

Mercedes Air Suspension

AAA: Anti-freeze, Air Filter and Air Tank

By Martin Werminghausen



Some of the neglected parts in the 60s and 70s Mercedes Benz air suspension cars (W112, W109 and W100) are the Antifreeze and Air Filter.

Let us start with the Air Filter problem.

Just imagine you have not changed the engine air filters on your car for 40 or 50 years. Guess what happens?

Well the difference between your engine air filter and your air suspension air filter is not that great. Yes, the amount of air passing through the air suspension filter is somehow less but still the paper filter element is the same principle and the filter material is not getting any better after the years. The fact that you don't see or feel a problem doesn't mean that it is still working properly.



Diagram 1 Damaged Air Filter

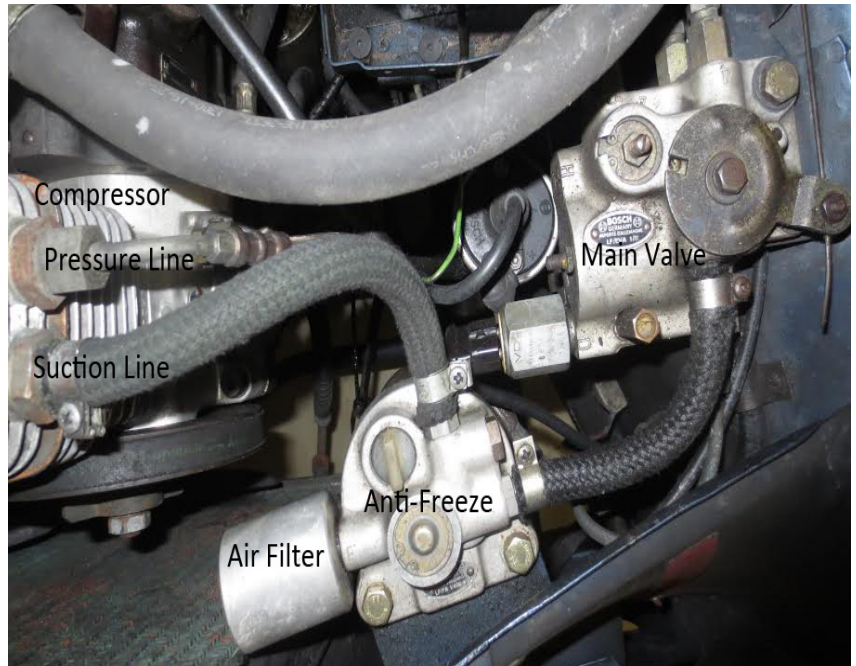


Diagram 2 Anti-Freeze in engine bay, W112

In fact I have opened many air suspension filters (# 1 in Diagram 3) and what I have often found was a deteriorated filter element. Black from debris and sometimes with disintegrated paper, these filter elements are way overdue. Air is still passing through without noticeable restriction but it doesn't mean that the air is filtered. These paper elements are supposed to be changed frequently.

How often are these filters supposed to be changed? There is a short note in the Mercedes Service Manual saying that the filter should be changed after 30,000 miles. This is easily overseen. I'd recommend changing this filter at least within the noted mileage or every 5- 10 years depending on how much you drive your Mercedes.

The next troublemaker is the Anti-freeze device itself (# 3 in Diagram 3). Within this unit there are 2 hidden valves and a nozzle. The nozzle is similar to the one in a carburetor, which mixes evaporated fuel with air. The failure or malfunction of the 2 valves is also not visible or obvious. And this is the real problem. No warning light goes on. And this does not mean that everything is fine.

Let me explain the functions of the Anti-freeze in more detail. The Anti-freeze device is the 'organ' of the air suspension

that controls the air going in and out. And it controls when the air will stay within the system. The filter is the location where air is going in and out of the system. There are precise rules when air has to go in or out or stay. This is not random.

