

## **W211 E55 Installation of Rear KMac adjustable bushings, Arnott air bags, control arms. (Revised copy with errata incorporated)**

**Disclosure: I provided Kevin at KMac a draft of this writeup with a request for comment. I incorporated his comments where appropriate in this latest revision.**

### **Miscellaneous thoughts:**

-The following is provided for guidance only. Use at your own risk. I am not a certified mechanic and am only sharing my experience learning about and working on my car. I regard major body work as a 10/10. Engine or transmission rebuild 8/10. Replace all plugs, wires, belts, pulleys on an M113K engine 4/10. This took me three weekend days and two additional blocks of 2-3 hours each to correct the final alignment. **(UPDATE: Revised estimate of difficulty as 5/10 based upon KMac-instituted upgrades.)**

### **E55 with code 489 air suspension specific!**

-The E55 uses larger bolts in the rear suspension compared to non-AMG models. Any torque values provided were what I used on my car. Use the WIS to look up your car's values. If you don't agree with my torque values, use your own. Loc-Tite or equivalent thread-locker is your friend if you can't get a torque wrench onto a nut or bolt.

### **Control Arms**

-I went into this not intending to replace the control arms. Upon disassembly, I discovered the control arms' outboard bushing were very loose; it required only ounces of pressure to "waggle" the control arms. With 100K miles (162K Kilometers), I decided to just go ahead and replace the control arms.

Budget \$500 for the two control arms. New control arms took greater than 10 pounds of pressure to move the bushings compared to ounces in the old control arms.

-If replacing rear control arms, the rear brake calipers must be removed from the disc to provide clearance to remove the outboard control arm bolts. You must disable the Sensotronic Brake Control (SBC); failure to do so can result in damage or injury if the system is triggered by any one of multiple possible inputs. It is preferable to use the diagnostic system as this relieves system pressure. After job completion, you must reactivate the SBC using the diagnostic system.

### **Air Bags Suspension**

-If replacing the rear suspension air bags, use a diagnostic system to deflate the old air bags and to inflate the new air bags. Go to "Control Units", "Chassis", "Airmatic", select the air bag on which you will be working and follow the instructions.

### **KMac Adjustable Bushings**

-The provided bushing removal tool removes the control arm stock bushings pressed into the subframe. Be aware, however, you must provide significant amounts of torque to press them out. My impact gun failed to break the bushings loose. I recommend a 16" breaker bar then shift to a 12" to 16" ratchet once the bushing breaks loose. You will have to reconfigure the tool part way through the process to complete removing the bushing. The tool actually worked better than expected. (I installed KMac front bushings into new front control arms still to be installed; that particular KMac-provided tool folded on the second bushing I attempted to press. If that tool had a thicker wall thickness it might survive.)

**Feedback from Kevin at KMac: This issue is since corrected. New press tool has a thicker wall.**

-(**Note: I had an older kit with only one tube for the toe bushings. Kevin at KMac has since instituted a “two tube” system; one tube to support the rear of the toe arm and the other tube to press out/in the toe bushings. This task should now be easier to perform.**) I recommend a 6” vise to do this task. The bushing removal tool will also press out the toe arm outboard bushing if you use a little ingenuity to support the outboard end of the toe arm. (Note: Use this technique with caution; I bent and had to replace a toe arm.)

Getting the new bushings in is a bit more difficult and requires ingenuity (**Note: should be easier with the new two-tube system**). A vise and 30mm socket will start the new bushings; you can finish using a large (30mm or so) socket and a 1.75” to 2” diameter piece of pipe 1/2” length. Alternatively, use a large socket on the shoulder side and two small sockets supporting the other side of the toe arm. The latter approach requires juggling to make it work. **Note:** The bushing is only pressed into the toe arm until it is centered.

Do not press it all the way in to the shoulder of the bushing!



