Jeep TJ 5.2 / 5.9 Swap Guide

Saving as much money as possible while still doing it “right”.

First off, let me start this, and I will reiterate it throughout--I do things one way, you do things another, and everyone has their own way. This can be done a million ways, but this way works, and I think it’s a healthy choice for those looking to be reliable and fun. My goal was to have a Wrangler that didn’t lack in power, was reliable, and was somewhat unique (but not so unique parts are impossible to come by!) I do not claim to be an expert, and I am not responsible if you follow these IDEAS and it does not work, or you get hurt. It should go without saying, you’re messing with a vehicle, wiring, electricity, etc. Fires, breakages, etc can happen, especially when parts meant for a I6 or 2.5L are used for more powerful motors.

I suggest collecting all parts prior to starting the project. If you do this right, you could potentially do the swap in a week or so, assuming you have the PCM you need and all the parts. It took me about 6-8 weeks to be fully up and running 100%. I hope this document will cut that time down for you. A lot of my time was spent tracking wiring (since there was no good “instructions” online) and trying to figure out small stuff like what clutch to get or what crank sensor to get.

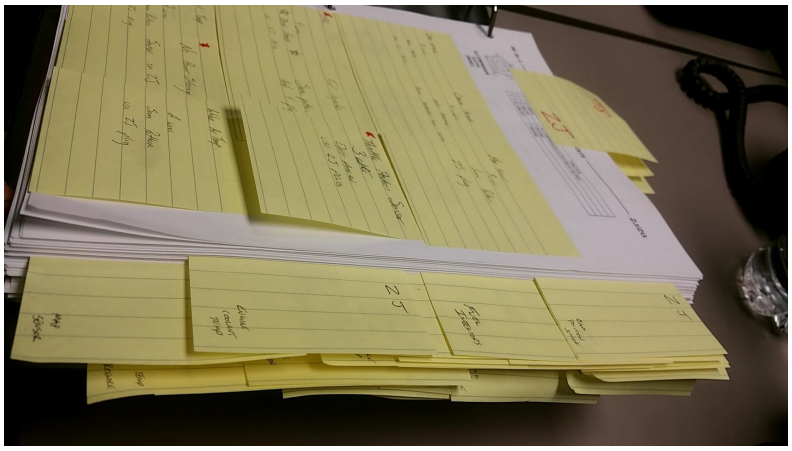
I have a document with every part (of importance) that I used, along with the price and a link to either where I got it, or where to get it. Please use this as a reference, and please don’t get mad at me if something on it is wrong. I tried to maintain it throughout and keep it updated. I didn’t include things I didn’t have to buy, but generally speaking, those items were of low cost (except I had the donor motor in a totaled vehicle.)

If you shop around and take your time, after selling your factory drivetrain, a conservative estimate of $1000 will be spent. I believe I spent around $500, but as you will see, I bought a AX-15 (I swapped a 4 cylinder), and over spent on a few items (flywheel).

Wiring- This is always the most intimidating, but if you take your time, you can do it with only basic knowledge. If using your existing TJ harness:

- Items needed:
    - FSM for your jeep
    - FSM for the vehicle your motor is derived from
    - 75’ Wire (18 gauge)
    - Wire strippers

- Soldering iron and solder
- Heat shrink tubing
- Lots of zip ties (8" or so is plenty big enough)
- Your TJ harness
- Optional: donor vehicle harness
- PCM pins (if you have the donor harness, you can steal them from that.



