Rear Wheel Steering
(QUADRASTEER™)

Service Technical College
Caution

In order to reduce the risk of personal injury or property damage, carefully observe the following information:

The service manuals of General Motors Corporation are intended for use by professional, qualified technicians. Attempting service procedures without the appropriate training, tools, and equipment could cause personal injury, vehicle damage, or improper vehicle operation. Proper vehicle service is important to the safety of the service technician and to the safe, reliable operation of all motor vehicles. If a replacement part is needed, use the same part number or an equivalent part. Do not use a replacement part of lesser quality.

The service manuals contain effective methods for performing service procedures. Some of the procedures require the use of tools that are designed for specific purposes.

Accordingly, any person who intends to use a replacement part, a service procedure, or a tool that is not recommended by General Motors, must first establish that there is no jeopardy to personal safety or the safe operation of the vehicle.

The service manuals contain Cautions and Notices that must be observed carefully in order to reduce the risk of personal injury. Improper service may cause vehicle damage or render the vehicle unsafe. The Cautions and Notices are not all-inclusive. General Motors can not possibly warn of all the potentially hazardous consequences that may result by not following the proper service procedures.

The service manuals cover service procedures for vehicles that are equipped with Supplemental Inflatable Restraints (SIR). Failure to observe all SIR Cautions and Notices could cause air bag deployment, personal injury, or otherwise unneeded SIR repairs. Refer to the SIR component and wiring location views in Restraints before performing a service on or around SIR components or wiring.

If multiple vehicle systems are in need of repair, including SIR, repair the SIR system first to reduce the risk of accidental air bag deployment and personal injury.

January 2002
Welcome to Rear Wheel Steering (QUADRASTEER™)

Before the broadcast begins, please read the following information which will help you understand the One Touch site controller and keypad — your links to the instructor and the other course participants.

Using One Touch

1) Logging in to the system

To log in to the system, follow these steps:

1. **Verify correct HOST number** for your session by referring to the Host number that appears in the lower, right corner of the TV screen during the broadcast.

2. **Check the Host Number that appears on your OneTouch site controller,** which is the large black box located near your TV equipment. If necessary, use the Plus (+) or Minus (-) key on the site controller's display to change the host to the correct number, and then press the Enter Key (↵) to log onto the host.

3. **Once the keypad asks for you ID, enter your student identification number.** (U.S. Social Security, Canadian EIN or Mexican IMSS or Person ID, effective January 2005) on your OneTouch keypad, and then press the Enter Key. The message "Validating" appears on the keypad for a few seconds. Next, your name appears. this confirms that you have logged onto a host.

**NOTE:** If you have already logged in to your keypad and you determine that our site controller is NOT set to the correct host number, you must first log off the site controller by pressing the Esc key on the site controller's display. Wait until the sytem logs you off, and then follow the steps above for logging back into the system.

Finally, if you are experiencing any technical difficulties and are unable to log in on both the keypad and the site controller, please call the **GM Training Help Desk at 1-888-748-2687** and press prompt 1.

2) Speaking to the Instructor

For best results while speaking to the instructor, follow these tips:

1. Place the keypad near the front of your desk. Put your class materials between you and the keypad.

2. Speak directly into the microphone on the keypad. The microphone is located just below the row of five function keys. Speak in a normal tone from your standard seated position. You will be heard by all of the other course participants and the instructor.
## Using the Keypad

<table>
<thead>
<tr>
<th>If you want to...</th>
<th>press:</th>
<th>and this will happen...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask a question, make a comment, enter a discussion, or cancel a call to the instructor.</td>
<td><img src="image" alt="Call" /></td>
<td>Your WAIT light will be turned on and your name will be added to the queue. Your SPEAK light will come on when it is your turn to speak. If you press the CALL key a second time, your WAIT light will go off, and your call will be canceled.</td>
</tr>
<tr>
<td>Signal the instructor anonymously that you do not understand.</td>
<td><img src="image" alt="Flag" /></td>
<td>The percentage of students signaling the instructor is displayed on the instructor's monitor. The instructor may adjust the lecture accordingly.</td>
</tr>
<tr>
<td>Answer a multiple-choice question.</td>
<td><img src="image" alt="Options" /></td>
<td>If you are taking a multiple question quiz, the answer is stored until you answer the last question. On single questions the answer is transmitted to the host site when you press the ANSWER key.</td>
</tr>
</tbody>
</table>
| Answer a question with a numeric answer. | ![Options](image) + ![Enter](image) | If you are taking a multiple questions quiz the answer is stored until you answer the last question. On single questions, the answer is transmitted to the host site when you press the ENTER key.  

