

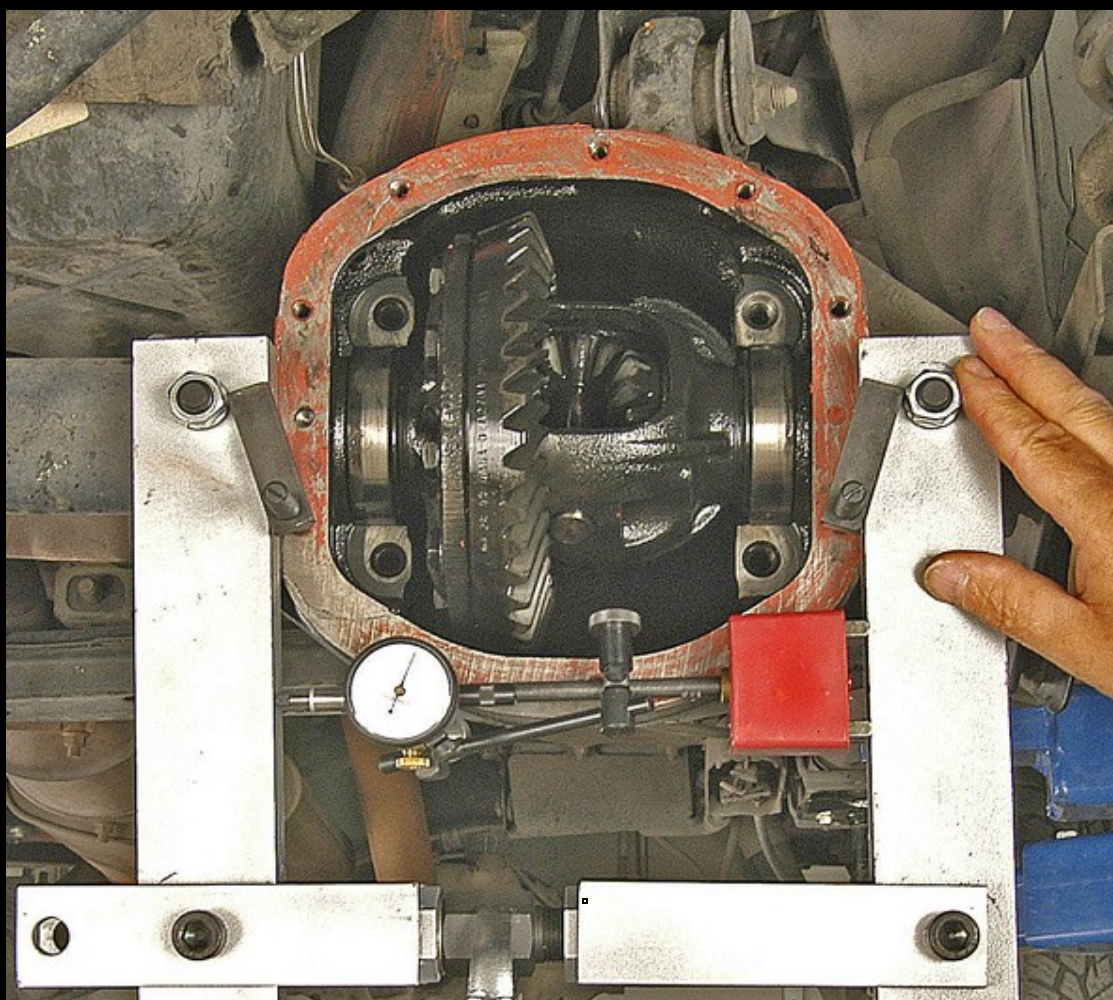
# Moses Ludel's

# 4WD Mechanics®

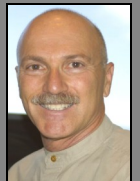
*“Monthly Technical News for Jeep® Enthusiasts and Four-Wheel Drive Shops”*

**Issue Number 2**  
**March 2010**

**Tech Feature for the Month: *Traction: How Much is Enough?***



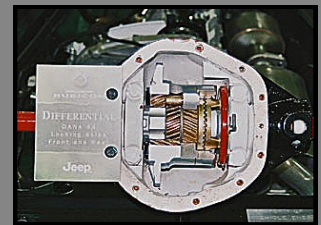
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**Question:** “My brother bought a 1992 XJ Cherokee 4-door new, and it now has 260K miles...He has offered me the Cherokee at no cost... Should I take my brother's XJ and make it a project off-roader?”—Joe M.

**Question:** “I've heard that complete JK Rubicon axle assemblies are available from Jeep. I have a '98 TJ model, and one of our Jeep club members has a '92 Wrangler. Would these axles fit? Are they complete with the lockers and disc brakes? How complete and what installation work is involved here? Will they fit both of our Jeep models?”—Bob R.

## '4x4 View' by Moses Ludel

September brings the first hint of fall, with autumn colors unfolding in the high country, crisp mornings and optimal daytime temperatures. That Saturday in 2007, we rose early and packed the XJ Cherokee for a day of wheelin'. Joining our 4WD friends in town, the group headed south toward the Sweetwater Range.

Highway 338, traffic free, took us quickly to the Nye Canyon dirt road, an inconspicuous left turn near the 7,120-foot Sweetwater Summit. The local high desert provided a crisp, blue-sky morning. Blue jays flitted through the hearty Junipers, a red-tail hawk hovered overhead, the aspen, turning colors, shaded the lazy Herefords that grazed in sagebrush and the tall, late-summer meadow grass. Nearby, lofty Desert Creek Peak, cresting at 9,020 feet elevation, reflected a white speck of north-face snow, a remnant of the last winter.

Opening and closing the barbed-wire gates, avoiding unnecessary tire spin and dust clouds, the procession soon stopped near a loosely stacked stone wall. Estimates had placed a 9,000 B.C.E. build date on the site, constructed by the first Americans who inhabited these lofty mountains. They built the basaltic rock wall to trap antelope and bighorn sheep.

Carbon-dated petroglyphs, fire rings and arrowheads tell the story of those skilled hunters, a nomadic people who roamed this region without reserve. Migrating to and from winter habitat in lower valleys, these people walked miles between the summer springs and ice-melt creeks in this high country. They pursued an abundant variety of game, avoiding the snakes and predators.

I thought about these hunters. In my teens, an F-head, four-cylinder CJ-5 gave me access remote hunting reaches in the nearby Pine Nut Range. At the two-track's end, I would shut off the engine and reach for my open-sighted rifle. A fragmented mining road, deer trail, ravine, creek bed or etched shale side hill became a hiking path to the thin-aired timberline—where big muley bucks hung out. In those years, 4WD routes got

us deep into remote, primitive country. We parked the truck and moved silently over footpaths, *much like these early nomadic hunters.*

At the dirt road's end near Bald Mountain, the vehicles stopped. A two mile hike placed us on a bluff overlooking the East Walker River and Flying 'M' Ranch. C-130s flew above us, searching this remote region for a small plane flown by Steve Fossett. I thought of my Search-and-Rescue work with the Oakridge, Oregon, four-wheel drive club and Lane County Sheriffs 'SAR' unit. In October 1992, we parked our Jeep 4x4s at the fringes of the Waldo Lake Wilderness and searched until dawn for two scared, numb youngsters. The 'SAR' team returned them safely to their frantic parents.

