Installation and Height Adjustment for Level Control Valves Type LF/VNC for W112, W109 and W100

By Martin Werminghausen

This manual is written for the committed hobbyist and mechanic as a guide for installing the rebuilt Level Control Valves and setting Axle Heights with simple tools, without an alignment shop and without access to setting jigs or a test bed. This procedure is for an approximate adjustment only. Warning: You should use common sense and be careful. Never put yourself in danger. Never attempt to place any body part underneath an air suspension car without safety measures because the axle can drop immediately due to an air loss! Don't open lines under pressure. 12 bar air pressure can be powerful and dangerous. If you are unsure what you are doing please visit a professional shop.

Basics and Tools

Let's assume you own a Mercedes Benz and you have gone through the frustration of a dropping car and leaking air suspension. You had your level control valves (LCVs) removed and sent for remanufacturing. Then you received the package with the 'new' valves ready for install, however with the valves in hand you don't know exactly what to do?
This manual is written for this situation.

Basically you install the rebuilt LCVs and connect them to the air lines in exactly the same location in the reverse order you removed them . After that you will set the car's height via adjusting the connecting rod's length. This is indeed easier said than done.
From here on you need to prepare for this work. The next steps are:

*Find a level, smooth ground for placing the car, preferably a clean garage floor

*Clean the areas around the LCV locations at the front and rear axles. Always clean the air fitting screw connections and flush the air lines. Fastidious cleanliness is important!

*Prepare tools you will need for installation and adjustment: basic wrenching tools, nitrile gloves, flash light, a set of metric wrenches, especially helpful are 12mm and 14mm open flare-nut wrench for the air lines, electronic level and measuring tools in millimeters

*3 lock pins: 5.00mm pins preferably in hard wood (2" long) or 4.95mm-5.00mm drill bit shafts (diameter ideally 4.98mm...smaller than 5.00mm but not much).

*Bring time and patience. The installation and adjustment procedure may take many hours or half a day if you do this for the first time

*You need to schedule time for preparation of the work well before you start installing.

*Car axles in good shape? A) Check the center position of rear axle as an optional preparation. A centered rear axle is important. B) Check carrier arm bushings for the rear axle (center trunk location) and subframe mounts for front axles (both side front axle). C) Check torsion bar bushings rear axle. If these items are worn out they will affect the axle height relative to the chassis. Replace before setting an axle if needed.
Good work preparation is key. Read my air suspension article at www.600airsuspension.com for more background information.

'Cleanroom'

I have to give you one very important notice which overarches all the work you are going to do on the air suspension especially during assembly and connecting the 'new' LCVs: Cleanliness is key! If you are not working in the cleanest environment possible including a clean system (in and out!) your newly acquired leveling valves may not work as intended. They might leak! Imagine this: The leveling valves are built in a very clean environment, in a 'cleanroom' with the tiny, little valve seats inside the bullets extremely 'sensitive'. In other words if there is dust,

fine dirt or other particles inside the lines, in the air bags or outside on the male air fittings during assembly you have a problem. Even with the stock filter sieve in the B-port there is a good chance that your valves can catch dirt and A valve might leak. This does not mean that E -valve will not leak but you will not be able to find out because it is 'invisible' at this point assuming the system is in good order. You might be lucky that the leak is temporary and goes away over time as the residues might be 'flushed out' by the air moving through. But there is no guarantee. This warning is especially true for a system that has not been used for some time as dried up dirt might break loose during install. Your system will be contaminated and cleansing a dirty system won't be easy. Excessive cleanliness during install is the best advise I can give.

