loose wheel bearings
  - wheel or tire run out
  - worn tires
  - tires of different sizes and types
  - incorrect tire inflation
  - worn steering or suspension components
  - incorrect curb height and weight incorrect cradle adjustment

Wheel alignment pre-check

Incorrect wheel alignment results in a vehicle that may pull or be hard to steer and causes rapid or improper wearing of the tires. A pre-alignment inspection is performed to ensure that the vehicle is an appropriate candidate for alignment. Worn and loose suspension or steering components, low tire pressure, and heavy objects in the trunk make it impossible to perform an accurate alignment. As with any diagnosis, verifying the customer's concern is the first step. Be sure to test-drive the vehicle prior to the pre-alignment inspection, listening carefully for any unusual noises and noting any improper driving control issues related to the suspension and steering systems.

To perform a pre-alignment inspection, follow the steps in skill Drill 29-18:

1 Remove any heavy items from the trunk and passenger compartments. Do not remove any item or equipment that is supplied with the vehicle and normally kept in the vehicle.

2 Check all four tires for proper tire size, and adjust tire pressure to specifications.

3 Check the vehicle's ride height. Carrying out a successful wheel alignment with the vehicle's ride height incorrect is impossible.

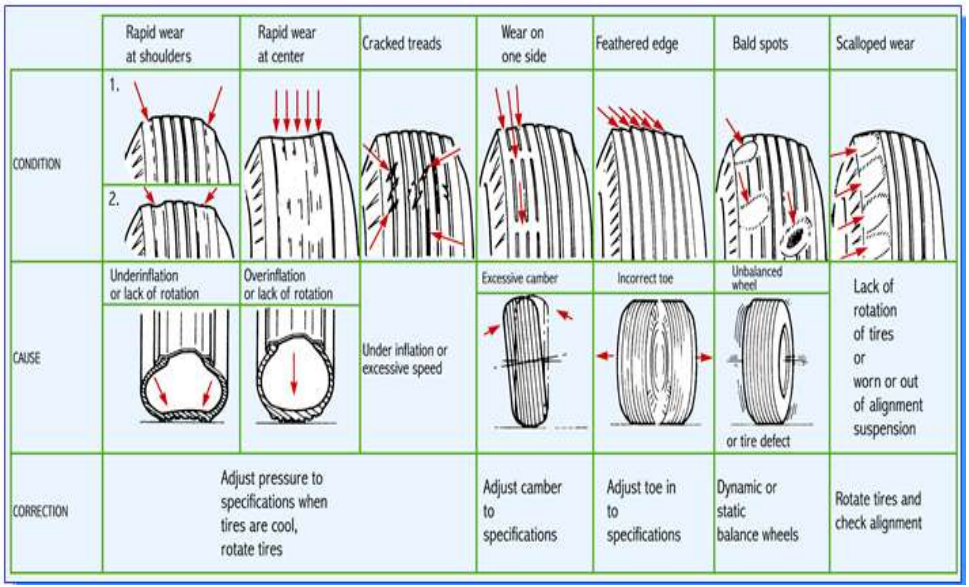
4 Check the play of the steering wheel. Excess play must be corrected before undertaking the wheel alignment.

Bounce each corner of the vehicle to check the correct functioning of the shock absorbers.

6 With the vehicle raised on a hoist or jack, inspect all suspension and steering components according to service information, including the wheel bearings. Repair or replace all damaged or worn suspension components prior to aligning the vehicle.

