



4BT Cummins Swap into an Early Bronco

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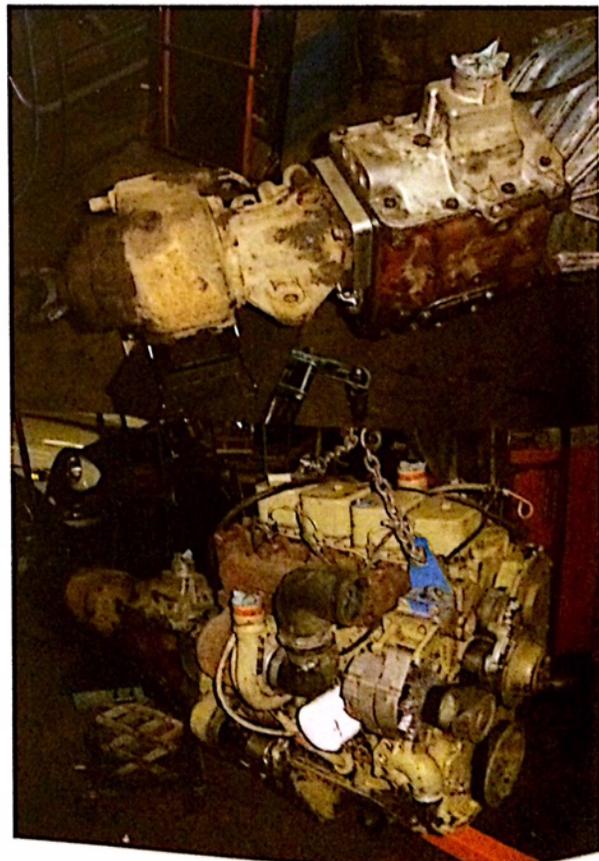
Although I have been thinking for some time about installing a diesel engine in one of my early Broncos, I've apparently come to the 4BT somewhat late. I'm not an internet geek and don't even like computers so it took a magazine article a little over a year ago to alert me to the possibilities of the Cummins engine. Several years ago I tried to fit a Mercedes 300D engine but gave up because of issues I could not solve. That being said, the 4BT installation was surprisingly easy. The following is a step by step account of how it was done.

While friends of mine researched the internet, little hard information was found. Most people seemed more interested in how to pump the engine up than the nuts and bolts of how to install it. There were a few hints but by and large I was flying by the seat of my pants.

To start you need to find an engine. What makes this engine desirable is that in the eighties and maybe even into the early nineties very large fleets of step van bread trucks were converted from either Ford or Chevrolet/GM engines to Cummins 4BT diesels. To do this, adapters were created to mate the engine to either Ford or Chevrolet transmissions. My information, right or wrong, is that they were mated to both manual and automatic Chevys but only to manual Fords. In theory the manual Ford version would be the easiest. You could actually mate the stock Bronco 3-speed to it as well as NP435s, BW T18s, T19s or ZF 5-speeds, all of which have adapters available to mate to the Bronco transfer case. It is possible, however, to use either of the GM versions as well.

I could be wrong, but if you are a dedicated automatic transmission user you will need the Chevrolet setup and an adapter to mate the Bronco transfer case to a GM transmission. If you have an engine mated to a GM manual (SM465) there are several options.

Option One is to use a Chevrolet bell housing for an NV4500 and then adapt it to the Bronco transfer case. Option Two is to buy an aftermarket bell housing scattershield that will accept a Ford transmission. Option Three is what I did: Chevrolet from '67 through '72 used close ratio NP435s in two-wheel drive trucks. By changing the mainshaft to a 28 spline Ford NP435 mainshaft and



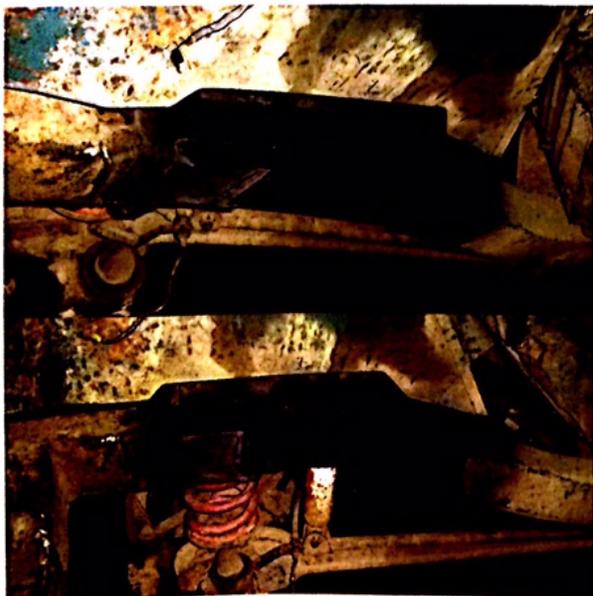
redrilling the back of the case and/or the adapter it can be adapted to the Bronco transfer case. I went one step further. I wanted the lower gears of the Ford NP435 so I swapped all the internal guts of the two transmissions. This required two minor machining operations.

