40 Percent More Power For A Jeep 4.0 Inline-Six

Six Bangin'
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By Tom Habrzyk

If you don't have one of the old and trusty 4.2L- or 4.0L-equipped Jeeps you probably had one in the past or have a buddy with one. So what do you do when you want to get some more power from a used six-cylinder without breaking the bank? That is exactly what we aim to find out with this Jeep hop up.

The chassis this particular 4.2L engine is comfortably residing in is a typical lifted '81 Jeep CJ-7 with big tires, heavy-duty drivetrain, and a Mopar Performance fuel-injection conversion replacing the OEM carburetor set-up. To find out just where we stood, the first item on the agenda was to run some chassis dyno baseline tests. It's always good to know exactly how much, or in our case how little, power reaches the pavement. In order to keep drivetrain stress to minimum during dyno tests we tested it in rear-wheel-drive mode using Third gear in Hi-Range. This minimizes tire and driveline speeds. We've seen drivelines break on similar trucks during dyno tests done in Fourth gear. However, keep in mind that power assessment is most accurate with the transmission in 1:1 gear.

Our CJ's 258 put down 76hp to the wheels at 3,500 rpm and 129 lb-ft of torque at 2,600 rpm. It seemed like it hit a wall, and didn't want to go over 3,800 rpm. Why so little power? The answer lies mostly in the heavy-duty drivetrain and large tires. Basically, heavy-duty translates to less efficient in terms of drivetrain power losses. However, a more efficient drivetrain will not hold up to the extreme environment of rock crawling and 4x4 abuse, so that is the tradeoff.

After the dyno baseline tests a cylinder leakdown test revealed the valves were in poor shape. So what does every hot-rodder do now? Well, the typical approach is to overhaul the tired cylinder head and slide a new performance camshaft in place of the old one. Of course opting for hand porting the intake and exhaust ports of the cylinder head will yield even more potential power increase. So we went ahead and did just that.


COMP
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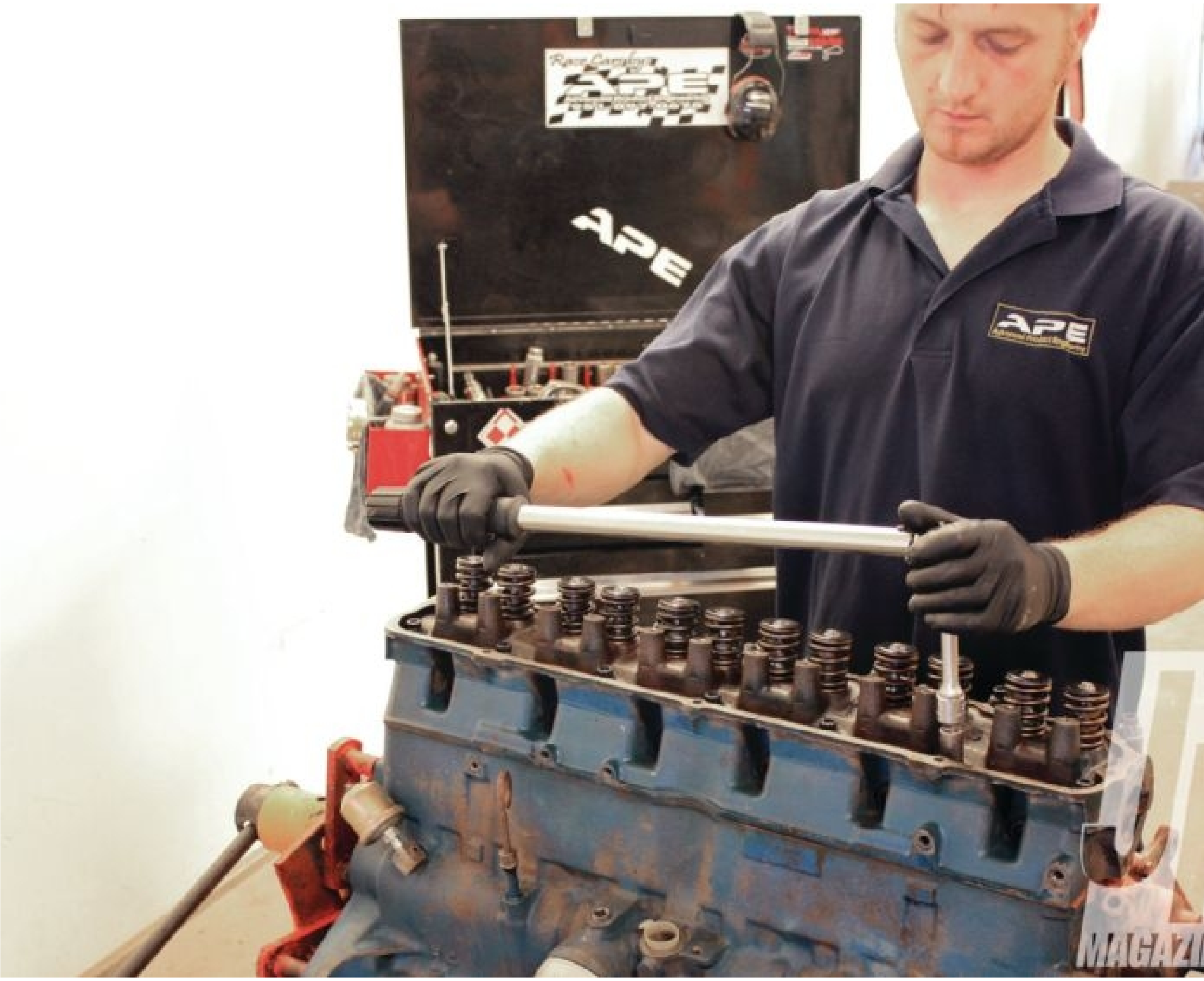