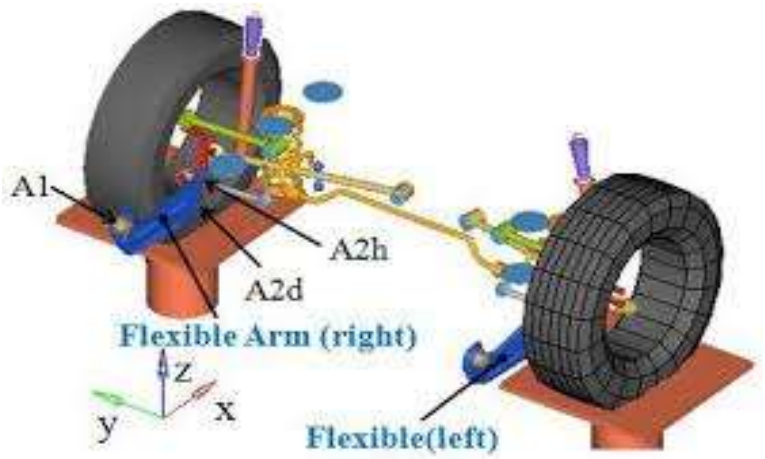
7 Position the vehicle on the wheel alignment rack, making sure the front tires are positioned correctly on the turntables.

8 Position the rear wheels on the slip plates or rear turntables,



- **Vehicle horizontal position on Rotary and sliding plate**

Wheel with tire that rolls over a smooth level surface and at the same time performs longitudinal and lateral slipping motions, will develop horizontal deformations as a result of the presence of frictional forces which attempt to prevent the tire particles that have entered the contact area, from sliding over the road. Besides areas of adhesion, areas of sliding may occur in the contact patch. The latter condition will arise when the deflection generated in the range of adhesion would have become too large to be maintained by the available frictional forces. In the following, a set of partial differential equations will be derived that governs the horizontal tire deflections in the contact area in connection with possibly occurring velocities of sliding of the tire particles. For a given physical structure of the tire, these equations can be used to develop the complete mathematical description of tyre model behavior as will be demonstrated in subsequent chapters. Consider a rotationally symmetric elastic body representing a wheel and tire rolling over a smooth horizontal rigid surface representing the roads.



1.4.2; checking tire pressure:

Importance of tire inspection
• Tires wear down.
• Air pressure decreases.
• It is possible that foreign substances such as pieces of metal may enter the tire as it contacts the road surface.
Inspection/Replacement interval
1. *Wear*
• Inspection: every 10,000km (6,000 miles) or 6 months
• Replace the tire when the tread depth of the tire wears below 3mm.
• If the depth of the tire tread reaches 1.6mm, the tire indicator appears on the tire surface and indicates the need for replacement. (It indicates the limit of tire wear.)
2. *Air pressure*
Inspection: every 10,000km (6,000 miles) or 6 months
• It is possible to judge by looking.

• It is possible to get a flat tire when the air pressure is abnormally low.
• Refer to the Owner's Manual for the prescribed air pressure.
• Check the spare tire at the same time as the tire inspection.

Condition of tire wear/uneven wear (Alignment):

When there is uneven wear such as both edge wear, center wear, feather wear, one side edge wear (inside or outside) toe and heel wear, or an abnormal wear, it is a sign that there is a problem with the wheel alignment, not only with the air pressure.

5.2.1 Inspect tire

Monitoring and maintenance

- Check tire pressure prior to any run and adjust pressure if it does not correspond to the recommended working pressure. Tire pressure must be checked they are cold (the tires have not been driven, they have not been warmed)
- Inflating tires with nitrogen does not exempt you from having to check tire pressure routinely.
- In case of unusual loss of pressure, check the outside and inside condition of the tire as well as the condition of the wheel and of the valve.
- Any visible perforation, cut or deformation must be checked in-depth by a tire professional. Never use damaged tires or tires that have run flat without the help of a professional.
-

DIRECTIONAL TIRES

- Remove the cap from the valve stem.
- Press the tire gauge on the stem to obtain the pressure reading.
- Compare the reading to the pressure recommended by the vehicle manufacturer. o If the pressure

is high, press the metal stem in the center of the valve to release air from the tire and recheck the pressure with the tire gauge. Repeat this step until the correct pressure is reached Reinstall the valve stem caps.

Before checking tire pressure and adding air, know the correct pressure for the tire. The specification is in the owner's manual and on the vehicle tire-information label. Maximum pressure should never exceed the maximum pressure marked on tire sidewall. Inflation pressure is given for a cold tire. Pressure increases as tire temperature rises. Highway driving on a hot day can increase the tire pressure from 5 to 7 psi [35 to 48 kPa]. As the tire cools, it loses pressure. hot tire to reduce its pressure. The pressure will be low when the tire cools. Install the cap on the tire valve after checking pressure or adding air.

