

Introduction

Individuals have been successfully installing popular Chevrolet and GM engines to Jeep vehicles since the 1960's. The Jeep XJ / MJ is certainly more sophisticated than their early CJ predecessors, but the swaps can actually be even more successful. Below is a summary of the information we've gathered since our first XJ conversion in 2001, and includes the valuable insight of our many customers gained during their installs.

Despite whatever your experience with this type of work may be, we strongly advise you to read these instructions well. Contained in these instructions are the requirements, tips, hints and tricks of years of performing these conversions, both in our own facility and information we've gained from discussing these swaps with our customers. Put this information to good use. Failure to implement the practices and information in these pages may jeopardize the quality of your work, as well as the product warranty.

We currently only recommend low profile Gen. I-II Small Blocks and low profile Gen. III Small Blocks, the latter being the car engines, such as the LS series. Truck accessory packages and intakes are too tall for the low hoods of these Jeeps.

About Your Engine Mounts

Novak's bolt-in Gen. I-II engine mounts and bolt-in Gen. III+ engine mounts for the Jeep XJ / MJ Cherokees / Commanches provide immense strength and a rapid and precise GM V8 engine installation.

Ease of Installation

These mounts are a purely bolt-in design. No firewall or frame rail modifications are needed. No welding is required nor recommended.

Strength

The Novak mounts feature a thick 3/16" steel construction and a welded box design for the maximum strength available. They employ the best engineering and geometry to assure that they'll survive even the wildest V8's.

Placement

We have predetermined engine placement for the installer. There is a very fine window in which the GM Gen. III+ V8 can properly fit into an XJ Jeep, and we've done this design legwork already.



Novak's #MMXJ series mounts



American Made



JEEP POWERTRAIN SUPERIORITY



Compactness

The mounts keep themselves out of the way of the steering, allowing the installer to keep the entire Jeep steering system intact and undisturbed. They will also clear the exhaust headers we recommend, our block-huggers. Clearance from all other retained factory components is also excellent.

Vibration Isolation

Each mount kit comes with our high-grade urethane isolators that are gauged well for that ideal balance of isolation and firmness. The large, graded 5/8" bolts and all associated hardware are included. Additionally, Novak will always be here to inexpensively provide

replacement urethane bushings, if needed - years down the road.

Corrosion Resistance

Our #MMXJ mounts are black zinc coated for resistance against corrosion. However, if you have a certain theme to your installation, you may enamel, powdercoat or otherwise finish the bracketry to your own style.

Jeep XJ Information

In the late seventies, forward thinking AMC engineers and executives began planning and designing an entirely new concept and breed of four-wheel-drive. This new Jeep was to be somewhat roomy, like its namesake Cherokee (the two-door, sportier version in the SJ Wagoneer / J Truck series) but more agile, more compact and more fuel efficient. The result that was delivered in 1983 for the 1984 model year was a significant departure from all versions of Jeeps that had come before, though the

spirit was much the same. The XJ Cherokee was the first Jeep with unitized body construction, coil spring and track arm front suspension and a set of road manners that made it a broad hybrid. The styling was fresh, with a lower hood line than any previous Jeep, a wide stance and a handsome design.

The new downsized Cherokee weighed in at just over 3,000 lbs. Two and four-door versions were available. There were an extremely limited amount of parts carried over from previous Jeeps. These new Jeeps were offered in three trim levels; the Pioneer, Laredo ('85) and Wagoneer. Later, Stage II and Stage III packages included the Limited, Country and Sport levels.

Germane to this discussion is the frame and the coil suspension system, which called for the frame rails to arc in towards the engine to clear the coils. Also, the upper control arms pose a possible interference threat to conversion V6 & V8



engines and their accessories.

With all these things in mind, it was no small challenge to engineer a set of engine mounts that would put the GM engine in the right location that would allow for all the right steering, suspension, accessory, cooling, firewall and hood clearances requirements.

Preliminaries

Suspension Lifts

It is helpful to have a suspension lift when installing a Gen. I or Gen III+ V8. We recommend about 2" or more so that axle-to-oil-pan clearance is achieved.

Air Conditioning

Because of the inward arc of the frame, we recommend that you install our Air Conditioning Relocation kit, which provides a new compressor and mounts it up at the passenger side head location. This is a much more graceful method of clearance in lieu of cutting and welding the frame to clear the factory A/C compressor.