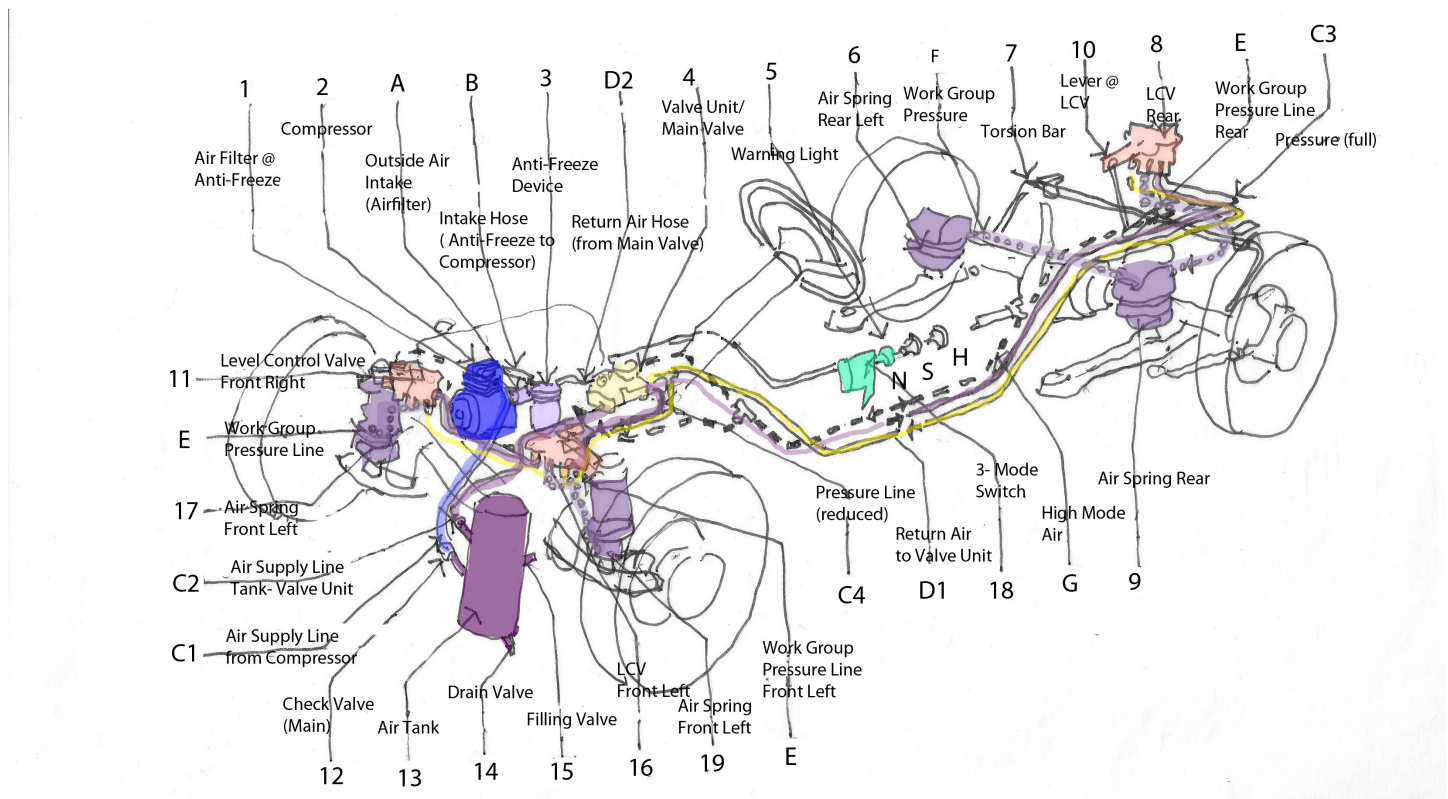


Diagram 3 Air Suspension Overview W109

Then there is the important third mode which is the recirculating of exhaust air back into the air compressor and turning exhaust air into compressed intake air. For that mode the Mercedes air suspension is called a semi closed loop system.

How does this work?

Fresh air is added to the system only if absolutely needed. This has a reason. The third mode has the advantage that the recycled air is already filtered and conditioned (dehumidified by the ethanol and compression stroke in the air tank) and therefore no water or ethanol is added to the system, which means less energy and material is needed. The recycling mode is a smart saving mode. I will explain later the drainage of the condensate of the water /alcohol mixture in the air tank which is the cleansing and expulsion device and how you can analyze the system by the quality of the drained liquids.