My advice is to brush the male air fittings connectors followed by a wash-down with alcohol and compressed air. Then flush the lines internally with alcohol (similar to an A/C line flush) and blow plenty of compressed air through the system including the airbags until all inner volumes are dry and clean.
I mention this to you for good reason: I have experienced this frustration (obviously) with leaking components after installing a perfectly tested LCV.
A LCV is bench-tested before it leaves the 'lab' and hasn't seen any dust however same LCV may develop a slight leak once contaminated during a 'dirty' installation.
While this leak may be temporary and hopefully go away after some driving, it is painful and avoidable. If it happens the problem can be tackled. The easiest solution requires some driving and luck (of course). Driving will cause plenty of air to move through the lines and hopefully flush particles out. It is also good to fill the alcohol bottle with ethanol before driving. Another cure might be to get the car 50mm up in High-mode followed by switching back to 'N'. Lots of air will move through the A-valve this way. Repeat this step several times.
The most critical moment when contamination can potentially occur is while 'connecting the air lines'. This is when dried up fine particles might break lose (when you fiddle with the air lines). And with the first movement of air , dirt gets blown right into the valve seat. Murphy's law!
But once the system is installed, clean and closed up, usually there are no more problems. It should work for years if the air suspension components are in order.
Here comes another notice: Check you air filter. I have seen air filters that look 'normal' from the outside but the filter element on the inside had failed. With a failing air filter there is contamination. This problem is hard to analyze unless the filter element is removed. However removing the filter element typically damages the aluminum housing of the filter. This is why the air filters are frequently neglected in the air suspension cars.
Most of them still have the original filter element inside. In the future, I hope to offer a reasonable solution for changing the air filter element to help the community.
I will now walk you step by step through the process of installation and height adjustment.
Installing the Level Control Valves

It is normal procedure to adjust the axle height after a level control valve renovation. This procedure is inherent of the system.
The remanufactured Level Control Valves (LCVs) are now ready for installation. The LCVs include seal rings for the air fittings (with female fine pitch thread M12x 1). Please have your car, garage and tools well prepared, clean and ready with good light and basic tools.
Start installing the 3 LCVs on their brackets. Look at the label on the LCV which indicates the location as each of the LCVs is slightly different and specific to the location (codes are: Front Right-LF/VNC 3/1 or 0500003004, Front Left-LF/VNC 3/2 or 0500003005, Rear-LF/VNC 4/3 or 0500003006).
Please take great care when connecting the steel air lines (6mm outer diameter) and the attached M12 x1 male fitting. They are prepared and perfectly clean inside and outside. In case of contamination please flush the inner tubing with alcohol/compressed air and clean the male thread.
When everything is clean start installing: Align the male screw fitting to the female LCV fitting (center line of both components must be well aligned).
Don't use any force here because this connection is a fine pitch thread.

It is helpful to loosen the air fitting (14mm wrench, best tool is an open flare-nut wrench) slightly from the LCV body in order to gain some side play for better alignment of the male fitting (12mm wrench, open flare-nut wrench). The M12x1.5 connection to the valve body is less prudent to cant. Then start the fine thread.

Now continue the fine pitch thread connection by hand two or three turns, then retighten the LCV fitting in the valve body. Torque for the 12x1.5 thread [14mm wrench] is 2.5kpm. The last step is to tighten the connection. Do not use any great force here. The air tightness is reached by the cone and seal ring, not by typical screw pressure. I have seen many damaged fitting screw connection because people over torque. The torque for the M12x1 fine thread [12mm wrench] is 1.5kpm!
After mounting the LCVs -DO NOT mount the connecting rods at the lever of the LCV!
Fill the air tank with air by idling the engine or even better by using an outside air compressor via the Schrader valve connection at the air tank. You will need at least a 10- 12 bar from an outside air source and 12-14 bar for the 600 because the car is heavier. Be ready to refill the tank whenever you need air. Put lever in 'N'- mode (Normal Driving).

Air line fittings need to be carefully examined regarding air tightness. At this point only the E-port is under pressure. The other fittings are not currently under pressure and will have to be revisited and checked later when they are. For air tightness testing it is helpful to use soap water (Big Blu or a 20-30% soap/water mixture with a lot of bubbles), a fine brush and a good flashlight. Check each E- port connection for air bubbles. The best practice is to use a

professional leak detecting fluid. The slightest air leak will lead to malfunction of the system and has to be avoided. You will need to revisit B and A-ports ports later. When the car is up on its air springs the B-port is also under pressure and when car is in high mode (50mm higher) the upper line in the brass bracket is also under pressure. A-port will be under pressure (3 bar) when the car goes down and if the valve unit works properly (pressure holding valve)...the time after.
If the air suspension E- ports are airtight the axle rods are ready to be adjusted. This is necessary in most case and normal procedure after renovation of the LCV due to the system.