Factory Computer & Gauges

For 1995 and earlier models, you will entirely remove your factory Engine Control Module and *engine* (not chassis) wiring harness. You will also remove the Transmission Control Module and its wiring if your Jeep





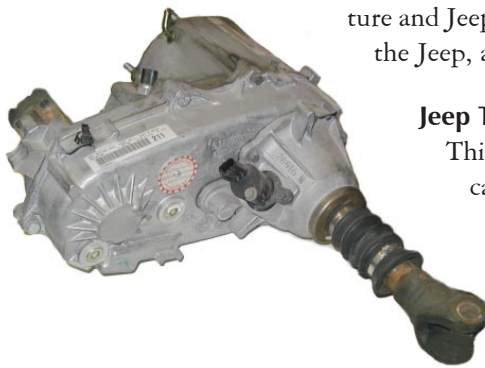
was equipped with the AW4 automatic transmission.

For 1996 and later models, you will leave your factory Jeep powertrain control module (PCM) in place. For engine removal, you need only disconnect the plugs that are directly



related to engine management, which are typically the black and white connectors. To have the Jeep PCM run your factory instrument cluster, you will reconnect these at a later point according to *The Novak Guide to Wiring for Jeep PCI BUS Gauges*, available with our XJ engine mount kits.

Prior to installing your engine, you should install your Jeep water temperature and Jeep oil pressure gauges into the engine prior to lowering it into the Jeep, as shown in the images.



Jeep Transfer Cases

This guide is based on the retention of the 231 and 242 transfer cases in your Jeep. They are extremely reliable, very durable, and easily and affordably adapted to your conversion powertrain.

Your Powertrain Assembly

If you have purchased a Novak Turn-Key powertrain, you can skip the following preliminary step.

It is recommended that you pre-assemble your powertrain outside of the Jeep. Follow the instructions provided with your Novak adapter kit to assemble your chosen gearboxes behind your GM engine. You should assemble the powertrain as completely as possible, including the headers, wiring, accessories, belts, clutch releases, air intakes, etc. At Novak, we actually pre-assemble and test run our powertrains prior to installing them into the Jeep. If you assemble as much as the powertrain as you can and follow this same paradigm, asking the question, "Given battery, fuel and coolant, could I run this engine on a stand?" you will be well on your way. Because of superior access to things and for organizational purposes, you will enjoy the work more and take a few hours off of your project.



Removal of the problematic factory coolant fill/pressure bottle is another welcome event in the swap procedure. Novak's XJ conversion radiators with an integrated fill neck obviate the need for this outgoing system.

This section precedes the others in that it is a very good idea to have the powertrain assembled to the fullest extent possible prior to disabling your Jeep for the conversion process.

Begin the Conversion

As with all other Jeeps, we'll begin by disconnecting the negative battery cable and by then disconnecting the coolant, fuel, air, vacuum, exhaust and electrical circuits into the engine. Once the coolant is drained, remove the radiator, A/C condenser, transmission cooler, any winches, etc. Now, remove the grille from the fenders and front crossmember. It is not necessary to remove the hood, as it may be tilted fully

Preparation Details

Make sure that all A/C and heater circuits are plugged off to prevent ingress of contaminants.

Few things will add to your enjoyment of the project as much as a good pressure washing of the engine bay while it is open.



The old Manifold Absolute Pressure Sensor is both an eyesore and unnecessary for the conversion. It should be removed before the engine is pulled.

out of the way against the windshield frame.