Build It Up
For easier access we removed the engine from the engine bay. The cylinder head was then pulled and inspected for wear. We found the kind of typical valve seat and stem wear that the leakdown test suggested. Other than that the head was in usable shape, and even the valveguides checked out OK. Next, the original cam was removed and inspected. During the inspection we found out that the existing cam was stamped with this mysterious "RV" on it. Of course, without actual part numbers we couldn't easily ID the cam profile, but based upon the stamping it was probably a very mild aftermarket piece.

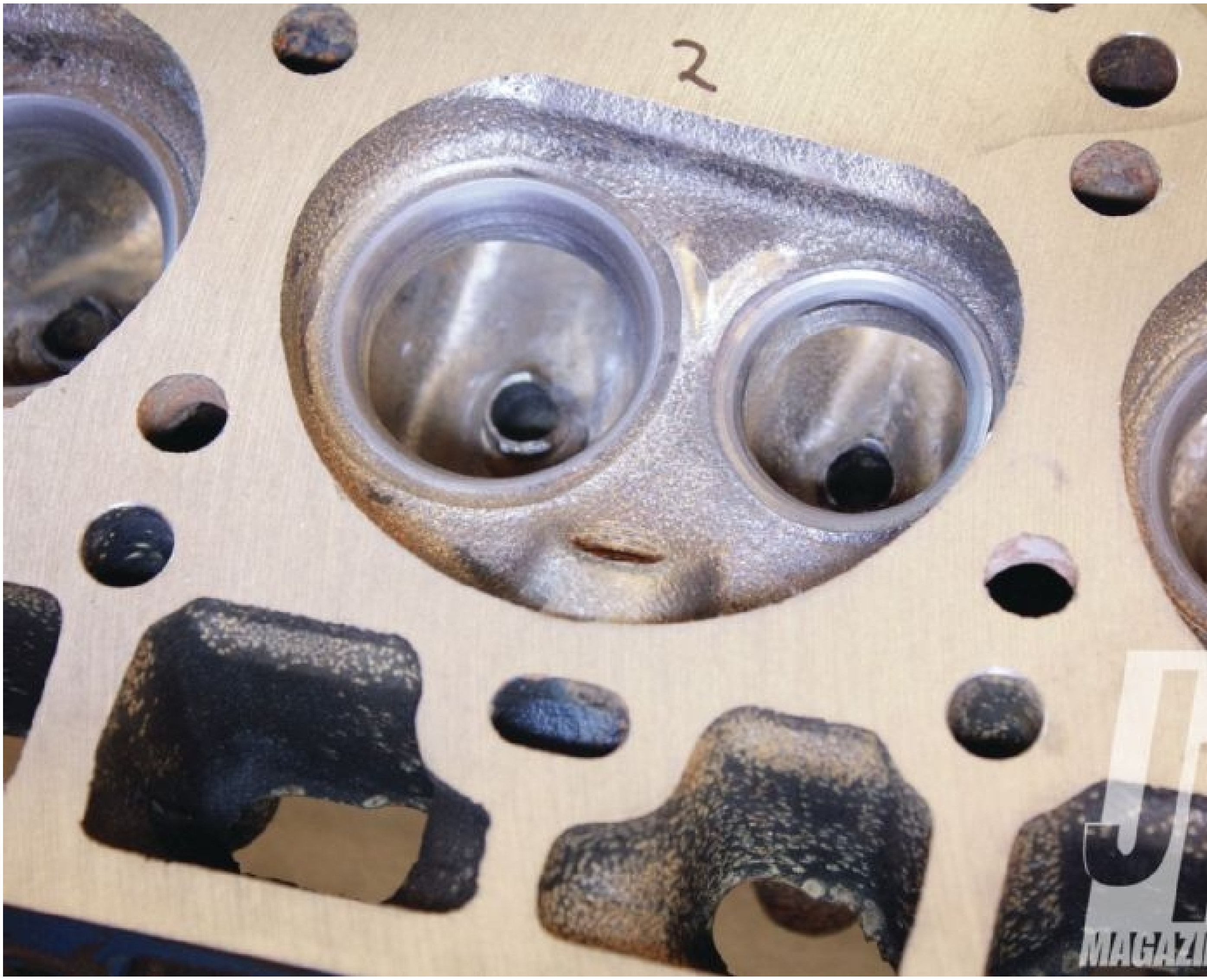
Next, the cylinder head was ported using all of the principals of keeping the port as small as possible and improving the short- and long-turn radius sections within each port. Sticking to those principals keeps the port efficient at low-lift values and lower in the rpm range. This is exactly what we are after since the inline-six design is famous for not wanting to rev very high. After porting, Ollie Hellert of Ollie's Machine Works handled the cylinder head machining. He started by re-machining the head gasket mating surface to ensure a good seal. As he told us later, “The head was tweaked a little.”

Since most cast-iron heads have hardened seats, it’s usually not necessary to install new valve seat inserts, but it varies from head to head. Some iron heads are hardened deep into the cast-iron material, while the hardening process in others is not so deep. In deciding whether the seats should be replaced, we relied on Ollie’s experience during this process. As he machines the seats he can judge the hardness by how the material is being cut by the cutter. After making the first cut he gave it the thumbs-up, which is great since this will make the cost of rebuilding the head much lower than it would be if installing all new seats. All of the valve seats were machined using a three-angle cutter.

The worn-out OEM valves were all replaced with new Elgin stock replacement valves. Rather than just sliding the new valves in place, they were treated to additional back-cut angles on the valve grinding machine. All of the extra angles will improve air flow especially at lower valve lift values where the valve spends most of its open time in a mild flat-tappet cam application like this one. Last, Ollie re-cuts the top of the original valveguides to accept positive-style valve stem seals. These will replace the original umbrella-type seals to keep the oil consumption in check on our fresh head.

