

## AUTOMATIC AIR SUSPENSION IN CARS

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### ABSTRACT:

A new approach to constraint-based path selection for dynamic routing and wavelength allocation in optical Air ride suspension carries the load on each axle with a pressurized air bag much like a high pressure balloon. Air ride suspension systems have been in common use for over forty years and have proven to provide the smoothest and most shock-free ride of any known vehicle suspension system. Modern air bags are constructed using the same methods as a tire by using high strength cords which are then encapsulated in rubber. These units are very durable in service and have a proven life of many years.

In addition to providing extremely smooth ride quality, air ride suspension also provides other important features. First, the system automatically adjusts air pressure in the air bag so that the trailer always rides at the same height, whether lightly loaded or heavily loaded. This allows the suspension system to always provide the maximum usable wheel travel independent of trailer load. In addition, the higher air bag pressure associated with higher trailer loads automatically provides a stiffer suspension which is exactly what is required for a smooth ride. The lower air bag pressure for lightly loaded conditions automatically provides for a softer suspension, thus providing the same ride quality for all trailer loading conditions. Since each axle is independently supported by its own air bag, the air ride suspension is a truly, fully independent suspension system. The automatic control of the air bag pressure is accomplished by a solid state electronic control system specifically designed and packaged for vehicle use. This system continuously monitors the "ride height" of the trailer suspension and increases air pressure if the ride height is too low, by turning on an on-board air compressor. The air compressor stops automatically when the proper ride height is reached. If the ride height is too high, an automatic vent valve vents excess air pressure and stops venting when the proper ride height is reached. All required electrical power is provided by a 12 volt battery contained in the trailer equipment compartment.

**KEYWORDS:** Suspension System, Air Spring, Air Bag, Ride Comfort.

### 1. INTRODUCTION

Suspension is the term given to the system of springs shock absorbers and linkages that connects a vehicle to its wheels. Suspension systems serve a dual purpose contributing to the car's road holding handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps, and vibrations, etc.

These goals are generally at odds, so the tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different. To fulfill these requirements different optical transport network architectures have been proposed driven by fundamental advances in WDM technologies. The

availability of ultra long reach transport and all optical switching has enabled the deployment of all optical networks.

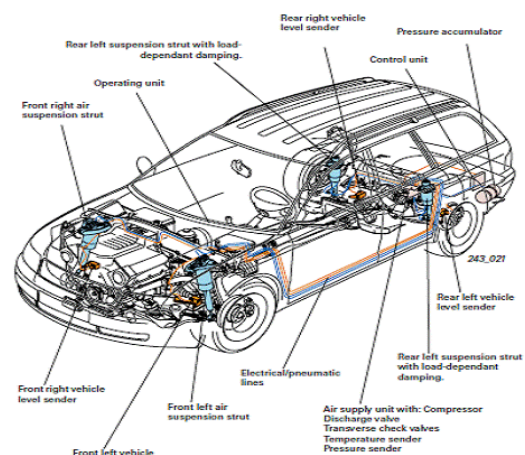


Figure 1: Locating Suspension Units

A suspension system comprises springs, shock absorbers and linkages. This suspension connects an automobile to its wheels. The suspension systems not only help in the proper functioning of the car's handling and braking, but also keep vehicle occupants comfortable and make your drive smooth and pleasant. It also protects the vehicle from wear and tear. To know about the suspension system, one needs to know about the spring rate or suspension rate.

Various spring types are used for different vehicles. In case of heavier suspension loads, the spring rate is higher and vice versa. Spring rate is measured as a ratio used to measure how resistant a spring is to being compressed or expanded during the spring's deflection besides spring rate, one needs to take in account the wheel rate. Wheel rate is the effective spring rate when measured at the wheel. It is generally equal to or considerably less than the spring rate.

There are two types of suspension systems- dependent and independent. A dependent suspension comprises a beam that holds wheels parallel to each other and perpendicular to the axle. An independent suspension helps in the rising and falling movement of the wheels. There is also a semi-dependent suspension where the motion of one wheel affects the position of the other but they are not rigidly attached to each other.