I cut about 3 foot of the C1/2/3 connector off at the junkyard for about $5, or you can over pay on eBay or Amazon)
- Multimeter
- Various loom of your choosing -- I prefer black (3/8" 1/2" 1" at minimum)

- How I suggest doing it:
  - Print the Connector Pin Out sections for both your TJ and the donor vehicle
    - Compare Powertrain Control Module C1, C2, and C3 for both vehicles. Highlight any missing pins on the donor pages (will likely be the 2-4 injector drivers, but you HAVE to verify these are the only ones)
    - Now go through the same pages and ensure everything else on the two PCMs are pinned to the same locations.
    - Finally, go through every pin out in both FSMs. Note any differences between them.
      - Keep in mind that you are using the sensors from your donor vehicle (most likely). My notes reflected this as well, i.e. “wire colors/pinning are the same, keep TJ plug (or change to donor plug)
  - Label every single connector on both of the harnesses. Don't try to remember every plug...it's not worth it
  - Lay out the donor wiring harness in one of two ways; on in the ground evenly laid out as if it were on the motor in the engine bay or a lot of people claim zip tieing the harness on a 4x8 plywood sheet in the same manner.
    - If you do not have a donor harness, you will want to wait until you have the V8 completely ready to install, and then deloom the TJ harness and start rerouting, changing, adding, etc from there.
  - Deloom the entire harness from your TJ, DO NOT deloom the donor harness
  - Reroute the TJ plugs to match the location of the donor harness
  - Change connector ends as needed (make sure all your wires stay the same. Easiest way is to do 1 wire at a time, even when connectors have multiple wires)

- Solder all wires. You can choose to do this before putting it on the jeep, or you can wait until you start it for the first time. I chose to solder the ones I was confident in.
- Put loom over all of it you can (finish after everything is soldered)
- *If you're using the donor harness, you might be better off. In hindsight, it might have been easier to use the ENGINE HARNESS from the donor as most things would have remained the same. The kicker for me was I switched to a manual Ax-15 and my donor was an Auto, so I had ALOT of extra wiring if I had gone that route...Just cutting that section of the harness off is cheap and I did not want to do that.*

- Quick notes from first hand experience
  - My 2001 wrangle had a alternator plug, like a sensor. My donor did not. It had an external box on the radiator. I thought it was the voltage regulator. It's not. The PCM is the voltage regulator, don't forget about wiring these 2 wires up, or your alternator will only charge at around 10.5V.
  - Understand the ASD system. The ASD wires provide 12V,and the PCM "drivers" ground out, completing the circuit. Learn this before hand.
  - Keep your ASD wires the same color (they're usually about the same from the factory for all injectors) BUT use unique colors for every added injector. I did not use unique colors and I regret it big time.

  - When you remove the PCM plugs, make a mark so you know How the connector goes together. Trust me when I say is easier than you think you flip one upside down.
  - Some of the newer TJ's have a sensor style plug that is one wire, while probably all of your 5.2\5.9 donors will just have the traditional lug that goes to the starter solenoid. Just cut the connector end off and add a lug, it will function the same
  - The FSM isn't always 100% correct. Should it be wrong, or someone fixed your harness at some point, I suggest always using a multimeter to verify continuity on a pin or wire before altering it.
  - ***TAKE YOUR TIME-- It took me at least 24 hours across days to get mine all the way wrapped and everything correct. Due diligence pays off here. It will look like a giant mess when you get into it, but by the time you're done, you will have gained skill and experience, as well as understanding!***

Jeep TJ 5.2 / 5.9 Swap Guide

Chassis/suspension/motor mounts

- Items needed
  - Driveshaft considerations: see later
  - If you notice sag in your old/worn out suspension, adjustments there might be needed...coil spacers are a cheap way out and will work fine
  - Motor mounts, preferably from Advanced Adapters
- Chassis changes
  - The only change will likely be the driveshaft, see it's own section later
- Suspension
  - There didn't seem to be any sag on my front factory springs. I will comment on ride after driving it for awhile.
- Motor mounts
  - You can choose to make your own, but when three are reasonable priced mounts specific for this swap, why waste your time? See parts list for the Advanced Adapter part number
  - Make sure the mounts are level as possible front to back and left to right. Try to get them centered as well so that the engine is in the middle of the engine bay. Personally, my motor has more front to back lean than I'd like, but does not cause any driveline vibrations.