### **Alignment**

--I performed my own rear wheel alignment using a SmartCamber camber gauge and strings. FWIW, I place the car on 6” ramps in the front and set the rear of the car on 6” worth of stacked wood squares with slip plates on top. I use two 1” diameter PVC pipes laid across jack stands front and rear of the car. 5 pound weights are used at each end of 30 pound test monofilament line to keep it taut. Jackstand height is adjusted using boards and floor tiles to ensure the monofilament line is lined up with the center of the hubs both front and rear.

--For my car (stock factory wheels and tire size), I cut grooves 1830mm apart in each PVC pipe. When everything is parallel, the star center of both front wheels center cap will be 44 mm from the lines; the star center of the rear wheel caps will be 47 mm from the line. Using a clear plastic ruler makes it easier to see the measurements. Remember, measure carefully, a half millimeter counts here.

--It took me several attempts to get the alignment correct and the toe-in was tedious. My first set of slip plates (floor tiles with grease between) ended up sticking and camber was off. Second attempt at slip plates using aluminum plates and oil worked at first but ended up “sticky” before I finished.

--If the KMac bushings are not tightened upon installation, as soon as you lower the car onto the suspension and slip plates, the KMac bushings will rotate and the wheels will splay out to -3.3 degrees or so. Even with a decent slip plate, it takes a lot of effort to pull the wheel in using a socket on the KMac bolt. You must use a slip plate or the bushings deform (and possibly tear) and your camber will be incorrect when the elastomeric bushings spring back into a relaxed position.

**ADDITIONAL RAMBLING NOTE:**

One axiom is, "If it is stupid but works, it isn't stupid". I was disgruntled with my slip plates so, on my third attempt, I re-measured the camber (Left rear @ -1.9 degrees measured vs -1.5 degrees desired), determined how much I needed to change it (add +0.4 degrees), raised the car so suspension was at full extension, measured the camber at that point (-0.2 degrees), and added +0.4 degrees camber (new measure +0.2 degrees). Tightened up the camber bolt, lowered the car, set the toe, and the final camber was -1.6 degrees. Not quite the -1.5 degrees I was targeting but within the cross-camber parameters.

It took a bit of trial and error to determine the error sources. As I stated earlier, none of my slip plates were satisfactory. Each time the plates started off as slip plates but 30 minutes later were "stuck" plates. Seems there is a reason they use ball bearings in the quality versions.

**Create and use a checklist**

I compile a checklist of what I need to reinstall/re-enable as I perform the work. When re-assembling, I use the checklist in reverse order to ensure I did not miss anything. For this particular job, I created the following checklist during disassembly, and used it in reverse order to verify I did not forget anything:

- remove/install/torque lug bolts
- deflate/inflate air bag suspension
- loosen/tighten pneumatic junction block lines
- Deactivate/activate SBC
- remove/install exhaust tie-bar
- remove/install left rear and right rear exhaust hangers
- remove/install left front and right front exhaust hangers
- remove/install/torque toe arm outboard bolts
- remove/install/torque toe arm inboard bolts
- remove/install/torque inboard (camber adjust) control arm bolts (bend tabs on KMac lock)
- remove/install/torque outboard control arm bolts
- remove/install/torque air bag suspension bolts
- remove/install/torque shock absorber (damper) bolts
- remove/install/torque brake caliper bolts

## START OF JOB

-Place car on jackstands and remove rear wheels.

-If replacing air bags, deflate air bags using diagnostic system. You will need a 10mm combination wrench to loosen the fittings on the junction block mounted on the sub-frame between the two toe arms.



-If replacing control arms, deactivate SBC using diagnostic system.

-The stock exhaust of a W211 E55 must be lowered out of the way to access toe and control arm bolts.

--Remove center tie bar; two nuts, 12 mm hex head. ¼" drive ratchet or ratchet wrench.

--Unbolt two hangers in front of the axles; each two nuts 13 mm. Ratchet wrench here.



--Unbolt two hangers between rear bumper and rear of mufflers; each 2 nuts 13mm. ¼" drive ratchet here. It's a tight fit for big hands.