**NOTE:** To confirm that your response has been received by the system, your letter or number choice will be found in brackets in the upper right-hand corner of the keypad display. |
| Erase a numeric answer. | ![Clear](image) | The answer in the window will be erased. On single questions, you must press CLEAR before you press ENTER. |
| See the next quiz question’s answer set, and any response you may have entered for that question. | ![Next Quest](image) | The next question’s ID and answer character set will appear on the keypad display. If you have already answered the question, your answer will also display. |
| See the previous quiz question’s answer set, and any response you may have entered for that question | ![Prev Ques](image) | The previous question’s ID and answer character set will appear on the keypad display. If you have already answered the question, your answer will also display. |
Rear Wheel Steering (QUADRASTEER™)

Introduction
Welcome
Welcome to Rear Wheel Steering (QUADRASTEERTM)

One Touch Familiarization
• Press the red call button to ask a question
• Wait for a green light before speaking
• Anticipate a momentary delay when speaking
• Contact the Technical help desk at 1-888-748-2687, prompt 1, if necessary

Question 1
In which of the following regions is your dealership located?
A. Atlanta
B. Chicago
C. Dallas
D. Los Angeles
E. New York

Course Goal
Upon successful completion of this course, you will be able to identify the Rear Wheel Steering System, associated components and apply concepts and procedures to diagnose the system operation.

Session Objectives
♦ Identify the Rear Wheel Steering System and its benefits
♦ Identify system components and their roles in operation
♦ Identify unique system features
♦ Identify diagnostic procedures

Strategy Based Diagnostics
Step 1. Verify customer concern
Step 2. Make quick checks
Step 3. Follow diagnostic system checks
Step 4. Check service bulletins
Step 5. Diagnostics
Step 6. Decision on cause isolation
Step 7. Repair and verification

Question 2
Which of the following best describes your experience level at GM dealerships?
A. Greater than 10 years
B. Between 5-10 years
C. Between 2-5 years
D. Less than 2 years

Special Instructions
The diagnostic charts in this courseware are for reference only. Refer to Service Information when servicing Rear Wheel Steering Systems.
### Course Components

- **A 1-component course** has no recommended prerequisite(s) or follow-up component.

- **A 2-component course** has a recommended prerequisite(s) CBT or Video component which you should complete before attending the IDL. (or) it consists of an IDL or CBT followed by a Hands-On component which you will need to take in order to complete the course.

- **A 3-component course** has a recommended prerequisite(s) CBT or Video component which should be completed before attending the IDL. You will need to take the follow-up Hands-On component in order to complete the entire course.

The dealership STS Report is credited when all components of the course are completed.

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**NOTICE:** You’ll see your Training Record and Individual Training Plan change as each course component is successfully completed. Just visit www.gmtraining.com and check TMS.

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*To purchase authentic GM Service Training Materials, contact the GM Training Materials Headquarters at 800-393-4831.*
Rear Wheel Steering
(QUADRASTEER™)

Module 1
Rear Wheel Steering Introduction
Module 1 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 and operation
- Identify the cautions associated with using in-ground hoist/jack stand

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
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 ahead 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)

The changes between the phases are subtle, gradual changes.
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 Outline – 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:
• 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 Outline cont. –

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:

Why do we use a 5° positive phase steering vs. a 12° negative phase?
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

Rear steering angle is determined based on:

• Mode selection by the driver
• Speed of the vehicle

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

Video Outline – Component Locations

• Steering Wheel Position Sensor – base of steering column
• Mode Select Switch – instrument panel
• Yaw Rate and Lateral Accelerometer – beneath front passenger seat (Removed in MY04)
• 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
• 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 – subsystem of the vehicle harness
**TECH TIP**

**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.

- 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:
  - Select "General Information" and then "General Information" again. Next select "Introduction". Finally select "Lifting and Jacking the Vehicle".

**Video Notes:**
Fill in the blanks on the illustration below with the letter for each component shown in the list.

Exercise: Component Locations

Components
A. Steering Wheel Position Sensor
B. Vehicle Speed Sensor
C. Mode Select Switch
D. Control Module
E. Steerable Rear Axle

Hit your flag key when finished.

Identify any one of the three inputs and its purpose.