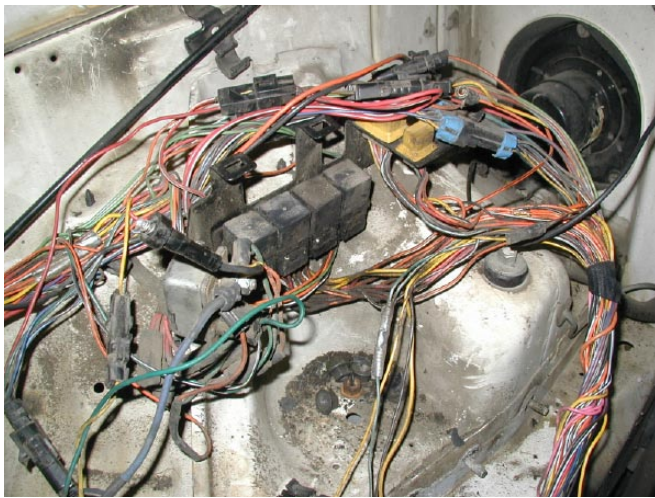
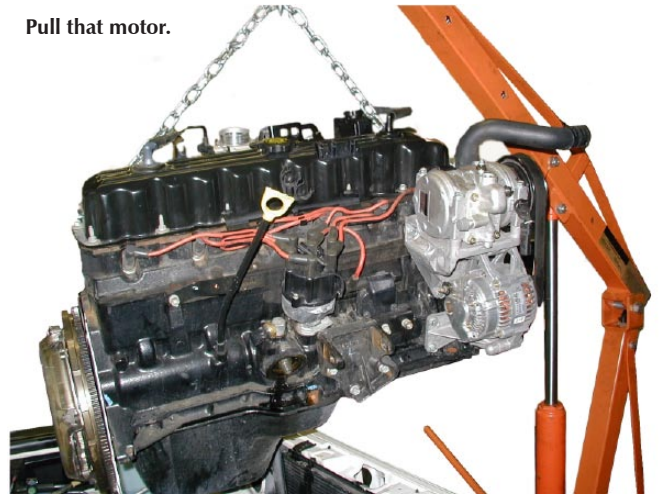
Powertrain Removal

It is usually recommended to remove not just the engine, but also the transmission and transfer case, even if you are retaining both of them in your conversion, such as with the AX15 manual transmission. Because the GM engine will relocate the geartrain forward by about 2-1/2" to 3" forward, removal and assembly to your new engine outside of the Jeep is generally helpful and not difficult.

Drop the crossmember / skidpan assembly, supporting the transmission and transfer case with jack stands. Disconnect the front and rear driveshafts and set them out of the way.

If your NP231 does not have an SYE kit installed, or if you have an NP231 transfer case with SYE whose fluid is due for change, drain the transfer case fluid. You may wish to do the same for the transmission.

Pull that motor.



Nearly this entire rat's nest of archaic diagnostic ports, relay and fusible link wiring will be cut out and removed from the the passenger's side fender area. In fact, the only circuit that remains from this bundle is the heater blower motor wires. Instead of routing these wires down the fender wells and across the front clip, we'll shorten them and reroute them down the firewall instead.



This is the outgoing engine's control trunk to and from the old PCM. It can be removed entirely.



The grommet on the flank of the firewall indentation has the Transmission Control Module circuits. It can be entirely removed and the grommet can be nicely plugged with black RTV silicone.

The bundle that goes to the passenger fender can also be entirely removed.

Disconnect the transfer case shifter and speedometer connection. Remove the transfer case from the factory transmission adapter and set it aside. Note here that it is possible to remove the transfer case with the engine and transmission assembly as you thread them up and out of the engine bay. However, generally, it is easy to remove the transfer case. Disconnect the transmission shifter assembly from its housing. This is typically done by removing its four bolts that secure the shifter assembly to the top of the transmission. Disconnect the hydraulic clutch release line.

Remove the grille assembly, including the header, radiator, etc. Remove the hood, making sure to keep track of the alignment shims on each side for easier reassembly.