-Remove toe bar.

--Remove outboard bolt. It will be under tension so expect the toe arm to slap upward when you remove the bolt; don't let your face be in the way. Ratchet, T50 Torx, and combo wrench.



--Remove two bolts from toe arm inboard bracket, one is E16, other is Torx T50.



--Set toe arm to one side or replace the bushing at this point.

-Remove from the control arm the lower bolts for shock absorber (damper), air bag (the brake line bracket on the other side will bind the bolt when attempting to remove said bolt), and inboard bushing end (Triple-square spline bit required).



**--NOTE: If replacing the control arm perform next steps. If not, skip ahead to the "JUMP POINT". You will need a 12mm allen head wrench or bit to remove the outboard bolt. After spending a bit of time looking for one in town, I ordered one from Amazon.com for about \$10 with free two-day shipping.**

NOTE: if the SBC is not de-activated, you run the risk of losing fingers if the brake system activates while you are removing or installing the calipers! The system runs at 60 bar (880 psi) pressure! If not disabled, the system will activate, pressurize the calipers, and slam the pads on your finger tips whenever someone:

- opens a door on the car
- operates the central locking system with the key fob
- depresses the brake pedal
- turns ignition key to position 1
- operates the parking brake

NOTE: The air suspension control arms are aluminum alloy; use only a rubber mallet if you need to whack the new arm a bit to seat it in the hub. Do NOT use a brass or steel hammer except to remove the old control arm.

NOTE: The alloy control arms are two pieces connected at the outboard end by a pressed in bushing. Check the two halves for alignment by running the bolts through the arms. If out of alignment, you can twist them back into alignment by rotating the arms around the pivot point. One of my brand new MB control arms was off by approximately 5mm. I was about to return it when I realized the arms can be adjusted if necessary.



--Use a pry bar to spread the brake pads (compress the pistons into the calipers) sufficient to remove caliper from disc.

--Remove two external Torx bolts holding the caliper onto the bracket. These are tight and held with factory locking material on the threads. I had to use a ½" drive breaker bar to loosen them.

-Tie brake caliper out of the way

-Use the 12mm allen head bit and a combination wrench to remove the outboard bolt. (If you do not remove the caliper, the brake line blocks the bolt before it pulls out of the hub assembly.)



-NOTE: The hub assembly uses a press fit bushing that clamps down on the control arm outboard pivot point. This bushing may be pressed in far enough it prevents the new control arm pivot bushing from sliding into the hub. I could not find a way to press the bushing back out of the hub assembly; I ended up using a flat file to remove approximately 0.005" of material from the control arm pivot point. This provided sufficient clearance to install the new control arm using a **rubber** (not metal) mallet.



-Install 12mm allen head bolt. Tighten snugly. Torque to final setting upon end of job.  
-Reinstall brake caliper. Medium strength thread locker and torque it down.

#### **JUMP POINT**

##### **Air Bags Suspension**

NOTE: A Dremel tool or similar with a cut-off wheel will make this next part much easier.

-Carefully cut nylon tie-wrap holding air bag lines to air bag. Do not remove electrical connector or the pneumatic line yet.

NOTE: If you weren't wearing safety goggles yet, put them on now!

-Use Dremel tool to cut the stock hose clamps on the air bag external line. One clamp is next to the air bag, the other clamp is underneath the car at the external aluminum reservoir.



-Bend and remove clamps (yes, they are sharp from the cut-off wheel). Use a sharp knife to slice the external hose from the fittings on the air bag and the external aluminum tank. You'll pull the hose out after you remove the air bag.



