ASE 4 - Suspension and Steering

Module 3
Rear Wheel Steering

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Contents

Module 3 – Rear Wheel Steering

Objectives

- Identify the benefits of the Rear Wheel Steering System
- Describe the three phases of operation
- Describe the three modes of operation
- Identify system components
- Describe the operation of the Rear Wheel Steering System
- Identify the cautions associated with the Rear Wheel Module 2 Objectives
- Identify individual system components and their operation
- Describe the complete system operation
- Identify unique system features
- Identifiy diagnostic information as it relates to component operation
- Identify Tech 2 Alignment Procedure
- Identify Tech 2 Special Functions

Rear Wheel Steering System Benefits

The Rear Wheel Steering System, in combination with the front steering system, offers several benefits over typical non-rear steering systems:

- Reduced turning radius
- Increased stability during high-speed maneuvers such as passing and lane changes
- Increased maneuverability when towing a trailer
- Better maneuverability during low-speed maneuvers such as parking

Turning Radius

The turning radius of a vehicle is significantly enhanced with Rear Wheel Steering.

- The turning radius of the GMC Sierra with Rear Wheel Steering can be compared to the turning radius of a Saturn Sedan

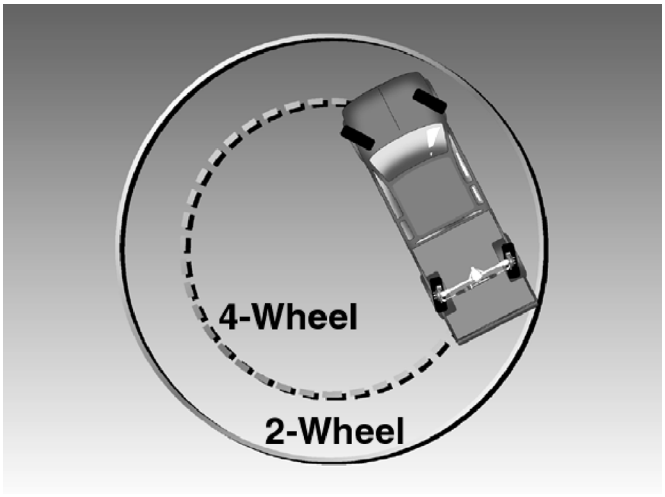

Figure 3-1, Turning Radius

Driving Phases

Depending on the various inputs communicated to the controller, the system operates in one of three phases:

Negative Phase

- Used during low-speed maneuvers for increased maneuverability
- Steers the wheels in the opposite direction of the front wheels
- Between zero and 45 mph (approximately)

Neutral Phase

- Used during front-wheel only steering
- Rear wheels remain in a straight forward position no matter what direction the front wheels turn
- It is the fail-safe phase of operation
- 45 mph (approximately)

Positive Phase

- Used during high-speed maneuvers and when towing a trailer at high speeds for increased stability
- Steers the rear wheels in the same direction as the front wheels
- 45 mph and above (approximately)

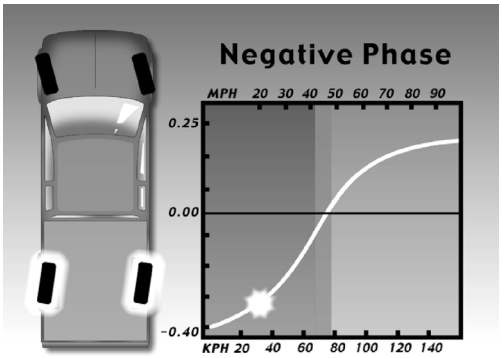

Figure 3-2, Negative Phase

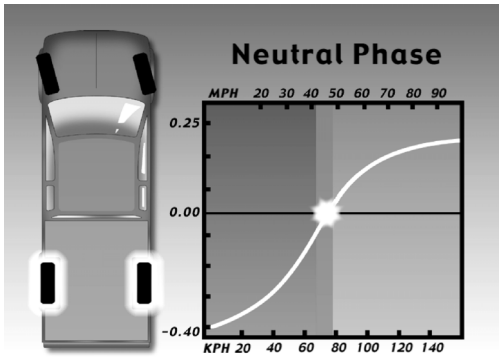

Figure 3-3, Neutral Phase

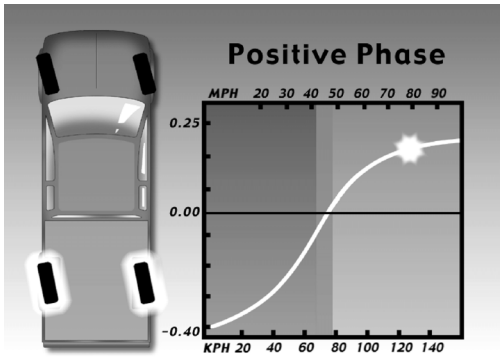

Figure 3-4, Positive Phase

High-Speed Stability, Trailering Maneuverability, and Low-Speed Maneuverability

These videos demonstrate how the combined steering of the front and rear wheels improves the truck's maneuverability. These three video segments will show high speed stability, enhanced trailering and improved maneuverability during parking.

Video Outlines – High-Speed Stability

- The Rear Wheel Steering System helps improve stability during high-speed lane changes
- With the Mode Select Switch in the 4-wheel steer position, the front and rear wheels turn in the same direction during high-speed maneuvers
- When both the front and rear wheels turn in the same direction, the system is operating in the positive phase
- Positive phase Rear Wheel Steering improves stability during higher-speed maneuvers

Video Notes:

Figure 3-5, Front and Rear Wheels Turned in Same Direction

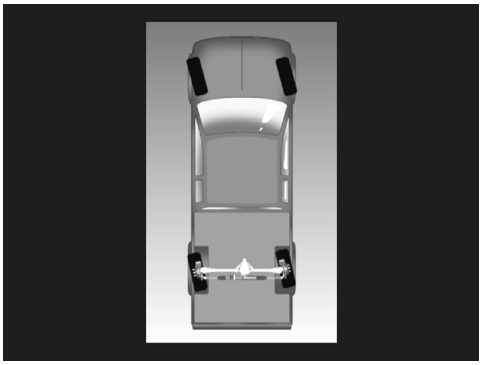

Figure 3-6, Lateral Motion Affected by Direction Changes in Wheel Angle

Video Outlines (continued) – Trailering Maneuverability

- Stability of Rear Wheel Steering continues with a trailer attached
- System continues operating in positive phase, allowing the trailer to track the truck more directly
- With Rear Wheel Steering, backing and parking a trailer becomes easier, particularly when additional maneuvering space isn't available
- When operating at slow speeds in the tow mode, the rear wheels turn in the opposite direction of the front wheels
- Allows for much easier maneuvering of the trailer, particularly in tight spots

Video Notes:

Figure 3-7, Lane-Change When Towing a Trailer

Figure 3-8, Vehicle Parking with a Trailer Attached

Figure 3-9, Front Wheel and Rear Wheel Turning in Opposite Directions

Video Outlines (continued) – Low-Speed Maneuverability

- Normal vehicle parking, especially in tight parking spaces, also becomes much easier with Rear Wheel Steering
- With the Mode Select Switch in the 4-wheel steer position, the front and rear wheels turn in the opposite direction during low-speed maneuvers, such as parking
- When the front and rear wheels turn in the opposite direction, the system is operating in the negative phase
- Negative phase Rear Wheel Steering improves maneuverability while operating at low speeds

Video Notes:

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_____

_____

_____

_____

How does Rear Wheel Steering enhance parking maneuverability?

_____

_____

_____

Figure 3-10, Vehicle Pulling into Parking Spot

Figure 3-11, Front and Rear Wheels Turning in Opposite Directions

Modes of Operation

The modes of operation steer by using the driving phases.

- 2-Wheel Steer
  - Conventional front steering
- 4-Wheel Steer
  - Conventional front steering with rear wheel steer
- 4-Wheel Steer Tow
  - Conventional front steering with rear wheel steering optimized for towing

Front and rear steering angle is determined based on:

- Mode selection by the driver
- Speed of the vehicle

Video Outlines – Component Locations

The video on component locations demonstrates the visual placement of each component in the system.