If the recycling mode does not work properly, the unit draws multiple times more unconditioned air into the system than it is designed for. In the worst case scenario, it draws in unfiltered air. Fresh air always draws moisture, which then needs to be removed later otherwise it will cause trouble. This is not different than with any other air compressor.

The second function of the device is the mixing of intake air with ethanol (ethyl alcohol) through a nozzle (directly at the Suction Valve seat) in order to bind moisture of the intake air, which would freeze up the system at lower ambient temperatures. Diluted in the condensate soup the ethanol prevents the condensate from freezing. Ethanol however should be filled into the plastic container at all times no matter what the ambient temperatures are (in all seasons and all climates). The main reason is to remove moisture therefore avoiding water and corrosion in the system. As a welcoming side effect it also 'lubricates' the inner rubber parts. The rubber seals need to be compatible with the ethanol. This is an

important point. There is a reason why MB specified 96% ethanol. Nothing else should be used except for a product used in Europe called Wabcothyl which consists of approx. 90+% Ethanol, Butanon (1-5%) and Ethandiol (1-5%).

Functions of the 2 Valves of the Anti-Freeze

Both valves are basically check valves, which open and close relative to defined pressure differentials by compression spring. There is the Exhaust Valve and the Intake Valve, also called Suction Valve.

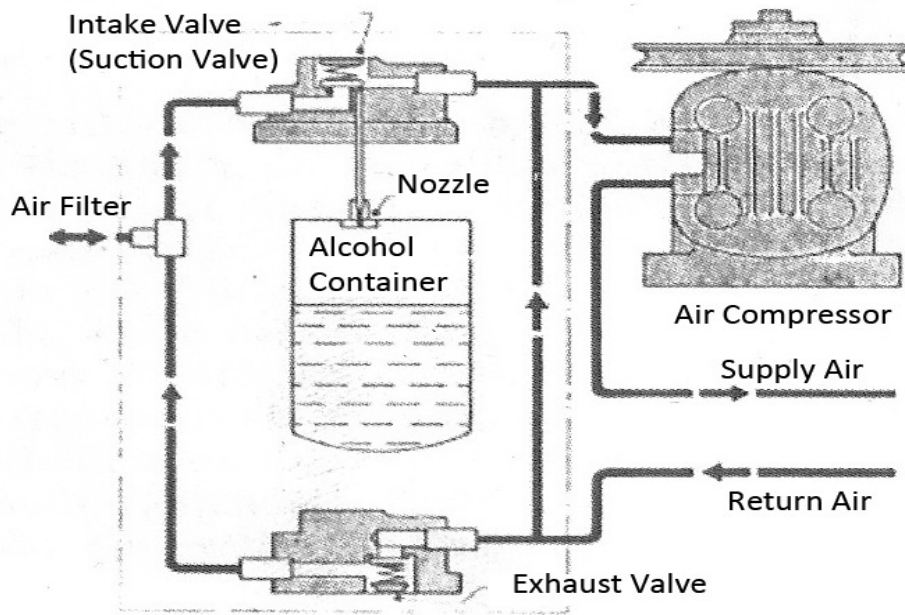


Diagram 4 Components of the Anti-Freeze Unit

The Exhaust valve opens at about 200mbar positive pressure from the exhaust line and releases the air that is under higher pressure than the opening pressure via the Filter to the atmosphere. The opening pressure or threshold pressure is caused by exhaust air coming from the A-valves when the suspension is exhausting air from the Air Springs to the Valve Unit to the Anti-Freeze. In this overpressure situation the Suction Valve is always closed by design and prevents air from leaking towards the filter this way.

The Suction Valve opens only if the threshold negative pressure is reached at approximately -20mbar, a very slight vacuum. This suction pressure is not great and is produced by the compressor. To give you an idea what -20mbar means: You can suck on a hose and get to -20mbar.

Let us pretend that the Suction Valve and /or the Exhaust Valve are not working properly and are leaking. This is in fact a very realistic assumption because the rubber seals inside are hardened after 20 years. This is not a guess but a fact. In this case the air stream is not controlled any more and air will get in and out randomly.