- With the hose cut off the air bag, the air bag can be rotated to better access the connector and fitting.
- Use small screwdriver to depress tab on electrical connector; unplug.
- Use needle-nose pliers to unscrew air line from air bag. A piece of painter's tape around the open end will keep debris out of the line. A new connector is included with the Arnott air bags. Note the orientation of the compression ring when inserting into the connector.
- Use pry bar to pull air bag off of its plastic mounting tab. These tabs are one-time use only. New plastic tabs are included with the Arnott air bags.
- Pull the old hose out.
- Remove the external aluminum air reservoirs. 3 each 13mm hex head bolts each. Each reservoir has two bolts that cannot be removed from the sub-frame. Have available 4 each M8 x 1.25mm thread pitch hex nuts and install those on the bolts so they won't rattle.

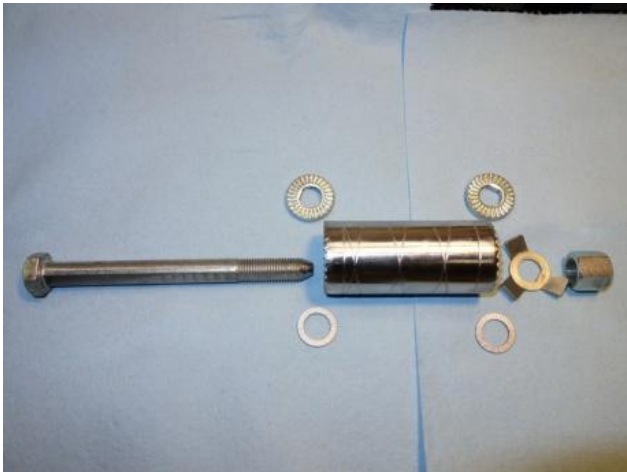


## KMac Adjustable Bushings

NOTE: If you run out of the included silicon grease and need more, be advised that di-electric grease is silicon grease. e.g. Permatex Di-Electric grease; it is available in a 3-oz pressurized container for about \$10. Or you can buy it in 0.33 oz size at \$4 each. I mention this as it took me awhile to figure out what went where and I ran out of grease before I ran out of kits (I had several variations of the KMac kit from various stages of development. I ended up installing the latest release and not an earlier experimental version.) Latest version: 1.25mm pitch threads, 4mm tooth separation on center, folding lock tabs



NOTE: Use the thin washers for the alloy control arms. The thick washers with teeth stamped into the perimeter are intended for steel control arms (non-air-bag suspension).



-Assemble tool as shown in photo. It will take a lot of torque to break the stock bushing loose from the sub-frame. (If the bushing's outer shell begins to deform outward, remove the press part of the tool, use a hammer and punch to bend in the bushing's outer shell so the tool will stay seated.)

NOTE: you will have to raise the axle for the tool to clear the CV boot.



-Expect to run out of deep socket before the bushing is completely removed. Disassemble the press tool, insert a standard length socket over the threaded rod, reassemble and continue pressing the bushing out of the sub-frame. FWIW, I used a ½" drive 22mm socket on mine.



-Clean sub-frame bushing mount.



-Insert the two halves of the KMac elastomeric bushing into the bushing mount.



-Grease the KMac metal center piece with included silicon grease. Press it into the elastomeric bushings using your hands. If it gets stuck half-way through, remove, reverse positions of the elastomeric bushings, and re-attempt to hand press in the metal center piece. Do NOT attempt to tap it in using tools! Right-hand photo shows what happens. Fortunately, I had spares. These are the obsolete 2mm tooth separation versus the revised 4mm tooth separation seen in left photo.



### Reassembly

- Install new brass fitting onto end of pneumatic line. FWIW, prior to installing the new compression fitting I trimmed the end of the line where the old compression fitting deformed the plastic line.
- Insert electrical connector. Fasten pneumatic line to air bag using needle nose pliers. This takes very little torque to seat this fitting.
- Fit air bag onto tab.
- Verify you tightened the pneumatic fittings on the central junction block on the sub-frame. These are the lines you had to loosen when deflating the air bags using the diagnostic system.



- Install shock absorber bolt.
- Install air bag bolt. The brake line bracket will attempt to bind the bolt when you insert the bolt. Keep the bracket up against the control arm and it should slide in easily.