Drivetrain (*not including motor, this section refers to the front differential, transmission, transfer case, rear differential, and will touch on the drive shaft*)

- Items needed
  - Motor from donor
  - Transmission
  - Transfer Case
  - Driveshaft
  - Differentials
- This will be unique to the way you choose to do the swap; where you place the motor and what transmission you use will be that determining factors
  - The "easy" way (automatic trans):
    - If you're using an auto, the AA motor mounts will have dowel pins that will make alignment for the motor mounts almost too easy. I can't speak as to where this puts the transmission as I went manual, but the AA motor mounts are designed for an auto swap. After putting them in, you can sit the motor/trans/transfer case in and test your driveshaft for fitment and go from there
  - The other "easy" way (manual trans):
    - Even though the motor mounts are designed for an auto, that is only for the drivetrain length to be ideal. The motor mounts are no different of course between transmission types. You can drop the motor/trans/transfer

case, and place the drive shaft in. From there you can cut the dowels off the motor mounts (takes less than a few seconds with a harbor freight cut off) and tack the motor mounts in, pull the drivetrain, and weld them in place. This will allow you to keep your driveshaft. However, it will make it so that you will more than likely have to hammer in your firewall

- The way I did it, and suggest doing it:
  - You're doing a motor swap, unless you just don't care about hammering in your firewall, you can go this route:
    - Put your transmission in place, sliding it all the way forward on the crossmember
    - Lower the motor in, and put a couple bolts in your bell housing
    - Check for clearances once the motor is pressed up against the block. I have around 3" of clearance around the top of the heads, and less than 2" on the back of the block by the firewall. However, I have PLENTY of room to get to the crankshaft position sensor, the distributor, etc which is priceless to me.
    - Put your motor mounts on the engine, center and level, tack, and then weld
      - NOTE: I had to get shorter bolts for the ground straps on the back of the block due to how close it was to the firewall. Remove all the ground bolts on the rear of the head before dropping the motor in!
    - Now try to put your driveshaft in...unless you have a Rubicon, your driveshaft is probably too short. Mine had around ⅜" of grab on the transfercase...not nearly enough. See the driveshaft section for my remedy
    - This will also move the shifter forward, and you will have to bend the stalk back. If you remove the plating around the shifter, you can shift into all gears, but you will hit your hand on the dash in 1-3-5. Cut the metal plating around the shifter accordingly.

- Differentials
  - Your differentials are up to you. I personally have started with what was there from the factory (4.11 geared D30/D35). The D30 in the front will be plenty for my uses, while the D35 will get replaced with a 8.8 in the future. If you wheel hard or often, I suspect the D35 will not hold up to the newly added torque for long.
- Transfercase

        - Keep in mind that a 4 cylinder TJ has a 21? Spline shaft and the 6 cylinder has a 23? Spline shaft. The V8 will need the 23 spline, so if you are swapping into a 4 cylinder TJ and plan on keeping the Jeep transfer case, you will need one from a I6 TJ/XJ/ZJ or V8 ZJ. I'm running a 242 because it suits my needs and I had it when I did the swap
    - Driveshaft
        - If your driveshaft is too short, buy one unless you are comfortable with making your own. Obviously, a drive shaft spins at a very high RPM, and can create some major carnage if it breaks, so build accordingly. Slip shafts are easy to come by from multiple manufacturers, and run less than $400 on average for a basic shaft with a slip.
            - My driveshaft was too short. At the time of writing this, I have ran my custom made shaft without any issues or vibrations, and honestly don't expect to upgrade anytime soon.
            - See the section later on how to make your own length driveshaft.
        - This is a good time to consider a SYE kit if you want one or have the money for one.
- Cooling System
    - Radiator
        - There are plenty of "Chevy V8" swap radiators out there. From what I've seen, most of them will work just fine. See my Master Parts List for the radiator I used, and you can simply match up dimensions and inlet-outlet sizes if you find another one.
        - You can get "adapters" for your sensors on eBay for cheap enough. See parts table for links to what I used. You can choose how you want your fan to work. I chose to stay as close to 5.9L ZJ Limited Factory as possible.
        - A ZJ radiator will not fit, I tried
    - Fans
        - The 5.2 and 5.9 motors are known for being hot. That's okay. The TJ engine bay has 5x as much room as my donor ZJ did, and the aluminum swap radiators help as well. Just get a good fan; the "taurus fan" swaps will be plenty. I am running the 5.9L ZJ fan with the shroud cut down.
            - Just a anecdotal comment: I ran no fan and only the aluminum radiator to get my Y pipe made in nearly 90* weather and high humidity. It stayed under 210, even sitting at red lights