Since I now had a Ford input shaft I needed a Ford-sized pilot bushing in the 4BT flywheel. A simple turn down of a Ford bushing with a larger O/D than the hole solved that. I used a Ford 12" clutch disc with the GM pressure plate and another minor machine operation allowed a Ford NP435 seal to be installed in the Chevrolet bearing retainer. Thus a Chevrolet 435 case was easily adapted to a Bronco transfer case and, loaded with Ford 435 guts, was mated to the 4BT engine. This is not as complex or as difficult as it sounds, and I believe it's the least expensive method of working with the GM manual transmission setup. If you are primarily looking for a fuel sipping street runner I would stay with the close ratio Chevrolet 435 with a Ford mainshaft and 3:50 axle ratios. Or if you obtain the Ford setup, go with a diesel T19 and 3:50 axle ratios.

Once achieving a workable matchup between engine, transmission, and transfer case, the next step is to get it mounted in the Bronco engine compartment. Since I knew I would probably have to lift the engine in and out several times before I solved all the problems, I wanted to make that as easy as possible. To that end I first cut off the motor mount perches. Then I removed the entire front clip (it's easier to do that than just the grill section) and cut the top crossbar out of the radiator core support. With this done the engine, transmission and transfer case could be lifted in and out several times as a one piece unit. When the job was finished, I fabbed a new crossbar for the core support that can now be removed by unbolting it.



The first obvious thing needed was to notch the frame rail on the passenger side to clear the starter motor. I had anticipated this from one of the hints from the internet. The starter is one of the reduction gear types and as such sticks out quite far from the right



side of the engine block. I did some research but could not find a direct drive starter that would work. If one could be found it would eliminate the need to notch the frame. As it was I ended up with a deeper notch than was necessary and thusly went outside the frame



with a piece of channel iron as well as welding the spring tower to the shock tower, and the shock tower to the channel iron to reestablish rigidity lost by notching the frame.

Once satisfied with the frame notch I turned my attention to the oil pan. Although it is a rear sump pan you would have to have an enormous lift and extremely stiff springs to keep from hitting the front differential. However, notching it as shown in photos along





with a slight modification to the oil pickup tube solves this problem while losing only a small amount of its oil capacity.

The motor mount(s) proved to be much easier than I anticipated though doing it the way I did will involve a slight massaging of the firewall and moving the rear transmission/transfer case mount back approximately 3". Another of the hints gleaned from the internet suggested notching or completely removing the front crossmember. I can only surmise that those who did that were unwilling to move the transmission/transfer case back. For me, the obvious thing is to use



the front crossmember as the motor mount. The only modification to the crossmember other than drilling two holes was to remove the triangular brace on the passenger side. In hindsight, that did not need to be completely removed, only modified slightly. The mount pictured is made from two small pieces of heavy angle iron mounted vertically and bolted to holes in the side of the block intended for motor mounts. A longer heavy piece is then bolted horizontally across the front and set on top of the front crossmember. The rubber pucks pictured are actually stock rear transmission mounts. While this is a mount I fabricated it is a standard method that is used to mount these engines in certain applications. Although it looks close in the photo, there is room to get the alternator belt in and out.

Somehow the only photo I have of what was done to move the transmission back is a photo of the driver's side frame bracket. The two holes indicated by the "X" are new holes drilled in the bracket. The bolts used in these holes are put in the rear threaded holes on the frame. New holes are then drilled in the frame to a 3/8" tap drill size through the holes indicated by the "O". A 3/8" self threading bolt can be used in those holes. The passenger side is a mirror image



of the driver's side. If, like me, you are not using a body lift the position of the rubber pucks for the transmission mount must be reversed. Also a small section of the floor stiffener directly above the transfer case must be removed. Driveshaft length will have to be adjusted but quite often than can be done simply by swapping the female ends of the driveshafts.

Before actually bolting the engine in I had to make sure the header pipe off the turbo was going to clear the firewall. This is what the firewall massaging

was about. Basically a fancy way of saying I beat the heck out of it with a big hammer on the passenger side. At some point I was afraid I might damage the heater box or the heater core so I did not get it quite massaged enough to completely clear the header pipe. This resulted in having to flatten the header pipe slightly at the first bend and grinding a little excess metal off the bellhousing to snug the header pipe as close to it as possible.



Also before bolting the engine in... if your Bronco is a 1970 or older jump ahead and read the section on wiring. The first operation there must be done before bolting in the engine.