- **Loading condition**

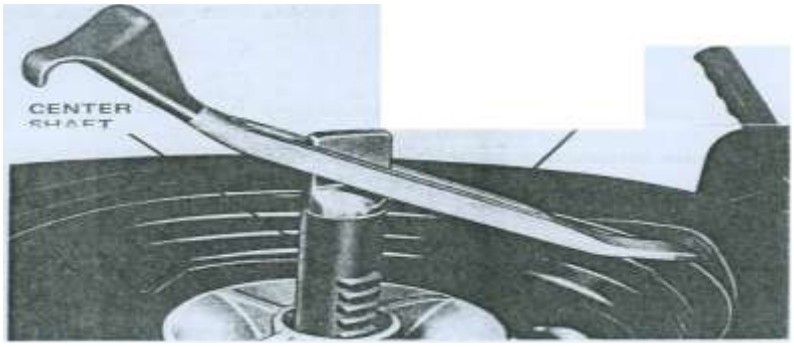
  Driving your vehicle in an overloaded condition is dangerous. Overloading causes excessive tire heat build-up and internal structural damage. This can cause a tire failure, even at a later date, which could lead to serious personal injury or death.

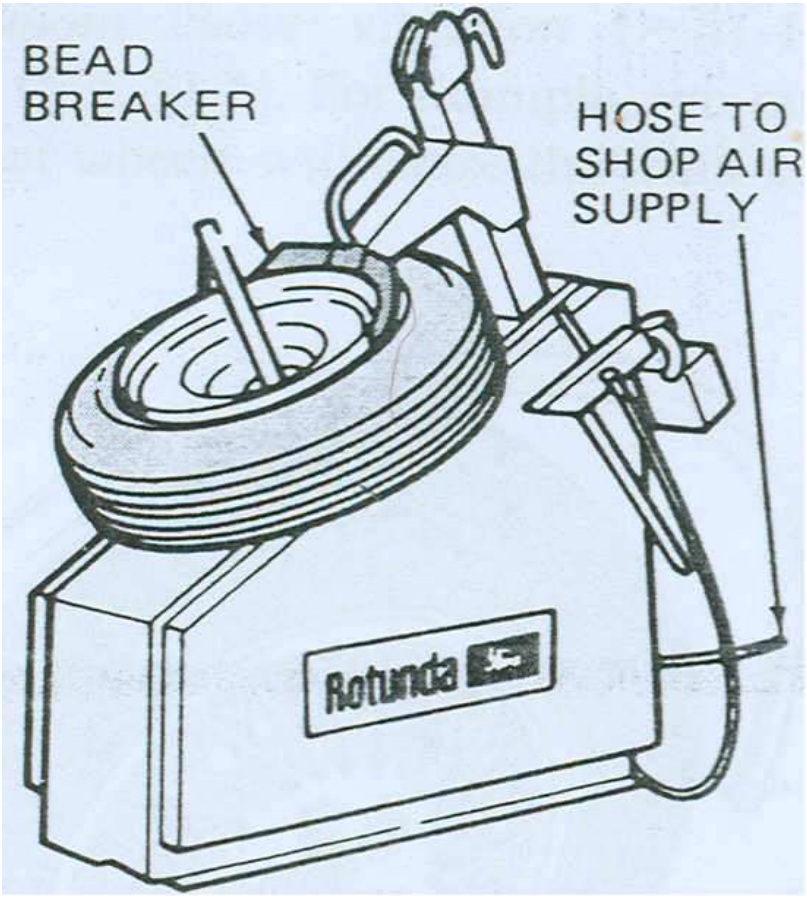
  • Always keep the vehicle manufacturer's recommended inflation pressure in all your tires, including inside duals. Check their pressure at preventative maintenance intervals and during pre-trip vehicle inspections.