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TECH TIP
Do NOT change the tire size. This may cause interference with the wheel housing and calibration concerns with the ABS, PCM and the Rear Wheel Steering Module.

Module 1 Summary
♦ Benefits of System
♦ Three Phases of Operation
♦ Three Modes of Operation
♦ System Components and Operation
♦ Caution When Using In-Ground Hoist/Jack Stand

TECH TIP
GM recommends you do not use tire chains with the Rear Wheel Steering System. The chains could hit the wheel housing when the wheels are turning left or right. If you must use chains, keep the vehicle in 2WS mode.
Rear Wheel Steering (QUADRASTEER™)

Module 2
Rear Wheel Steering System Operation
Module 2 Objectives

- Identify individual system components and their operation
- Identify unique system features
- Identify diagnostic information as it relates to component operation

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:
  - Steering Wheel 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
Steering Wheel Position Sensor

The Steering Wheel Position Sensor determines the driver’s steering input.

- Pin can only be installed in one position due to sensor cap alignment
- Not the same sensor used on earlier trucks for EVO
- Similar to that used on Corvette (active handling) or Cadillac’s Stabilitrac
- Located at base of steering column
- Identifies position of the steering wheel
  - Identifies direction that front wheels are pointed
  - Indicates how far the steering wheel is turned

Steering Wheel Position Sensor Signals (Outputs)

Unlike most two-wheel-steer trucks with this type of sensor, the Steering Wheel 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

Tech Tip

The Steering Wheel Position Sensor is pre-indexed and should NOT be rotated after pulling the shipping pin. If the shipping pin gets removed, or if you are reassembling a column and reusing the original sensor, you can center the sensor by plugging it into the harness and installing a scan tool. Navigate to the rear wheel data screen and view the steering wheel sensor analog voltage signal. Rotate the inner portion of the sensor to obtain 2.5 volts. This is the centered position. The sensor can now be mounted onto the column with the wheels in the straight ahead position.
Analog signals:
- 5-volt reference
- Signal out
- Sensor return
- Reports to BCM for MY2003 and above
- Vary between near 0 or near 5 volts for all Quadrasteer vehicles
- Indicate when steering wheel is furthest turning capacity of either direction (+/- 225 degrees from center)
- Indicate position of the steering wheel
- When the steering wheel is at 0 degrees, the analog sensor voltage will be about 2.5 volts

Digital signals:
- Phase A and Phase B signals indicate the direction and range of motion of the front wheels
  - Digital signals have a 12 volt reference and vary from approximately 11.49 to 0.25 volts (for MY03 and newer)
  - MY02 uses a 5 volt reference circuit
- Index pulse marker signal indicates:
  - When the steering wheel is in the centered position
  - When the front wheels are positioned straight ahead
  - Used for mode change
  - Sensor must indicate steering wheel has moved ±10° for change to occur
Steering Wheel Position Sensor Digital Output to Control Module

Notes:
Sensor Malfunction

These three bulletins are related to steering wheel position sensor malfunction: PI01736, PIT3057c, PI00196.

- For PI01736 - Ground fastening interior issue
  - G203: Left side of IP near A pillar is loose
  - G107 & G104: Braided ground from strap cowl to engine block is loose - ensure it is tight

- For PIT3057c, C0455 code - Specific wheel
  - Caused by steering wheel turned within first few seconds of engine start
  - BCM and RWS control module compare SWP data over Class 2
  - Class 2 bus is busy, message is delayed
  - Refer to bulletin

- For PI00196 - Underhood megafuse
  - Inspect megafuse; 125 amp at underhood fuse holder wire; may be loose
  - Check circuit 1042, red wire
Question 3
What assists with Steering Wheel Position Sensor installation?
A. Sensor molds to installation
B. Sensor is pre-indexed
C. Sensor is color-coded to mounting
D. 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 ohms to 2.2k ohms when switch is released
  - 450 ohms to 550 ohms 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
- Module is looking for specific voltage drop, depending on if the switch is pressed or released

Mode Select Switch
The position of the Mode Select Switch determines the steering mode selected by the driver.
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 in the shop
• 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
What is the main difference between 4-Wheel Steer Mode and 4-Wheel Steer in Tow Mode?

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**Mode Lamps**

If all mode lamps are illuminated, the vehicle requires wheel alignment. A learn alignment procedure is also required. Replacing the module without reprogramming will illuminate all the mode lamps.

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**Tech Tip**

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

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**Transitions**

To change modes, press the desired mode switch on the dash.