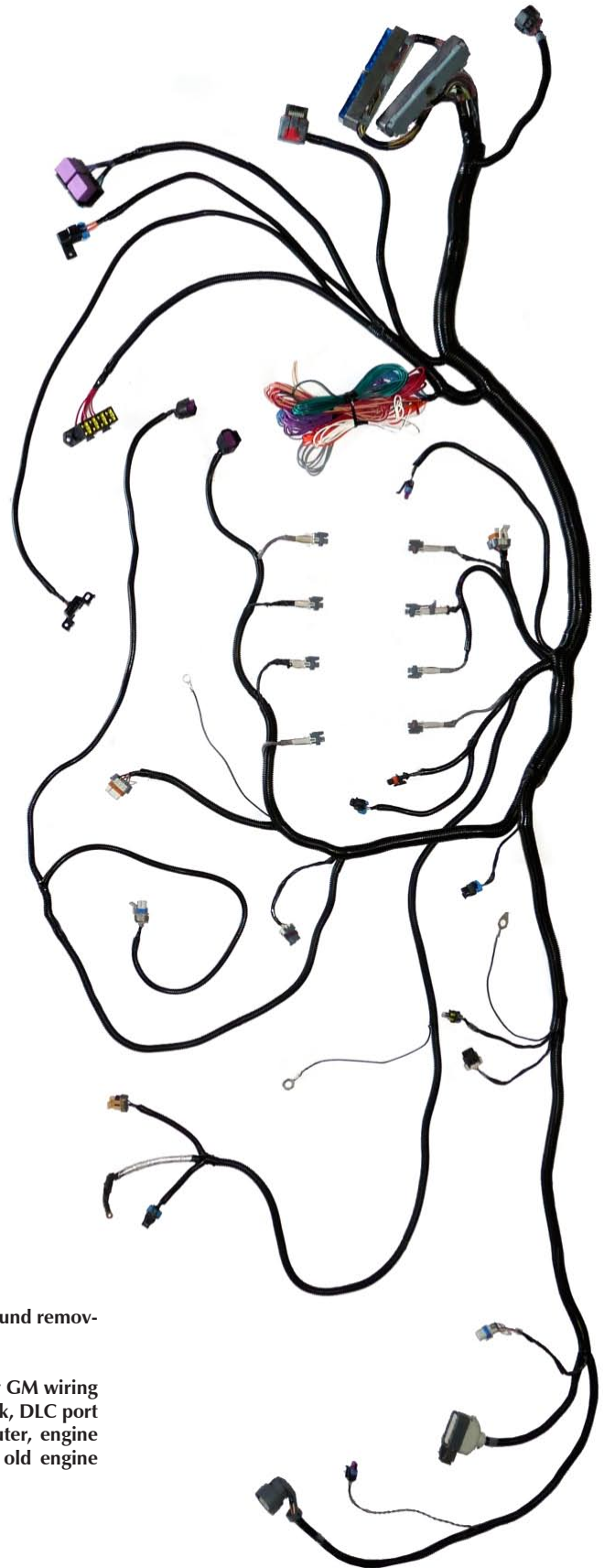
Unbolt the factory engine mounts from the frame horns. Safely secure a lifting jig to your outgoing motor and carefully pull it from the bay. Typically, the transmission cause the powertrain to tilt back and allow it to feed out from the engine bay at the proper angle, but having an assistant or two to guide it out is helpful.

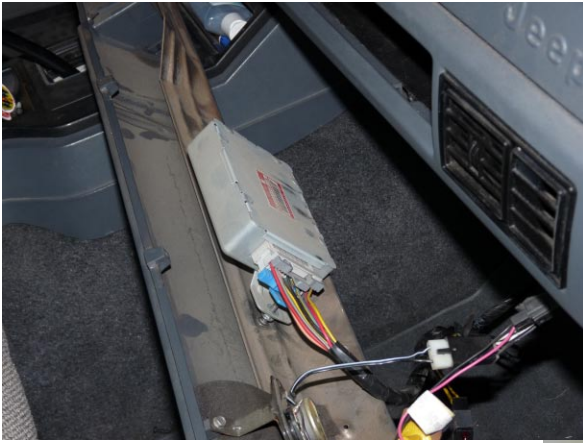
Wiring Removal

You will be removing most of the factory wiring from the engine bay. In fact, your removal of the old wiring systems, brackets and sensors can fill a large garbage can. You will be quite amazed at the simplicity, cleanliness and superior organization of the engine bay after the conversion.

It is hard for some customers to get their minds around removing so much of the Jeep's old wiring.

Novak can rework and greatly simplify your factory GM wiring harness. It will come with the new relays, fuse block, DLC port and all connections necessary to your GM computer, engine and transmission. As such removal of the Jeep's old engine control harness should not seem so disconcerting.

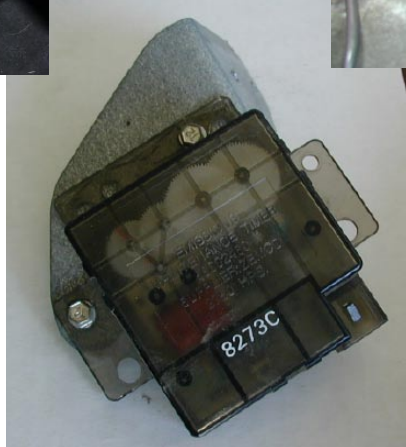




This is the Transmission Control Module for the XJ's equipped with the AW4 automatic transmission. It and all of its wires can be removed in their entirety.



This trunk is our main focus in terms of wiring retention. You will keep the circuits intact for the heater blower motor, horns, blinker / park lights, wipers, washer and headlights intact.



The remainder of the wires here contain the 12V constant, 12V switched run, starter signal, grounds, A/C request, etc. that will be connected to the conversion system.