There is chaos. In one of the scenarios through a damaged filter -unfiltered-and through the 'back door' of the leaking Exhaust Valve, air could get uncontrolled into the system. It could then bypass even the Alcohol nozzle. Fortunately the Intake Valve is still partially functional and will suck some alcohol, hopefully.

There could also be another scenario: The recirculation air from the exhaust side into the compressor does not travel as designed because the Suction Valve is leaking and most of the exhaust air is going the wrong way ... exhausting the air sucking alcohol. When the compressor then sucks fresh air it draws more alcohol. The alcohol consumption might be

several times higher than with a proper working system.

Be alert if the system drinks too much alcohol or too little. But how should you know. This is hard to control or know.

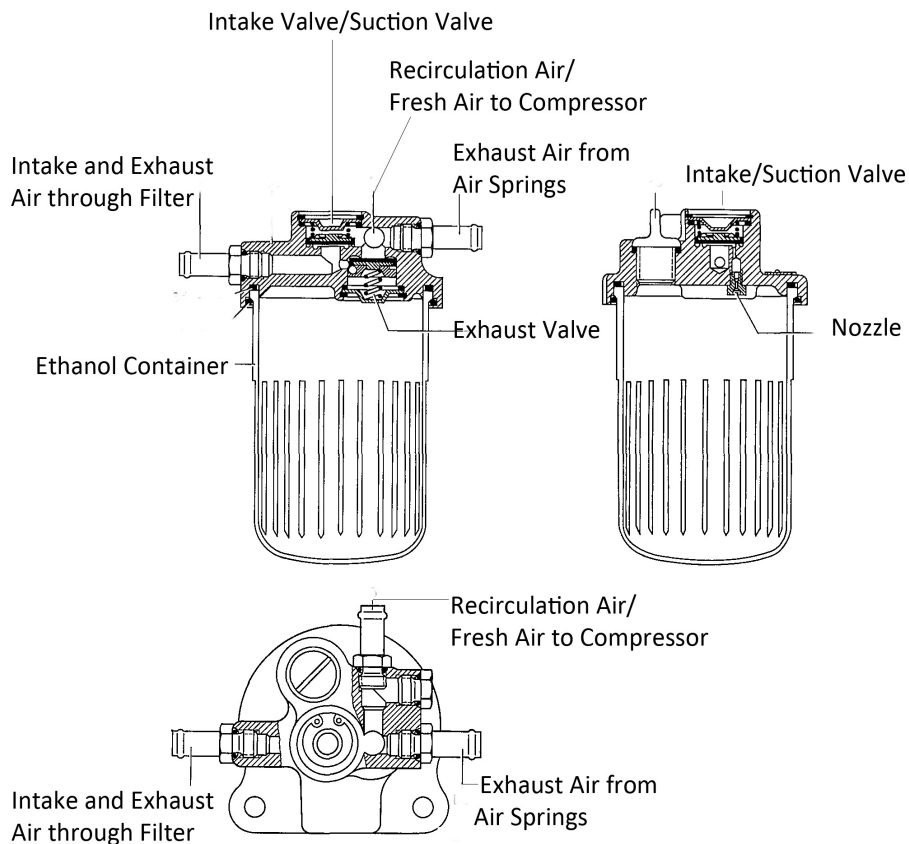


Diagram 5 Anti-Freeze Drawing

Here is another scenario: The filter does not filter any air, both valves are leaking and the nozzle is clogged with the system running dry or drinking too much alcohol. In this case the air is passing by the Suction Valve in both directions when it is not supposed to.

Any of these different scenarios are possible. In addition also clogged valves or any combination of clogged and leaking valves are possible. The analysis is complicated and almost impossible for the owner to figure out. I just want to give you a warning. I regularly see leaking and sometimes clogged valves and damaged filters. And the owner didn't know.

What happens to the system with malfunctioning Antifreeze and Air Filter?

If unfiltered air is entering the system it will damage the sensitive air suspension system faster, depending on the degree of contamination of the air. Unfiltered air is one cause of premature failure of the Leveling Valves. It might even do some damage to the compressor if unfiltered air is compressed over a long time. A damaged compressor might throw more engine oil into the compressed air chamber and contaminate the system down the 'food chain' to the degree that it becomes a problem.