The dependent suspension includes Trailing arms, Satchell link, Panhard rod, Watt's linkage, WOBLink and Mumford linkage. The independent suspensions includes Swing axle, Sliding pillar, MacPherson strut/Chapman strut, Upper and lower A-arm (double wishbone), multi-link suspension, semi-trailing arm suspension, swinging arm and leaf springs.

## 2. AIR SPRING:

Air springs combine spring and shock absorbing action in one unit and were often used without metal springs. The first one was developed by Cowey Motor Works of Great Britain in 1909. It was a cylinder that could be filled with air from a bicycle pump through a valve in the upper part of the housing. The lower half of the cylinder contained a diaphragm made of rubber and cord which, because it was surrounded by air, acted like a pneumatic tire. Its main problem was that it often lost air.

The newest air spring, developed by Goodyear, is found on some late-model Lincolns. Like the ones that have preceded them, these ride-on-air units are more costly than conventional springs and hydraulic shock absorbers.

The air suspension system is an air-operated, microprocessor controlled suspension system. This system replaces the conventional coil spring suspension and provides automatic front and rear load leveling. The 4 air springs, made of rubber and plastic, support the vehicle load at the front and rear wheels.

An air suspension supports the vehicle on the axles with an arrangement of air bags instead of some type of steel spring, leaf or coil, or some type of torsion spring arrangement. The air bags are sometimes referred to as air springs or bellows. Suspensions that have steel or torsion springs that are supplemented by the use of air bags are not considered air suspensions. There are combination systems that have both air and steel springs. Usually the air suspension components are used on the rear of the vehicle.

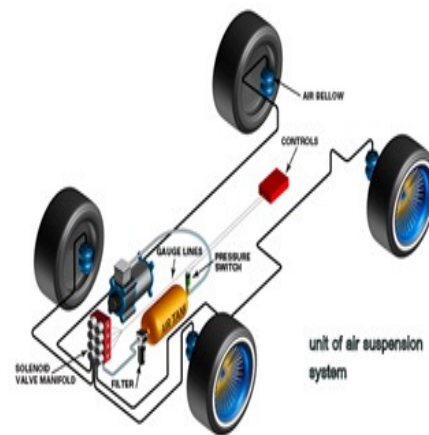


Figure 2: Advanced Air Suspension

## 3. PROBLEM DEFINITION:

### General Problems without Suspension

- **Unsprung Weight**  
Having a large beam connecting the two front wheels results in a lot of mass. This extra mass really hinders the road holding capability of the suspension on rough road.
- **Wheel Movement**  
Because both wheels are tied together the force acting on each wheel are directed to the other wheel. Under the load this causes the wheels to 'Shimmy' and decrease the stability of the vehicle in corners.
- **Bad Bump Steer**  
Because a beam axle makes locating the steering correctly difficult, most solid axle suspensions suffer

from an uncontrollable amount of bump steer. Again, hindering the performance of the car.

• **Size**

Simply put solid axles are huge and fitting them into a chassis requires an amount of space practically available.

• **Ride Quality**

Due to the high mass of the axle and the wheels being connected there is not much ride isolation between the springs and unsprung mass. This results in rough ride and even worse, compromised road holding capacity.

**4. HOW DOES AIR SUSPENSION WORK**

An air-suspension system is used to replace coil springs in an automobile, traditionally used to absorb shock and provide a smoother ride, with air springs made of heavy-duty rubber. They use onboard compressors, airbags, solenoids, valves and lines to balance heavy payloads and improve a vehicle's ride. As of 2014, air-suspension systems offer distinct advantages over metal springs, including instant tuning, improved suspension and adaptability to different driving situations.

In newer vehicles, this automotive technology offers more control and easier installation than conventional springs. In air-suspension systems, air bags replace coil springs and the airbag is inflated to the appropriate ride height. The system uses an onboard compressor, which is an electric pump, to feed air to the bags through multiple lines. The compressor pulls outside air into the pump, compresses the air and transfers it to the bags. Valves are used in the system to allow air to enter different parts of the system. Valves play a major role in controlling the direction of the air. Solenoids are useful for inflating and venting the airbags in electronically controlled systems. When the system makes adjustments for different driving conditions, the solenoids open and close to change the amount of air entering each airbag. In electronic systems, there is an electronic control module that controls the analog on/off controls, manages ride height and monitors pressure.

