Alignment Electronics

NOT

Electronic Alignments

Ron Henningsen, Undercar Digest
Provided there are no lights on on the dash/or fault codes set...
Alignment Electronics and Alignment Service

An Alignment Technician’s Main Concern
Is / Does The Vehicle Have a Steering Angle Sensor and Does It Have To Be Reset After An Alignment!

If it’s a 2014-15 vehicle the answer most likely is YES.
If it’s a 2010-13 vehicle there is a very high chance that the answer is YES.
Don’t guess that it should be done. Check!
This 2015 Vehicle Has

Electronic Power Steering
ABS
Traction Control
TPMS
Lane Departure (optional)
Dynamic Brake Proportioning
Lane Assist (optional)
Active Back-Up Camera

9 different input sensors affecting vehicle handling
3 different cameras
Note: Vehicle Base Price was $14,500
Steering Angle Sensors

Steering Angle Sensors (SAS) monitor the driver's input by continuously measuring the position and turning rate of the steering wheel.
Network of Information

- Information from the SAS is used by other driver-assist systems.
- Each of these systems depends on "knowing" the driver's intended steering direction and turning force.
Integrity of SAS Information

It is important that the SAS, as well as other related sensors, be calibrated with the front wheels steered parallel to the thrustline of the vehicle.

Related sensors include yaw rate, torque angle, etc.
OEM Mandates

For years, shops have calibrated or reset SAS under OEM mandates for special cases such as sensor replacement or collision repair.

Today, a growing number of OEM’s require a SAS reset or calibration after wheel alignment service is performed.
It Is Even More Important That..

* The vehicle does not have any Thrust influence while driving
* That individual front toe be equal on the front wheels
* That toe was adjusted with the steering straight ahead
* That rear toe not only be equal on the rear wheels but that the Thrust Toe Relationship be correct
* Have you ever heard of a Rear Thrust Toe Relationship?
To Understand Thrust Think About How a Fork Lift Steers

Before alignment adjustment
- Pre-alignment angles out of specification

Rear adjustment
- Rear wheels measured and adjusted to set vehicle thrustline to the centerline

Front adjustment
- Steering wheel leveled
- Front wheels adjusted to new thrustline
Specifications Can Sometimes Be Confusing

- 2009 – 2010 Ford Focus
- Total Rear Toe: 0.36 deg. +-0.20 deg.
- Individual Rear Toe: 0.18 deg./+-0.20
- WHAT????
- Also, there isn’t any Thrust spec on this vehicle
- You could easily have almost a .4 deg. Thrust angle that wouldn’t affect the SAS but would affect the yaw sensor on this vehicle. Do you know why?
Worn Parts...

* What do worn parts do to the straight ahead position of the steering wheel?

To the “assumption” by the SAS, Yaw and other sensors that the vehicle is going down the road straight and the steering wheel is centered?
Electronic Stability Control
Electronic Stability Control

Electronic Stability Control (ESC) is designed to measure the driver’s steering input and compare it to the lateral force, yaw rate and individual wheel speed of the vehicle. ESC is capable of braking one or more wheels to keep the vehicle traveling in the intended direction.
In 2004, the National Highway and Traffic Safety Administration (NHTSA) published this study. By 2006, NHTSA issued a requirement that all new vehicles weighing up to 10,000 pounds GVW be equipped with ESC by 2012.
Variations to the ESC Theme

<table>
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<td>ACURA</td>
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<td>VOLVO</td>
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Electronic Stability Control

* ESC systems may include the following components:
Electronic Stability Control

Electronic Stability Control’s primary function is to avoid over-steer and under-steer.

"Understeer", also known as "push", occurs when a vehicle doesn't turn as quickly as the angle of the front wheels are steered.

“Oversteer” occurs when the vehicle wants to turn too far, with the back end sliding around trying to pass the front.
Electronic Stability Control

* ESC relies on accurate steering input from the SAS to analyze conditions and apply appropriate measures to help direct the vehicle on the intended path.

* Over 22 million vehicles require resets ... and growing!

* By 2012, all new vehicles sold in the U.S.A. will be equipped with Electronic Stability Control. Many will require SAS reset.
Electric Power Steering
An electric motor and control module provide steering assistance to the driver when needed.
Electric Power Steering

EPS works by using the SAS and torque angle sensor to measure the rotational motion of the steering column. This information tells the control module to apply varying amounts of assistive torque supplied from the electric motor to match driving conditions.