We have not touched the cycles of the compressor but in a well functioning system (car not dropping and airtight support system) the amount of fresh air required is actually very little.

However if the system is leaky and the car is sitting regularly on its oil pan in the morning you can imagine how much fresh air has to pass through the air filter to be compressed in order to bring the car back up on its normal height.

Similarly excessive fresh air has to support the normal riding height during driving in order to keep the car up against the leaks. The W109 support system will need about 100-150 liters of ambient air for a dropped car compared to almost zero to a few liters of fresh air for a proper working car that works to specs (if the driver sits in the car the suspension is already correcting for the driver's weight using fresh air drawn by the compressor in order to compensate and reach the equilibrium pressure in the air tank. However maintaining the functional system is just a little portion of power /air needed compared to lifting the entire car to its riding height and 'maintain' a leaking system.

When the tank pressure reaches the equilibrium (the pressure the compressor is able to produce at the actual speed and altitude) the compressor starts 'idling' which means it stops pumping air. In this mode it compresses and decompresses the same air volume over and over with minimal energy consumption (interior friction and air leakage only).

The energy storage of the air suspension is in the pressure air tank which is located under the left side front fender. The air is compressed by the compression stroke of the piston and exhausted into the air tank. Once compressed and inside the air tank, the air cannot return due to the main check valve assuming the check valve is functioning as designed (if not to specs the check valve needs to be repaired). The air gets heated up during the compression stroke and the moisture falls out as condensate when cooling down and a bit decompressed inside the tank. This is similar to what happens with any air compressor. The condensate here however is a water/ ethanol mixture and therefore does not freeze in winter. Some of the ethanol will stay in vaporized form in the support air and reach all parts of the inner air system. The system is able to handle - 40 degrees Celsius (- 40 F) . This is the reason why this device is called Anti-Freeze.

The condensate is accumulating at the bottom of the tank. It needs to be drained once in a while, every 300 -500 miles. Please use rubber gloves when you do this job once a month or more often depending how much you drive. It is good to catch the drained fluid mixture in a bucket and analyze it. If the liquid is relatively clear, yellowish or slightly brownish- this is a good sign. If the fluid is darker brown in color or even with clear signs of engine oil...then there might be a problem.



One problem is a failing compressor and the other is corrosion inside the tank. There can even be solid parts of rust which has accumulated at the bottom of the tank and which needs to be removed from the mesh filter of the drain valve (early cars have no filter installed on the drain valve). Sometimes the drain valve starts leaking due to the particles caught in the valve seat and hardened rubber.



We are offering this rebuilding of the drain valve and check valve to 'like new condition'.

If there is brownish fluid mixed with engine oil it is time to renovate the compressor.

The compressor repair will be covered in another article.

New Parts

The Anti-Freeze device is NLA (no longer available- last price was \$850). The Air Filter was available for around \$350.

Maintenance and repair of the old unit:

The filter change is a no-brainer, in theory. However technically the filter element is not easy to change. Unfortunately the paper element is flanged into the aluminum housing. This difficulty might be the reason why the filter is commonly not changed. The repair requires special tooling and a new filter element. There aren't many people offering a professional repair of the air suspension filter and therefore it is not cheap. However if you have to consider the costs of following repairs down the 'food chain' (damages to the Support group and Work Group mostly the sensitive leveling valves and the main valve and the pressure regulator in a 600) then the preventive renovation of these units are well worth the cost. Bottom line is: The Filter and Anti-Freeze repair is well-invested money for the next approx.10 years.



Diagram 6 Rebuilt Air Filter

The Antifreeze unit can be rebuilt and serviced but also this is not easily possible with common shop procedures and tools. The rebuilding is specialized work involving the ability to test and measure smallest pressure differentials. All seal rings and check valve rubber seats need to be exchanged, lubricated and tested. The nozzle can be checked and cleaned (This is relatively easy and DIY). All air fittings, the plastic bottle and plug screw will receive new seal rings. All steel part will be plated in a professional repair. With the exception of the alcohol nozzle this is not a DIY repair.

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