-Install KMac adjustable bushing bolt. This one took a bit of patience. The end of the bolt kept hanging up on the far side of the control arm. I tapped in the bolt slightly enough to begin spreading the ends of the control arm, then rocked/rotated the bolt using a 19mm wrench while tapping on the control arm with a rubber (not metal!) mallet. You should consider using a floor jack under the control arm but there was not much room under the car.



-Install the toe arm at the outboard end where the KMac adjustable bushing is now installed. Do NOT bolt the inboard end of the toe arm to the sub-frame! Outboard bolt should be snug but not tight!  
-Loosely tighten all bolts. Do not torque down to final values until you have inflated the suspension air bags and the car is sitting on its suspension.  
-Use diagnostic system to inflate air bags to 0.5 bar pressure. Use floor jack and camber gauge on wheel hub; raise the control arm to approximately -1.2 degrees. Use diagnostic system to inflate air bags to 2 bar pressure.  
-Mount wheels. Lower car onto 6" to 8" stack of wooden squares (I have a large stack of 3/4" thick high-quality plywood cut in 12" squares".)  
-Start car. You will most likely get a "car too low", "stop driving" alert. If assembled correctly, the air compressor will activate and the car will rise to its proper height.  
-Reactivate the SBC using the diagnostic system. This will take several minutes for the system to re-pressurize all four corners and perform a self-diagnostic test. It will require a key on/off sequence.

-A couple of courses of action here:

--One school of thought is to tighten the suspension bolts now.

--A second school of thought is to lower the rear of the car to the ground, back it off the ramps, back it several feet to the end of the driveway, then drive it back into the garage. Tighten the suspension bolts if they can be reached with the car on the ground. Otherwise, put it up on ramps. Naturally, this takes a bit more time.

--Having said the above, do not install the inboard toe arm bolts and do not torque the outboard toe arm bolts at this time!

-I used the following torque values:

M14 – 85 to 90 ft-lbs depending upon use of thread locker.

M12 – 60 ft-lbs

M10 – 35 ft-lbs

-You now have a choice of taking it to an alignment shop or aligning it yourself. Even if taking the car to an alignment shop, consider following the information below to get rear alignment in the ballpark.

### **Alignment DIY – Camber**

**-Important! When setting camber, ensure the toe arm is completely disconnected from the subframe on the inboard end! If connected, the toe arm will bind and cause incorrect camber settings.**

**-You must use a 6-point 19 mm socket on the KMac bolt head to adjust camber. The head of the bolt is sunk into a machined pocket in the alloy arm. An open or box-end wrench will slip and round off the bolt head! The KMac extended nut on the other side required an 18mm deep socket.**

**-Depending upon the position of the KMac adjustable camber bolt, the toe arm may cover the head of the bolt and prevent the use of a socket to adjust camber. If you are going to adjust the camber, you must drop the inboard toe arm bracket from the sub-frame. I learned this when I went back the second time to adjust camber.**

**-Adjusting camber causes significant changes in toe and will bind the toe arm; just accept the pain and drop the toe arm inner bracket if you are going to adjust camber.**

As stated earlier, this is how I finished the final alignment once I determined the sources of my errors. I was in the ballpark but still not at my desired end-state. Left rear was at -1.9 degrees, I wanted - 1.5 degrees. I decided to remove 0.4 degrees of camber while suspension was unloaded. Not the normal method but I was tired, disgruntled, and brainstorming ideas at the time and figured it was worth a try.

--Front wheels on 6" ramps.

--Car in approximately level position, rear supported by jackstands at jack points.

--Rear wheels mounted, suspension at full extension.

--- Left rear camber measured -0.2 degrees. I removed 0.4 degrees of negative camber; setting the camber to +0.2 degrees. Torque KMac bolts to 60-65 ft-lbs. Don't bend the tab over the nut yet.