- Indicator lamp of selected mode flashes until steering wheel passes through center
  - passing through ±10 degrees
- Once steering wheel passes through center, indicator lamp of selected mode remains illuminated

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**Mode Lamps**

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.
- With the vehicle in the park or reverse position, Rear Wheel Steering is limited to ±5 degrees.
- PRNDL info is pulled from Class 2 data

If the system has a malfunction, the system will default to 2-wheel steer mode.
**Question 4**

If the Mode Select Switch lamps are all illuminated, ______.

A. replace the indicator  
B. the vehicle is in 4-wheel tow mode  
C. the mode is changing  
D. perform a learn alignment procedure

**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. It was eliminated in MY04.

- Voltage range for the sensor is 0 to 5 volts
- Sensor reports to rear steer module: uses special functions under rear steer to center the lateral accelerometer portion of the sensor
  - This zeros out the sensor settings and it learns center position

*Yaw Rate/Lateral Accelerometer Circuit*
Vehicle Speed Sensor

The Vehicle Speed Sensor (VSS), also used for the Instrument Panel Cluster (IPC) is used as a discrete input to the Rear Wheel Steering Control Module. If this signal is not present, the system will default to 2 wheel steer.

- The rear wheel steering module also receives a Class 2 VSS signal as a comparative signal
- If Class 2 and discrete signal vary by more than > 9 mph (15 kph), DTC C000 sets
- 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

Steerable Rear Axle

The steerable rear axle consists of:
- Ball joints
- Tie rods
- CV joints on quarter shaft
- Rear actuator
- DANA 9\(\frac{3}{4}\) in. limited slip differential
- Rear actuator assembly bolts in place of rear differential cover and serves as both differential cover and actuator mount
  - Axle fluid service does not require removal of the actuator, utilizes drain plug
  - Axle fluid contains a friction modifier
  - No recommended service interval

TECH TIP

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

1. Diaphragm seal must be rolled onto cardan joint to prevent damage

2. When inserting the axle shaft into the housing, be sure to avoid damaging the axle shaft oil seal

What components were added to make the rear axle steerable?

Rear Wheel Steering Control Module

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

The module is mounted in the rear underbody near 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

Pinch Point between Ball Joint housing area of the Rear Axle and the Steering Knuckle - OPEN

Pinch Point between Ball Joint housing area of the Rear Axle and the Steering Knuckle - CLOSED

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

- Calibrations are unique to each vehicle for MY02 only
- There are three different part numbers for the control module, each with an individual calibration
- For MY03 and later there is one part number and it is programmable through TIS

Control Module Features

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

C0550 will set with any internal failure in the rear wheel steering control module.

If normal Class 2 communication is interrupted or disabled, a DTC U1305 may set.
Question 5
Which of the following is a true statement about the 2002 Control Module?

A. There is only one software calibration.
B. A DTC C0550 can be set only one way.
C. It has three part numbers with three software calibrations.
D. 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

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

Video Outline – Operational Characteristics
- 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

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

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 (2-sided wrench)
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.

**TECH TIP**

When servicing the system, only puller J 24319-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

**TECH TIP**

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

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
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

Boot Check

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

Question 6

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

A. The actuator should be replaced.
B. The inner tie rod is worn.
C. The actuator is working normally.
D. The rear position sensor is out of alignment.

Rack and Pinion Boot

- Rack and Pinion Boots can be damaged by an in-ground hoist
- If boots are damaged on the hoist, replace the boots with boot kit
- 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

TECH TIPS
Rear Position Sensor

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

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
• Do not rotate sensor; it cannot be relocated
• Use Blue LocTite 242
• Properly torque bolt when reinstalling to 35 in/lbs
• Provides rear wheel steer control module with actuator position

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 is present when servicing Rear Position Sensor, replace actuator assembly
• If sensor is replaced, perform the learn alignment procedure
• With wiring or connection malfunction, replace motor assembly
  – Do not attempt to repair harness or terminals as they are integral part of motor assembly

What steering components could cause the vehicle to drift?
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.

Video Outline – Rear Position Sensor Operation

- 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.
Rear Position Sensor Circuit

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

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

Question 7

Does the Rear Position Sensor obtain its data from circuits internal to the steering motor?

