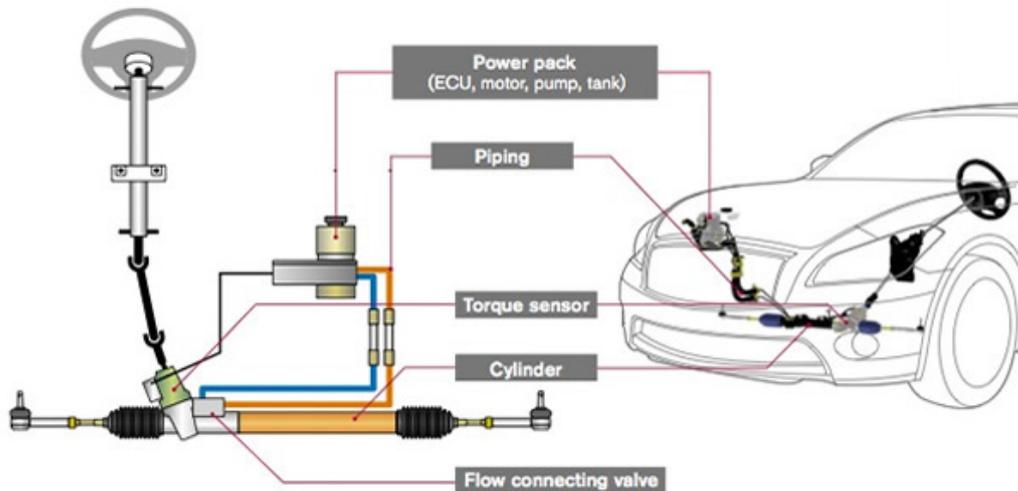


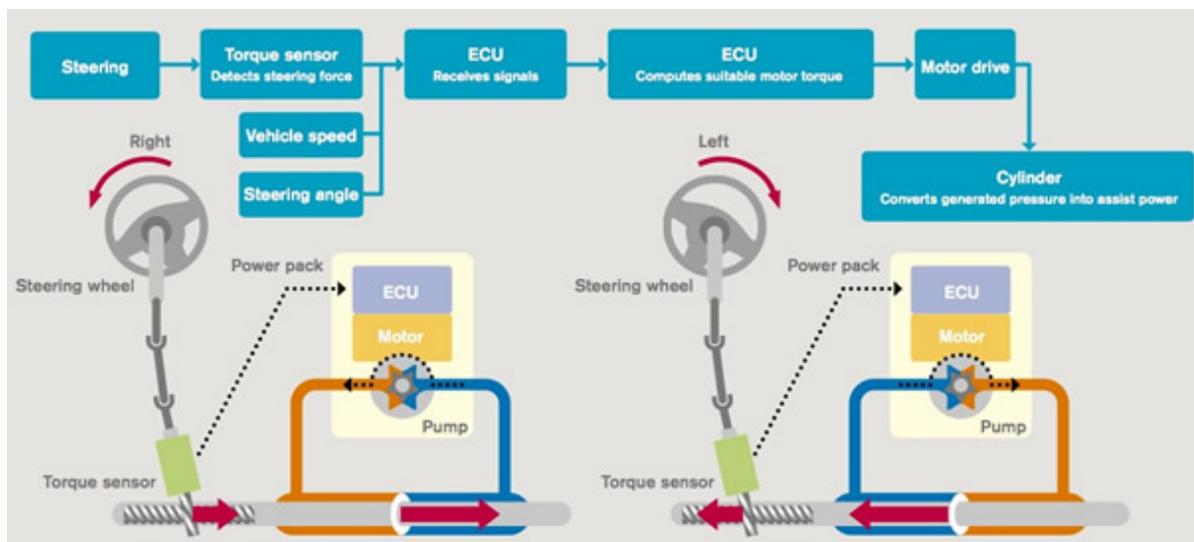
Electro Hydraulic Power Steering Systems

The first version of Electric Power Assisted Steering (EPAS) was the changing of the power source for the traditional hydraulic power steering from a mechanical pump, driven off the engine via a belt drive arrangement to an electrically driven pump.



Electric Power Assist Mechanism Operation

- According to the steering action of the driver, the Power Steering angle sensor detects the steering speed, and then outputs a steering speed signal to the EPAS control module. The EPAS control module uses the steering speed signal, vehicle speed signal, and other vehicle conditions, to determine the proper motor speed.
- Based on the motor speed determined by the Electro Hydraulic Power Steering Systems (EHPAS) control module, the current from the motor drive circuit to the EHPAS motor is controlled to within the target current amount and the oil pump operates accordingly.
- The hydraulic pressure created by the oil pump is used to assist the shaft to turn axially. Due to this, the steering operation load on the driver is reduced.