- Handwheel Position Sensor – base of steering column
- Mode Select Switch – instrument panel
- Yaw Rate and Lateral Accelerometer – beneath front passenger seat
- Vehicle Speed Sensor – transmission housing
- Steerable Rear Axle – normal rear axle position
- Difference is steerable rear axle includes quarter shafts with steering components on ends of quarter shafts
- Rear Wheel Steering Control Module – frame mounted on rear undercarriage of vehicle

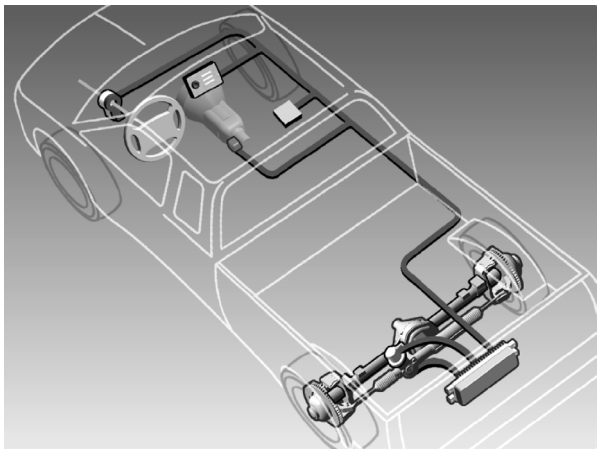

Figure 3-12, Component Locations

- Rear Actuator – positioned on rear axle and consists of:
  - Inner and outer tie rods
  - Rear Position Sensor
  - Steering gear motor
  - Rack and pinion assembly with boots
- Wiring Harness – integrated with vehicle harness
- Notice how close the lift point is to the boots
- Use caution when lifting this vehicle
- The recommended method to lift the vehicle is using an above ground hoist
- Use current Service Information for details

Caution

When lifting the vehicle using an in-ground hoist or supporting the axle with jack stands, it's very important that the hoist is positioned at the correct lifting points on the vehicle. If not, boot damage may occur.

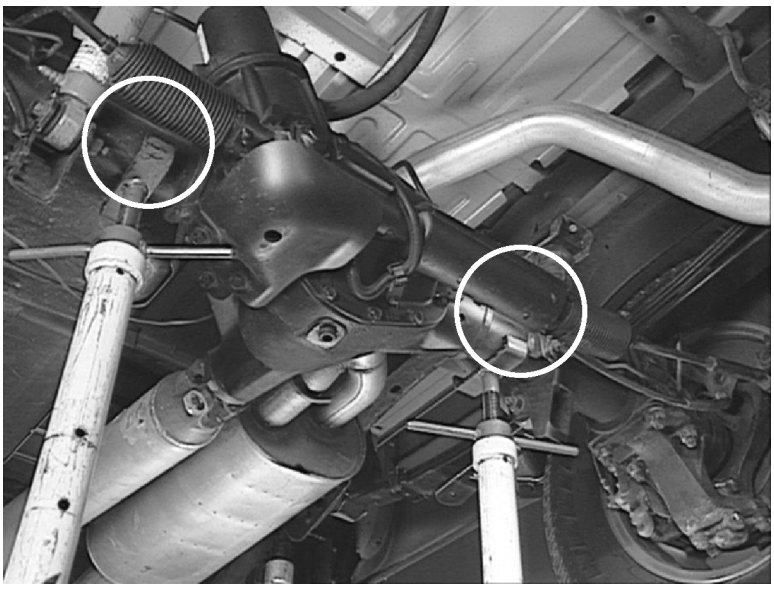

Figure 3-13, Component Locations

Exercise: Component Locations

Fill in the blanks on the illustration below with the letter for each component shown in the list.

Components

1. Handwheel Position Sensor
2. Vehicle Speed Sensor
3. Mode Select Switch
4. Control Module
5. Steerable Rear Axle

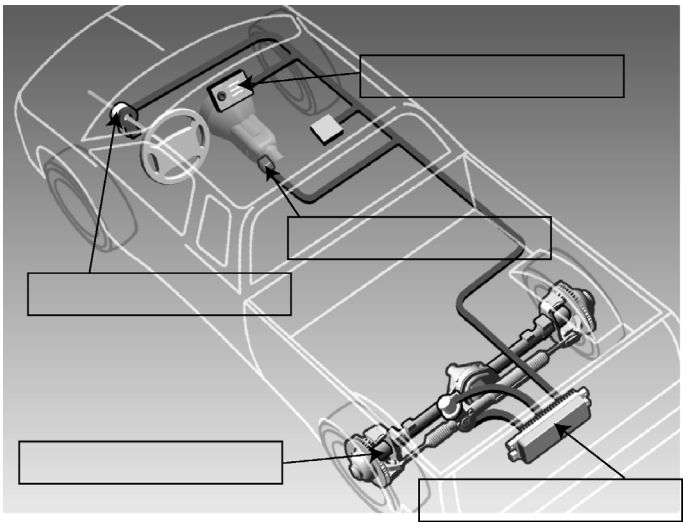

Figure 3-14, Component Locations Illustration

Identify any one of the three inputs and its purpose.

_____

_____

_____

Notice:

Do NOT use tire chains with the Rear Wheel Steering System. The chains could hit the wheel house when the wheels are turning left or right.

Video Outline – Rear Wheel Steering System Operation

- With the Mode Select Switch in the 4-wheel steer position, the Rear Wheel Steering Control Module identifies inputs from:
  - Handwheel Position Sensor
  - Vehicle Speed Sensor
- Based on information from those sensors, the control module will react either:
  - in the negative phase, turning the rear wheels in the opposite direction of the front wheels
  - in the positive phase, turning the rear wheels in the same direction as the front
- The amount rear wheels are steered in either direction is based on an algorithm programmed into the control module
- Algorithm takes into consideration mode of operation selected, position of the steering wheel and vehicle's speed
- Control module then processes this information and turns the rear wheels
- At a slow speed the wheels turn in the opposite direction, or in negative phase
- At a higher speed the wheels turn in the same direction, or in positive phase

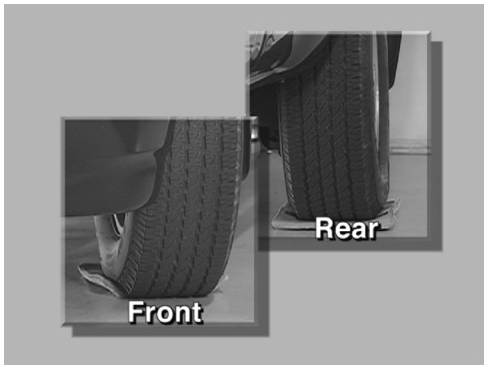

Figure 3-15, Front and Rear Tires in Same Direction Illustration

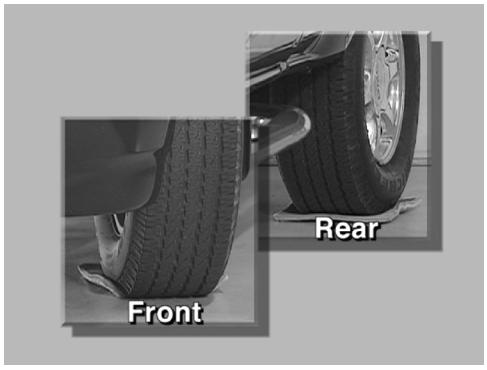

Figure 3-16, Front and Rear Tires in Opposite Direction

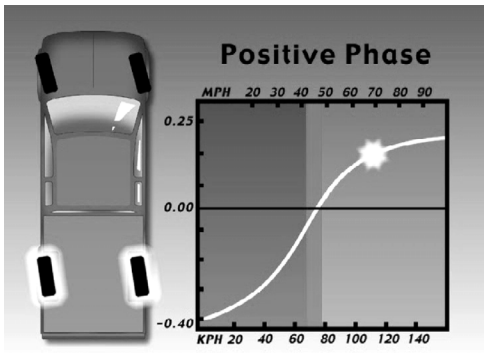

Figure 3-17, Algorithm Chart

Handwheel Position Sensor

The Handwheel Position Sensor determines the driver's steering input.

- Pin can only be installed in one position due to sensor cap alignment
- Located at base of steering column
- Identifies position of the steering wheel
  - Identifies direction that front wheels are pointed
  - Transmits position of front wheels as an input to the Rear Wheel Steering Control Module

Note:

The Handwheel Position Sensor is pre-indexed and should NOT be rotated after pulling the shipping pin.