For valvetrain solutions we turned to Comp Cams for a cam kit. Since this is a California Jeep that must pass an emissions test, we picked a cam kit designed especially for fuel-injected 4.2L and 4.0L engines. This K kit comes complete with all of the necessary parts to successfully cam-up an engine. The supplied cam, lifters, timing chain, valvesprings, retainers, and locks fit just like they should. To make sure the valvetrain works to its utmost potential, the spring’s installed height is checked and adjusted. The springs call for 1.800-inch installed height, which we nailed plus/minus 0.010-inch by simply removing the original valvespring spacers also known as valvespring inserts.

Setting the installed height dimension properly will ensure that the springs will not coil bind at the max valve lift point, and that they deliver the correct pressure. It’s also a good practice to always check the retainer and keeper clearance to the top of the valveguide at maximum valve lift prior to installing the springs (don’t forget to have the seals installed during that check). In our case the maximum valve lift is just below 0.480-inch, which gives us plenty of clearance. Once everything was checked and confirmed to be on target, the springs are installed for good using a special valvespring compressor.




2TON
1TON

With the fresh cylinder head fully assembled, it was time to turn our attention to the cam. The new camshaft was pre-lubed using Comp Cams' recommended red cam lube prior to sliding it in place. Then, the new timing chain set was installed, aligning the dots in-line pointing up on both the lower and upper sprocket. Even though the supplied timing chain set does not allow for any adjustment, it is still a good practice to check the cam timing using a degree wheel. This ensures a proper installed position of the cam in relationship to the crankshaft.

We proceeded with the degreeing-in process, and as expected Comp Cams' components check out within 1-degree from the recommended position. Using quality components always pays off. Next, the new lifters are installed after being pre-soaked in Comp Cams break-in oil. Always use this type of oil when installing a new flat-tappet camshaft and lifters. Comp's break-in oil is specially designed to help prevent the possibility of the cam going flat during its break-in period during the first few minutes of operation.

After cleaning the block's deck surface, a new Fel-Pro head gasket was installed after coating its surface with Permatex Copper Coat spray. This is done mostly to glue the gasket to the block to keep it from sliding during the cylinder head installation. Most blocks have dowels that do this job but this particular engine does not have any dowel provisions. We secured the head in place with custom-matched 7/16-inch ARP head bolts. These are installed and torque gradually in a circular pattern from the center out to a final 85 lb-ft using the recommended ARP bolt lube. To finish the valvetrain, the pushrods and new stock replacement rocker arms were installed after pre-lubing them with Comp's break-in oil. Since the engine was out of the Jeep, it was a perfect opportunity to finish it off with a new Mopar blue sparkle paint job.

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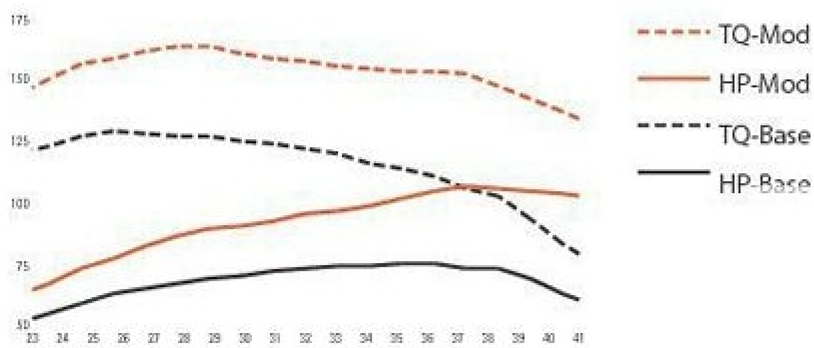