The Bald Mountain area was under consideration for wilderness designation. If established, *all existing roads would remain accessible to motorized vehicles.* Hunting, fishing, the grazing of livestock, hiking and camping would remain, too. *Gone* would be the risk of a federal agency swapping this remote, unique land to a private land developer in exchange for property elsewhere.

Our group included fourth generation locals who grew up in this region. Avid four-wheelers, many of us access primitive country on designated trails, respecting fragile eco-systems,\* wildlife and artifacts. Like the pre-Columbian nomadic people, we consider the land and its legacy sacred, to be enjoyed by future generations.

We enjoyed a day of wheelin', awed by the 100-mile panorama of pristine mountains and remote valleys. The low-range 4WD roads reached ancient artifacts, historical sites and the natural splendor of the Bald Mountain wilds and high desert...

*Moses Ludel*



*\*Eco-tip: As a member of the 'Tread Lightly' board of directors, I learned that sagebrush takes 150 years to reestablish. Please avoid driving over sagebrush! Stick to roads and designated trails...*

[1]

# *Traction: How Much is Enough?*

Read other 4WD magazines. Visit scores of Jeep forums. What is the first and foremost theme discussed? **TRACTION!** The market is rife with products directed at 4WD traction. Locking differentials, big wheels and oversized tires, 'traction' lift kits, slip yoke eliminators, CV drivelines, the list goes on.

There is clearly a place for improved traction—*like when your specific driving environment demands such equipment.* When making the decision to modify your Jeep, separate *needs* from *trends* and advertising hype. In the process, you might even consider your driving skill. Inexperienced or ham-fisted drivers are quick to blame loss of traction on their equipment shortfalls. Know the difference...

To begin, do you really need 38" diameter tires and an elaborate lift kit on a TJ or JK Rubicon model? Who says you do? For that matter, who am I to state flatly what you need or don't need? Maybe your Jeep does need all the tricks and devices; know though, that the cost for ultimate traction can be substantial...Here's my experience.

## **Who Am I to Talk?**

On my sixteenth birthday, a bright June day long ago, I tested for my first driver's license. The examiner at Carson City raised an eyebrow as we approached the test vehicle, a stone stock, one-year-old 1964 CJ-5 Jeep. The CJ had a cloth top, no seat belts, no roll bar, a hand choke and a single braking system...In those years, DMV examiners surely were not paid enough!

Over the next few years, I steadily honed my four-wheeling skills and made friends with the quirks of a high center-of-gravity vehicle. A ¾-ton utility truck, the CJ-5 had a very short, 81-inch wheelbase and no track or sway bars! A high C.G. has always vexed off-pavement vehicles, and in those years, 8-inch wheel rim widths and 31" diameter tires were the only

fix. This CJ did not even have that advantage, and in the summer of 1967, fresh out of high school, I joined a group of four-wheelers from Contra Costa County, California, for a weekend Sierra trail run and campout on a trail described simply as "The Rubicon."

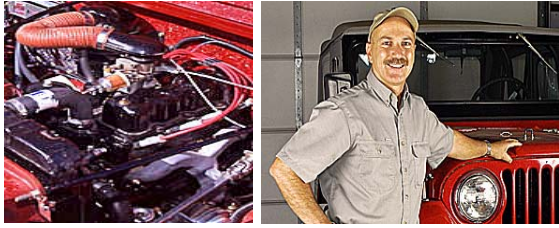
We met at South Lake Tahoe, a string of Jeep CJs and one FJ-40 Land Cruiser, and drove the reverse route from Lake Tahoe toward Georgetown. This meant climbing *up* each sluice box, a more difficult assault for this trail. At age eighteen and new to that trail, I thought the route made perfect sense.

Suffice to say, that stone stock four-cylinder Jeep benefited from its 4-speed T-98A transmission option, which enabled extreme gear reduction in compound 1<sup>st</sup> gear, low range. This bode well for inching over V-8 size boulders that characterize the rougher stretches of the Rubicon Trail to this day. The CJ-5 came through unscathed, even its low-hanging step plates at each door remained unblemished.

*Note: The additional traction equipment found on modern Rubicon Trail vehicles can be justified. This trail has actually gotten worse over the years. Heavy traffic and rough winters have taken their toll. In 1967, a stock Jeep CJ or MB sufficed. Today, a moderate lift and traction devices would be wise.*

For the record, the CJ ran with open differentials—*no limited slip option.* The 30" diameter stock 7.00x15 Goodyear Suburbanite 'M&S' tires had narrow tread cross-sections. Packed with camping gear, the on-trail vehicle weight was near 2,700 pounds. This was the quintessential backcountry vehicle from the postwar era well into the 1970s. Maximum traction from the late 1950s onward took the form of a factory rear axle option like multi-plate Posi-Traction, Powr-Lok, Trac-Lok or the unique Detroit No-Spin. Each is an automatic type locker system.

[2]



The F-head engine boasted 75 horsepower at sea level, with a scant 120 ft-lb of torque to match! At 8,000 feet elevation, about 35 of those horses were still available. A low range ratio of 2.46:1 with a compound low gear ratio of 6.4:1 made the Rubicon Trail accessible. At right is our family's current '55 CJ-5.

Since 1967, I have driven all types of 4x4 light trucks and 4WD SUVs. As a magazine journalist, I was responsible for testing and evaluating new 4WD vehicles. Consulting to major vehicle manufacturers, I assessed new vehicles, pre-ran 4WD events and led groups of journalists over challenging test trails. I tested the very first YJ Wranglers and XJ Cherokee 4.0L models, including participation in the 1987 and 1988 Jeep Cup Rally Series events in California, Arizona, Nevada and the wilds of Ontario, Canada.

As a publicity stunt and research effort, my high water mark for the Rubicon Trail came as a challenging assignment from Chevrolet in the mid-'90s. The task was to successfully negotiate the trail with two Geo Trackers. CALMINI Products' co-owner Steve Kramer and a trusting G.M. engineer joined the quest.

Oh, let's not forget the photographer. Chevrolet media communications commissioned a freelance photographer to document the trip. The evening before we hit the Rubicon Trail, the well-meaning waitress at a Georgetown Mexican restaurant had given us the bear sighting numbers for the region. Our photographer had now spent two sleepless nights too many in bear country. Just before we reached Rubicon Springs, he hitchhiked out with some seasoned CJ folks. The CJ Jeep 4x4s would have him at Lake Tahoe in hours—at our pace, we still had one night and a full trail day ahead. In addition to driving both vehicles down the sluices and spooling endless yards of winch cable, I took the final photo sequences and served as camp cook and trail boss. After 46 hours of persistent trail work, the trip was a success.