I'm going to jump ahead slightly for a moment. In the photo of the final install you may notice the



engine is leaning slightly to the passenger side of the engine compartment. This is because the adapter plate for the Chevy bellhousing clocks the engine several degrees in that direction. I do not know why this was done but it is something that has to be worked with. If it wasn't clocked in that fashion I may not have had to do anything to the firewall or the header pipe. I also would not have needed as big a notch in the frame for the starter motor. Not having seen one of the Ford adaptations I do not know whether the Ford adaptation



does the same thing or not. I might have been able to clock the transfer case adapter in the other direction and let the transmission lean towards the driver's side to compensate. I may try that if I ever do a second install.

After the engine is bolted in the next logical step for me was the clutch linkage. The rod off the pedal and the outer pivot point are unmodified. The V8 bellcrank can be used unmodified but I lengthened the lower arm because I felt the linkage needed a bit longer range of movement. The pushrod back to the



throwout fork needs to be considerably longer but there are several ways that can be achieved. The inner pivot point needs the most modification/fabrication. I started with the bracket off the bread truck and modified it to work. The modification consisted of lengthening it, using a pivot bushing compatible with the Bronco bellcrank, and adding an extra tab to it for an extra bolt. To facilitate the extra bolt, a hole was drilled and tapped in the side of the adapter plate. After doing these mods the clutch linkage bolts in pretty much the same way the stock linkage does.

Wiring the diesel conversion is quite easy for the most part. The only really difficult part occurs if your Bronco is so early that the main harness comes through the firewall near the throttle linkage. With the engine as far back as I put it there is no clearance for the two big harness plugs coming through the firewall. The smaller plug, with three or four wires on later Broncos, may need to be moved also but this is much easier. My solution, on my '68, was to cut the plugs out of the harness. I then drilled a hole with a hole saw at the very top of the firewall, installed a good sized rubber grommet, brought the harness from under the dash out through this hole, and spliced it back into the engine compartment harness. There is enough excess harness under the dashboard to do this. Do not, however, use crimp type but splices to do this. Solder the wires back together, observing the color coding, and use shrink wrap tubing to finish off the splice. Do not mix up the two heavy gauge black wires or the amp gauge will read backwards. You do not need to hook up the coil wire because it is not going to be used. This is a somewhat tedious and time consuming operation but not really that difficult.

The Ford coil wire runs through a resistance that drops the voltage to the coil, after the engine starts, to extend the life of the coil. I don't believe that reduced voltage would be enough to properly operate the injector pump. In order to get a wire to the injector pump with full voltage you will need to go



directly to the ignition switch and splice into the run terminal. It should be either a red wire or red with green tracer wire. Once spliced run, it through the firewall to the injector pump. For the temperature and oil pressure gauges install your Ford sending units in the appropriate places on the engine and extend the appropriate wires to them. You don't need the Ford starter solenoid because the starter has a built in solenoid. Run a heavy gauge positive battery cable directly to the large terminal on the starter and extend the red with blue tracer wire off the Ford solenoid to the small terminal. The alternator on my engine has an internal regulator but still required a second exciter wire. The 10 gauge wire off the Ford alternator goes to the large terminal on the 4BT's alternator. Either the switched wire off the Ford regulator or the injector pump can be run to the lower spade terminal on the side of the alternator. If you have a single wire alternator you will not need an exciter wire. A proper ground connection and you're done.

The next task tackled is the fuel system. Diesels require a return line to the fuel tanks. If your Bronco is new enough to have the evaporative emissions control system on it you can use those fittings for your return line. However the Bronco I did this to is a '68 without any such



vent lines. The tanks are vented through the caps. Everybody, I hope, knows you don't go welding on gas tanks. However, once the filler necks are removed from the vehicle I have no problem welding on the filler necks. I welded 1/4" nipples down low on each of the filler necks in such a fashion as to direct the fuel being returned back into the tanks.

If you have decided to run one tank, no switching valve of any kind is needed. If however you intend to continue running two tanks you will need a six port valve to accomplish this. Only the early '73 Broncos ever came with mechanical six port valve and unless you can find one of those rare valves you're going to have to use an



electric six port valve. Universal six port electric valves are, however, easy to come by and reasonably priced. As an added bonus there are three unused terminals on the switch for your fuel gauge that can be wired to switch the valve at the same time you switch the gauge.

Hooking up the accelerator pedal to the injector pump should be easy. I made it more complex than necessary. The Bronco I was converting was a 6 cylinder and thus had a cable type linkage. I went to the trouble of modifying the pedal assembly to take an alternate cable I had lying around. In retrospect it would have been easier to install the V8 bellcrank on the firewall and route either a rod or



even a small chain out to the linkage on the injector pump. The pump has a built in return spring so no additional return spring is needed.