Since you are probably installing a more advanced engine, you may be able to remove the Emissions Maintenance Timer. This is the subtly noisy little thing that churns away, busily doing no good for you, your Jeep nor the environment.



Removal of the factory Engine Control Module and its entire wiring harness is indicated and preferred in pre-1996 XJ's. It is located above and to the right of the throttle pedal.

Post 1995 XJ's use PCI gauges and we recommend you leave their ECM in place as a gauge mule.



This Cherokee has had its engine bay stripped clean, pressure washed with detergent, prepped and then masked for fresh paint. Many individuals going through the effort of a good engine conversion like to make sure their engine bay looks great. It is very much worth the time.



Our MJ Comanche gets an even more thorough repaint due to the full removal of all firewall grommets, bulkhead connectors and accessories.



Frame Bracket Installation

Temporarily locate the supplied Novak mounts on the frame as to match the contour of the mounts to the contour of the frame rails. It will be readily obvious which side is which. The 10mm vertically slotted holes in the Novak frame brackets will locate over factory studs protruding from side of uni-body/fender structure. The lower shelf of the Novak frame mount aligns with the factory holes on lower unibody lip.

Lightly fasten the two upper 10mm factory nuts on fixed studs protruding frame. Lightly fasten two lower 1/2-13 bolts on lower shelf of motor mount.

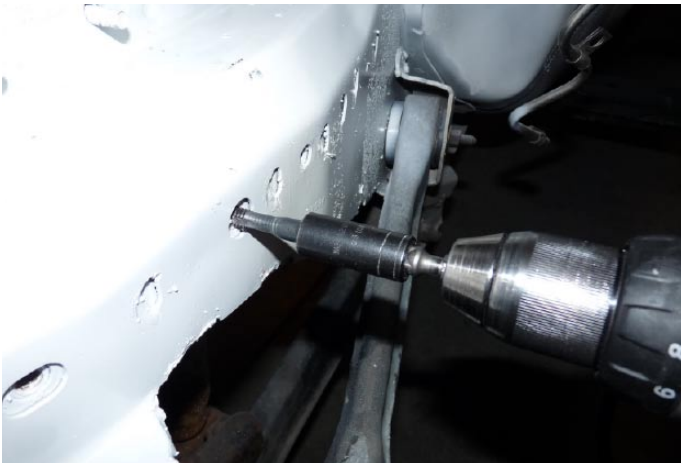
Once these four fasteners (per side) are semi-secure, use the motor mount bracket as a drill jig to mark the upper two, 3/8"-24 holes. If confident with marking, you may remove the mount or you may simply leave it in place as you are drilling. Doing this may prevent any wandering of the drill that could create a misaligned hole. Drill these holes to clear 3/8 bolt, typically using a .406" drill bit. These upper 3/8" bolts will ultimately go through the mount, through the frame structure and protrude out towards the coil/shock area. For verification purposes, install both of these 3/8" bolts and hand tighten supplied nuts on the backsides.



With these six bolts now lightly in place, verify alignment of the three horizontal holes running in the

middle of the mount. Some of the XJ/MJ frames are equipped with imperial thread bolts while others have metric threads. For the sake of consistency, we have provided 7/16"-14 bolts as fasteners on these three holes. With mount still in place, use mount as jig to drill holes for threading of a 7/16"-14. Drill size is 23/64" or .359". Once drilled, remove mount. Use 7/16-14 tap to re-thread the three factory holes in





uni-body.

Now, reinstall the frame mounts. Lightly refasten all bolts including:

a. 10mm nuts on factory studs

b. 1/2"-13 bolts through lower plateau of mount. Do not forget to install factory draglink mounting bracket on driver's side of Jeep. The drag-link bracket shares holes with motor mounts and together act as a rigid support structure

c. 3/8"-24 bolts sandwiching to frame

d. 7/16"-14 hex-head bolts

Note – the steering shaft on the driver's side **DOES NOT** have to be removed. Simply tilt mount such as to slide under steering shaft, slide mount forward as necessary for proper alignment on factory uni-body holes, and then tilt mount down to normal stance.



Once all this hardware as been loosely installed, work the different necessary wrenches around the mount in a circular, consistent, and even pattern. As doing this you will notice mount securely fastening to the frame and removing any gaps between uni-body and mount. Once the mount is fully encapsulating the unibody frame, the hardware is tight.