- **Correct tire and rim size**

With the wheel off the vehicle, make a chalk mark or *index mark* across the tire and rim. Then you can reinstall the tire in the same position on the wheel. To demount the tire, place the tire-and-wheel assembly on a *tire changer.* Remove the valve core and release the air from the tire. Remove any rim mounted *wheel weights*. Follow the tire-changer operating instructions to remove the tire from the rim. A typical procedure is to position the *bead breakers* (top and bottom) and loosen both tire beads from the rim flanges. Lubricate the inside of the wheel and the bead areas with *nibbler lubricant.* With the bottom tire bead in the wheel well place the *tire iron* under the top bead. Push the slot in the tire iro~ o~o the *rotating finger* of the tire changer. Start the tire changer. As the finger rotates, the tire iron removes the top bead from the nm. As the tire iron rotates. The bottom bead is raised up. This frees the tire from the rim. If a rim is dirty or corroded or if the tire is not centered on the rim, the tire bead may bind" on the rim and refuse to seat. Allowing air pressure to

build within the assembly in an attempt to seat the bead is a dangerous practice. Inflation beyond 40 psi (275 kPa) may break the bead (or even the rim)





With explosive force. This can cause serious injury to the person inflating the tire. Injuries caused by such explosions include severed fingers, broken arms, broken jaws, and severe facial lacerations.

1. Be certain that the rim flanges and bead ledge (especially hump and radius) areas are smooth and clean. Remove any oxidized rubber, dried soap solution, rust, heavy paint, etc., with a wire brush or

a me.

2. Lubricate the tire beads, rim flanges, and bead ledge areas with a liberal amount of thin vegetable oil soap solution or with an approved rubber lubricant. Use a tire mounting band. The use of a tire mounting band (or bead expander) is helpful when inflating tubeless tires. This device constricts the tread centerline of the tire, thereby helping to force the beads onto the bead seats of the rim. Follow these steps.

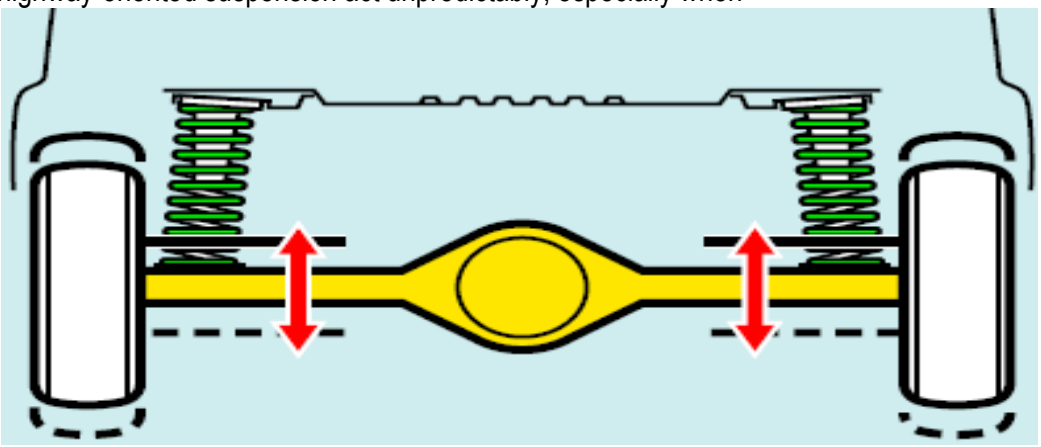
- **Compress the car's suspension firmly**.

Bottom Out: When the tires hit the body of the car when the suspension is compressed. This happens when the car doesn't have enough suspension to absorb the force of the bump it is traveling over. ... Bottoming out can easily damage the body, wheels, or suspension system. Damper" is a term that describes the primary function of a shock or strut.

They do this by damping the spring's natural tendency to oscillate by using hydraulic fluid. Struts have a very important secondary function. They are an integral part of the suspension. Replacing just the four shock absorbers or struts that are part of the suspension system can cost $200-$1,500 for an average vehicle or $2,000-$5,000 for luxury vehicles or those with difficult access or heavy rust; do-it-yourself costs for replacement of shocks/struts averages $150-$250. Wheel imbalances due to misalignment or through damaged tires can cause uneven wear to suspension components which can lead to damage and breakage of coil springs, shocks and struts.