Electric Power Assisted Steering (EPAS) Systems

Electric Power Assisted Steering (EPAS) has replaced hydraulic power steering in many new vehicles today. One of the advantages of EPAS is that it eliminates the power steering pump, which can use as much as 8 to 10 horsepower under load. This improves fuel economy while also eliminating the weight and bulk of the power steering pump and hoses. Getting rid of the hydraulics also does away with fluid leaks and the need to check the power steering fluid. Electric power steering is also quieter than hydraulic systems because there is no pump noise and no fluid flowing through hoses and valves. But the most noticeable difference is in handling and steering refinement.

Electrically assisted steering or EPAS, is a power-assist system that eliminates the connection between the engine and steering system. EPAS or direct electric power steering takes the technology a step further by completely eliminating hydraulic fluid and the accompanying hardware from the system, becoming a full “electric power assisted steering system” or EPAS.

An EPAS Direct electric steering system uses an electric motor attached to the steering rack via a gear mechanism and torque sensor. A microprocessor or electronic control unit, and diagnostic software controls steering dynamics and driver effort. Inputs include vehicle speed and steering, wheel torque, angular position and turning rate.



Advantages:

- Small compact units, requiring only a battery connection to work.
- No messy hydraulic connections or systems to bleed.
- Weight saving advantage over hydraulic systems.
- Reduced mechanical drag on engine compared to hydraulic engine driven pumps.
- Built-in fail-safe which allows the system to revert to conventional steering in the unlikely event of a fault occurring.

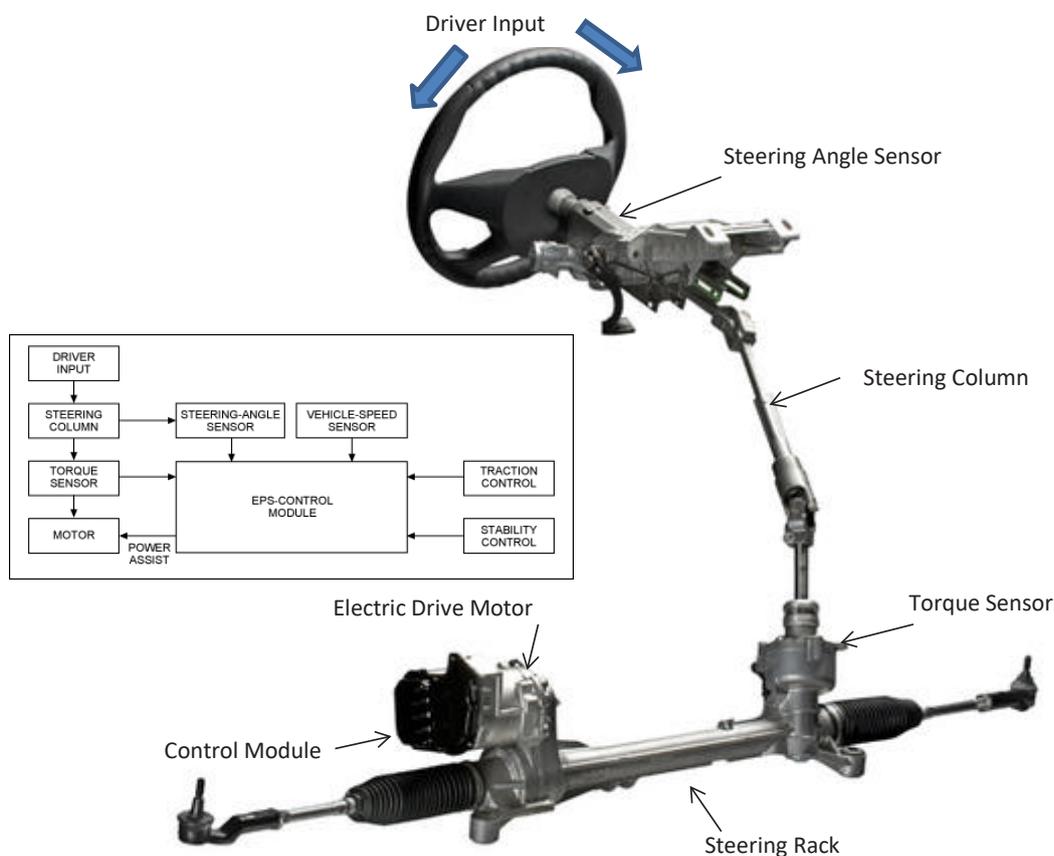
Electric power assist steering can be fine tuned with a precision that is hard to match with hydraulic controls. By monitoring the driver's steering inputs, vehicle speed, and other suspension dynamics, the system can provide just the right amount of steering feel and effort to match rapidly changing driving conditions. EPS can deliver extra effort when you need it, and reduce steering effort when you do not need it. It can even provide steering assist when the engine is off.