A well-equipped, lifted Jeep CJ or Wrangler can do the Rubicon Trail in 12 hours. In perspective, the two-door Geo Trackers were at or near *stock*. One Tracker had a 2-1/2" CALMINI Products lift, a set of BFG 29" tires, a Warn winch, added skid protection and a locker device at the rear axle. The

other vehicle was *stone stock* beyond an under-belly skid pan that Steve Kramer devised and built—a *must item*.



Two Geo Trackers on the Rubicon! Top, I'm driving the stone stocker at a sluice box; bottom, a winning demonstration with the "modified" vehicle. Note the whopping 29" diameter tires! At night along the trail, Steve and I reassembled a separated front half-shaft under lantern light. Luckily, we found the balls that had scattered across the trail! The lift and severe trail stresses, including recovery work, pulled the half-shaft apart.

Everyone wants a limelight vehicle. I have built *five* magazine project 4x4s; two were FJ-40 Land Cruisers, one a CJ-5 Jeep, our current XJ Cherokee plus an R-body SWB vintage Dodge W100 that I slipped into the mix. I teamed with BTB Products on the second Land Cruiser project. The first 'Cruiser, the two Jeep builds and the Dodge 4x4 were strictly my own handiwork. In addition to many magazine features and some cover shots, several of these rigs made it to the television screen, one showed at the SCORE Show and one at SEMA. Our current trail rig, the XJ Cherokee, final tested at Moab as a Four-Wheeler Television subject.

As four-wheel driving experts, I co-instructed the national Tread Lightly 4WD Clinics with Bill Burke (Camel Trophy participant and head of 4-Wheeling America). Bill and I taught subjects like winching and water fording in the Northwest, climbing steep Sierra gradients and negotiating slickrock coated with oozing clay mud in a torrential Georgia rainstorm!

I've taken a variety of stone stock new 4WD and SUV models through their paces, leading journalists in the process. My G.M. assignments included the '95 Blazer launch at Moab that helped win a *Motor Trend* 'Pick of the Year,' the '96 Tahoe (which garnered another *Motor Trend* 'Pick of the Year') and a Geo Tracker launch over Engineer Pass between Ouray and Telluride. We returned by way of Red Mountain

Pass before visiting Animas Forks and Silverton. While others ate their gourmet lunch at Telluride, I rushed a blue-lipped fellow journalist out of the Rockies and down to Farmington, New Mexico. Altitude sickness had gotten the best of him...

At Vance and Huntsville, Alabama, I participated in the international press launch of the American-built Mercedes-Benz ML320s, followed by launch events throughout the U.S.A. I helped select venues, pre-ran trails and guided anxious journalists who wanted to know just what the German-bred 4x4 could do. The following year, Subaru assigned a unique project. I selected trails and lead journalists on Washington and Montana backcountry routes with the Outback 'SUS.'



*Land Rover Trek 1996, our third set of in-the-mud winch exercises...Canoeing and bicycling in Georgia's red clay mud? Six months' training with a Polar heart rate monitor paid off! (See my 'Getting in Shape for Moab' regimen at the website 'Tech Blog.')* Left, Sue Mead and I guide our British teammate Nick Dimbleby in winch competition. At right, teamwork and cheering encourage my bicycling finish...I preferred canoeing!

For the 1996 U.S. Land Rover Trek competition, I represented Tread Lightly on the U.S./U.K. team. We took home trophies after a very long day of triathlon competition and competitive four-wheeling. Before dawn, we started the event with a cross-country run and compass orienteering. Bicycling in sprocket-deep clay mud, ropes exercises and canoeing highlighted a non-stop day of 4WD slaloms, hardcore winching and four-wheel drive gymkhana. 47 years of age, I trained hard through the months leading to the event...

### Determining Your Real Traction Needs

So, let's begin by identifying our mission: *Traction is successfully negotiating rough terrain with minimal wheel spin and the least amount of impact to the vehicle and environment.* Since minimizing tire spin is a key part of the equation, tires must play a role.

Common lore and strong advertising have many assuming that bigger tires must be better. Huge tires and ultra-wide wheels, however, require a radical lift, axle gear ratio changes, driveline modifications and speedometer correction. Is all that expense worth it?

If your driving environment is a sandy river wash, waist high boulders, a mud bog or frame-deep snow, big tires can help. Tire *flotation* can enhance a vehicle's ability to distribute its weight over a *wider footprint*, helping us stay atop these challenges. Riding a dirt motorcycle in sand, we quickly learn the benefit of keeping the front wheel light to prevent bogging.

So, do you always need big tires? More importantly, is there a place where high flotation tires are detrimental? *Absolutely.* A glaring example is an icy highway. Do you want your 3,200 pound, short wheelbase Jeep to rip into a corner on high flotation tires? With less pounds per square inch on the tire's contact surface and lateral forces pressing the vehicle toward the outside of the curve, *bigger tires may not be better!* Here, a narrower tread tire with liberal use of sipes will have more stick, resist skidding and be more apt to keep the Jeep from leaving the road.

This same rule applies on wet slickrock. Applying the brakes or cornering too fast can create a loss of traction as the big tire "floats" laterally or skids. If icy highways and wet, rocky surfaces sound like your driving venue, consider a narrower tire tread while maintaining the correct track width for a stable C.G. (center of gravity). Remember, as I share in my Jeep® books, a wider track width means more C.G. stability—*raising the vehicle's height always requires a wider track.* You can increase track width with shallower backspace wheel rims—an increased "negative" offset—or by use of wider axles. (See this issue's 'Q & A' for comments on wide axles and the Mopar Performance retrofit wide axle options.)

Tread patterns also play a role here. Large tires with open cleat tread and sipes may work if the tread design provides enough pounds per square inch of pressure applied to the contact surface. *Be aware that tires with ample sipes enhance lateral stability on icy roads.* No sipes mean far less stability! Choose tread carefully.



Tires are important! Top left is classic 'military' tread, no sipes, deep cleats, staggered, reversible tread. Right and bottom are modern Goodyear Wrangler tires with great lateral stability, plenty of clawing capability and gripping sipes.

An open, conventional differential allows the wheel with the least resistance to spin. A factory-type limited slip is an *automatic* locker, which will transfer torque from the spinning side to the wheel with greater traction. For most users, this is sufficient for minimizing spin. The only downside, which I've always stressed, is that a locked axle will want to move laterally on an off-camber road if traction is very poor—like an icy highway or a slanted, muddy road.

A full locker, like the ARB Air Locker and other manual types, allows the driver to control *when* both wheels will get equal torque. Locked up, both tires can spin, so a locked axle acts much like a limited slip on an icy highway. The manual locker, unlike a limited slip, allows a *choice* of whether or not you want torque at both rear wheels simultaneously. *On icy highways, I prefer a manual locker in its open, unlocked mode.*



Popular Dana 35 rear axle in '87 YJ gets an ARB Air Locker. I've used ARBs since the late '80s with great success. At right is our XJ's Dana 30 front diff coming out—the right way, using a spreader and dial indicator to prevent excess housing stretch.