--Lower car's rear tires onto 6" stack of 12" square 3/4" plywood to set toe. Rear air suspension elevated car approximately 4" or so above normal. The gap between the tire and fender looked like the car was in "raised" mode. This caused camber changes for which I had to account.\*\*

---Camber measured -1.2 degrees (Reference only. I was adjusting toe at this time.)

--Lower car to ground, drive to end of driveway and back (rear of car lowered on its own to the proper position), pull into garage and re-measure.

---Camber measured -1.6 degrees. (Not my desired -1.5 degrees but "good enough for government work".)

--From this quick and dirty measurement, from full extension to normal laden height, the left rear camber on my car swings from +0.2 to -1.6 for a change of 1.8 degrees.

\*\*I could not get the rear to lower. It was almost as though I had pressed the "lift car" button. Starting the car would not lower it but it lowered itself as soon as I drove it off the ramps. <shrug>

## Alignment DIY - Toe

-Important! When setting camber, ensure the toe arm is completely disconnected from the subframe on the inboard end!

-Improper toe settings will rapidly destroy a tire.

-At some point in the past, a previous mechanic failed to install the shim that fits between the bracket and sub-frame. I made a replacement using 0.030" aluminum (vs 0.060" stock) from a trashed florescent light fixture; Dremel cutoff wheel, drill bit, and a round file did the rest. This cost me an hour of labor but it was faster than ordering one even if available.



-Expect trial and error. Everything is reversed and it is easy to go the wrong way.

-After setting the camber, note the wheel's toe (in, out, how much?), then use the outboard KMac adjustable bushing to line up the toe arm inboard bracket slots with the bolt holes in the subframe.

--Start the bolts, then adjust toe arm in or out using the KMac adjustable bushing on the toe arm to obtain sufficient adjustment range with the inboard adjuster. For now, leave the inboard bolts loose enough that you can see the slots.

--Don't just set the bracket so the bolts are dead center in the slots; offset the slot so you maximize the adjustment range available with the stock adjuster. You may need to start the bolts, adjust the toe as much as you can using the stock adjuster, then go back to the KMac adjustable bushing on the outboard end of the toe arm to pull or push the toe arm inboard bracket into a new position in the direction you are trying to go.



-The toe arm inboard bracket bolts now need to be snug but not tight; you need the bracket to move when you rotate the adjuster with a 21mm box-end wrench. My routine is to slightly loosen the lock bolt (T50 bit) on the adjuster, rotate adjuster to move bracket in desired direction, then slightly tighten the lock bolt. The photos below do NOT show the 21mm box-end wrench on the 12-point cam adjuster. It would be on the inboard bolt in which the T50 bit is inserted.



-When desired toe is achieved, tighten the lock bolt that is NOT the adjuster. E16 Torx bolt. Recheck toe.



-Keep the 21mm box-end wrench on the adjuster and tighten the other lock bolt. T50 Torx bit. This photo does not show the 21mm box-end wrench on the 12-point cam adjuster. The 21mm wrench should be holding the cam adjuster steady whenever you are loosening or tightening the lock bolt.



-Torque both to 60 ft-lbs.

-I could not get a torque wrench onto the KMac deep nuts on the outboard end of the toe arm. Loosen nut to expose threads, apply thread-locker liberally, then tighten using an 18mm wrench to what feels like 60 ft-lbs. On the driver's side (left-hand drive) a box-end wrench would fit. On the passenger side, the sway bar end-link interfered and I could only get an open-end wrench on it. This is where the folding tab locks would provide some reassurance.



-Bend locking tabs over the KMac adjustable bushing bolts in the control arms.  
-Lift rear of exhaust and place hanger brackets over studs.



-Fasten exhaust hangers in front of the axles. Ratchet wrench works well here.



-Go back to rear of exhaust and install the hanger bracket nuts. A ¼" drive ratchet works best here.  
-Fasten center tie-bar. ¼" drive ratchet or ratchet wrench works well here.  
-If all went well, go for a test drive and enjoy the fruits of your labor.