Adjusting the Axle Height

One key link between the axle movement and the LCV is the connecting rod which is adjustable in length by right hand and left hand M6 treads. This means you could even adjust length when the rod is already in place but not locked. However it is best to adjust the length before the rod is mounted.
While the best place to adjust axle height for the air suspension is at a professional alignment shop with swash plates and Mercedes jigs, gauges etc., it is however possible to set the car height at home.
Swash plates are helpful so you can avoid rolling the car forth and back after each adjustment in order to release tension from the suspension for correct readings (camber is the measurement reading for rear axle height and wishbone heights for the front).
A professional adjustment is done with specific setting jigs and tools but they are available at specialized shops only.
In strict adherence with the following rules, the hobbyist can set the car height within acceptable tolerances. However the home procedure will take longer to execute accurately than for a professional shop with test stand and jigs. So please be very patient. You will need to go back and forth more than once and approach the desired result step by step much like with tuning an instrument. The adjustment starts with the rear axle.

A Level Ground
The car should be placed on level and smooth ground. For instance, a perfectly level garage floor should be fine. Please check with the tools you have (level) to see if the floor is horizontal. If not, find a more horizontal garage or surface. There should be enough space around the car to push it forth and back in order to adjust the suspension for camber and allow for settling.

Centering the Rear Axle and Replacing worn Bushings
The rear axle ideally should be ‘centered’ so that both rims have the same distance to the inner side wheel well. Vertical suspension forces are designed for a centered rear axle. In other

words: A centered rear axle is of importance because the spring piston and the air spring need to be aligned. This test is not absolutely needed if your car is in good order and you could skip this step if it is not convenient. If you do skip this test and don't want to hear about worn axle bushings...please continue with the next chapter.
For checking the center of the rear axle there is a special jig or gauge for the various type of axles. In absence of the tool you can at least check to see if the axle sits mostly centered in the wheel wells, left and right.
For example, a W109's centered rear axle means that the middle joint of the rear axle is off-center (middle line of car does not match with the rear axle joint) by the amount of 36mm +/- 2mm. Therefore there is only one position where both camber measurements (left and right wheel camber) are exactly the same. This is at precisely zero degrees camber or a perfectly horizontal rear axle.
The approximate center position of the rear axle can be tested by the following method:
The gap from the inner rear rim to the inner wheel well should be the same left and right throughout spring compression movement. Simulate the wheel movement into the wheel well with a car jack on both sides and measure the cap with a 'feeler gauge'. The car must be on solid stands for this test. For instance if you can fit the same thickness of an open wrench left and right side between rim and wheel well...then you should be fine.
The center of the axle is corrected by adjusting the diagonal strut. There is one strut for the W109/112 and two struts for the 600. Find the section in your shop manual for proper adjustment procedures or visit a Mercedes shop for proper adjustment.
Also replace worn subframe mounts as they can cause up to 1 inch of height difference in the front.
Replace carrier arm bushes at the rear axle if worn out. This is a difficult job to do. Also replace rear torsion bar bushings if worn out. All these items affect the level control valves and quality of the air ride.

Adjusting Car Height without Jigs in 20 Steps

With all the preparation work done and the LCVs now installed, the height can now be adjusted by the connecting rods

1) 3 LCVs are installed on their brackets and air system tests airtight

2) Bring air suspension system to at least 10bar support pressure

3) Car is standing on a level surface and the surrounding work area is clean. You'll need some space around the car for rolling forth and back in order to allow the suspension to adjust to new geometries

4) Put air suspension in normal 'Drive' mode (N for Normal Driving). Do not use 'Lock' (middle position) or 'High' mode. Make sure the low-pressure light is not on. Check this from time to time. If light comes on please refill air tank.