Oversized tires and wheels, a quality lift kit, locking differential packages with correct gear ratio changes, heavy-duty axle shafts, add-on skid plates plus a slip yoke eliminator,

new drivelines and a speedometer correction can be a considerable expense. This work performed all at the same time by a 4x4 shop can cost \$10,000 or more. A rear disc brake conversion may add additional costs.



Break-over point is the issue (left). Stock TJ bellies over the mound on its skid plate. At right is a big tread, 6-inch (long-arm type) suspension lift from Full-Traction Suspension. Note exceptional axle articulation and dramatic ground clearance.

Let's assess the net gains. The oversized tires will provide more ground clearance and, if wider as well as bigger in diameter, additional flotation effect. For sandy desert washes, deep snow, craggy rock crawling (like the Rubicon and some Moab trails) or mud bogging, this approach will provide gains. For loose traction surfaces in general, steep climbs without ground clearance issues, logging roads, light snow, icy highways or areas that require moderate ground clearance, such as urban or suburban commuter use, stock or near stock Jeep-size tires will work fine. Choose the tread pattern that matches your driving.

At Camp Jeep workshops, I share with guests that a stone stock Rubicon TJ's 31" diameter tires or the newer JK Rubicon's 32" diameter tires are ideal for nearly all driving environments. Once upon a time, 33" tires were considered the outer limits for vehicles like these shorter wheelbase models.

33" tires can be fitted to a JK without the need for an elaborate lift kit; simpler coil spring spacers will suffice, and 33" tires would present only a short list of trickledown effects. 35" or larger tires, of course, will require a lift and a long list of necessary modifications. *In my view, 33" tires are plenty for all but the most specialized driving venues.* For the record, press fleet YJ and TJ Wranglers ran 31" tires over the Rubicon Trail for decades.

Let's not overlook the obvious: Tire tread design, by itself, can make a major difference in traction. Years ago, we mounted sets of coarse-cleat tires, specialty mud bog rubber or high flotation "sand" tires on spare wheel rims. Paddle tires handled extremes like sand drags or hill climb competition. For general driving and moderate trail running, a more

suitable, tamer set of tires and wheels sufficed. This also helped preserve expensive rubber!

Of course, there is always the "look" side of the decision process. If fashionable trends dictate your choices, likely no amount of practicality, financial consideration or horse sense will sway your thinking. Just be aware that if you must have that look and the image of an ultimate ground pounder, *you'll be buying the whole trickledown package in addition to the lift kit.* As for the day of trail reckoning, keep in mind that *your driving skill will still be more of a factor than equipment when the trail gets tough!*

If your Jeep needs traction, try these remedies first:

- 1) Practice minimizing wheel spin and using a higher transmission gear with less throttle application to reduce available torque at the wheels when climbing. Maintain a controlled speed, just fast enough to provide forward momentum. Less bouncing and controlled speed will maximize tire-to-road contact.
- 2) Consider a change in the tire tread pattern, perhaps a larger diameter tire that will not necessitate a suspension or body lift.
- 3) Try a single locking device at the rear axle, ideally an ARB Air Locker or similar manual locker.
- 4) If mid-chassis break over ground clearance is the only trouble symptom, consider a "Tummy Tucker" (fits the TJ Wrangler) or similar skid pan that rides higher and improves clearance at mid-vehicle. In fairness to those clamoring for lift kits, the YJ and TJ each have a ground dragging center pan.
- 5) If these changes are not enough, shore up your finances for the lengthy list of modifications that will accompany all but the mildest of suspension lifts!

For those on a budget and trying to avoid a radical chassis lift, consider model dynamics. Model MB and CJ models will require a 2"-3" lift for 31" tires. An XJ Cherokee needs 2" lift for 31" tires. Non-Rubicon YJ/TJ Wranglers also need 2" lift for 31" tires. For a TJ Rubicon, increased break-over angle via a Tummy Tucker-type skid pan may be the only modification needed. ZJ and WJ models are similar to XJ Cherokee guidelines. IFS models have their own lift standard.



33" tires were the goal for a stone stock XJ (left). This is the same vehicle (right) at Moab after installation of a six-inch long-arm suspension lift. XJ requires a radical approach for anything more than 31" diameter tires. I installed ARB Air Lockers front and rear with 4.10 gearing to restore the original engine speed on-highway. An SYE and CV-driveline were also necessities. Gee, I must really need these 33" tires! At a 100.4" wheelbase, they do prove useful and there is no need for body modifications or cutting out fender sections.

33" tires spell the end of the 'mild' lifts. You're now entering the realm of major gearing and driveline changes. Our XJ project took a 6-inch long-arm lift to mount 33" tires...Need that 33"-38" tire diameter? Your call...

# 4WD Tech 'Q&A'

## XJ Cherokee Project Prospects

*My brother bought a 1992 XJ Cherokee 4-door new, and it now has 260K miles. He plans to buy a new vehicle this spring. I've been offered the Cherokee at no cost. I always liked the vehicle and enjoyed projects like your '99 XJ Cherokee Trail Runner. Should I take my brother's XJ and make it a project off-roader? The vehicle is in good-to-decent condition, all original except for the water pump and the obvious—brakes, battery, tires, shocks, etc. It does need some TLC and minor interior work but seems mechanically sound. I am worried about the electrical system and other unknowns that may pop up after I start putting money into the truck. What should I expect to change or repair? What are your thoughts about this year and model Cherokee?*

*Thanks,*

*Joe Mac*

**Joe, the number of XJs produced from 1984-2001 was huge—over two-million units. This makes the XJ one of the most popular platforms in Jeep history and a coup in terms of donor vehicles, parts sources and aftermarket attention. The used XJ entry cost is always reasonable—often better than the utility model CJs and Wranglers. Shared parts with the YJ and TJ Wrangler keep vital replacement pieces available and relatively inexpensive, especially when compared to models like the Grand Cherokee, a Toyota product or even G.M. and Ford SUVs. The stats suggested it, and the XJ Cherokee has always been a great vehicle—both on- and off-road**



*Yes, this is the same 'XJ!' We found the stock '99 with only 94K miles on the odometer and a \$5600 price tag—worth every dime! Once home, \$8,600 in parts and 160 hours of labor later, we're at Moab! Is this what you have in mind? All it takes is time and money!*

**My first "compact" Cherokee test came about when AMC introduced the 4.0L Renix MPI engine in 1987. I wheeled a spanking new XJ from Southern California to the Jeep Cup Rally near Placerville, California. What immediately struck me was the handling, on the highway and in the off-road sections of the rally—so**

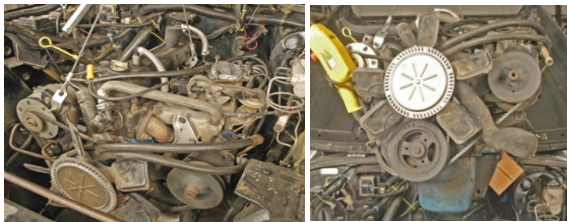
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***much better than the white knuckle 80"-97" wheelbase Jeep utility 4x4 models!*** Despite speculation that a unibody was too "car like" for a Jeep, the design provided a power-to-weight ratio substantially better than competitive 4x4 SUVs of the period. The engine boasted 177 horsepower and easily compensated for altitude with its feedback looped EFI and oxygen sensor.