- Exhaust
    - Headers/Manifolds
        - Where you place your motor will determine your options. Headers are the best choice of

course, but center dump manifolds can be used. I believe they were on the small block mopar V8 vans.
    - If you get headers, spend the extra time and money to either paint them or coat them. It will save you money down the line when you're not replacing them in a year or two from rust holes.
    - Install them for the first time the first time you drop the motor in or while it's on the stand/hoist.
    - Google **Header Buddies**. I did not use them, but they are gasketless and help prevent leaks. A good investment
    - Keep your o2 sensors, you will need both of them (even if you "disable" the rear o2 sensor. See PCM information below for detail)

  - Y pipe
    - I chose to have my exhaust done at a shop...for a few reasons. I was quoted $350 to make me legal (Catalytic converter, o2 sensors) if I brought the muffler (I asked since I had one from my donor that was ideal). I figured by the time I messed up bending pipe I'd spend over $200 in materials, so why not pay someone a little more and save myself the headache
  - Muffler
    - This is your choice. Keep in mind a TJ has a short wheelbase, so even though your truck sounds great with dumped exhaust, the TJ dump will be awful close to you (smell, and sound are to be taken into consideration)
    - I chose something quiet for the most part, but you can tell it's a V8 (magnaflow knock off)
  - Other exhaust considerations
    - 3" is ideal for the 5.9L I swapped, but according to the exhaust shop, you can't fit a 3" tailpipe over the axle unless you have around 6" of lift. I have no reason to question him as he is a professional and seems to know his stuff. I went 2.5" all the way back
    - Catalytic converters are required to be legal. I believe it is something like a $25,000 fine per person that knows you car does not have a converter on it. (So, the people at the shop, the shop owner, and you at a minimum), so most places won't touch it unless they're installing one. Get a high flow, or the new "Spun" converters, you won't loose any power. You can cut it out later if you don't have inspections to pass.

- <u>Parts</u>
  - See master parts list later.