5) You'll need basic tools, a flashlight and measuring tools /steel ruler (measuring in millimeters)

6) You'll need a good level. Best is an electronic level with digital display that can measure fractions of a degree for the camber on the rear wheels. If you don't have this level you should adjust for a relatively horizontal rear axle (by sight).

7) The connecting rods for the LCVs are clean but not installed at the LCV (yet). Check for excess play in the ball joints. Replace ball joints if you can feel the slightest play. Lubricate the joint with grease before you install (installation of rods will be one of the last steps but it is good to prepare).
The car sits on axle rubber stops (down) at this point. Without the connecting rod the lever of the LCV is 'down' by internal spring force (by design): This means that the Exhaust Valve (A-port) of the LCV is open and Intake Valve (E-port) is closed. Therefore no air is entering the air spring without the lever being moved 'up' by hand. Moving the lever up means air will enter the air spring and the car will rise.

8) You'll need 5mm diameter (~4.95- 5.00mm, use digital caliper) lock pins for locking the valve levers to 'neutral'. In 'neutral' the E and A -valve are both closed and with no air going in or out. Make sure the lock pins fit perfectly into the boring and lock the lever. Don't use force! Use care when installing. There should be almost no play in the lever with the lock pin. The MB pin is out of plastic that snaps off if not removed. With a steel lock pin, the LCV can be easily destroyed if you forget to remove it when you snap on the connecting rod. You can use the shaft of a drill bit or BETTER a precisely machined 5mm hard wood stick (from the hardware store) but be careful. The diameter has to be very! Close to 5.0mm but not bigger. If bigger than 5.0 it won't fit because the diameter of the female boring is diameter 5 H7 which is 5.00-5.02mm (ideal lock pin diameter in hard wood is 5.02mm, in steel ~4.98mm). The tolerance of the lever movement is minimal because the null zone is adjusted to a tight tolerance by 600airsuspension. Other rebuilders might handle the null zone differently with more play.
If the lever has too much play in the locked position it can cause the A-valve to stay partially open and some air exhausting (with a tight null zone adjustment). Excess play can be corrected by increasing the diameter of the lock pin slightly. As mentioned before the tolerances in the

neutral zone are small by design. Using the hard wood pin has the advantage that wood is a bit flexible and doesn't lead to catastrophic failure if you forget to remove the pin.
Adjusting the Rear Axle

9) Filling the rear air springs: You are lying next to the rear of car on the floor (on a mat or card board with proper clothes, nitrile gloves and a flashlight) and you fill the air spring by moving the lever of the rear LCV 'up' manually (pin is removed!). This movement opens the intake valve (E- port) –the air enters, you hear it and you feel it.
The car rises in the rear. You can stop the ascension any time by lowering the lever. At 'neutral', the E-port will close and you will not hear air entering. Try to make slight movements and avoid lowering to a point when A-port opens and air is exhausted (you can hear this, feel this).

10) Try and raise the car until the axle is almost horizontal (camber is negative if the car is down, and zero degrees with a horizontal rear axle, positive if too high). You are looking for an almost horizontal axle by eye. You can try and use a steel ruler or a straight edge and place it in your perspective when looking at the rear axle to better see if both sides of the rear axle line up horizontally. If the rear axle is slightly below horizontal, lock the lever with the pin. Now roll the car forth and back a couple feet both ways with the transmission in N.
If the car would stand on swash plates the axial movement of the rear wheels had no lateral resistance and we could measure directly the camber with the level against the rim. With the resistance of the rubber on the floor this is not possible. You need to take the tension out of the rear axle by rolling the car forth and back a couple of feet. Now measure camber.

11) During adjustment try to use the rising movement only (don't go backwards for final adjustment) and reach the set point for camber. If you do not have an electronic level you might try to adjust to zero camber, which is a perfectly horizontal axle. Try to find a way to judge on the imaginary horizontal line. Negative camber means the rear axle has a slight kink in the middle (the middle kink will be a couple millimeters down in the middle… approx. 10mm down for the W109 and W112 and approx. 20mm for the W100).