In current-day systems, there is always a mechanical connection between the steering wheel and the steering gear. For safety reasons, it is important that a failure in the electronics never result in a situation where the motor prevents the driver from steering the vehicle. EPAS systems incorporate fail-safe mechanisms that disconnect power from the motor in the event that a problem with the ECU is detected.

The next step in electronic steering is to remove the mechanical linkage to the steering wheel and convert to pure electronically controlled steering, which is referred to as steer-by-wire. This functions by transmitting digital signals to one or more remote electric motors instead of a rack and pinion assembly, which in-turn steers the vehicle.

While it has been used in electric forklifts and some tractors, as well as a handful of concept cars, the 2014 Infiniti Q50 was the first commercial vehicle to implement steer-by-wire. Although there is normally no direct mechanical linkage, the Q50 has a mechanical back-up. In the event that a problem is detected with the electronic controls, a clutch engages to restore the driver's mechanical control. As with throttle control systems, it is likely that steer-by-wire will become the standard once the electronic controls prove to be safer and more reliable than the current hybrid systems.

At this point in time E.P.A.S. racks are not repairable or serviceable, therefore if they fail internally a new replacement rack will be required.



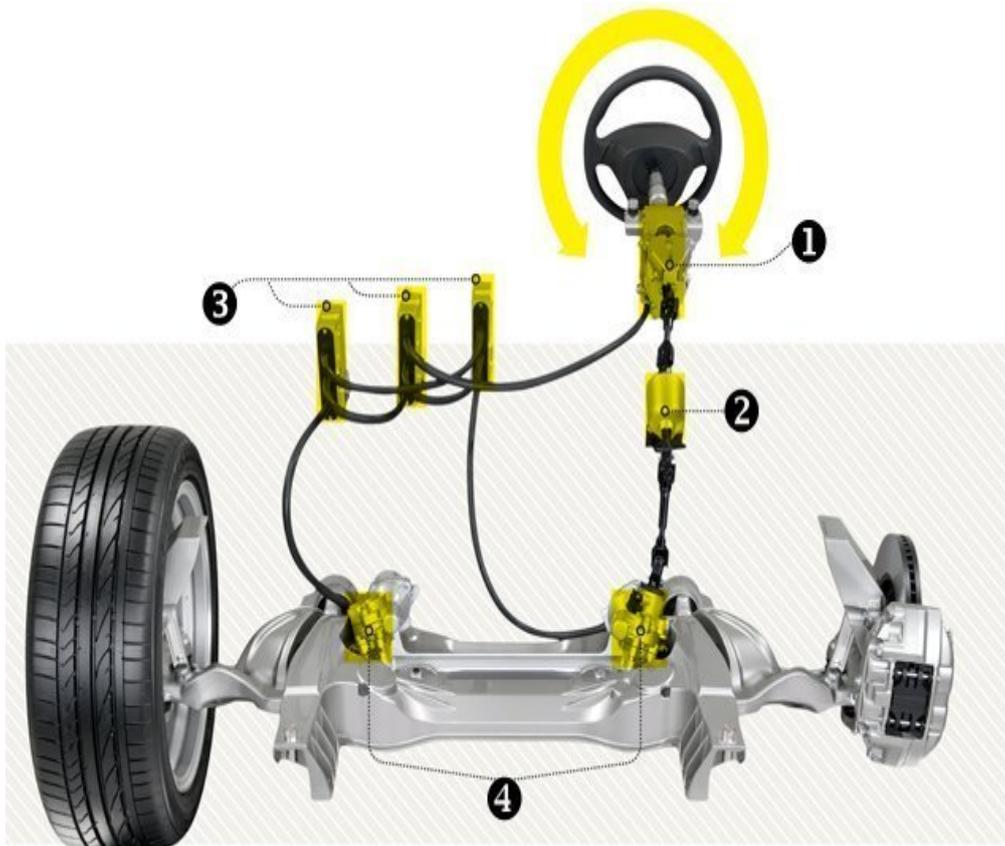
Direct Adaptive Steering (DAS) or Steering by Wire (SBW)

So-called “fly-by-wire” controls, which replace a mechanical connection between driver and automobile with an electronic signal, have become commonplace. Steering systems have not gone completely by-wire for good reason: It is a little scary to imagine front wheels that may or may not respond to the driver’s inputs, depending on a computer’s whim.