Yes
No
Rear Wheel Position Sensor Diagnostic Information

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

- Position 1 signal (300 degrees either side of center) - approximate signal
  - provides module with approximate rack location
- Position 2 signal - refined signal
  - provides module with refined location depending on approximate signal
- At 2.5 volts, actuator is in the straight ahead position
- If voltage is too close to 0 volts or 5 volts, it indicates a circuit fault

Question 8
Which of the following is important to check when replacing the Rear Position Sensor?

A. O-ring lubrication
B. Bolt torque
C. Pinion alignment
D. Sensor cover index marks
Steering Gear Motor

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

- Mounts to top of Actuator Assembly
- Operates through planetary gear set at 45:1 ratio

Steering Gear Motor Unique Features

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

If the motor is not operating properly it could generate an electronic-related DTC, which is C0538.
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 shorts all 3 phases together, causing the motor to act as an electromagnetic brake whenever the module removes power, slowing the rear wheel return to center
- Relay shorts all of these phases together
- Relay slows vehicle with a controlled return; doesn't "snap" back
- Motor shorting relay power and ground
- 3 phase brushless DC motor

Steering Gear Motor Inputs/Outputs

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Question 9
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.

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steering Wheel Position Sensor</td>
<td>Commands Rear Actuator</td>
</tr>
<tr>
<td>Rear Wheel Steering Control Module</td>
<td>Controller Input</td>
</tr>
<tr>
<td>Rear Actuator</td>
<td>Positions Wheels</td>
</tr>
</tbody>
</table>

Hit your flag key when finished.
System Operation

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

Video Outline – System Operation

• Explain system operation by looking at its sensor data

• Steering Wheel 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

Module 2 Summary

♦ System Components
♦ System Operation
♦ Unique System Features
♦ Diagnostic Information
Rear Wheel Steering
(QUADRASTEER™)

Module 3
Four-Wheel Steering Alignment
Module 3 Objectives

- Identify Tech 2 Learn Alignment Procedure
- Identify Tech 2 Special Functions

TECH TIP

Replacement of any serviceable component, other than the rear wheel steering motor, requires a learn alignment procedure, which in turn requires a four-wheel alignment.

Alignment Guidelines

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

1. Repair concerns and clear DTCs from the RWS system
2. Clear the learned alignment parameters:
   - The steering wheel position sensor and rear wheel position sensor straight ahead info
   - Connect Tech 2 and follow Special Function instructions
3. Perform the mechanical alignment
4. Perform learn alignment procedure

Mechanical Alignment Procedure

1. Repair concerns and clear DTCs from the RWS system
2. Clear the learned alignment parameters:
   - The steering wheel position sensor and rear wheel position sensor straight ahead info
   - Connect Tech 2 and follow Special Function instructions

Clear Alignment Information
Mechanical Alignment Procedure cont.

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

4. Perform learn alignment procedure
   • START engine
     – check to be sure the rear wheels are centered (lift rear wheels)
     – if OK, press CONTINUE

Perform Mechanical Adjustments

Start Engine
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 to repair it

**Question 10**

Before clearing the controller learned parameters, it is important to _______.

A. turn the ignition OFF  
B. run the engine for five minutes  
C. diagnose and repair any DTCs  
D. learn sensor positions

**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.
Tech 2 Special Functions

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

- Lamps
- Motor control
- Steering commands

**Video Outline – Tech 2 Special Functions**

- 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
- 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
Notes:

Module 3 Summary
• Tech 2 Learn Alignment Procedure
• Tech 2 Special Functions

Evaluation Instructions
• Turn to the Evaluation at the end of this session in your workbook; remove and complete the course evaluation as instructed
• Use the keypad to answer the multiple choice questions
• Press the "Next Quest" key after answering each question
• Press "Yes" when completed
• Fill out the back of the evaluation form
• Include today's date, time and time zone
• Fax your written evaluation to the Detroit Training Center at (586) 576-3319
Rear Wheel Steering
(QUADRASTEER™)

Appendix
**** QUADRASTEER™ Service Update ****

Features of normal QUADRASTEER™ operation

· Rear angle is limited to 5 degrees in park (w/ no vehicle speed) - once vehicle speed is present the system is capable of 12 degrees.

· Rear angle is limited to 5 degrees when driving in reverse

· Neutral operation - system defaults to 2WS if in neutral for more than 4 seconds. The 2ws mode light will be illuminated and the previous mode will be flashing. When shifted out of neutral the system will automatically go back to the previous mode.