- ✓ The suspension system joins the wheels to the body or the frame in order to support the vehicle physically.
- ✓ It absorbs and damp the various vibrations, oscillations, and shocks received by the vehicle due to road irregularities, in order to protect the passengers and cargo, and improve driving stability.
- ✓ Transmits the driving and braking forces, generated due to friction between the road surface and the wheels, to the chassis and body.
- ✓ Supports the body on the axles and maintains the proper geometrical relationship between the body and wheels

When the ride or ride comfort of a car is good, it means that the suspension has good road isolation. The suspension is able to move up and down when needed without jarring the vehicle. The manufacturers of these cars assume their demographic is looking for fast lap times at a track over road comfort. Also, vehicles traveling at racetrack-speed are getting a lot more down force from the air that could make comfortable highway-oriented suspension act unpredictably, especially when



Some possible problems with the body or ride to look out for include:

- Body Roll: When the body of the car leans to the outside when cornering. All cars do this to some extent when going around a corner, but if the body of the car rolls too much then the shift in weight

can cause the vehicle to spin, steer out of the turn prematurely, or lose traction on one or more wheels.

A car's Road Holding ability is measured by how well the vehicle can maintain good traction and even weight distribution when different forces are involved. To feel stable when stopping, a car needs suspension that doesn't let the front dive down whenever the brakes are pushed. For smooth acceleration, suspension that prevents the car from squatting down in back when the throttle is opened is required.

As mentioned above, the body rolling too much in the corners is bad for handling. Body roll is also bad because it shifts traction to one side of the car more than the other when rounding a corner. This causes the inside tires to lose traction and possibly leave the road surface. Suspension that provides good road holding will prevent this for the most part. Some traction problems that may be attributed to a less-than-ideal suspension system arrangement include:

- Bump Steer: When hitting a bump causes the car to turn left or right without the driver turning the wheel. Poor alignment of the suspension can cause the wheels to be angled in a way that causes this issue.

- Overseer: When the rear of the car loses traction and comes loose rounding a corner. If the body rolls too much cornering then the shift in weight may cause the rear wheels to lose traction.

- Under steer: When the front wheels lose traction rounding a corner and cause the vehicle to drift towards the outside of the turn. Under steer is especially dangerous because front-wheel drive cars steer and provide power with the front wheels. The less traction the front wheels have, the less the car can steer effectively.

- Both Over steer and Under steer are exacerbated by slippery road conditions.
  Suspension maintenance As the the suspension system's main job is to absorb shock in order to protect the vehicle and its occupants, parts are built to be fairly durable.

. If one corner of the vehicle becomes too bouncy when going over bumps, then have the shock absorbers or struts inspected right away. Problems with the suspension should be addressed immediately, so if the handling or shock absorption in a vehicle changes it should be inspected as soon as possible.

1.4.2 Carrying out wheel alignment

- Turn the steering to an angle of 20°
  When turning: outside wheel must travel in wider arc than inside wheel
  Turning radius: alignment angle that controls arc traveled