The torque angle sensor is a priority input to the EPS. It is also a direct modifier signal that governs how much EPS assist is provided.
EPS Operation

* When the driver turns the wheel, a steering angle sensor detects the position and rate of rotation of the steering wheel.
* Data is also gathered from other inputs, such as
  * vehicle speed sensors
  * traction control
  * stability control systems
  * Torque sensor

* The amount of steering assist computed and the ECU commands a motor to provide power assist
You May Want To...........

The EPS motor/relay can also be built into a R&P steering gear.

Check your technical reference material before doing any service involving rotating of the front wheels L to R or R to L on a EPS vehicle when the vehicle is on a lift with the key off/removed. Especially true on certain late model FWD Fords.
Rotational Amount/Direction and Speed of Rotation Input

- SAS input.
  - At O deg movement it has a 5v reference voltage.
  - At the start of movement it drops to .2v
  - At 90 deg. it has a 4.8v reference
  - At 91 deg. It again has a .2 reference voltage.
  - At 180 deg. it again has a 4.8v reference.
  - This continues on for full or portion of full rotations of the steering wheel.
  - Can you see why it’s important to have a centered steering wheel, zero thrust influence, no vehicle pulls or leads that causing a counter steer effort?
Electric Power Steering

Calibration of the SAS and torque sensor is important to the proper functioning of the EPS system and can correct certain steering symptoms such as:

- Steering wheel vibration
- Vehicle pull
- Differences in steering effort between left and right turns
What EPS Can Do For Handling It Can Counter

* Steering wheel vibration (become an electronic steering stabilizer that will never leak)
* Vehicle pull
* Road crown
* Cross Wind
* Chevrolet introduced EPS with these control compensation features in 2012 on certain HD straight and box trucks.
Many advantages are realized by eliminating the hydraulic fluid, lines and pump.

- Increased fuel economy
- Environmentally friendly
- Less space needed
Remember That All Inputs and Outputs From The EPS Assume...

- You are not counter steering because of a Thrust influence
- There is no rear Thrust Toe relationship issue
- Front individual was correctly set with a straight steering wheel
- There are no worn parts
- There are no unusual loads
- There have been no alterations to the suspension, ride height, tire size or anything else affecting the accuracy of the input sensor data.
An ABS WSS Input Signal is Bad So...

Your Electronic Power Steering Only Works at 30%

On some vehicles (through 2013) with indirect TPMS (the ones where the WSS calculates air pressure from tire rotational speed) the EPS may be severely limited if a input error is detected in a WSS circuit.

If this was actually done on purpose and not because of a programing glitch blame Chevrolet for this type of logic. They started it by dimming the interior lights and dash lights on S10’s when there was a excessive draw, resistance or open in the tail light circuit or trailer light/connection circuit.
Honda Insight, S2000 Roadster & Civic Hybrid

Electric Assist Power Steering

This is an early unit so it doesn’t have a safety relay

The S2000’s electric-assist steering motor is in the center of the rack & pinion unit. As shown here, the rack shaft goes through the motor armature, which has a recirculating ball at one end for reduced friction.
Some Unusual Problems Experienced With EPS In The Past

Vehicle A:
- Driving on a long sweeping clover leaf (like they have in CA.) the amount of assist would be excessive.
- Reflash the controller to eliminate the torque angle sensor input vs throttle sensor input.
- Quickly moving the steering wheel back and forth (10 o’clock to 2 o’clock) in extremely cold temps caused the steering wheel to continue to rock/move for 15-20 seconds.
- The problem was never solved.
Overheating Of EPS Can Be a Problem

The average drive would never do this but........

Holding the steering wheel at the max L or R positon can cause the motor to overheat.
Active Front Steering
Active Front Steering

Active Front Steering (AFS) electronically varies the amount of responsiveness between the steering wheel and the front wheels.
ZF-SEROV/OLECTRIC

OHNE SERVO-UNDERSTÜTZUNG
WITHOUT POWER ASSISTANCE
Electric Servo Assist Steering—This Is Not Power Steering

Servo Action Increases The Actual Angle Of Wheel Movement Over the Amount The Steering Wheel Is Turned.
Active Front Steering

Active front steering minimizes steering effort at low speeds and minimizes over-steering at high speeds.

