

## Section 8 Topics

### Diagnosing Vehicle Handling Concerns

- ▶ Customer Expectations
- ▶ 6-Step Troubleshooting Process Overview
- ▶ Verify the Complaint - Step One
- ▶ Classify the Complaint - Step Two
- ▶ Chassis Inspection - Step Three
- ▶ Pinpoint Diagnosis - Step Four

 **Test Drive**

### Technician Objectives

1. Demonstrate a thorough test drive, describing a given vehicle's performance under each of the most common driving conditions.
2. Identify and classify a handling complaint using the results of the test drive, the definitions listed in the textbook and specifications from the Repair Manual.
3. Describe the next logical inspection areas for a given vehicle based on the test drive and complaint classification.
4. Describe the process of conducting a thorough chassis inspection and how the chassis inspection contributes to the diagnostic process.

## Customer Expectations

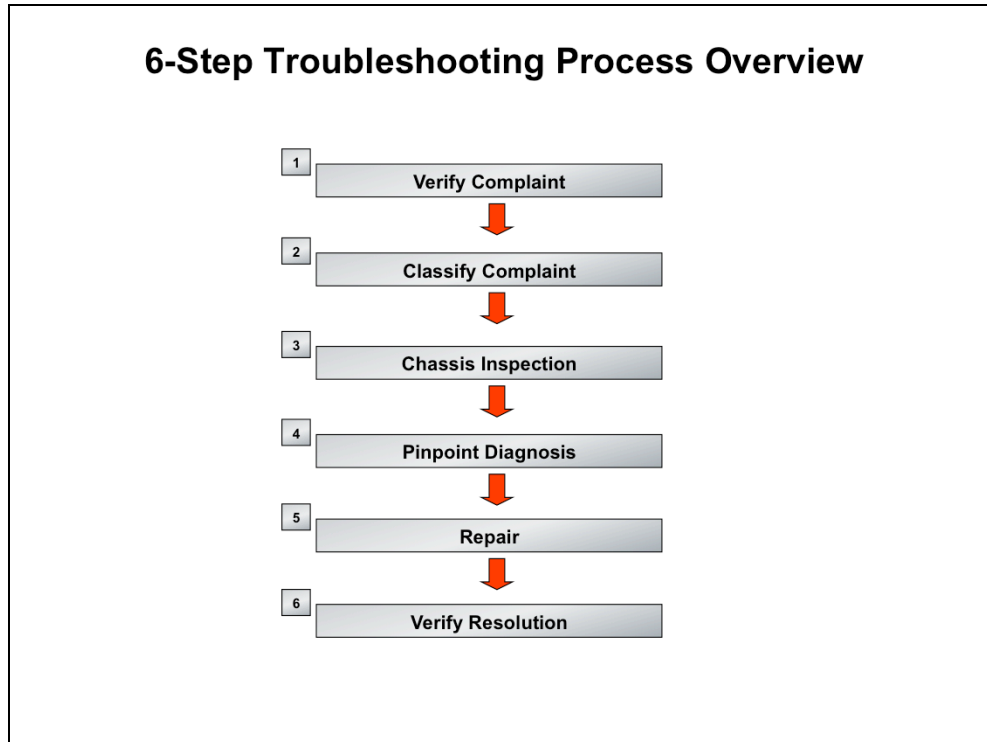


### Customer Expectations

Customer expectations regarding vehicle handling can vary widely based on the intended use of an automobile. One customer may desire a **smooth, quiet ride with predictable handling**, while another may be interested in **rapid acceleration and superior stopping ability** and may not be as concerned about ride quality. Although, customer expectations may vary considerably, most will, to some degree expect their vehicle to:

- Travel straight with minimal driver input
- Stop safely
- Steer responsively
- Absorb road shocks
- Maintain vehicle stability (limit body roll)
- Deliver a comfortable and quiet ride
- Minimize tire wear

When these expectations are not met, the vehicle will be brought in for service. Diagnosis of handling complaints is similar to the diagnosis of any other vehicle problem. You must thoroughly understand the proper function and operation of the systems, subsystems, and individual components involved, as well as **follow a consistent troubleshooting procedure**.



### **6-Step Troubleshooting Process Overview**

The diagnosis of handling complaints follows a six step troubleshooting process. This process provides a proven, systematic method for resolving customer complaints.

#### **1. Verify the Complaint**

- Duplicate the condition to see, feel and hear what the customer is concerned about.

#### **2. Classify the Complaint**

- Completely and accurately describe the complaint and any related conditions.

#### **3. Inspect the Chassis**

- Perform a general inspection of the chassis to eliminate possible causes of the complaint and direct your diagnostic effort.

#### **4. Pinpoint the Diagnosis**

- Inspect only those items that could be possible causes of the customer complaint.

#### **5. Repair the Problem**

- Adjust or replace the components causing the concern.