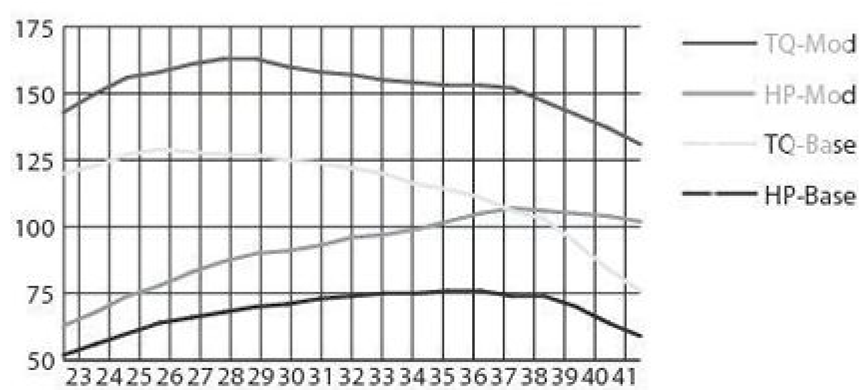

To the Dyno
Once the engine was bolted back into its home under the hood, the oil pan was filled using Comp's break-in oil. During the cam break-in period, it is best not to allow the engine to idle. Instead, as soon as the engine is started for the first time, run it in neutral with no load for 20-30 minutes while constantly varying engine speed

between 2,000-2,500 rpm. This ensures an adequate oil film on the cam lobes and lifters during this critical period. Remember to have your cooling system full and bled of any air prior to cam break-in to prevent overheating.

So, was all the effort worthwhile? Our labor was rewarded with an excellent improvement in power. On the very first test, the peak power jumped up to 100hp and 140 lb-ft at the wheels. After looking at the air/fuel ratio, we could see that the mixture was way too lean to allow the engine to make all the power it could. With the fixed programming of the Mopar ECU, we were locked out of software modifications to affect the mixture ratio. To richen the mixture, an adjustable fuel pressure regulator from Accufab was installed to increase rail pressure. Quickly, we found that the fuel pressure could only be raised by about 5 pounds from stock before the pump maxed out at 42 psi. Even adding just 5 more pounds produced an impressive increase in power and torque below peak hp rpm, where the ratio was really lean. With the enrichment from the fuel pressure increase, the maximum torque output moved up to 148 lb-ft, while top-end power stayed the same with a 100hp peak.

To cheat the mixture to a more optimal ratio, the Jeep needed a higher-pressure fuel pump to keep up with improved airflow. We would have to increase the fuel flow before we would see all we can get out of it. To get it done, we matched up an inline Walbro fuel pump that can supply fuel pressure up to 120 psi. Within a few adjustments of pressure between dyno tests, we quickly found the sweet spot, right at 50 psi. The engine responded with new peak numbers of 107hp and 163 lb-ft of torque at the wheels. Taking into account the baseline peak power number of 76hp, the result of our wrenching was an increase in peak rear wheel horsepower of just over 40 percent.

Parts List

- Comp Cams cam kit (K68-232-4)
- Comp Cams 10W/30 break-in oil
- Comp Cams valvestem seals (PN 505-16)
- Accufab Universal Fuel Pressure Regulator (PN UREG-1)
- Elgin Stock Replacement Intake Valves (PN I-1852B)
- Elgin Stock Replacement Exhaust Valves (PN E-1853B)
- Elgin Stock replacement rocker arms
- Fel-Pro gasket set (PN QFS8778PT)
- ARP custom-matched bolts and washers
- Walbro fuel pump from Summit Racing (PN ATX-E8248)

Dyno Results

’81 Jeep 4.2L Six-Cylinder, DynoJet 224xLC, SAE Corrected RWHP, Test at Advance Product Engineering

Engine Speed (RPM)	**Baseline**	**Modified**		
HP	**Torque**	**HP**	**Torque**	
2300	52	120	63	143
2400	56	123	68	150
2500	60	127	74	156
2600	64	129	78	158
2700	66	128	83	161
2800	68	127	87	163
2900	70	127	90	163
3000	71	125	91	160
3100	73	124	93	158
3200	74	122	96	157
Engine Speed (RPM)	**Baseline**	**Modified**		
HP	**Torque**	**HP**	**Torque**	
3300	75	120	97	155
3400	75	116	99	154
3500	76	114	102	153
3600	76	111	105	153
3700	74	106	107	152
3800	74	103	106	147
3900	70	94	105	142
4000	64	84	104	137
4100	59	76	102	131

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