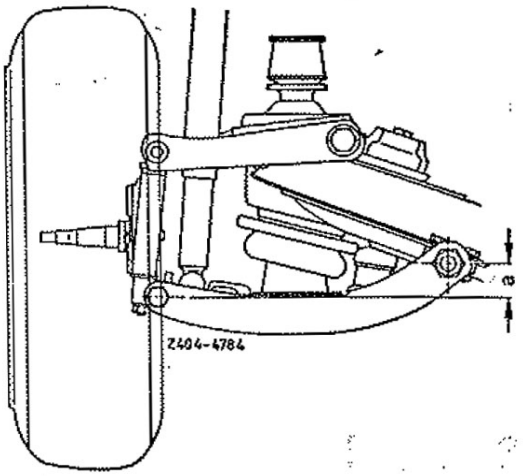

Fig. 40/22

Type 109

a = Wishbone position
Height difference between axis of wishbone seating and axis of steering knuckle seating (measured values page 392).

Measuring device:
111 589 03 21
In exceptional cases the height difference "a" can also be measured with the aid of a surface gauge.

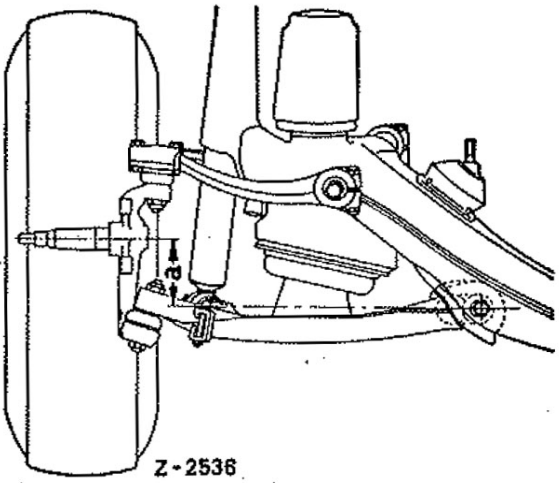

Fig. 40/23

Type 100

a = Wishbone position
Height difference between axis of wishbone seating and center of stub axle (measured values see page 392).
For measuring wishbone position, use testing device 100 589 21 00.

Diagram 1: Adjustment Values for Front and Rear, Table from Mercedes Technical Data 1971

Set point for W100 for camber rear axle is:
-1.5 degrees (+/- 0.25 degrees)

Set point camber rear axle for W109 and W112 is:
- 0.75 degrees (+/- 0.25 degrees)

12) If you went too far up (too high meaning positive camber) then you have to go back and lower the car, go back one step and start again with filling (rising the car). Always adjust height by filling the air springs and not by lowering the car.

13) If there is no air pressure left in the system you need to start the engine or use an external air source to charge the air tank.

14) If the car is perfectly set you lock the valve with the lock pin. No air should move.

15) Now you can move to the front axle.

	Normal level[1]) Values for adjustment[2])	Values for checking purposes[3])	Higher level[4]) Values for checking purposes
Type 109.016 109.056 109.057			
Front axle wishbone position	57 ± 2 mm	57 ± 10 mm	107 ± 10 mm
Rear wheel camber	—0° 45′ ± 15′	—0° 45′ ± 1°	+ 3° ± 1°
Type 109.018			
Front axle wishbone position	42 ± 2 mm	42 ± 10 mm	92 ± 10 mm
Rear wheel camber	—0° 45′ ± 15′	—0° 45′ ± 1°	+ 3° ± 1°
Type 100			
Front axle wishbone position	110 ± 2 mm	110 ± 10 mm	60 ± 10 mm
Rear wheel camber	—1° 30′ ± 15′	—1° 30′ ± 1°	+ 2° ± 1°

[1]) The normal vehicle level is obtained with the vehicle in curb condition by adjusting the connecting rods on the level control valves (left and right on front axle and in center of rear axle).