That said, there are several category years for the XJ. The first was the V-6 G.M. powered era, 1984-86, plagued by the same issues G.M. had with the 2.8L six in its own vehicles. Severe rear main seal and crankshaft failure problems were partially remedied by G.M.'s '85-'86 model years with a better crankshaft design. However, the '84 models suffered from crankshaft failures, and the '85 engines still used a poor two-piece rear main seal design. I know this well. As a fledgling freelance journalist, I moonlighted at a GMC truck dealership and did warranty work on 1983-84 models. Crankshafts broke on these engines when barely out of the showroom, typically an A/C equipped engine.

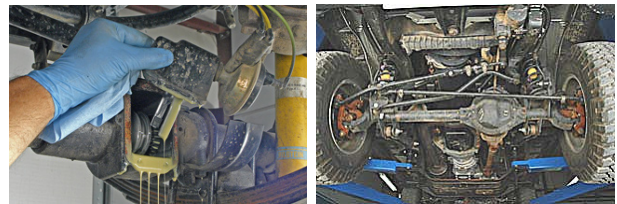
It's surprising that AMC did not use its own 4.2L six in the Cherokee initially. The 4.0L that emerged in '87 was essentially a 4.2L derivative. The standard, peppy AMC carbureted 2.5L four went to TBI in '86, and in '87, MPI appeared on the "new" 4.0L XJ inline six. The engine is standard issue AMC inline 199/232/258 design, and from '87-'90 uses the French Renix MPI system, not bad, a product of the AMC/Renault joint venture. When Chrysler purchased AMC-Jeep, they kept the Renix systems through 1990, then in 1991, the AMC 2.5L four got Mopar MPI and the 4.0L gained a Mopar system, too. This bodes well for your 1992 XJ prospect...



*I'm pulling this 2.5L AMC TBI four from an '87 YJ Wrangler. AMC was smart, sharing many components between the Wrangler and XJ Cherokee. Wide use and economies of scale keep maintenance costs and current parts availability reasonable. The rugged 2.5L four held up far better than the 2.8L G.M. V-6!*

The '87-up XJs also feature the AW-4 automatic. This is a virtually bulletproof transmission, a good match for the essentially bulletproof 4.0L engine. Japanese built by Aisin-Warner, the 4-speed overdrive unit serves in XJs through 2001, improved steadily over that long season. Maintained properly, these AW-4s give very little trouble. Your brother's XJ likely has the Dana 35 rear axle if equipped with ABS. The Chrysler 8.25" is also used in '92, and our '99 has that axle. I like the 8.25" for its beefiness. An ARB Air Locker is available for either the 8.25" or the Dana 35. One alternative for each of these axles has been the now scarce MJ Comanche pickup's 8.5" Dana 44 swap. Your usage and tire size will dictate whether that retrofit is practical.

At the front, the XJ axle is a Dana 30 open knuckle design much like those found in the '72-up CJs or the YJ and TJ Wranglers. AMC built XJ and YJ axles with a unique disconnect feature that mimics some of the gains of earlier free-wheeling/locking hubs. The system had so many trade-offs that by 1991, both the Wrangler and Cherokee eliminated the right-side axle disconnect system. The '91-up XJ Cherokees are better off for it!



*At left is the Dana 30 front axle shaft disconnecting system on an '87 Wrangler. Many XJ Cherokees have this feature prior to '91. By disconnecting the right front axle shaft during non-4WD use, drag is reduced somewhat. The result, though, is a set of differential gears spinning twice as fast as normal, since the axle shafts are splined to the wheel hubs. Water seeped into this axle housing from stream fording and a worn axle shaft seal. Water can cause extensive damage in an axle.*

Federally mandated on-board diagnostics (OBD-I) were included with the '91 Mopar MPI. OBD-II did not come into play until the '96 models. In '96, the XJ has a transition wiring system to accommodate OBD-II JTEC, and '97-up JTEC has better reliability. Your 1992 XJ prospect has an 'SBEC' 60-way powertrain control module (PCM computer), a reliable package. 60-way also worked well through '95 on YJ Wranglers. This PCM

also provides a platform for Mopar's EFI Conversion kit to replace carburetion on '81-'90 4.2L inline sixes.



*Mopar Performance offers this great alternative to carburetion for '81-'90 AMC 4.2L inline sixes. The system employs '94-'95 YJ Wrangler or XJ Cherokee features. The 60-way (wire) PCM computer is central to the 1991-95 XJ models. There are several part numbers due to programming for emissions.*

So, overall, the '92 model has good stuff. As for weak areas in general, keep in mind that this is a unitized, essentially sheet metal body/frame. If from a rust region, structural damage should be considered. Look closely at body panels and the frame superstructure. You want a solid platform to build on. Also check wiring integrity, although the chassis harnesses are fairly well done, there is always the issue of corrosion.

A chronic area of concern is the engine cooling system. There is a lot of anecdotal commentary about XJs and poor cooling, some believing that the '97-up models were better than the earlier years. I'll share the simplest formula for cooling: horsepower = BTUs. BTUs must be dissipated from the engine, and in this case, the 'HO' output is 190 horsepower and more BTUs to draw away than earlier models!

The 4.0L was a shoehorn fit into the XJ chassis, and the stubby engine fan crowds to the right, with an auxiliary electric booster fan on the left side. This electric fan works steadily when the A/C or defroster is on. It also gets a workout when off-road, as slow-speed driving minimizes air flow through the radiator's short core. The fan shrouds do not cover the whole core, either, which further challenges cooling.

Complicating this further are the "burp" needs of the remote recovery tank and sealed radiator on pre-'91 XJ

4.0L models. These applications do not have a radiator fill cap. (2.5L four-cylinder models do, fortunately.) Summing it up, the cooling systems have always been marginal on 4.0L XJs in terms of radiator flow capacity, shrouding and fan draw. Suggested remedies include a high flow water pump in conjunction with increased radiator capacity, lower thermostat settings and special coolants. The 195-degree F factory thermostat setting meets EFI and emission requirements. This leaves little room before overheating occurs. Horsepower demand increases BTUs. High horsepower draw means higher heat to dissipate through the cooling system.

For desert trail use or pulling a trailer, the most common nemeses of an XJ's cooling system, I would toss the factory radiator and replace it with a custom aftermarket unit capable of handling far more BTUs. Modern "dimple tube" technology allows for far better cooling without increasing the radiator core size much. (The XJ does not allow for a much thicker core.) With increased radiator flow capacity, you can benefit from the popular addition of an aftermarket high-output water pump. Some find that the addition of Turbo City's thermostat housing also improves flow.