  Also called Ackermann angle Tires toe out during turn

Steering arms are angled inward or outward

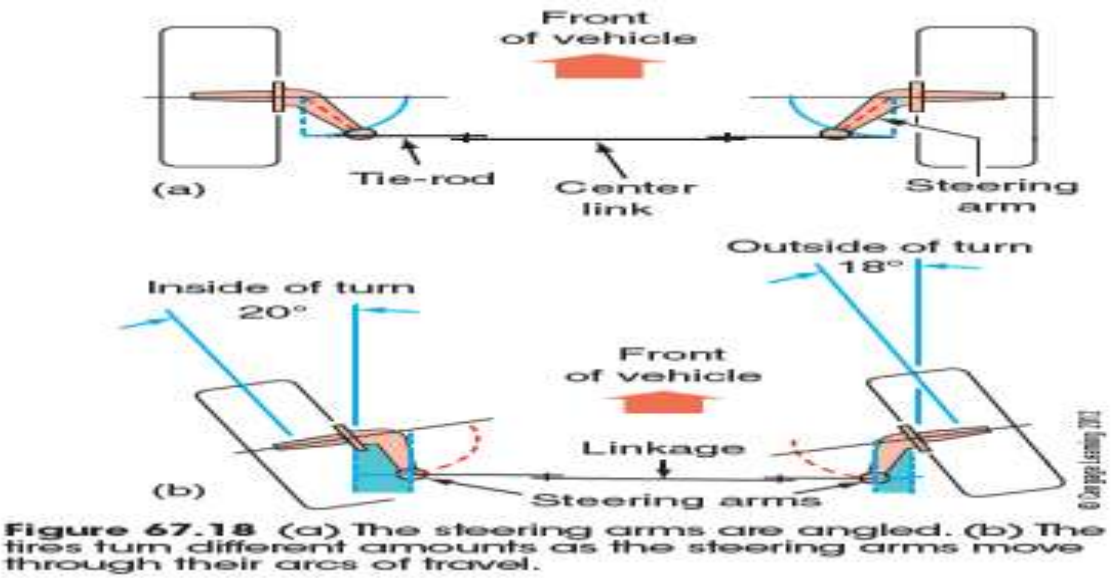


Figure 67.18 (a) The steering arms are angled. (b) The tires turn different amounts as the steering arms move through their arcs of travel.

- **Run-Out compensation**

Proper tire pressure is essential for properly aligning wheels. The correct pressure not only allows tires to perform at the standard for which they were designed, but is directly related to ride height. Remember that cold tires will register a slightly lower pressure than tires that are warm for usage. Tires with low pressure Positive Thrust Angle Negative Thrust Angle Basic Wheel Alignment Fundamentals – Continued will wear both outer edges. Over inflation will wear the canter of the tires. Tire size and make, if different can cause a vehicle with accurate wheel alignment to have a directional pull or non-cantered steering wheel. If tire sizes match, but brands and tread design differ, measure each tire individually. There is no manufacturer standard that dictates what the dimension of a given tire size will.

Self check	Written

1 How does the suspension system increase passenger comfort?

2 How does the suspension system increase passenger comfort?

Operation sheet 4	Carry out vehicle wheel alignment pre-checks

Operation Title: **Carry out vehicle wheel alignment pre-checks**

Equipment, Tools and Materials: safety stand, hydraulic jack, cross wrench, chalk, and vehicle with wheel Procedure

Procedure

1. Park the vehicle on a level surface.

2. . Remove the jack, tire iron and, if necessary, the spare tire from their storage compartments.
3. Check the owner's manual for the jacking points on your vehicle. Then, place the jack in the proper position.
4. If equipped with lug nut trim caps, remove them by either unscrewing or pulling them off the lug nuts, as appropriate. Consult the owner's manual, if necessary.
5. If equipped, remove the wheel cover cap. In most cases there is a groove along the cover's edge, insert the tapered end of the tire iron in the groove and pry off the cover.
6. . Apply the parking brake and block the diagonally opposite wheel with a wheel chock or two.

To install:

1. Make sure the wheel alignment mating surfaces, as well as the wheel lug studs, are clean and free of all foreign material..

2 Install the tire and wheel assembly and hand-tighten the lug nuts.

3. using the tire wrench, tighten all the lug nuts, in a criss-cross pattern, until they are snug.

4. Raise the vehicle sufficiently to withdraw the jack stands, then lower the vehicle.

Note:

Use the wheel lug torque specifications from the owner's manual, shop manual, new car dealer or other reliable source.Four-wheel aligners are used to test alignment parameters of vehicle wheels, components of suspension system and components of steering system. By comparing the measured parameters with designed parameters of vehicle manufacturer, aligners guide technicians to make relevant adjustments to wheel alignment parameters. This ensures ideal driving performance, guarantees the stability/safety of driving and ease of steering. Proper alignment also reduces tire shoulder wear and gas consumption.

List of Reference

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  - Auto mechanics 9th end
  - Modern automotive