- AFS reacts to information from on-board sensors, including SAS, to automatically modify the steering ratio of the front wheels and stabilize the vehicle.
Some Vehicles With AFS Have

* A Mode Selector That Can Be Driver Selected For:
  * Sport Mode
  * Normal Mode
  * Performance Mode
  * High Speed Mode

If so equipped on some vehicles the AFS Steering Mode changes when a Ride Control Mode is driver selected.
Lane Departure
Lane Departure technology warns the driver if the vehicle drifts over the edges of its intended lane, unless a turn signal is on in that direction.
Lane Departure

Most Lane Departure systems use a forward mounted camera that monitors the lane markings in view as the vehicle is travelling.
Lane Departure

Using input from the camera, turn signals and other devices, a control module determines if the driver should be warned of the vehicle leaving its intended lane.
I Believe

I want to know the condition of anything that has input into or can in any way affect the handling/align of the vehicle I’m working on.

The quickest way do a complete diagnostic check of any and all systems that can effect vehicle handling or the Alignment Electronics is to perform a total vehicle system check with a scan tool.
Wheel Alignment (1978 – PRESENT)

* Total four-wheel alignment evolved to service vehicles with adjustable rear wheels.

* Rear individual toe is measured and adjusted to place thrustline parallel to geometric centerline.

* Advantage:
  * Level steering wheel
  * Maximized tire life
  * Dog-tracking is eliminated

* Disadvantage:
  * none
**SAS Reset..The new last step**

If OE Says That The SAS Must Be Reset and You Don’t Do It AfterAligning A Vehicle Why Align The Vehicle?

*Over 22 million vehicles require Steering Angle Sensor reset ... and growing!*

By 2012, all new vehicles sold in the U.S.A. will be equipped with Electronic Stability Control. Many will require SAS reset.

Today Every Vehicle Sold Has A SAS and Most Must Be Reset After An Alignment Or Any Chassis Service That Affects Alignment Settings.
Alignment corrects mechanical adjustments, but the SAS requires an electronic reset to match the vehicle's new thrustline.

The actual position of the SAS is unknown after an alignment, which is why measuring and resetting the SAS is now the new last step of alignment service.
Steering Angle Sensor Reset

* Failure to perform SAS reset when required can affect the proper operation of electronic driver-assist systems that rely on precise steering information from the SAS.

* Failure to reset SAS could illuminate malfunction indicator lamps, cause steering-wheel vibration, cause lead and pull complaints, and/or lead to a variety of other issues.
SAS Reset Options

* Currently, millions of vehicles on the road require reset of SAS along with other related sensors during the alignment service.
  * These reset procedures typically involves a tool capable of communicating with the vehicle’s computer system.

* OEM scan tools are an option, but consider these facts:
  * No integration with WinAlign® alignment software
    * Tech will need to know when a reset is required
  * No documentation confirming reset
  * Costly software upgrades
  * Interface system is complex
  * No alignment specific reset instructions
  * May be in use by another technician
* CodeLink® finishes the job right

* Only CodeLink® works with the alignment sensors to insure front wheels are straight ahead compared to thrust angle.
* Guaranteed precision when working with small steering angle thresholds
* Reduces the possibility of errors sufficient to create a customer “come-back”
**SAS identification**

- The biggest problem is solved immediately!
- The alignment database within WinAlign® is coded to know when a vehicle is a candidate for a SAS reset.
SAS Reset Alert

* System alerts technician of the need to reset SAS by displaying vehicle-specific information and placing the reset in the proper sequence of the alignment procedure.

Vehicles equipped with the following systems require an OEM scan tool or WinAlign CodeLink (if applicable) and special tools/procedures after a wheel alignment:

- Adaptive radar cruise control systems such as: ACC, ADR, Distronic, etc.
- Lane Departure Warning systems (LDW)
- Electronic stability control systems such as: ESP, PSM, DTSC, VDC, VSC etc.
- Electric power steering, Variable ratio, and 4-wheel steering systems such as: EPS, AFS, VGRS, 4WAS etc.

Refer to OEM documentation for further information.

To determine if a vehicle is equipped with Electronic Stability Control (ESC):
Immediately after turning the ignition to the ON position and during the instrument cluster bulb check, look for the ESC indicator. This may be a symbol as shown or the actual name of the system (VSC, VDC, ESP, etc.)
Rear Adjustments

The OEM preferred alignment procedure is selected and the adjustment sequence is defined.
SAS Reset

- CodeLink® resets SAS to 0° with the front wheels steered in the straight-ahead position.
- Verification is shown on-screen, along with additional info.
- Additional sensors may be reset during this process.
• Show customers completed work with before-and-after color printouts of alignment and SAS reset.

• The final alignment printout verifies communication with the on-board computer to reset SAS and other related sensors.
Questions?

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