*Tip: If you use the popular Flow-Kooler water pump, it may require a thicker mounting gasket to prevent the impeller from scraping the #1 cylinder jacket of the block. Check clearance here!*

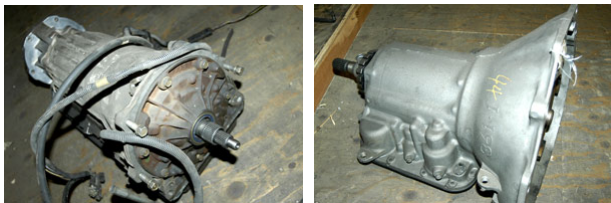
Officially, the thermostat should be 195-degrees F for emissions and PCM signal demands. Using a 180-degree F thermostat, some claim, leads to better fuel efficiency and cooler overall operating temperatures. If use of a 180-degree F thermostat still permits the engine to come off its cold-start cycle, this claim is likely true.

The 180-degree F thermostat needs to be tested on an emissions dynamometer to rule out the possibility of continued fuel enrichment after the engine warms up. Efficiency does improve when you reduce excess upper cylinder heat and detonation (ping). There are also rumors that a 160-degree F thermostat works even better. I am firmly against that notion, as complete combustion *will not occur* at these low temperatures. Over time, carbon will build up in the upper cylinders.

As a final cooling note, I prefer a copper/brass radiator to aluminum. Aluminum is great for NASCAR and high air flow environments, also a nice weight saving factor; however, heat dissipation at low speeds with lighter fan CFM can be an issue. Any improvement in the XJ's fan and shrouding arrangement would also help. The XJ's cooling issue deserves a tech feature!

With all of the generalities out of the way, let's assess the condition of that '92 XJ—or any other used Jeep vehicle. This list is important for CJ, Wrangler, J-truck, ZJ, WJ and other Jeep 4WD models. You can use this approach to decide whether your brother's XJ is right for your off-road 4x4 project. Here's the inspection checklist, Joe:

**Engine**—Check for engine oil leaks, especially the rear main seal, which is not that easy to replace on a 4.0L engine. Run a cylinder leakdown test—do not bother with a “compression test.” The leakdown test is far more reliable and a better diagnostic tool. Look for signs of sludge in the valve cover (peek through the oil filler cap at least). Run the engine with the filler cap removed and the PCV valve disconnected. This will reveal oil burning blow-by better than any other quick method. Listen for knocks, clicking and rattles on start-up cold, a sign of excessive bearing clearance or lifter trouble. 4.0L engines in your year range can have piston-to-cylinder wall noise that disappears once the engine is warm, not a major issue. Make sure this is not bearing or wrist pin noise.



*AW-4 automatic (left) was used exclusively by the XJ Cherokee 4.0L six-cylinder models from 1987-2001, a very wise choice that contributes to the XJ's reputation for reliability and longevity. I upgrade the AW-4 for JeepSpeed™ or rock crawling. At right is a durable Chrysler-type 3-speed automatic, popular in the CJs, YJs and earlier TJ Wranglers.*

**Transmission and transfer case**—If the XJ has the AW-4 automatic, check for the acrid scent of overheats. Dirty

fluid is not a good sign, burned fluid even worse. Check for seal leaks. Seepage at the front of the transmission is the front pump seal. If no leaks or shift problems, no slippage between gear changes, consider a professional flush-and-replenish that includes the torque converter.

If a manual five-speed, the AX-15 is rugged and either working right or not. Listen for whining, bearing sounds or synchronizer balking on shifts. Change the gear lube, using only Mopar's recommended AX-15 oil. Note signs of clutch slip, roughness or shudder on engagement. The transfer case should shift properly and not whine. Check for chain play by rocking the front driveshaft back-and-forth with the transmission in gear (manual) or Park (automatic) and the transfer case *low-range* engaged. If a part-time NP231, you can rebuild the unit when you install the slip yoke eliminator (SYE) kit and CV-rear driveline required with a chassis lift. The NP242 can be checked similarly and will also require an SYE with a lift.

**Axles**—Rear axle shafts have C-clips, so check for axle shaft endplay. Check pinion gear backlash by rotating the driveline and noting play. Check for fluid leaks. Check the front axle shaft joints for wear or signs of dryness and fatigue. Check for steering knuckle ball-joint play. Expect front wheel hub wear and plan on replacing both front hubs. Check lube condition in the axles and change the gear lube if you are not rebuilding these axles. If a limited slip rear, use friction modifier supplement with the gear lube. I recommend Mopar's limited slip additive. Fortunately, the front axle of a '92 XJ does not have a vacuum disconnect system.

**Steering**—Saginaw steering gears last a very long time, however, I would check for sector/cross-shaft play with steering in the straight ahead position. These gears often need rebuilding at the mileage you describe, at least a complete reseal and restoration of tolerances. Steering linkage is another wear point; check tie-rod ends for looseness.



*Saginaw power steering was available throughout the XJ years. Rotary design is bulletproof. A reseal and tolerance adjustments can often rejuvenate a unit. Here, a similar YJ application shows signs of upper seal leak at higher mileage. I rebuilt the unit.*

**Brakes**—Customary brake needs include new rotors, calipers and rear drums at this mileage. Despite regular brake work, unless these items have been replaced, they will need replacement. Hoses and the master cylinder should be shot. The ABS system is another area of concern and expensive to restore.

**Springs and suspension**—Leaf spring bushings are likely shot. Leaf springs fatigue, too. If you plan a lift kit (mandatory for 31" or bigger tires on an XJ), get a kit that renews the rear springs and bushings. A quality lift kit will include front coil springs. New rear leaf springs will restore ride quality and off-road capability. Worn springs would likely break.

**Body and frame**—I cannot emphasize enough the importance of a stable, rust-free frame and body. Fatigue is another issue; hardcore wheeling can flex and crack an XJ frame. Long-arm suspension helps alleviate this kind of stress; aftermarket stiff springs with short arm front suspension can be brutal on an XJ's unibody.



*Electrical components wear out, too, as induction test at left confirms! At right is Mopar's factory rebuilt starter motor by Mitsubishi. A high quality part, the unit restores starting to like-new performance. Mopar 'Reman' can supply many of the electrical components that commonly wear out. See your local Jeep dealership's parts department.*

**Wiring and electrics**—No man's land! You want the wires to be intact, not cut up or spliced from cheap

aftermarket add-ons, not brittle, not corroded, clearly with a look of originality. *You do not want to "re-wire" an XJ!* Assume that the alternator, starter motor, wiper motors and cooling fan motor may need replacing unless already done. Mopar's rebuild program can provide many quality parts. Avoid cheap aftermarket alternatives if you want reliability. The sound system should be at the end of its duty cycle as well.

**Emissions and fuel system**—Often overlooked is the need for engine emission system work. In states with emissions inspection, many aging XJs have ended up in recycling yards. The PCM, feedback sensors, especially the oxygen sensor, are likely at the end of their duty cycle. The evaporative emissions system always needs attention at this mileage. An electric fuel pump is in the fuel tank and suspect as well. Check for fuel tank leaks.

**Upholstery, paint, steering wheel and cosmetics**—this is all obvious stuff and subjective. Take the cosmetic issue to whatever level you want. Consider a roll cage if you plan any serious off-roading.