Welding the frame brackets to the Jeep is not recommended.

Engine Block Plate Assembly

Now that all the preparatory steps are completed, pull out the provided Novak engine block mount plates. You will no-

tice that the square hole in the center has a round cutout. This round cutout must be oriented downward at the 6 o'clock position. Insert the carriage bolt through the inside face of the block plate and fit the plate to the engine block mounting bosses.



Now, loosely bolt the block mount plates onto the block using the 3/8"(Gen. I-II) or M10 (Gen. III+) bolts. Notice that these plates are adjustable fore and aft. We recommend you install them in the center hole location at first, and then adjust them later to perhaps mitigate any unforeseen future adjustments.

You'll notice that the round cutout in the engine plate allows the carriage bolt to droop downward - nearly vertically. This will greatly aid the installer as the motor is lowered down into place. Take some vinyl tape and wrap the bolt with a couple of rounds of it about halfway up





the threads. This will help retain the upper isolator in place as you maneuver the engine into place.

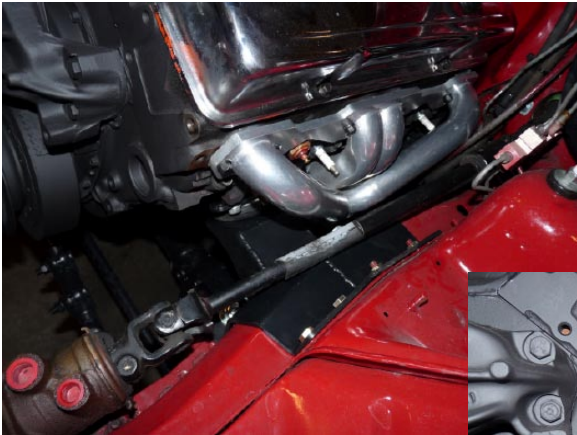
Install The Engine Into The Jeep

Proceed by lowering the engine into engine compartment. Gently dip driver's carriage bolt down through the hole in the frame mount horn. Make sure the upper isolators stay in place as you do this. Once the driver's side carriage bolt is through the frame mount, gently lower passenger's side and insert carriage bolt through the motor mount hole.

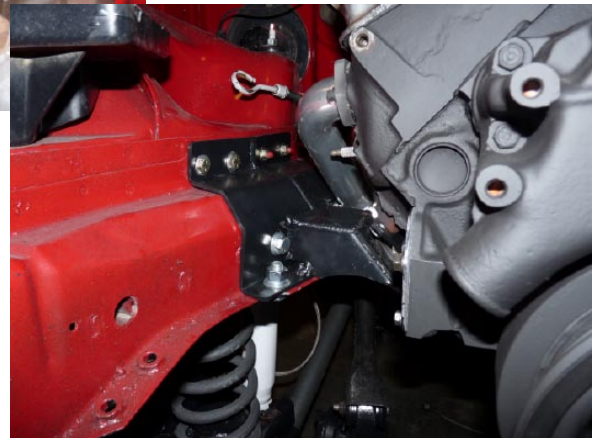
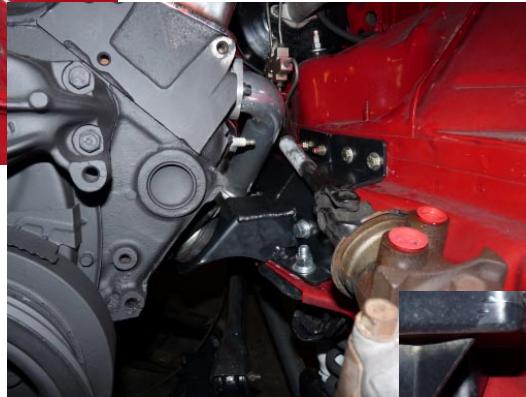
With the frame mounts and engine plates now secure and all in place, install the provided lower motor mount bushing. This slides over the 5/8" carriage bolt and bottoms out on the underside of the frame mount. Notice the locating shoulder on mount should essentially self align with matching diameter hole on frame mount.



Temporarily install the provided, standard 5/8"-11 nuts to verify all aspects of the conversion, including all clearances. Once you are satisfied with your installation, trade the standard 5/8"-11 nuts for the provided TopLock 5/8"-11 nuts. Tighten them down only enough to barely begin to deform the upper mounts. They will remain locked in this position.



