

Steering and Suspension

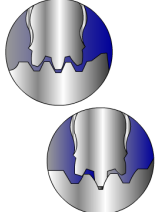
Steering Systems

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Steering and Suspension

Driver Input

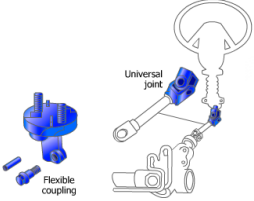
- When the steering wheel is rotated from lock-to-lock the front wheels turn about 30 degrees in each direction or 60 degrees total
- A steering ratio of 15:1 is common for passenger cars
 - fifteen degrees of steering wheel rotation moves the front tires one degree
- Variable ratio



Steering and Suspension

Steering Wheel and Column

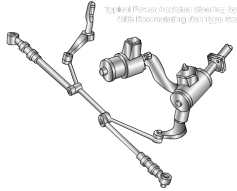
- The steering wheel, column, u-joints and flex couplings deliver the driver's input to the steering gear, provide vehicle feedback to the driver and insulate the driver from excessive road feel or harshness
- The steering column is also designed to collapse during a collision



Steering and Suspension

Parallelogram Steering

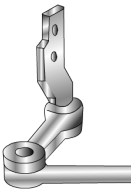
- The parallelogram linkage insulates the driver from road noise and vibration, but component wear leads to a feeling of steering looseness
 - Pitman arm
 - Center link
 - Idler arm
 - Tie rods
 - Tie rod ends



Steering and Suspension

Idler Arm


- The idler arm is bolted to the frame and supports the center link opposite the pitman arm
- Excessive idler arm play may cause steering wheel play and allow the vehicle's toe setting to change while driving or under load



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Tie Rod Ends

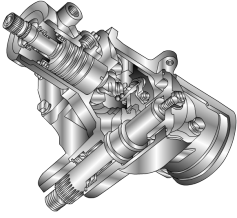
- Tie rod ends connect the tie rod to the center link and the steering knuckle
- Tie rod ends are often checked for proper articulation effort
- Excessive tie rod end play may cause steering wheel play and allow the vehicle's toe setting to change while driving or under load
- Binding tie rod ends can cause increased steering effort or binding



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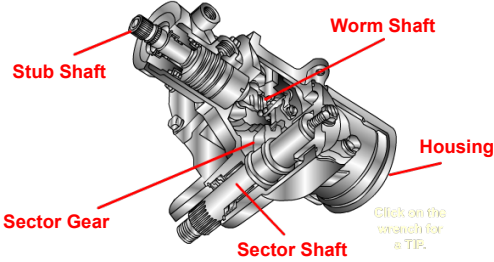
Recirculating Ball Gearbox

- Converts the steering wheel's rotary motion into linear motion
- Commonly used on light trucks and large cars
 - Minimal internal friction
 - Road shock isolation



Steering and Suspension

Steering Gearbox Components



Steering and Suspension

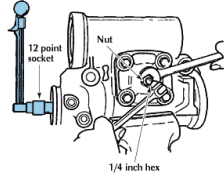
Steering Gear to Linkage

- Steering wheel drives the steering shaft
- Steering shaft drives the worm shaft
- Worm shaft drives the ball bearings
- Ball bearings drive the ball nut
- Ball nut drives the sector gear and shaft
- Sector shaft drives the pitman arm
- Pitman arm drives the center link
- Center link drives the inner tie rod end
- Inner tie rod end drives the tie rod
- Tie rod drives the outer tie rod end
- Outer tie rod end drives the steering knuckle

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Adjustment

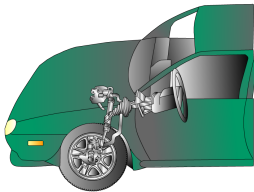
- Two adjustments are commonly required for recirculating ball steering gear service:
 - Worm-shaft preload for manual steering gears
 - Sector-shaft mesh-load
- Sector shaft mesh-load procedures are commonly available for bench and on-car service



Steering and Suspension

Rack and Pinion Steering

- Light and compact design
 - Pinion drives rack
 - Rack drives tie rods
 - Tie rods drive steering knuckle
- Fewer friction points than parallelogram steering
 - increases road feel
 - Noise and vibration transmitted to driver



Steering and Suspension

Rack and Pinion Service

- Internal failure or leakage
- No assist when cold
- Boot or bellow damage
- Inner tie rod ends



Steering and Suspension

Rack and Pinion Replacement

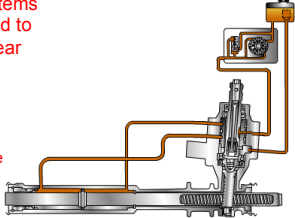
- Raise vehicle and remove wheels
- Separate outer tie rod ends from steering knuckle
- Remove power steering lines
- Loosen steering column to pinion pinch bolt
- Unbolt and remove rack
- Replace rack
- Bleed steering system
- Check alignment and adjust toe



Steering and Suspension

Power Steering System

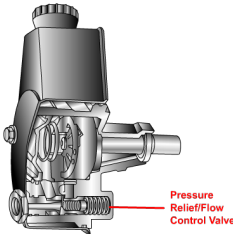
- Power steering systems use pressurized fluid to assist in steering gear operation.
 - Belt and pulley
 - Pump
 - Flow control and pressure relief valve
 - Rotary valve
 - Steering gear



Steering and Suspension

Power Steering Pump


- Positive displacement hydraulic pump that provides fluid volume and pressure.
- Excess fluid is returned to the reservoir by the flow control/pressure relief valve.



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Rotary Valve

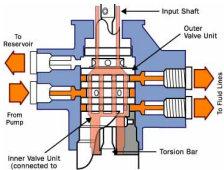
- The rotary valve consists of:
 - Inner spool
 - Outer spool
 - Torsion bar
- The outer spool rotates with the torsion bar
- The inner spool rotates with the steering shaft



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Rotary Valve Operation

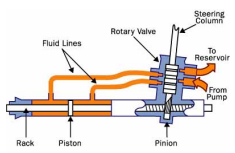
- The difference in degrees of rotation between the steering shaft and torsion bar controls the passage alignment between the inner and outer spools
- Fluid remains on both sides of the piston when the wheels are straight ahead



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Power Rack Steering Operation

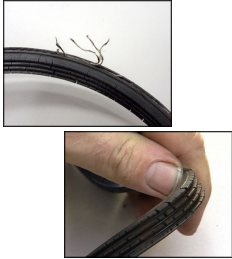
- When the steering wheel is turned the rotary valve directs pressure to the appropriate side of the piston to and release pressure on the other side of the piston to assist in operating the steering gear



Steering and Suspension

Preliminary Inspection


- Fluid level, type and condition
- Belt tension and condition
- Pulley and mounting bracket condition
- Hoses and lines for condition, leaks and proper routing



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Power Steering Analyzer

- The analyzer can help to pinpoint a faulty pump, gear, or a malfunctioning spool valve. The analyzer provides readouts for the following:
 - system pressure
 - pump flow
 - steering/gear internal leakage
 - pump relief pressure
 - restriction in hoses or fittings
 - sticking gear valve
 - inefficient pump cam pack
 - sticking relief valve



Steering and Suspension

Under Car Steering Inspection

- Hoses and lines
- Steering linkage
- Steering gear
- Steering column
- U-joints and flex couplings
- Steering play