· Mode changes - QUADRASTEER™ will only change modes when the steering wheel passes through center, until then the requested mode will be flashing. ('03 and newer models will switch modes immediately if speed=0)

Vehicle requirements for QUADRASTEER™ to operate

· Engine must be running

· Alternator / Charging system must be functional. If a fault is detected by the Alternator/Charging system, the QUADRASTEER™ system will become inoperable to minimize battery drain.

· System voltage must be within a 9 - 16 volt range.

· System voltage is supplied by 1 high-current connection, 1 low-current connection, & 1 ignition line.

· Valid vehicle speed information from the PCM (hard-wired & class II message) and ABS (class II message) must all correlate.

· Valid hand wheel position information must be received. Analog information from the Truck Body Controller (TBC) via Class II and digital information is obtained from phase A, phase B, & Marker pulse of the position sensor wired directly to the QUADRASTEER™ control module.

· Valid signals from rear position sensor.
Most common mis-diagnosed QUADRASTEER™ issues

· QUADRASTEER™ does not operate and all three mode lights illuminated solidly
  
  *May be caused by*
  
  – Service control modules need to be programmed (03 MY and above) and/or needs tech II alignment to be performed. No class II information is available until module is programmed.

· QUADRASTEER™ does not operate and blinking mode lights
  
  *May be caused by*
  
  – Vehicle in Neutral. QUADRASTEER™ will return to normal operation when shifted out of Neutral and steered through straight ahead.

· C0550 DTC - internal controller fault
  
  *May be caused by*
  
  – A loose 125 Amp Mega-fuse.
  – Shorted Lat / Yaw combo sensor
  – Water intrusion into rear position sensor

· C0522 DTC and/or C0532 DTC - Rear Wheel Sensor and Rear Sensor to Hall Comparison
  
  *May be caused by*
  
  – Shorted Lat / Yaw combo sensor
  – Water intrusion into rear position sensor

· C0455 DTC - Handwheel Position Sensor (HWPS)
  
  *May be caused by*
  
  – Improper terminal tension at HWPS connector
  – Loose or damaged ground at circuit G203 (03 MY and above).
  – Damaged harness between C201 and HWPS connector

· QUADRASTEER™ inoperable with no DTC’s present
  
  *May be caused by*
  
  – Missing required vehicle signals such as Ignition (541), Batt2 (2640), Engine Run message (Class II) or faulted Charging System. See Vehicle Requirements for QUADRASTEER™ Operation above.

**Note:** Clearing History DTCs from the controller is NOT required to restore normal operation during troubleshooting. PLEASE LEAVE CODES STORED IN THE MODULE. This will aid in root cause analysis.
Rear Wheel Steering
(QUADRASTEER™)

Evaluation
Customer Satisfaction Survey
Interactive Distance Learning

We value your opinion regarding this course. Please take a few minutes to complete this evaluation, including your suggestions for course improvements.

If a statement does not apply, leave it blank.

Relevance / Value

1. This course provides knowledge/skills useful to me now and/or in the future.  
   Strongly Disagree  Disagree  Somewhat Agree  Agree  Strongly Agree
2. This course met the stated objectives.  
3. I will recommend this course to others.  

Design

4. The amount of material presented in this course is just right.  
5. The content is realistic and practical.  
6. The content is sequenced so that it is easily understood.  
7. The participant materials support the instructor’s presentation.  

Instructor

8. The instructor appeared well-prepared and organized.  
9. The instructor demonstrated a thorough understanding of the subject matter.  
10. The instructor presented course material at a comfortable pace.  
11. The instructor responded effectively to questions.  

Delivery

12. There were no technical (equipment) problems during this course.  
13. Handouts, workbook, visuals and/or other aids are clear, effective, and understandable.  
14. The activities / exercises helped me better understand the information presented.
Customer Satisfaction Survey
Interactive Distance Learning

We value your opinion regarding this course. Please take a few minutes to complete this evaluation, including your suggestions for course improvements.

Course Date: _____/_____/_____   Time: _________________   Time Zone: AT ET CT MT PT

Instructor's Name: ____________________________________________________

Additional Comments

Please share any additional comments you may have to improve the **relevance** of this training.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Please share any additional comments you may have to improve the **design** of this training.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Please share any additional comments you may have regarding the **instructor** conducting this training.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Please share any additional comments you may have to improve the **delivery** of this training.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Please share any additional comments, positive or negative, you may have regarding course improvements.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Thank you for taking the time to help us build an effective GM Distance Learning Program.

Please fax to: Detroit IDL Center at 586-576-3319