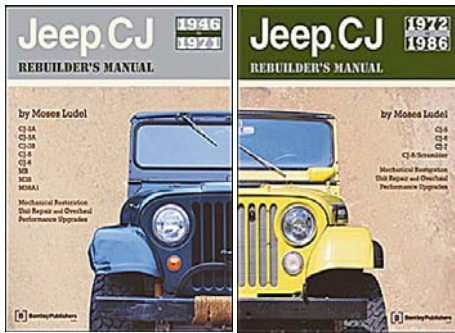
These checks should provide a sobering view of the XJ. The tremendous lifespan of these vehicles is due largely to the mix of car and truck-based engineering. In particular, the axles are light truck beam design; the transfer case is shared with counterpart YJs and TJs. AMC inline, seven-main bearing sixes are incredibly reliable. All of this plays well for XJ Cherokee buyers; however, 260K miles suggest the end of the trail for most of the vehicle's wear components.

If you want a "kick-around" vehicle, one approach would be to *not* modify the vehicle but rather drive it to the end of its useful life. If this is a platform worth using for a JeepSpeed™ prototype off-road project, then plan on axle rebuilding, engine rebuilding (perhaps Mopar's nice exchange long-block program), an AW-4 overhaul, cooling system upgrades, complete suspension revamp, steering system rebuilding, including steering knuckles, driveline replacement/rebuilding, and so forth. There's no middle ground with an XJ unless you want to stick with 31" tires maximum. Once you target 33" tires, you can expect to do largely the same things that I have done with our '99 XJ Cherokee Trail Runner project.

### Nice Feedback on the Jeep® CJ Rebuilder's Manual

*I just finished overhauling my '47 CJ-2A and wanted to say a big THANK YOU for making the Jeep® CJ Rebuilder's Manual: 1946-71. This book was incredibly valuable to me during my rebuild...Thanks, again!*

Jonathan A.



Nice to get your feedback, Jonathan! You're just the reader I had in mind when the book was conceived. My photos went well beyond the publisher's expectations, as I know how much illustrations help. Glad the CJ manual worked well for your '47 CJ-2A project! This book earned a Mopar® official part number. So did my Jeep® Owner's Bible and 1972-86 CJ Rebuilder's Manual.

### '97 Jeep TJ Automatic Transmission Buildup

*Hi, I have a '97 TJ with a bad transmission. We drive it on the street and mountain trails with rock climbing. It has a 4.0L engine, Dana 44's w/4:88's running 39" Swampers and a 10" long-arm suspension lift. I purchased it set up this way. I'd like a quote to rebuild the transmission, both stock and a buildup based on your recommendations. I was told the transmission has a stall converter @ 2400 rpm, which I have no need for. Looking forward to hearing from you and thanks.*

Curt G.

Curt, the stall speed is way too high for trail running and fuel efficiency. You have 4:88s to compensate for the tire diameters. The converter would need rebuilding and a restoration to a reasonable stall speed. Actually, I prefer an 800-950 rpm hold speed for preventing rollback on slopes at near idle speed and to provide proper compression braking. (Idle speed should be the

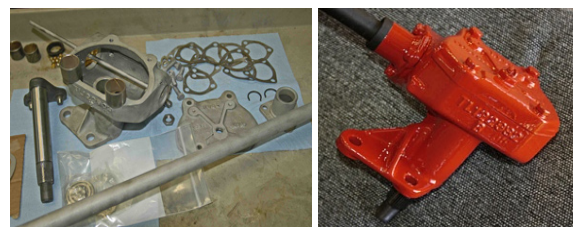
determining factor.) I select a stall speed that will create this dynamic. A deeper sump oil pan and matching filter depth will help reduce risk of dangerous aeration on these early TJ units when climbing slopes.

On my bench, I would thoroughly restore your 32RH transmission using premium upgrade friction materials, quality bearings and thrusts. All tolerances would be restored and corrected. A "blueprint" rebuild would cost in the range of \$2600-\$3200 plus return freight and would include the custom converter work plus all available upgrades. (You have a lockup converter, which costs somewhat more to rebuild and balance.) This is ballpark figure dependent upon the condition of existing hard parts within the transmission, Curt. We would welcome your project.

### Identifying a Ross 'TL' Willys Steering Gear

*Moses, per your request, here is the steering gear housing casting number from my 1962 Willys PU Model 475—with the exception of the casting number, what appears are the letter "B" and the 'Ross' brand, no other numbers visible. If I discover any additional numbers after I remove the unit, I'll copy you. Here is the casting number: TL122992...I plan to pull the gear this weekend and ship it your way early the following week. I'll be sure to forward you the tracking number. Thanks...*

Matt F.



Matt, thanks for the details. We like this sort of referencing before the gear arrives. I can get genuine Jeep/NOS parts lined up that way...Your gear is original for the Model 475. I have rebuilt many of these units. They always need a new sector/lever shaft, as the twin pins wear flat on one portion. (The light-duty Ross gears do not benefit from the rotating pins found in larger truck applications.) Studebaker also uses the 'TL' gear, and that 'TL' designation describes the size and type

housing. Your worm-cam is likely okay unless there is chipping or corrosion. I glass-bead all parts before inspection. Cams, by design, do not have the marked wear commonly found at the lever shaft pins. Once all hard parts are glass-beaded, inspected and cabinet washed, I will install, align-hone and finish fit new bushings then reseal the unit. Worm-cam ball bearings will be renewed, using only OEM/NOS parts. Off-shore bearing races are of inferior quality and questionable hardness. I use only OEM pieces here, and they are getting scarce!

During assembly, I precisely adjust the worm bearings with a spring scale and backup torque wrench test method that I have devised for the TL gears. I do a similar approach with the critical over-center mesh adjustment at the sector/lever shaft and cam groove. Custom paint is an option, or I will final seal and detail your gear with epoxy primer and stock color. The gear will ship back looking and performing as new, ready for installation, Matt...Thanks for the business!

#### **JK Wrangler Rubicon Axles for a TJ or YJ?**

*I've heard that complete JK Rubicon axle assemblies are available from the factory. I have a '98 TJ model, and one of our Jeep club members has a '92 Wrangler. Would these axles fit? Are they complete with the lockers and disc brakes? How complete and what installation work is involved here? Will they fit both of our Jeep models?*

*Bob B.*

**Bob, you've heard about the best deal going! Mopar® Performance began this program a few years ago. These axles are genuine Rubicon JK Dana 44s and other factory performance-oriented axles straight off the assembly line. Complete packages even include brake rotors and calipers—yes, a ready-to-go axle assembly!**

**The JK Rubicon assemblies have 61.9" track width, 4.10 gear sets and 5 on 5" wheel bolt patterns. A major advantage of this setup is off-the-shelf Mopar® service parts access—exactly the parts you would order for a comparable JK Rubicon!**

**Wider than stock CJ, YJ, XJ or TJ axle housings, these axles help compensate for a vehicle height increase. Instead of relying solely on a change in wheel offset, you get approximately 2.5" of added axle width at each side! If you lift the vehicle to run large tires, wider axles are the best way to restore center-of-gravity. Ratios of 4.10:1 (Dana 44s and 60s) and 4.56:1 (Dana 60s) are available to meet users' needs.**