Handwheel Position Sensor Signals (Outputs)

Unlike most two-wheel-steer trucks with this type of sensor, the Handwheel Position Sensor generates four output signals. One signal is analog and three signals are digital.

- Analog signal
  - Sensor Signal
- Digital signals – all high/low output
  - Phase A
  - Phase B
  - Index Pulse
- 5-volt reference
- Signal out
- Sensor ground

Figure 3-18, Handwheel Position Sensor

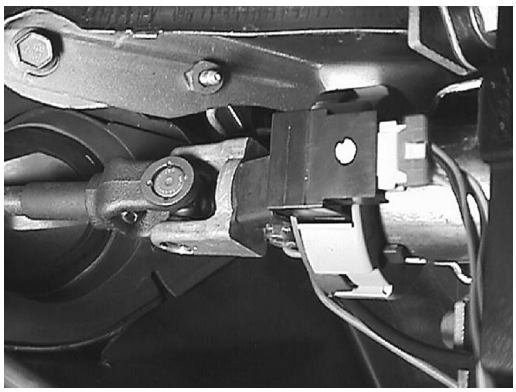

Figure 3-19, Handwheel Position Sensor Location

Analog signals:

- Vary between 0 or 5 volts
- Indicate when steering wheel is furthest turning capacity of either direction (+/- 225 degrees from center)
- Indicate speed of turn

Digital signals:

- Phase A and Phase B signals indicate the direction of the front wheels
- Index pulse marker signal indicates:
  - When the steering wheel is in the centered position
  - When the front wheels are positioned straight ahead

Sensor Malfunction

Malfunction of the Handwheel Position Sensor can set two DTCs – C0253 and/or C0455.

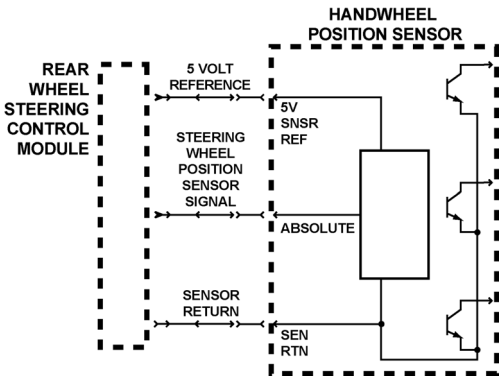

Figure 3-20, Handwheel Position Sensor Analog Output to Control Module

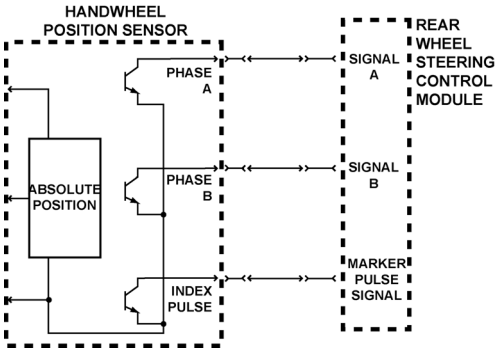

Figure 3-21, Handwheel Position Sensor Digital Output to Control Module

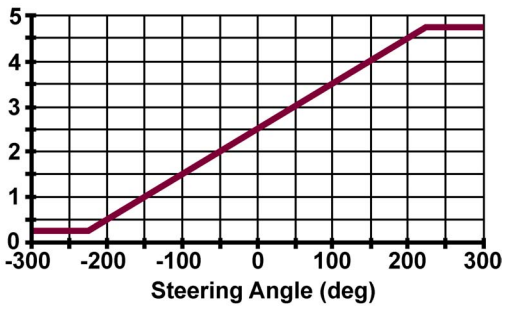

Figure 3-22, Handwheel Analog Signal

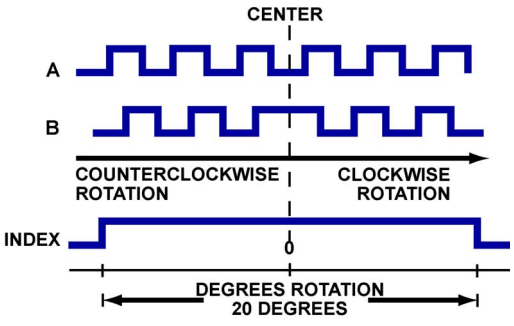

Figure 3-23, Handwheel Digital Signal

Review Question:

What assists with Handwheel Position Sensor installation?

1. Sensor molds to installation
2. Sensor is pre-indexed
3. Sensor is color-coded to mounting
4. Alignment of screw holes

Steering Modes

Mode Select Switch Circuit

The Mode Select Switch Circuit provides an input to the module for the driver's request on steering mode.

- Resistance of the momentary contact switch is:
  - 1.8k W to 2.2k W when switch is released
  - 450 W to 550 W when depressed
- Reference voltage is 5 volts
- Normal voltage range is 0.49v to 4.2v
  - DTC B3593 sets when voltage is outside this range

Mode Select Switch

The position of the Mode Select Switch determines the steering mode selected by the driver.

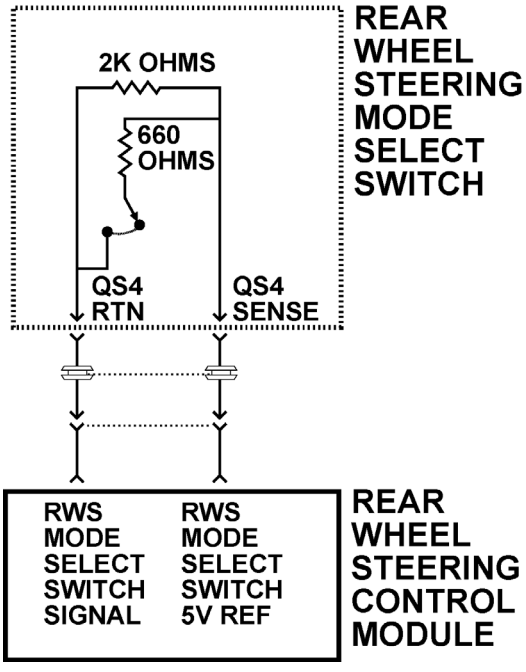

Figure 3-24, Model Select Seitch Circuit

Video Outline – Steering Modes

- With the Mode Select Switch in the 2-wheel steer position:
  - the rear wheels are locked in the straight ahead position
  - the vehicle steers and operates in the same manner as a normal, 2-wheel steering vehicle.
- 2-wheel steering is also called neutral phase. Rear wheels do not move relative to the front wheels
- With the Mode Select Switch in the 4-wheel steer position:
  - system will operate in the negative phase at low speeds, turning the rear wheels in the opposite direction of the front wheels
  - or in positive phase at high speeds, turning rear wheels in same direction as front wheels
- Both negative phase and positive phase are determined by control module and are based on position of steering wheel and speed of vehicle
- Resulting amount or degrees the rear wheels are turned determined by the algorithm programmed into the control module
- In the positive phase, this amount could be as high as five degrees with the vehicle traveling at higher speeds or as low as twelve degrees when the system is being controlled by the Tech 2
- With the Mode Select Switch in 4-wheel steer tow mode, system works essentially the same as in 4-wheel steer, except that system is optimized for towing a trailer

Figure 3-25, 2-Wheel Steer - Wheels Remain Straight

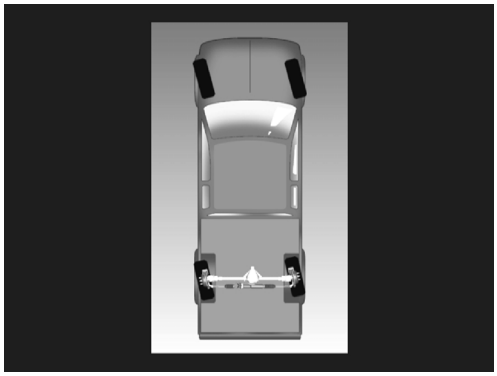

Figure 3-26, 4-Wheel Steer - Positive/ Negative Phase

Figure 3-27, 4-Wheel Steer Tow - Positive/Negative Phase

Review Question:

What is the main difference between 4-Wheel Steer Mode and 4-Wheel Steer in Tow Mode?

_____

_____

To change modes, press the desired mode button.