<u>Things I ran into, and I'm sure someone else will as well</u>

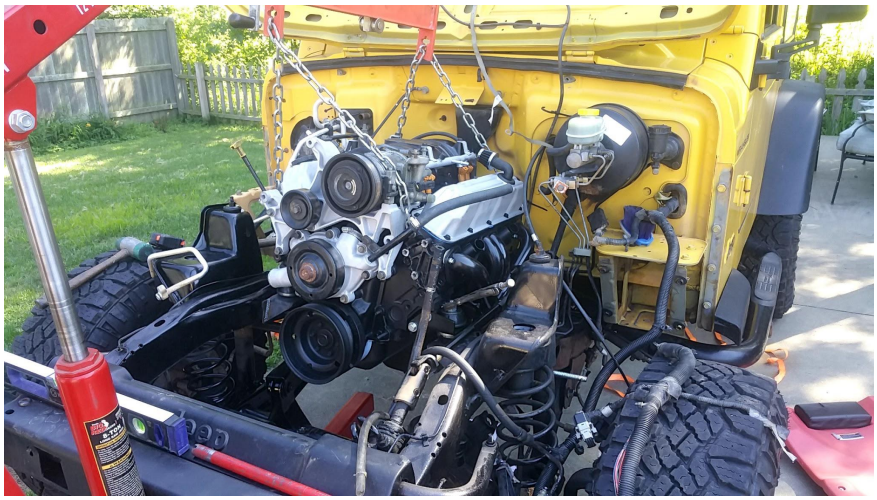
- Grounds

    - Grounds are obviously important. I couldn't get my starter to turn over with the Key, only when "hotwiring" it. Turns out, the Ax-15 (maybe the AX-5 as well?) has a plug on the right side of it that has 4 wire that all go to ground at some point. I believe the connector is C154. I simply soldered all of these into 1 ground, ran it to the frame, and the starter kicked over fine with the key.
- Header Bolts
    - Buy ARP, the header bolts that come with Summit Headers aren't the best (or the worst) but the money is well spent on those bolts
- Transmission Mount
    - Ax-5 and Ax-15 do not use the same mounting plates. Keep in mind that you might have to modify or make your own
    - Replacing your mount might be a good idea if it is worn at all.
- PCM
    - ***If you don't know the difference between PCI and CCD, learn it! It's not too complicated, you just need to understand why you have to have the corresponding PCM to your gauge cluster/year.***
    - If you have a CCD Wrangler (1997-2000), and are going manual, you are better off. Finding a 5 speed ram/dakota isn't too awful here.
    - If you have PCI (2001+) and want to go manual, be prepared. You will be buying a PCM from a Durango more than likely ($120 on eBay usually) and sending it off to have it flashed for your application (no, a dealer won't do it generally speaking. B&G was overly nice and worth the money. See parts list for more information.
    - You can "remove" the rear o2 sensor readings from the computer, so if you choose to not run a converter, you won't get the Check Engine Light. However, the computer MUST see a signal of some sort, so you have to have a sensor plugged in.
    - The B&G tune/flash will give a base of 20-25HP and 20-25 ft/lb torque, more if you have more modifications to the Jeep. Personally, I only have headers, so 20-25 is what I got.

    - A automatic ECU will not work for a manual, even if you are thinking, "I'll just get CEL for the automatic transmission". It will throw the PCM into limp mode (According to Backwoods). So you could "test" that your wiring is right potentially, but you can't drive it like that.
    - Same limp mode rule applies for CCD/PCI PCM interchangeability.

<u>Installation Notes:</u>

- So, now that you have everything bought and ready it's time for installation. Here are some quick notes I suggest.
    - Test fit your harness on your fully assembled motor. If you have not made your changes to your harness yet, do so now.
    - You will be pulling and tugging on the motor to center and align it once it's in the engine bay...mount the hoist to the engine accordingly, and remove any accessories in danger of being damaged. I.e. I had a metal power steering pulley, the factory one is plastic, so I ended up bending my pulley by accident.
    - You will probably put the motor into the engine bay 3 times or so. Don't hesitate to pull the motor in and out if you notice something you want to change. It's less work now that it will be later.



        - First to test fit how you want to mount it (see above options)
        - Second to get the motor mounts in place and clamped
        - Third for the final install
    - Be mindful of the A/C items. I plan to keep A/C but kinked my evap core inlet when installing the motor. Learn from my mistakes. Keeping A/C is well worth it, custom lines will need to be made, but A/C is amazing...plus in my opinion a swapped vehicle that retains all previous functionality is "cleaner" and looks better. There are plenty of options if you don't want A/C though.
    - Removing the fenders is worth the time and effort...you'll thank yourself when you install the headers and such.
    - Take advantage of having everything taken apart! Pressure wash the engine bay thoroughly, and paint the frame and everything to make it look good and for added protection in the future.

<u>Making your own driveshaft (lengthening one)</u>

- This can be a little daunting to think about. A lot of people will tell you it shouldn't be done, and some will even tell you it can't be done. With anything, where there's a will, there's a way. And for every person that says you shouldn't do it, there is someone who has been doing it for years without issue. All I can say is this method seems to work fine, and I've yet to have any issues or vibrations.