There's no reason a stock radiator in good condition would not

work. Diesels in general do not run as hot as gas engines. There are some problems to solve however in getting the hoses hooked up. The lower radiator hose fitting as it came out of the bread truck points straight down. That's nearly impossible to work with. After a little research I found there are numerous other fittings available for other applications. The best and most reasonably priced one I found is used on Case tractors and construction equipment. It points down at approximately a 45 degree angle and retails for about \$65. If that sounds expensive compare it to \$185 quoted at the local Cummins dealer. I lucked out because the local Case dealer had a used one on the shelf for \$30. This still leaves sizing to solve. Both inlets and outlets on the engine are larger than the corresponding fittings on the Bronco radiator.

Fortunately for me the hoses from the bread truck were in very good condition. The upper hose at a glance looks almost the same the upper Bronco hose. It's longer however and belled at the thermostat fitting to accept the larger size. By cutting it in the middle to the proper length and splicing it back together with a piece of 1.5" thin wall brass tubing it fits like it was made for it. The lower hose was somewhat more problematic. Like the upper hose it was belled at the engine fitting but was such a convoluted series of bends it took some thinking to make it work. Using the idea of splicing it with 1.75" brass tubing I came up with two sections of it that worked. The photo however shows that I am not using a stock Ford radiator so it might be a bit more problematic for someone else. I'm not using the Ford radiator because this was 6 cylinder Bronco and I did not trust the 6 cylinder radiator.



Although there is a pulley where it looks like a fan could be attached it would require an adapter be made and even then I could not come up with one of sufficient size that would clear the upper radiator hose. In fact the bread truck used an electric fan. The fan from the bread truck wouldn't work but there are several after market fans that can be fitted to the Bronco radiator. The bread truck did however have a thermally activated switch in the lower hose fitting that I ran through a relay to cycle the fan.

A brief word about the radiator I used. This is an aluminum all-welded radiator sold as a somewhat universal radiator by Summit racing. It is slightly narrower than the Bronco radiator and the same height. It can be had with the fittings as you see in the photo (GM and early small block Ford) or with the fittings reversed for later model (fuel injection) Fords. They are an easy install with only minor mods to the stock V8 brackets. I've put three of them in Broncos with 351Ws and in triple digit weather they run right at the



thermostat setting. What really makes it sweet is they retail for about \$165 plus shipping.

As the pictures show this Bronco is not a beauty queen. Even before this engine install it was built to crawl the rocks without having to worry about scratching it. It's been locked front and back and has had power steering, disc brakes, and an NP435 transmission



from the beginning. In keeping with that spirit I decided it needed an exhaust with attitude. I ran flexible 3" exhaust tubing straight off the header pipe up through the floor behind the bulkhead to a solid pipe about three feet tall clamped to the back of the cobbled together half cab. A rain cap like you might find on a bulldozer finishes it off. It is not a stealth vehicle. It does, in fact, sound something like a bulldozer.

The last thing to explain is the intake. The bread truck came with this huge one-piece air filter. The whole thing was designed to be used and thrown away in one piece when replaced. I priced a smaller version of the same unit and it was \$40. Since you could end up replacing filters quite often when operating off road this was

unacceptable. I wound up cutting it apart and using the base of it to fabricate my own air cleaner that in fact uses the stock Bronco element. I know there are those who would say just get a K & N filter. I may someday, but I get a kick creating something out of seemingly nothing. Also in order to avoid cutting some kind of hole in my hood I had to lower the cross over pipe from the turbo to the intake manifold. This was accomplished by eliminating a hard 90 degree bend in the pipe and replacing it with a 90 degree bend from a radiator hose. That and shortening another section of the pipe with radiator hose allowed me to lower the pipe by at least 2". After removing a small section of the bracing it all fits under a stock hood.

This completes the explanation of the install. Within two weeks of completion and with almost no chance to debug it, I took it to the Moab Easter Jeep Safari. It ran the two acknowledged toughest trails that are run that week, one of them twice, and never missed a beat. Although heavier front springs were installed, there needs to be more sorting out of the suspension because the engine weighs 750 pounds. The only problem found with the actual installation was in the clutch linkage. After the initial clutch wear in I found I had not made the pushrod to the throw out bearing fork quite long enough for additional adjustment. That problem has been fixed.

As stated before I am not a computer geek and quite frankly don't like E-mail. If anyone wants to contact me about this installation or other Bronco related questions or comments I have no problem talking on the phone. I have been working on and modifying early Ford Broncos for over 25 years. I specialize in inexpensive power steering, front disc brake, and NP435 conversions. My phone number is 208-338-1449. ☐