[2]) Actuate level control valves by hand until the specified level values are arrived at.

[3]) The difference in the tolerances between the values for adjustment and the values for checking arise from the dead travel of the level control valves.

[4]) The values for the higher level are not indicated for adjustment, but only for checking purposes.

Adjusting the Front Axle

15) The adjustment of the front axle height is in principle the same procedure however the set points are a bit more complicated to measure.
If adjusting per specs (see diagrams: wishbone measurements) seems to be too difficult, you can alternatively try and set the body relatively horizontal. By measuring at the bottom of the stainless steel trim below the doors or the the underside of the rocker panel, you align these level or facing front slightly down (front end approx. 10-20mm lower than rear end between wheel wells). Note that this is eyeballing and not to factory specs.
This is probably okay as a rough approach to adjust the rocker panel or the door entries to be level or slightly lower in front relative to the rear.
The difficulty is that you need to get left and right side very close before you do the final adjustment. Like tuning a string instrument (one string affects the tone of the others) the adjustment of one front side will affect the other side slightly. Both sides are connected by a strong sway bar and will affect each other. Also roll the car back and forth slightly to get the tension out of the system

16) For the ones who what to know. The proper MB set points are the following (see diagrams 1 and 2)

Set point for W100 front axle:
Measurement ‘a’: 110mm +/- 2mm height differential between axis of wishbone seating (sub frame) and axis of steering knuckle seating. You need a special MB gauge to do this properly.

Set point for W 109 and W112 front axle:
Dimension ‘a’ is 57mm +/- 2mm (or 42mm +/- 2mm, see diagram 2) height differential depending on the Type between axis of wishbone seating (sub frame) and center of wheel (stub axle). There is a gauge but ‘a’ can be measured approximately with a small level, steel ruler, 3 hands and a lot of patience.

17) Again the rule: Always approach the set point from the lower side by pushing the lever up (air flowing into the air spring). If car is too high – go back to the starting point and try again by opening the intake (lever up) and raise the car to axle height set point.
If the height seems perfect, lock the lever with the pin so no air shall flow in or out.

Connecting the Rods

19) With the 3 lock pins in place adjust the connecting rods to length. Adjust and dry fit the seat, adjust and dry fit. This will take some time. Then install ball joints with grease and tighten the lock nut, remove the lock pin from lever/collar, then lock the rods in place (there are various versions of the ball joint heads. Some have an external wire clip for locking the ball, others have only the internal clip).

20) Please remove the 5mm lock pins during or RIGHT after you are mounting the rod. Double check before you finish the job that the lock pins are removed and the lever can move freely. If you forget to remove the pin especially if the pin is in steel it might end up causing expensive damage to the LVC and disaster!

If this method is used successfully and you check back and forth, and left and right side multiple times, do the final check and drive! Go slow and be suspicious of anything unusual. It is important now to drive the new air suspension for a good while in order to have the new O-rings settle in the valves. Don't forget to fill 96% ethanol into the alcohol bottle all year around, even in summer. Don't judge the system before you have really driven the car.
If you are unsure of what you are doing please have your car checked and adjusted by a professional alignment shop according to MB set points.

If there is an air leak with remanufactured LCVs after this procedure and the car drops, the problems will need to be tackled. I have insisted on cleaning and flushing the components before and extreme cleanliness during install. While cleanliness and patience is the best guarantee to do it 'right', there still might be a slight leak which sometimes appears at the A valve. The E valve is invisible in a way at this point.
For the hobbyist this is not easy to trouble shoot. (I have given the procedure for finding the leaking A valve in my article about air suspension available online). Experience with the system is the best basis for judgment.
If I am rebuilding the LCVs the product will be bench tested (air tightness according a protocol) and I am giving a 2 year limited warranty for internal air leaks.
And I will assist you and help you trouble shoot if the car drops after installation.

Good luck with your 'new' air suspension and enjoy the ride.

Martin Werminghausen
Boston, March 2014

www.600airsuspension.com