- Indicator lamp of selected mode flashes until handwheel passes through center
  - passing through ±7 degrees
- Once handwheel passes through center, indicator lamp of selected mode remains illuminated

Mode Lamps

If all mode lamps are illuminated, the vehicle requires wheel alignment. All mode lamps will be illuminated only when there is an incomplete electrical alignment procedure.

Figure 3-29, Mode Lamps

Note:

After performing an alignment procedure, confirm all mode lamps are NOT illuminated. If all the mode lamps are illuminated, this would indicate an incomplete electrical alignment procedure.

With the vehicle in Neutral for 4 seconds, the system will default to 2-wheel steer and flash the previous mode until the transmission is place in gear.

- This is to accommodate automatic car wash requirements and is normal. It is something you may notice in your diagnosis

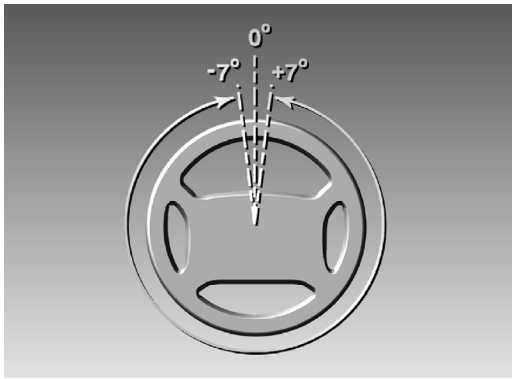

Figure 3-28, Steering Wheel Centers

- With the vehicle in the park position, Rear Wheel Steering is limited to ±5 degrees.

If the system has a malfunction, the system will default to 2-wheel steer mode.

Review Question:

If the Mode Select Switch lamps are all on, _____.

1. replace the indicator
2. the vehicle is in 4-wheel tow mode
3. the mode is changing
4. the system needs alignment

Yaw Rate and Lateral Accelerometer Sensor

The Yaw Rate and Lateral Accelerometer Sensor is one combined component rather than two individual components as on some other systems.

- Only purpose of the sensor is to monitor the system
- Voltage range for the sensor is 0 to 5 volts
- Replacement of the sensor requires the Tech 2 Special Functions to center the lateral accelerometer portion of the sensor
  - This zeros out the sensor settings and it learns center position

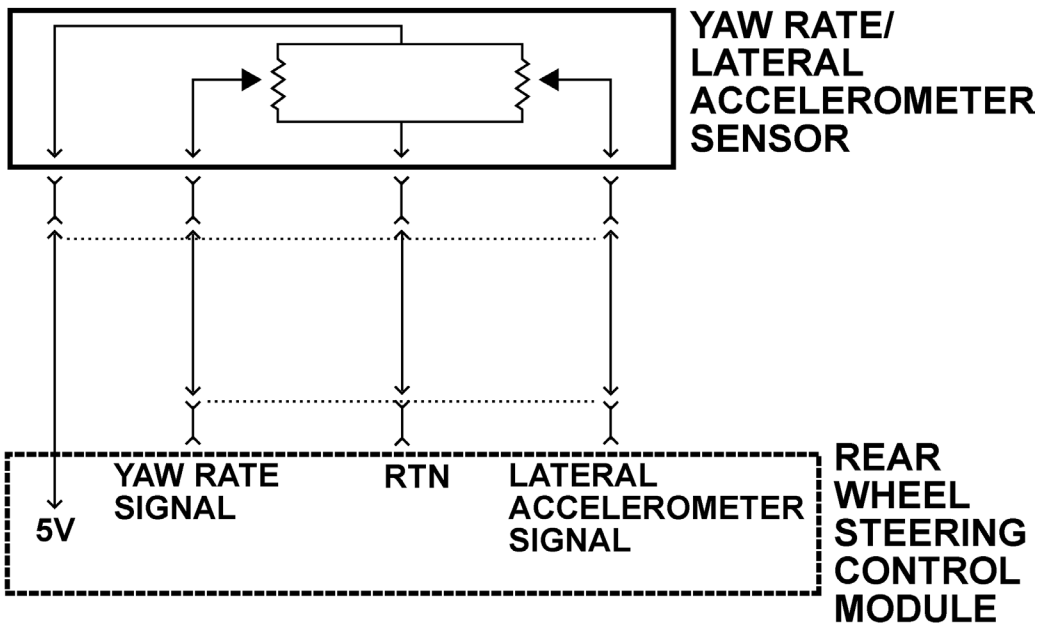

Figure 3-30, Yaw Rate/Lateral Accelerometer Circuit

Vehicle Speed Sensor

The Vehicle Speed Sensor (VSS), also used for the Instrument Panel Cluster (IPC) is used as an input to the Rear Wheel Steering Control Module.

- Located on the transmission/ transfer case output housing
- Signal is processed by the Powertrain Control Module (PCM)
- Signals are then sent to the Instrument Panel Cluster and the Rear Wheel Steering Control Module

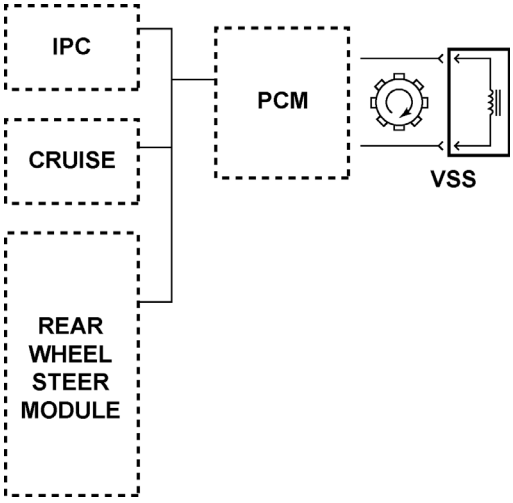

Figure 3-31, Vehicle Speed Sensor Schematic

Steerable Rear Axle

The steerable rear axle consists of:

- Ball joints
- Tie rods
- Rear actuator
- CV joints on quarter shaft
- Rear actuator assembly bolts in place of rear differential cover and serves as both differential cover and actuator mount

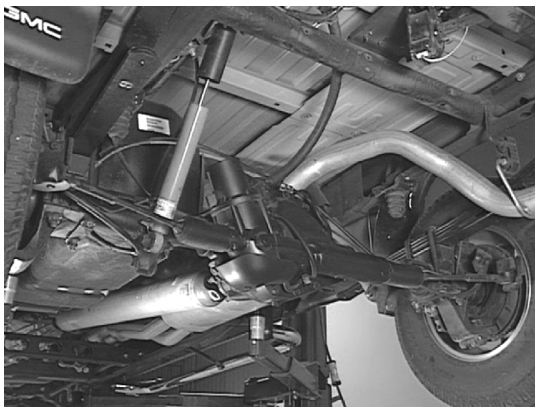

Figure 3-32, Steerable Rear Axle

  - Axle fluid service does not require removal of the acutator, utilizes drain plug
  - Two rear axle fluid numbers

    - U.S. only: 12378557
    - Canada only: 88901362

Note:

- Rear axle fill capacities
  - Oil capacity: approximately 3 L
- No friction modifer for locker equipped axles

Quarter Shaft Operation

The video on the rear axle quarter shaft operation demonstrates the basic function of the quarter shafts.