**5. PROS AND CONS OF AIR SUSPENSION SYSTEM**

Do you have a truck and it sags more than you like when towing a trailer or a hauling a bed full of supplies? Ever wonder what is the best solution to get rid of the suspension sag, so your truck drives normally?

- Air springs or non-air suspension kits?

- Air Lift or Timbren?
- Firestone air springs or Firestone work-rite non-air suspension kits?

These are common questions and we will touch on a few of the pros and cons of each to make your buying decision a little easier. Which is better? In our experience over the years, we've found that both air suspension kits and kits that don't use air will reduce suspension sag. If you search the web, you'll find truck, motor home and SUV owners around the world using one or the other that would recommend either of them to friends. Rather than ask which is better, perhaps a better question is "Which suspension kit is better for me?"

- Firestone Ride-Rite
- Firestone Coil-Rite
- Firestone Sport-Rite
- Air Lift Load-Lifter 5000
- Air Lift 1000
- Air Lift Ride-Control
- Hellwig Air Springs

Pros and Cons? Let's take a quick look and a few of the pros and cons of each kit to help you weight your decision

**Pros:**

**Air adjustable:** A little obvious, but this is the major plus that a non-air kit can never overcome, the ability to adjust your truck to the desired ride height. Hook up your trailer, truck sags a few inches, no problem. Inflate the air springs until your truck is level. Done towing and just using the truck for the daily commute? Simply remove the air pressure until air springs are at the minimum required air pressure, and your good to go.

**Level Side-to-Side:** Have a motor home with a tank full of water on one side, or a pickup with a slide in camper and your leaning to one side? With air springs, you have the option of running a "T" fitting and inflating both the air springs equally, or running the air lines separately to each bag which allows you to increase the pressure on one side over the other. This allows you to level out the side with the water tank, etc.

**Cons:**

Using air to level your truck is a major plus, and the advantages do outweigh the disadvantages, but air does require more attention and opens the door for cons that a non-air load leveling kit will never experience. When dealing with air, you have the

potential to run into leaks, damaged air line, holes in air springs etc. These problems can all be easily repaired, and are not very common in the big picture, but they do happen. If you're planning on extensive travel, it's never a bad idea to have a spare air spring and some air line. Replacement air springs and air line are readily available and not very expensive.

#### **Time to install:**

You will have to allow yourself a few more hours to install an air suspension kit. The instructions get better every year and now include detailed images, and many kits are no-drill, bolt on installations, but it still can be time consuming. They are not technically difficult to install, but it can take some time to cut, run the air lines, etc. Click to view the Air Lift 57275 installation instructions for the Chevy 2500HD and GMC Sierra 2500HD.

#### **Maintaining Minimum Air Pressure:**

This is about as easy as it gets, but is one of the major causes of air spring failure. All kits require a minimum air pressure, usually 5-10 PSI. While it's easy to check them while filling up for gas or washing your truck, people tend to forget. Running air springs without the minimum air pressure can cause them to tear or rub against something causing a hole. The best solution if you're concerned about this, is an air compressor kit. This gives you the ability to monitor the air pressure from inside the cab and takes all the guessing away.

#### **6.CONCLUSION:**

Air suspension is today mainly feature for luxury vehicle . It offers a lot of feature for compact class. Cost or price level will be more attractive. Integration & smart design is key. The Air Suspension System has ability to change the load carrying capacity simply by changing the air pressure.

From the whole discussion in air suspension system, it is observed that the system is like a white blood cell. As white blood cell provides energy to our body to fight against diseases or viruses which try to destroy or try to decrease our life, in the similar way air suspension system provides the energy to a vehicle to protect itself from damaging, increasing life of the vehicle, increases the handling, increases comfort of passengers and many more.

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