But the steer-by-wire (SBW) system includes a fail-safe clutch in its column. In normal driving situations, this clutch is disengaged, but if one of the three control modules detects a fault, the clutch snaps shut and the steering acts as a conventional, electrically assisted rack-and-pinion system. The clutch also engages when the engine shuts off, so if the SBW-equipped car fails to start, the owner can still steer the car while pushing it.

1. Steering Force Sensor and Steering Angle Sensor - This plays two roles, the unit sends commands to the control modules and acts as the driver’s feedback source by varying resistance to the wheel.
2. Clutch - Most of the time it’s open. If a fault occurs in the electronics, the clutch will activate and create a solid link between the steering wheel and the rack.
3. Control Modules – This trio controls the electric-assist motors and the steering force sensor.
4. Steering Assist Motors.

The Direct Adaptive Steering can transmit the driver’s intentions to the wheels faster than a mechanical system. It also enables four different settings that allow drivers to customize steering effort/response to suit their preference or road conditions. Those settings include, in increasing order of driver engagement: standard/casual; standard/standard; heavy/standard; and heavy/quick.



Techstop Hints

Caution must be exercised, when turning the steering back and forth using the wheels

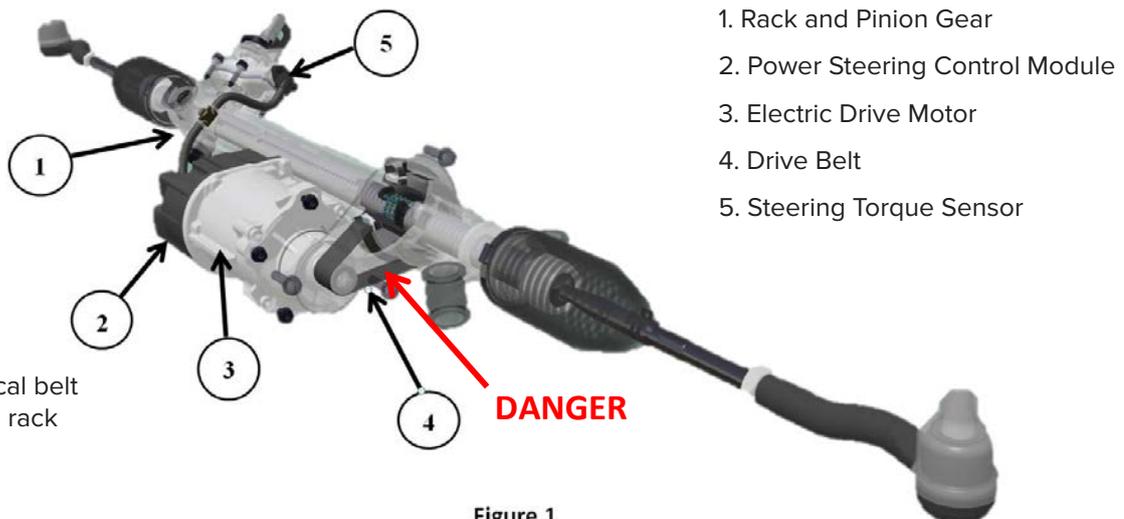
When a vehicle has been raised so the steering wheels are clear of the ramps or ground, it is stressed that the use of the wheels to turn the steering from lock to lock to the point of engaging the steering stops with any force, may cause internal damage to the steering rack.

Service CAUTION

The following precautions should be observed if the vehicle is on a hoist or the front wheels are OFF the ground. Failure to observe these precautions may result in steering rack damage. E.P.A.S. racks are not serviceable and the unit will have to be replaced.

- The front wheels should **NOT** be turned to full lock by manually moving the rack by hand at the road wheels with any great velocity or force.
- The front wheels should **NOT** be turned to full lock by using the steering wheel with any great velocity or force.
- If the wheels need to be turned towards full lock for service work, they should be turned **GENTLY** and care must be taken to avoid hitting the steering lock stops with any force.

This only applies to vehicles where the wheels are OFF the ground. This does not apply in normal operation whilst driving. The above procedure should be applied to EVERY E.P.A.S. rack.



This is a typical belt drive E.P.A.S. rack

Figure 1

DON'T FORGET about the S.A.S.:

Every time a front suspension repair has taken place and a wheel alignment is required, the Steering Angle Sensor (SAS) is to be checked using a scan tool and re – calibrated as required. This process is not an option, it is a must do. If not performed the vehicle may drift or steer left or right.