**For those planning massive wheel and tire packages or out-and-out high performance use, check out the Dana 60 axles. These rugged axle assemblies meet rigorous Mopar® Performance standards. Imagine the stamina of factory J8 or Ram Power Wagon® axles!**

**Current pricing is highly competitive. Best yet, these assemblies are the same engineering and quality you can expect from a spanking new Jeep® Wrangler Rubicon model or Ram truck! Your local Jeep® or Mopar® Performance dealer can order any of the assemblies offered, and as official Mopar® Performance products, the axles come with a Mopar® parts warranty.**

**If you go this route, axle housing fitment to an earlier chassis is the purchaser's responsibility. This can entail relocating or changing out spring pads and other attachments. Look at your current model's chassis, and compare it to a stock JK Rubicon layout. Consider all of the needs, including the brake hoses, steering linkage, shock mounts, spring perches and track bar locations.**

**For this changeover, also take into account the rear axle pinion angle and front axle's caster angle when setting up the chassis. Front axle caster angle and the pinion (driveline/U-joint) angles are critical. Follow the factory specifications for the chassis. *Align the axles properly.***

**Mopar® Performance targeted the CJ, YJ, TJ and JK models. (Some JK owners want Dana 60 axle upgrades.) Among the available packages are axles already set up for a TJ or JK chassis. For other installations, expect cutting, alignment and welding work. (If you do your own fabricating, the XJ Cherokee could be a candidate, too.) Make your axle installations safe and reliable! If you lack welding and fabricating skills—or equipment—*consider subletting the axle installations to a welding and fabricating shop. Note: Welding and metals***

*fabrication, including chassis work, are ongoing topics in 4WD Mechanix© Magazine. You will need these skills for safe, reliable upgrades.*

Mopar® Performance now offers several cost-saving axle options, including extreme duty (J8 and Power Wagon®) application Dana 60s. Look closely for the equipment, ratios and stamina that your Jeep® requires. Consider these currently available packages and options:



**P5153827**—This JK Rubicon 44 axle comes completely assembled with 4.10 gear, disc brakes, and locking differential.

**P5155252**—Axle, Front Assembly, Dana 44, 2007-09 Jeep Wrangler, 4.10 Locking Differential, Without Brakes

**P5155256**—Axle, Front Assembly, Dana 44, JK, Modified for TJ



**P5153825**—Rubicon front axle...(Superseded to P5155252.)



**P5155084**—Axle, Front Assembly, J8, Dana 44, 5 on 5.5 Hub, with Open Differential



**P5153826**—Jeep Wrangler Rubicon axle with locking differential, locking sensor, 4.10 ratio, disc brakes and mounting brackets.



**P5153826AB**—Axle, Rear Assembly, 2007-09 Jeep Wrangler Rubicon, 4.10 Ratio, Locking Differential

**P5155257**—Axle, Rear Assembly, Dana 44, JK, Modified  
For TJ

**P5155260**—Axle, Rear Assembly, Dana 60, J8, 4.10  
Limited Slip, 5 x 5.50" and 5 x 5.0" Bolt Pattern, Modified  
For JK



**P5155083**—Axle, Rear Assembly, J8, Dana 60, 5 on 5.5  
Hub, Limited Slip Differential, Leaf Spring

**P5155087AB**—Axle, Front Assembly, Stock Power  
Wagon, 4.56 Ratio, With Locker

**P5155088AB**—Axle, Rear Assembly, Stock Power Wagon,  
4.56 Ratio, With Locker

For more details on these axle products and the latest part number availability and supersedures, check out the Mopar® Performance catalog. For access to the latest catalog, including the 'Trail' section for your Jeep® 4x4, simply [click here!](#) Contact your local Jeep® dealership or a Mopar® Performance dealer for pricing.



## **Moses Ludel's 4WD Mechanix© Classified Ads**

Each monthly issue of *4WD Mechanix©* will feature a classified ad section. While commercial advertising is available and very welcome, the classified ad section is strictly for readers' needs. Ads appearing in the classified section will be viewed worldwide via *free* downloads of the magazine. Website viewers can access the published copy of the magazine and see your ad.

***THIS WEBSITE GETS A VERY LARGE NUMBER OF HITS EACH DAY!***

Ad rates are available at the [www.4WDMechanix.com](http://www.4WDMechanix.com) website. The issue with your ad will be readily accessible to *any* visitor who downloads a copy of *Moses Ludel's 4WD Mechanix©* digital magazine from the website. Viewers often encourage friends to check out the ad as well. When you choose to include one or two photos, each photo will appear in a highly visible 3.0" width with properly scaled height. (When viewing the PDF version of the magazine, readers can even increase the size of your photo to get maximum clarity!) There is no "skimping" on our ad display sizing or image resolution. The photo(s) will draw attention to your vehicle, parts or equipment.

As for text, please do the best you can—our ad staff will perform light editing as necessary, strictly for readability and to make the ad look its best...The *deadline* for classified ads is normally 2-weeks prior to the issue's release date. (Each magazine releases around the first day of each month.) Ads can be run by any Jeep® enthusiast or private party—you *can run as many ads per month as you want!* Each ad will be screened for appropriate language and non-commercial nature.

*We also offer highly visible display ad space within each issue of the magazine. Yes, these are real display ads seen by readers worldwide. Not flashing banners, click-links, pop-ups or other Internet gimmicks, just the kind of display ads that promote your commercial products or services! The goal is to provide traditional color advertising, laid out within the editorial pages of a widely circulated and respected download (PDF) publication. If you would like to promote your parts or service business, the products that you manufacture and sell commercially or vehicles that you sell through a dealership, please contact us. We present commercial ads in the most professional and artful ways possible. You can reach an international audience by associating your products or services with Moses Ludel's 4WD Mechanix© Magazine.*

*Our goal is to maximize exposure of your automotive parts, 4wd equipment or the vehicle you have for sale. Ads will be grouped to assure quick reader access...here is how a typical ad with photo appears in the magazine's classified section:*



**40-word ad with photo...**

**FOR SALE—1987 YJ Wrangler, fresh 4.0L EFI six with AX-5 trans, ARB's Lockers front and rear, 4.56:1 gears, 4-inches aftermarket lift with 33" BFG tires. Runs great on- and off-road. \$6,800. OBO. [xxx@yahoo.com](mailto:xxx@yahoo.com) or call (619) XXX-XXXX.**

***Note: The ad deadline for monthly issues of Moses Ludel's 4WD Mechanix® magazine will be the 20<sup>th</sup> day of the previous month (i.e., the April issue ad deadline is March 20<sup>th</sup>). Please submit your ad prior to that time if possible. Each issue will contain widely distributed classified ads.***

***Commercial advertisers, please consult us regarding display ads and small-business directory ads for the March-forward issues of the magazine. We look forward to serving your ad needs! Vendors and manufacturers will appreciate our high visual impact display advertising. Directory ads meet the needs of smaller businesses soliciting niche parts sales or service work.***