This is not the only way, or the best way, but it is a way that works and is semi-easy and takes no special skills other than decent welding.

- Step 1: Get a rear driveshaft from a ZJ (A XJ one would probably work as well, get one without a slip shaft)
- Step 2: Measure your TJ from the end of the output shaft on the transfer case to the CENTER of the u joint location on the axle.
- Step 3: Measure the amount of "engagement" the driveshaft originally had. (NOTE: if you were pushing the limits of your driveshaft length already because you're lifted or something, then you may need more than what was already engaging. I have around 3"-4" of engagement, not sure what "acceptable" is, but I will never have to worry about my driveshaft dropping off the transfer case with how I use my Jeep.)
- Step 4: Add the two measurements together. (i.e. 14 ¾" from yoke to transfer case shaft, plus 3 ½" of driveshaft engagement = 18 ¼")
- Step 5: Measure the length of the driveshaft you're going to cut down. Starting at the end of the yoke and going to the CENTER of the u joint on the other end
- Step 6: Subtract the length you NEED the driveshaft to be from the length of the driveshaft you're cutting down. Save this number.
- Step 7: Measure everything again and make sure you get the same numbers.
- Step 8: Once you're confident, measure the driveshaft you're going to cut down from weld to weld (the seam where the end caps/yoke is welded on.
- Step 9: Divide this number by 2, and measure that length from a weld to what should be the exact center of the driveshaft
- Step 10: Take your measurement of the difference, and divide it by 2, then measure out from the center line on each side so that you are removing HALF from the left/front and HALF from the right/rear.
- **STEP 11: MEASURE EVERYTHING FROM STEP 2 ON AGAIN, MAKE SURE YOU GET THE SAME NUMBERS.**
- **Step 12: Place your 2 driveshafts next to each other. Algebra "check your work" time. Make sure the measurement from the old driveshaft end point + the length to your furthest mark matches the overall length you're attempting to make your new driveshaft. You will want them lined up yoke to yoke**
- Step 13: Using a cut off wheel on a mitre saw, cut the 2 lines you measured out, effectively cutting out the difference between the 2 shafts. You could probably use a cut off by hand if you have a sanding wheel that can make the cut off side perfectly flat after cutting it by hand.

- Step 14: Using a grinding wheel or flap disk, grind/sand the two cut off ends to make them smooth and beveled (you're welding a pipe together, more or less.)

- Step 15: Get 2 clamps, preferably the ratcheting type. Harbor freight sells them cheap enough they are worth buying.
- Step 16: Take a peice of angle iron, and measure the length of the driveshaft again from weld to weld of the endcaps, take off a couple inches, and cut the angle iron into 2 pieces this length.
- Step 17: Clamp the angle iron on either side of the driveshaft, and but the two beveled ends up to each other. The angle iron will keep the driveshaft perfectly level (assuming your angle iron is straight).
- Step 18: Tack the driveshaft together, making sure not to get the shaft too hot.
- Step 19: Once the driveshaft is together good enough to not move, remove the clamps and angle iron.
- Step 20: Stitch weld the rest of the driveshaft until 360* of weld is achieved. Be careful not to overheat and warp the driveshaft. Welding this over the course of an hour or more will be plenty of gap...tack weld it, work on the wiring, stitch a few inches, work on something else, etc.
- *Optional: Depending on how your weld is, leave it as is, or grind it down and make it smooth/paint it. I chose to slightly grind my welds, but didn't take it down to smooth or paint it...I didn't want to chance the structural integrity of my weld since I'm not a professional.*

Making your own driveshaft (shortening one, not sure if this will ever be the case...)

- See above, but instead of cutting out the donor driveshaft length, cut it out of the TJ shaft. Or you could use a donor shaft and cut use the above steps to cut it to the length you want it.