Video Outline – Quarter Shaft Operation

- Quarter shaft operation parallels what you have seen on other axle shafts that are a constant velocity or CV joint
- The rear axle quarter shaft knuckle joints are able to move independent of one another
- Due to mechanical constraints only normal axle rotation and steering of the wheels at the CV joint is allowed
- There is no camber or caster adjustment. The only adjustment is for toe

Video Notes:

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Steerable Rear Axle Handling Precautions

- Diaphragm seal must be rolled onto cardan joint to prevent damage
- When inserting the axle shaft into the housing, be sure to avoid damaging the axle shaft oil seal

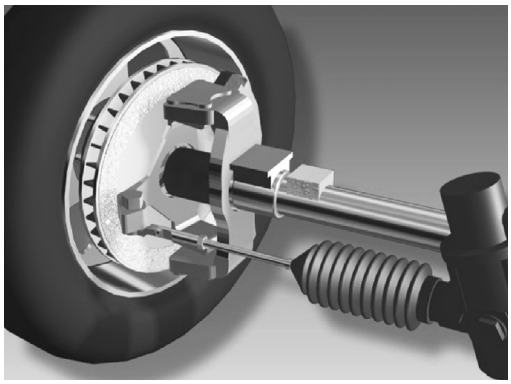

Figure 3-33, Rear Axle Quarter Shafts

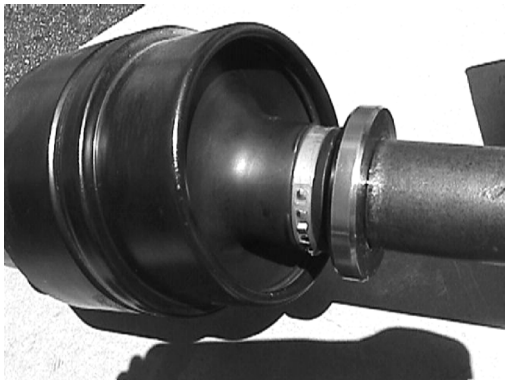

Figure 3-34, Diaphram Seal

- Watch for the pinch point between the ball joint housing area of the rear axle and and the steering knuckle
- The pinion angle should not be shimmed or changed

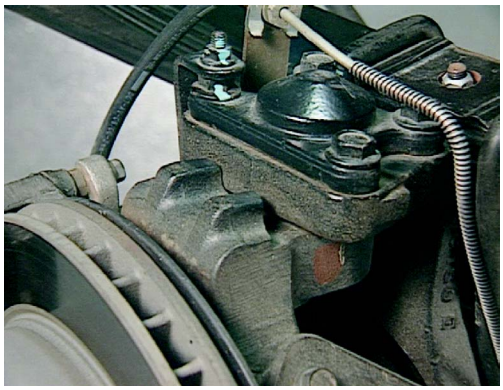

Figure 3-35, Pinch Point between Ball Joint housing area of the Rear Axle and the Steering Knuckle – Open

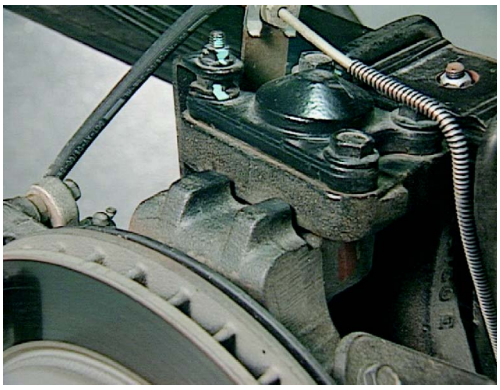

Figure 3-36, Pinch Point between Ball Joint housing area of the Rear Axle and the Steering Knuckle – Closed

Rear Wheel Steering Control Module

The Rear Wheel Steering Control Module monitors and controls the actuator.

The module is mounted in the rear underbody above the spare tire on a bracket connected to the frame.

- The Control Module determines the correct amount of rear wheel steering needed at the rear wheels
- Based on the inputs received, the module energizes the steering motor to turn the rear wheels either left or right

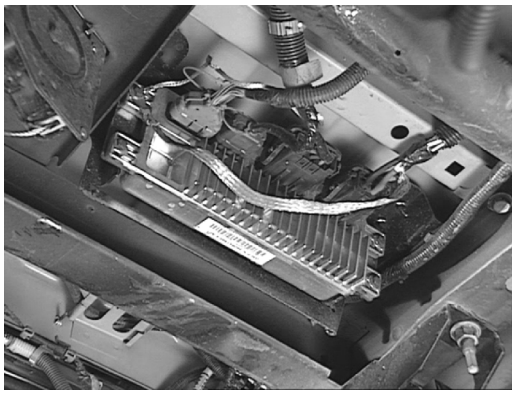

Figure 3-37, Rear Wheel Steering Control Module

Review Question:

What components were added to make the rear axle steerable?

_____

_____

Control Module Inputs and Outputs

Inputs:

- Vehicle Speed Sensor
- Class 2 Serial data
- Mode Select Switch
- Handwheel Position Sensor
- Phase 1
- HWP Phase A, B
- HWP Absolute
- HWP Index Pulse
- Rear Position Sensor
- Hall Sensor A, B, C

Outputs:

- Mode Select Switch
- Steering gear motor assembly - Motor phase 1, 2 & 3
- Service 4-Wheel Steer
- Class 2 serial data
- Shorting Relay

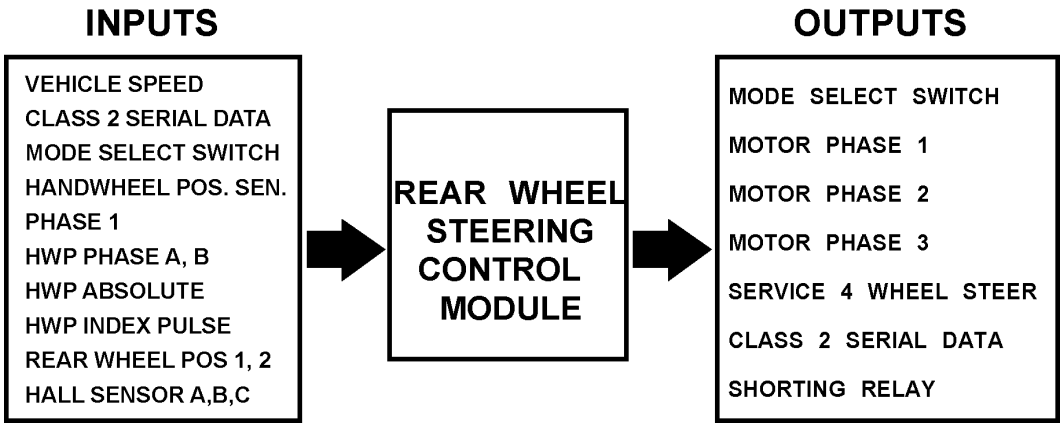

Figure 3-38, Control Module Inputs/Outputs

Control Module Unique Features

- Calibrations are unique to each vehicle
- There are three different part numbers for the control module, each with an individual calibration

Note:

Any time a controller is replaced, the truck requires alignment.

Control Module Features

There are two DTCs related to the operation of the module. They are C0550 and U1305.

If normal Class 2 communication is interrupted or disabled, a DTC U1305 may set.

Review Question:

Which of the following is a true statement about the Control Module?

1. There is only one software calibration.
2. A DTC C0550 can be set only one way.
3. It has three part numbers with three software calibrations.
4. There are three part numbers for the module with one calibration.

Rear Actuator

The Rear Actuator controls the direction of the rear wheels and consists of the following components:

- Inner tie rods
- Outer tie rods
- Rack and pinion unit with boots
- Steering motor

Video Outline – Operational Characteristics

The video on operational characteristics of the actuator includes the normal operating sound the actuator makes.

- During normal vehicle operation, no operating noise from the rear wheel steering actuator should be audible
- When commanded by the Tech 2, sound can be heard from the actuator during operation, which is normal

Note:

A mechanical binding condition in the actuator could generate an electrical DTC (C0543).

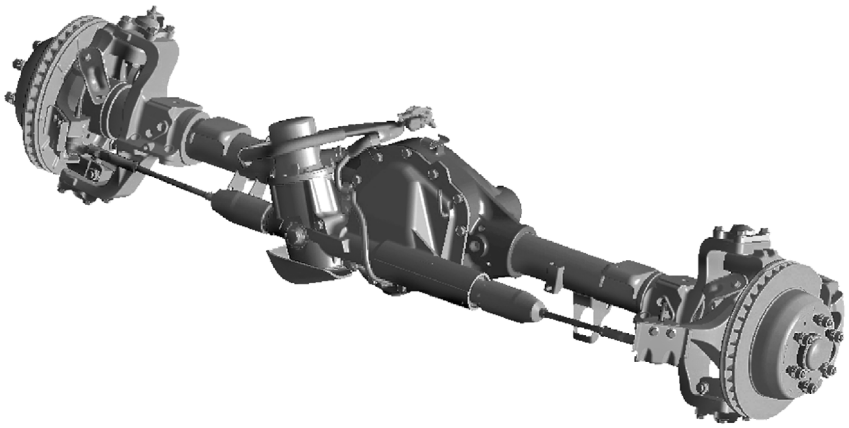

Figure 3-39, Rear Actuator

Inner Tie Rods

The inner tie rods are attached to the steering rack and turn the rear wheels as the motor rotates.