Once all this is done, you may wish to apply LockTite Blue to any engine mount fasteners you deem necessary. You can take one bolt out at a time, hit its threads with a drop of thread locking compound and reinstall it. Do this only if you are fully confident in your installation.



Rear Mount Unit

Installing the rear engine mount or the transmission mount (as it's better known) is generally a simple process. If you are installing the popular 4L60E transmission, our #F-UB4 bracket (image) works in concert with our #RMU isolator and the XJ crossmember.

If you are installing the AX15 transmission, Novak makes an adapter bracket that will simplify this process.

Firewall Clearance

Firewall clearance on the XJ Jeeps is just adequate, with both Gen. I-II engines and Gen. III+ engines. Our mounts position the motor for a balance of optimum clearances between the engine and firewall and the engine and radiator



Tunnel Clearance

Tunnel clearance is sufficient if you are working with any of the standard gearboxes, including the AX15, 4L60E, 700R4, TH400 and TH350 transmissions. If your tunnel clearance is not adequate, you may have your crossmember rear mount assembled improperly.

Fuel System

It is not only possible, but advantageous to use the factory Jeep fuel injection pump, should a future replacement ever be required. The Jeep fuel pump in 1987-2001 Cherokees is capable of natively producing ~100 PSI. This fuel supply is, however regulated down to 40 PSI up through 45 PSI for the 2.5L & 4.0L engines.

For a little history and context, the 1987-1996 Jeep engine fuel rail featured a regulator. These systems have two connections: a high pressure supply connection and a low pressure return connection that feeds the bled fuel overage back into the fuel tank via a return line. In 1997, Jeep moved the regulator from the fuel rail into the fuel module in the fuel tank sending unit. This permitted the elimination of the return line from the engine back into the tank. Proper and regulated fuel pressure is achieved within the high pressure supply line. This is a simpler system in terms of manufacturing and reliability.

In 2005, Jeep bumped the fuel pressure from ~45 PSI to ~60 PSI. We and our customers have run many Gen.III+ engines on this pressure and without modifications and it works great. However, if you are installing a truly wild GM engine in a race-type Jeep, it may require a more robust solution for adequate fuel supply and modifications as described below.

GM multipoint fuel injection engines typically require between 45-65 PSI of fuel pressure. Gen.III+ engines require 65 PSI. To facilitate this, Novak offers a fuel regulator bypass and bulkhead fitting assembly that fits into the Jeep fuel sending unit. Included is a regulator that is installed in proximity to the fuel tank so that a long return line is unnecessary. The installer will then drill and mount the bulkhead into the top of the Jeep's plastic fuel sender housing for a return circuit. Instructions for this kit are included.

Note that Earlier Gen. III motors were regulated at the fuel rail. Starting in about 2002, GM started regulating fuel pressure at the fuel tank or elsewhere on the circuit as described above.

Throttle Linkage

If your engine has a cable throttle linkage, you can connect your Jeep pedal to the GM throttle body. However, the majority of GM engines now feature a "throttle by wire" or electronic throttle assembly. For these systems, you will need to install the GM electronic pedal assembly and its associated Throttle Actuator Control (TAC) module, if required. Note that most Gen.IV engines do not use a separate TAC module as this function is integrated into the Gen.IV powertrain computer itself.

Transfer Case Linkage

We cannot stress enough the advantages of replacing your Jeep's shifter with the Novak #SK2X assembly. This shifter kit has become very popular for both the conversion and non-conversion crowds, simply because of its vast improvement over the factory linkage. Its added benefit is that it makes the conversion process and typical transfer case relocation go much more smoothly. It is a very affordable upgrade and highly adjustable to your installation, whether using manual or automatic trans-

missions. Detailed instructions are supplied with this shifter kit.

If you must use the factory shifter assembly, you will need to lengthen or shorten linkage rods and relocate pivot and anchor points, taking into consideration the geometry required to actuate the New Process transfer case shifter plate.



Transmission Shifters

If you're retaining your factory manual transmission, you will also retain your factory shifter cane and assembly. Instructions on how to best do this are included with your Novak engine to transmission adapter kit. Instructions for GM automatic transmission shifters are included with your transfer case adapter assembly.

Brakes

You can retain your factory braking system all together. No changes are necessary from the standpoint of the conversion itself.

The GM engine provides vacuum at the rear of the manifold, whether it be a Small Block Chevy or a GM Gen.III+. It may be necessary to tap for a simple, barbed brass fitting on some manifolds that had the Hydroboost brakes.

