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# TJ STEERING AND BRAKES

Steering and brake systems remained somewhat consistent through the Wrangler TJ's production run. The steering system did receive a few updates through the years, but the overall design and setup remained the same. Power-assisted front discs and rear drum brakes were the standard brake fitment, but a number of factory brake upgrades were also available and were usually dealer packaged as part of a brake and traction group.

## Steering System

All Jeep Wrangler TJs used a recirculating ball-type steering gear with a knuckle-under tie rod and drag link arrangement. The steering components include a steering wheel and column, steering shafts, a steering gear box, a power steering pump and reservoir, high pressure and return lines, a pitman arm, a drag link, a tie rod, and steering knuckles. Additional hardware items were also included in the system. A manual steering system was standard equipment until the 2000 model year when power steering was made standard.

### Steering Ratio

Steering ratio is the number of degrees that the steering wheel must be



*The TJ steering system is capable of handling up to 35-inch tires, but you can expect to bend a tie rod from time to time when tackling extreme trails.*

turned to move the front wheels one degree. For example, a 15:1 ratio means the steering wheel can be turned 15 degrees to turn the wheels one degree. Final steering ratio is also determined by the steering linkage ratio, and is calcu-

lated using the length of the pitman arm and the steering arms on the knuckles.

Manual steering featured a 24:1 straight ratio in 1997, while the power system offered a straight 14:1 ratio. This broke down to roughly 5.1 turns from

lock to lock with a manual setup and 3 to 3.5 turns for the power system. The manual system remained consistent until discontinued, but in 1998, the still-optional power steering was offered with a variable 15-13:1 ratio that remained until 2003. This is to produce a quicker steering effect in the beginning of a turn and less steering effort as the wheels approach the steering stops. In 2003, the better Saginaw/Delphi steering gear was replaced with a unit made by ZF Gear with a 15:24 ratio.

### Steering Gear

The TJ used two different steering gears, sometimes referred to as a steering box, over the years. The steering gears used in TJs before 2003 are Saginaw/Delphi units. Not much has changed to the overall design of the Saginaw steering gear since the introduction of the original Saginaw 800 Series in 1948. There are even parts in the original steering gears that are interchangeable with those used today. The TJ steering gear is a worm and recirculating ball gear. The balls in a recirculating ball system are ball bearings. It uses 50 ball bearings that circulate around the threads of a worm shaft inside a ball nut rack. Steering wheel motion goes to the steering shafts that lead to a worm gear shaft extruding from the steering gear. The worm-gear threads into the ball nut rack, which meshes with a sector gear that transfers the motion to the pitman arm. The ball bearings are in place to reduce friction, heat, and steering slop. GM pioneered this concept in 1940 at its Saginaw Steering Division in Saginaw, Michigan.

The ZF steering gear was introduced in 2003 model Wranglers, switching the steering system from a variable ratio to a constant ratio. Not surprisingly, this switch coincided with the purchase of Jeep by Daimler. ZF steering gears were used in most Mercedes passenger cars prior to the switch to rack-and-pinion steering systems. The ZF units are



**Power steering became standard equipment on the Wrangler TJ in 2000. Jeep Wranglers used a recirculating ball steering gear made by Saginaw/Delphi from '97 to 2002.**



**From '03 to '06 TJs came equipped with a steering gear made by ZF Gear. A few differences are apparent, including the overall shape and the bolt pattern to the frame.**



**The stock 4.0L power steering pump, known as a TC-type pump, uses an external reservoir that clips to the pump body.**

manufactured in India and offer a straight 15:24 ratio. There are many internal differences between the early and late-model TJ steering boxes and the two are not interchangeable. Both use a three-bolt mounting configuration, but the pattern is different, which is a helpful indicator should you receive the incorrect steering gear for your vehicle upon replacement.

### Power Steering Pump & Lines

The TJ power steering pump is a vane-type hydraulic pump with a constant flow rate and displacement. This type of pump is also called a TC pump and is part of the steering system in many Chrysler vehicles. The pump is belt-driven by the crankshaft via a drive pulley pressed onto the pump shaft. Pump pressure is monitored by a pressure relief valve inside the flow control valve. The pressure relief valve is integrated into the high-pressure line fitting. On 4.0L engines, a plastic fluid reservoir is secured to the pump body with spring clips, but 2.5L- and 2.4L-engine-equipped Wranglers use a remote pump reservoir mounted to the fan shroud. A pressure switch is also part of the four-cylinder power steering systems. The switch is mounted on the high-pressure supply line and allows the PCM to monitor the steering system for incidents when load increases on the power steering pump at low RPM. In response, the PCM will turn up the idle speed via the Idle Air Control (IAC) motor to avoid engine stalling. An increased load on the power steering system may occur during tight trail maneuvering or even while navigating a parking space. Once the pump pressure decreases to an acceptable degree, the pressure switch closes and the previous idle speed is restored.

Both the 4.0L and 2.5L power steering pumps are rated at 1,400 psi and should produce a flow rate of 2.4 to 2.8 gallons per minute (GPM) at 1,500 rpm. Actual pump pressure varies with each