- Support clamp has right hand threads
  - To remove the support clamp, turn it counterclockwise
- Support nut has left hand threads
- Check for tie rod wear by physical inspection

An important part near the Inner Tie Rods is the Return To Center Spring. This spring is an internal component of the actuator assembly and is non-serviceable.

- Spring is very powerful and no disassembly is allowed
- With the ignition OFF, the Return To Center Spring returns the wheels to the straight ahead position

Inner Tie Rod Special Tools

Two special tools are required when servicing the inner tie rods:

- J 44665-1 – Inner tie rod wrench
- J 44665-2 – Inner tie rod wrench

Two special tools are also required for the ball joints:

- J 44663 – Ball joint tool
- J 44664 – Ball joint tool

Review Question:

What should you suspect if you notice a slight whining noise from the actuator while operating the system?

1. The actuator should be replaced.
2. The inner tie rod is worn.
3. The actuator is working normally.
4. The rear position sensor is out of alignment.

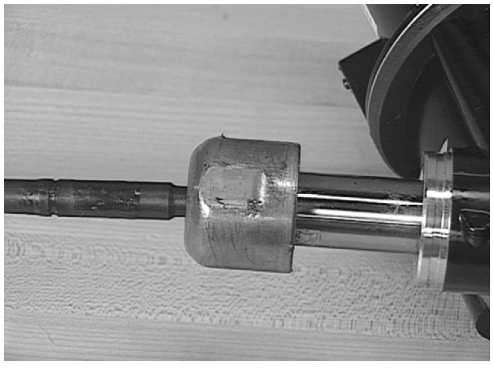

Figure 3-40, Inner Tie Rods

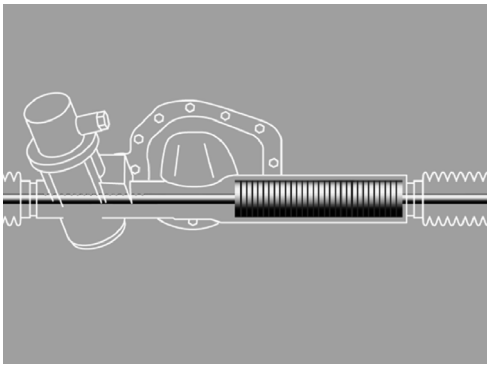

Figure 3-41, Return to Center Spring

Outer Tie Rods

The Outer Tie Rods are attached to the steering knuckles at the ends of each axle shaft. The tie rods use an overlaying bracket on each side.

Note:

When servicing the system, only puller J24319-B should be used to disengage the outer tie rod from the steering knuckle.

Tie Rod Bracket

- Prevents complete disengagement of the tie rod from the steering knuckle
- Bracket maintains tie rod operation, even if nut malfunctions

Note:

If the rear of the vehicle drifts or wanders, a malfunctioning tie rod may exist.

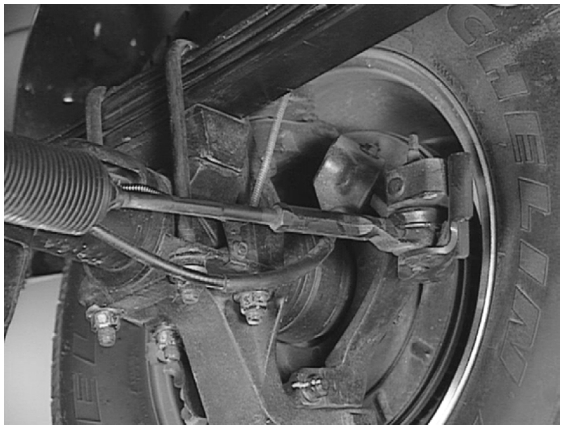

Figure 3-42, Outer Tie Rods

Figure 3-43, Tie Rod Bracket

Rack and Pinion Boots

The Rear Rack and Pinion Boots function similarly to the Front Rack and Pinion Boots. Differences from the front boots include:

- Rear boots are more robust, stiffer and thicker
- Rear boots may possibly be more exposed to damage by road debris
- When replacing boots, make sure they are in actuator and inner tie rod grooves

Video Outline – Boot Check

The video on checking boots demonstrates how to check boots for damage.

- To check boots for damage, such as punctures or holes, put the vehicle into a full turn and look at the expanded boots with a light
  - Repeat for the other side

Video Notes:

_____

_____

_____

_____

Note:

- Rack and Pinion Boots can be damaged by an in-ground hoist
- If boots are damaged in the shop, replace the boots with boot kit # 26091589
- If damage to boots occurs while driving, replace the entire actuator assembly
  - Damage could be due to water intrusion which would cause repeated failure of the rear position sensor

Figure 3-44, Rack and Pinion Boot

Review Question:

What might be a cause if the customer is concerned about drift in the way the vehicle rides?

Rear Position Sensor

The Rear Position Sensor is located in the bottom of the rack and pinion unit on the Actuator Motor Assembly.

- Povides the Rear Wheel Steer Control Module with actuator position

Video Outline – Rear Position Sensor Activation

The video on Rear Position Sensor Operation demonstrates the operation of the sensor as it picks up movement of the rack.

- Once the Mode Select Switch is placed in one of the mode selections, the rear wheel steering control module sends a signal to the motor assembly
- The motor then activates the planetary gear sets inside the motor housing
- The pinion gear drives the steering rack along its teeth and the rear position steering sensor through its center
- As the rack steers the rear wheels in the commanded direction, the rear position sensor sends a corresponding signal back to the control module indicating the position of the rear wheels
- The sequence continues constantly while the Mode Select Switch is in one of the four-wheel steer positions

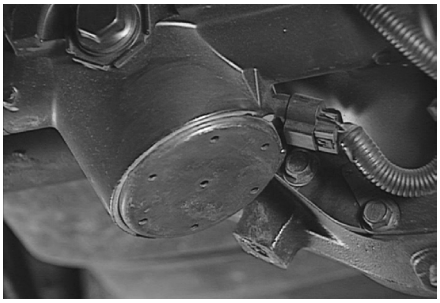

Figure 3-45, Rear Position Sensor with Cover Installed

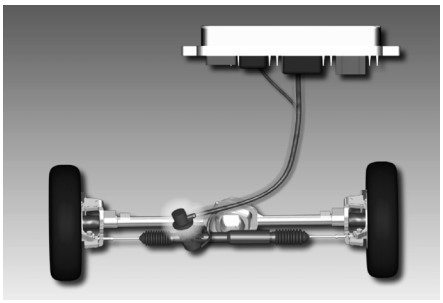

Figure 3-46, Planetary Gear Activated

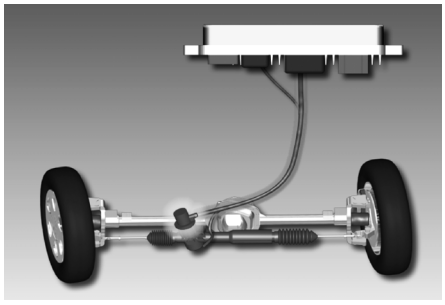

Figure 3-47, Pinion Gear

There are several inputs and outputs for the Rear Position Sensor.

- 5 volt reference
- Ground
- Position 1 signal
- Position 2 signal

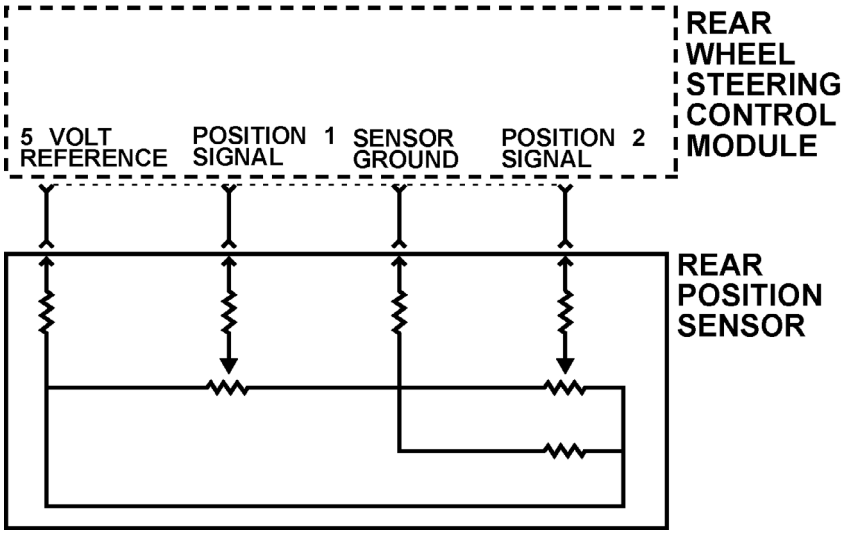

Figure 3-48, Rear Position Sensor Circuit

Review Question:

Does the Rear Position Sensor sit in the actuator housing and obtain its data from circuits internal to the steering motor?