The ABS computer is separate from all systems and runs independently. No mechanical, wiring or hydraulic changes need occur here.

Steering

There is no need to modify the steering shaft, steering shaft bearing and steering gear. The steering system essentially remains untouched.

The GM power steering pump will drive the Jeep power steering gear perfectly well. Hose fittings vary over the production span of the XJ.

The return line is simply low-pressure 3/8" hose, as is available from your local parts house. If you're feeling creative, you can even run this line through an external cooler to add to the life of your pump and gear in hard service situations.

Cooling System

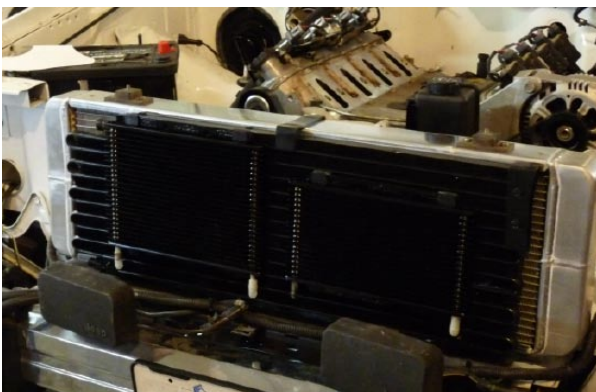
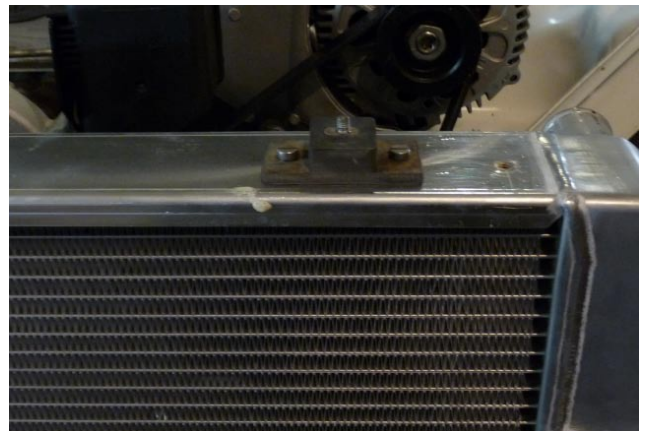
The Jeep radiator will be both inadequate, poorly configured for a GM engine and has a reputation for a lack of durability.

The Novak KryoFlow Radiator is a tough and very efficient radiator. It is a crossflow design and it bolts onto the XJ grille without mods.

It is not really possible to run a mechanical fan, and the electrics do very well.

We suggest the use of two factory XJ electric fans mounted side by side. They are self-shrouding and quite aggressive.

These fans are controlled by any GM computer equipped with a circuit to trigger a fan relay. Alternatively, you can install a fan control module and install it to our fan motor per the



manufacturer's recommendations.

Exhaust

XJ / MJ Jeep exhaust systems are slightly difficult to run. We recommend our #CCXJ3 headers for Gen.III+ engines and our #CC158 headers for Chevrolet Small Block V8's for optimal layout. Merge the driver and the passenger bank into a Y pipe and send it out as a single circuit down the passenger side, up over the axle out exiting at the rear.

Air Intake

Conversion air intakes have really evolved nicely. Typically, install a 4", 90 deg. elbow at the throttle body and point it towards the passenger side of the Jeep. You can then use a length of pipe, such as extruded aluminum and then a coupler to the Mass Airflow Sensor, which then connects to a cold-air style air filter assembly.

See the Novak air intake components page for assistance here.

Air Conditioning

Use the air conditioning compressor that is native to your Gen I-II Small Block engine. For LS conversions, we're seeking better solutions, as even the factory LS compressors get too close to the frame rail. We welcome you questions directly on this particular topic.



Conclusion

While reading through these instructions, and especially while performing the swap, it is often recognized that it is not the swap itself that provides the greatest difficulty, but in the ancillary things like linkages, clearances, and the like. Any good installation should consider all the points in this article and also allow for time, energy and funds for the dozens of variations in drivetrain conversions that cannot be anticipated.



Air pollution laws vary from state to state. Changing an engine or transmission in your vehicle may change its pollution status. It



is the customer's responsibility to determine that their vehicle conforms to whatever state and federal regulations that may apply to their vehicle. Neither Novak, Inc. nor its directors are responsible for any changes made to your vehicle.

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