Yes No

Rear Position Sensor Unique Features

- Skid plate must be removed to access cover and the cover needs to be removed to gain access to sensor
- Bolts must be properly torqued when reinstalling
- Do not rotate sensor; it cannot be relocated

Rear Position Sensor Additional Information

- O-ring in the actuator is green to be more visible and housing is black
  - Replace O-ring if sensor is removed/replaced
  - Retaining fingers in actuator housing hold O-ring in place
  - If oil or water present when servicing
- Rear Position Sensor, replace actuator assembly. This indicates malfunction of non-serviceable internal seal

- If sensor is replaced, perform vehicle alignment
- With wiring or connection malfunction, replace motor harness assembly
  - Do not attempt to repair harness or terminals as they are integral part of motor assembly

Rear Wheel Position Sensor Diagnostic Information

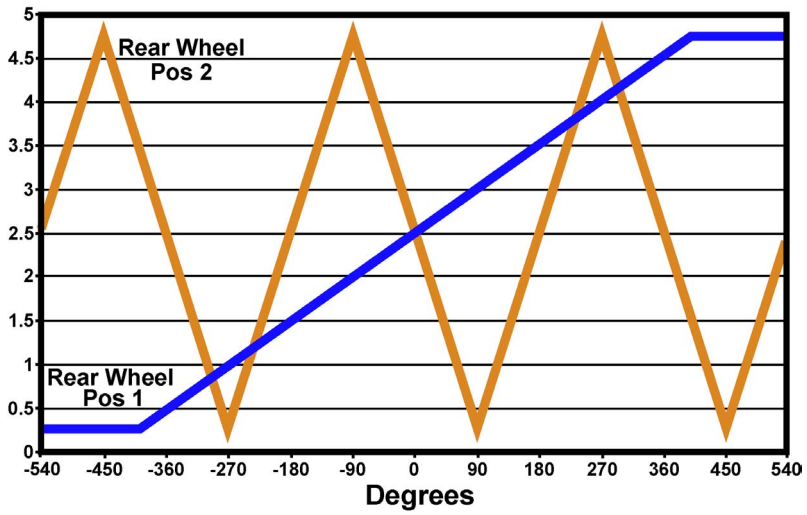

Figure 3-49, Rear Wheel Sensor Data

The two signals, when utilized together, provide very accurate position signals.

- Position 1 signal - approximate signal
  - provides module with approximate rack location
- Position 2 signal - refined signal
  - provides module with refined location depending on approximate signal
- With sensor malfunction and water present, there is a possible breech in the system
  - possibly damaged boot
  - water could trickle through actuator to sensor
  - new sensor will malfunction with water in system; actuator assembly must be replaced

Review Question:

Which of the following is important to check when replacing the Rear Position Sensor?

a. O-ring lubrication

b. Bolt torque

c. Skid plate alignment

d. Sensor cover index marks

Steering Gear Motor

The Steering Gear Motor is inside the Rear Rack and Pinion Steering Gear. It:

- Does the work in steering process by positioning actuator rack
- Mounts to top of Actuator Assembly
- Operates through planetary gear set at 45:1 ratio

Figure 3-50, Steering Gear Motor

The Steering Gear Motor inputs control self-positioning motor circuitry.

- Hall sensor 12v reference
- Hall sensor ground
- Actuator Hall A signal, Actuator Hall B signal, Actuator Hall C signal
  - used to determine which motor phase to energize
- Hall sensor malfunction only repaired by actuator motor replacement

The Steering Gear Motor outputs control motor operation.

- Actuator Phase A control, Actuator Phase B control, Actuator Phase C control
  - control module energizes phases
- The shorting relay operates as an electromagnetic brake in the event of a malfunction
- Motor shorting relay power and ground

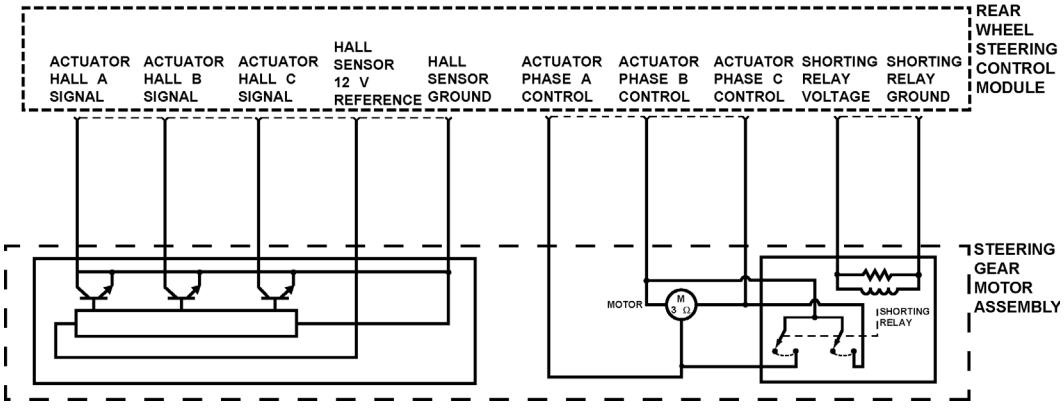

Figure 3-51, Steering Gear Motor Inputs/Outputs

Steering Gear Motor Unique Features

- If motor replaced, make sure O-ring installed and seated properly
- Motor removal exposes planetary gear set
  - must be protected from contamination (clean undercarriage before removal)
  - fluid not replaceable/not serviceable
- Motor installation requires engaging sun gear with planetary gears
- Harness must be oriented properly during motor installation
- Motor replacement does not require vehicle alignment
- Ground straps must be connected
  - one for the motor and two for the controller

If the motor was not operating properly it could generate an electronic-related DTC C0538.

Review Question:

When the motor is serviced, you should _____.

a. replace the lubricant

b. perform an alignment

c. re-calibrate the control module

d. protect the gearset from contamination

Exercise

Draw a line to match the component in the left column with its function in the right column.

Component	Function
Handwheel Position Sensor	Commands Rear Actuator
Rear Wheel Controller Input	Steering Control Module
Rear Actuator	Positions Wheels

System Operation

The video on system operation demonstrates how the components all work together.

Video Outline –

- Explain system operation by looking at its sensor data
- Handwheel Postion Sensor continuously monitors the position of the steering wheel and tells the control module the number of degrees from center the steering wheel has been turned in either direction
- Mode Select Switch provides a driver-selectable input to the control module of the desired steering mode
- Vehicle Speed Sensor is multi-purpose sensor that continuously monitors the vehicle's speed so it can determine rear wheel steering phase and amount rear wheels will be turned
- Yaw Rate and Lateral Accelerometer Sensor only records history information
- Rear Wheel Steering Control Module output consists of three voltage phases applied to the Rear Wheel Seering Gear Motor
- Last rear wheel steering input comes from the Rear Position Sensor
- This information, along with other inputs, is used to determine rear wheel steering phase and amount the rear wheels will be turned

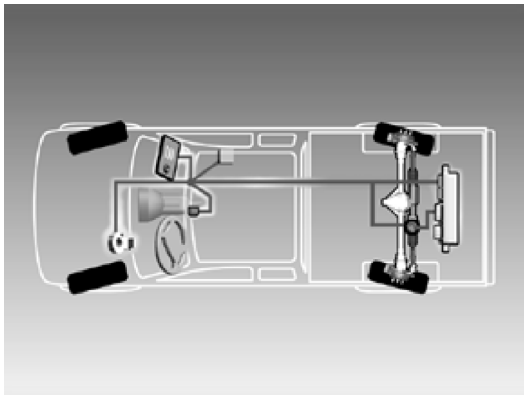

Figure 3-52, Handwheel Speed Sensor Activation

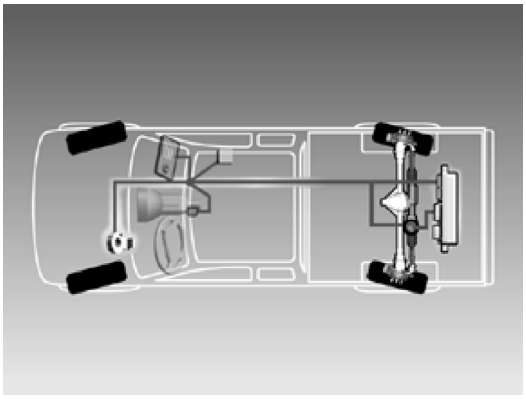

Figure 3-53, Vehicle Speed Sensor Activation

Alignment Guidelines

Alignment with the Rear Wheel Steering System consists of three major steps:

1. Clear the calibration
2. Perform the mechanical alignment
3. Perform learn alignment procedure

Mechanical Alignment Procedure

1. Clear the calibration
   - Connect Tech 2 and follow Special Function instructions

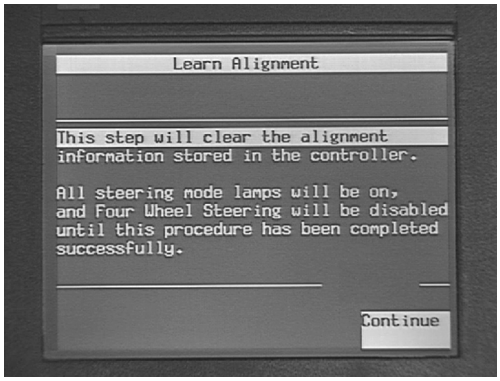

Figure 3-54, Clear Alignment Information

2. Perform the mechanical alignment
   - Tech 2 instructs you to turn the ignition OFF and perform mechanical adjustments as necessary
     – press CONTINUE when done

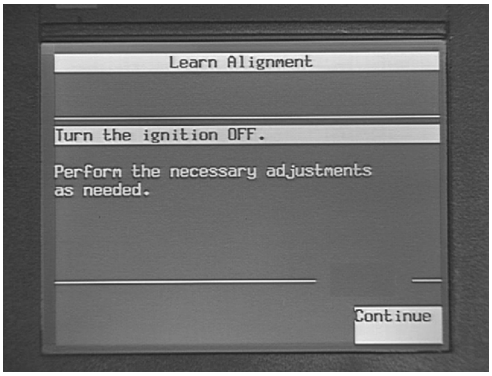

Figure 3-55, Perform Mechanical Adjustments

3. Perform learn alignment procedure
   - START engine
     – check to be sure the rear wheels are centered
     – if OK, press CONTINUE

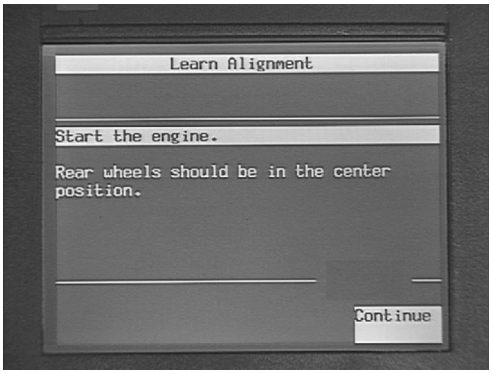

Figure 3-56, Start Engine

Note:

Replacement of any serviceable component, other than the rear wheel steering motor, requires a four-wheel alignment.

The Tech 2 directs you to turn the steering wheel 90 degrees (or a quarter turn) to the left, followed by turning to 90 degrees past center to the right.

- System “learns” front and rear sensor positions
- Tech 2 verifies “Learn Alignment procedure has been successfully completed”

Upon completion, the system defaults to 2-Wheel Steer mode. Drive the vehicle with all modes to verify proper 4-Wheel Steer operation.

If the Learn Alignment Procedure didn't function as expected, several things will happen to indicate that this has occurred.

Upon completion of learning the front and rear sensor positions:

- If Tech 2 screen displays “Learn Alignment unsuccessful,” then retry learn alignment procedure up to 2 additional times
  - Tech 2 identifies whether front or rear sensor is out of range
  - Follow Service Information
- Tech 2 may also identify that the system was “unable to perform the alignment procedure”
  - If so, refer to the Service Information

Alignment Procedure Wrap-Up

A test drive using all modes is required after an alignment is completed.

When in the four-wheel steering tow mode, the steering wheel may be slightly offset from center up to but no more than five degrees.

Review Question:

Before clearing the controller calibration, it is important to _____.

a. turn the igniton OFF

b. run the engine for five minutes

c. diagnose and repair any DTCs

d. learn sensor positions

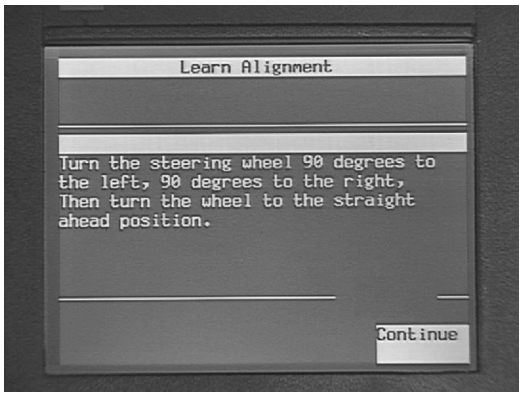

Figure 3-57, Learn Alignment

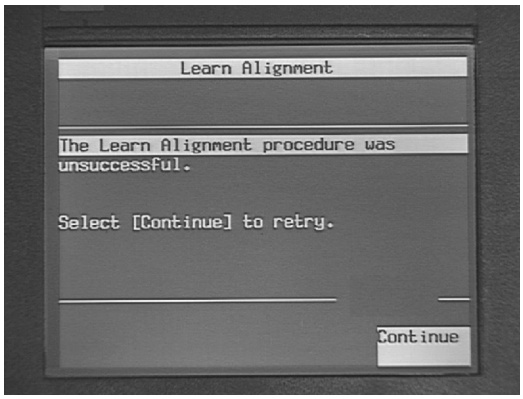

Figure 3-58, Unsuccessful Alignment

Video Outline – Tech 2 Special Functions

The video on Tech 2 Special Functions demonstrates the operation of the following:

- Lamps
- Motor control
- Steering commands
- Rear wheel steering system offers bi-directional interface for scan tools, such as Tech 2. Functional output tests allow verification of proper operation
- Functional output tests are listed by pressing F2 from the Chassis menu
- After F0, “Learn Alignment," other nine selections allow activation of system functions
- F1 through F5 command specific system actions. F6 through F9 operate system indicator lamps
- Using “Command Rear Steer” left or right actuates system to commanded position
- When ON is selected, rear wheels are steered to commanded position
- When OFF is selected, wheels return to normal straight ahead position
- Changing data parameters can be noted… most notably rear position sensor
- Selecting one of three mode commands allows system to be placed into that mode

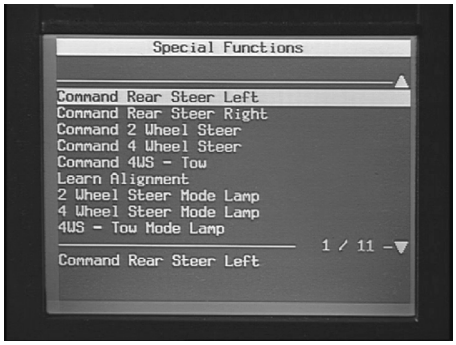

Figure 3-59, Tech 2 Special Functions Submenu

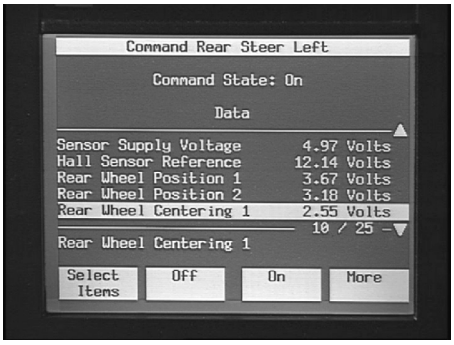

Figure 3-60, Tech 2 Data Parameters

Figure 3-61, Tech 2 with Mode On

- Selected parameter should be displayed until OFF is selected
- Four separate mode lamp tests possible to verify operation
- Each can be operated individually as well as all ON at once