#### **6. Verify the Resolution**

- Repeat the complaint conditions to confirm that the cause of the complaint has been resolved.

## Verify the Complaint – Step One



Customer Communication



Visual Inspection



Thorough Test Drive

### Verify the Complaint – Step one

Verification of the customer complaint is **the single most important step** of any diagnosis. It is impossible to repair a complaint that cannot be verified. On the other hand, you should never try to repair a complaint that is a normal characteristic of a specific vehicle.

In the interest of customer satisfaction, simply attempting a wheel alignment for every type of handling complaint is not acceptable. Understanding the exact reason the customer brought their car in for service is vital to an accurate diagnosis and repair, and more importantly fulfilling their expectations.

Verification of the complaint involves three components:

1. Customer communication
2. Visual inspection
3. Thorough test drive

## Customer Communication

- ☐ What is the customer's specific concern?
- ☐ Under what conditions is the vehicle normally operated and under what conditions does the concern occur?
- ☐ What is the vehicle's recent service history?



### *Customer Communication*

It is **important to understand why** a customer is concerned or a service is being requested. This information can provide valuable clues to the root cause of the complaint.

Situations that might prompt a customer to request an alignment might include:

- Abnormal tire wear
- New tires
- Changes or problems in the vehicle's handling
- Recent accident damage
- Major powertrain service

The customer should answer three questions, if possible, before you begin the service. The answers to these questions will help ensure a proper repair the **FIRST** time the vehicle is brought to the dealer for service.

- 1. What is the specific concern?** You will need specific details of what the customer sees, feels and hears that they believe is abnormal.
- 2. Under what conditions is the vehicle normally operated and under what conditions does the concern occur?** Find out when, where, and how the condition occurs and what are the road and weather conditions when it is happening.
- 3. What is the vehicle's recent service history?** Be sure to include all service, both mechanical and body or paint work.

## Visual Inspection

- ☐ Tire wear, size, type, and inflation pressure on each axle pair
- ☐ New tires, how many and their position on the vehicle
- ☐ Vehicle loading or signs of overloading
- ☐ Any accident damage or recently repaired accident damage including body panel fit and finish



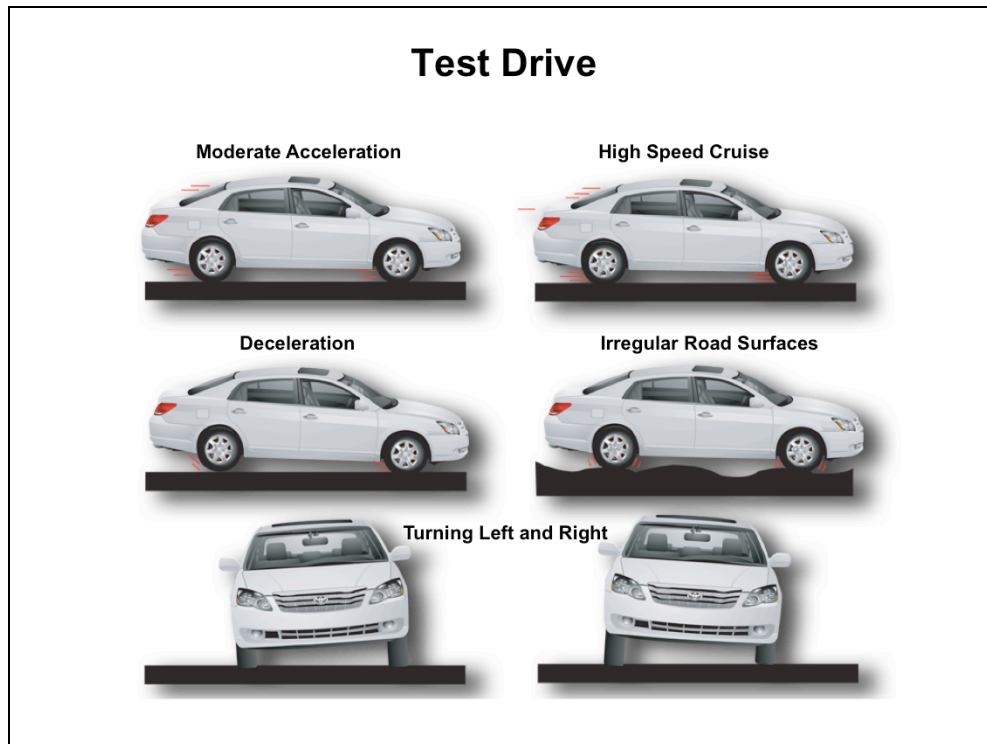
### *Visual Inspection*

The **visual inspection** is a precautionary measure and an initial diagnostic step to allow you to identify any safety concerns, obvious vehicle damage, or other visible problems that may be effecting the handling of the vehicle.

A short, but concise walk-around inspection can reveal a great deal about both the mechanical and operating conditions of the vehicle. You should pay close attention to:

- Tire wear, size, type, and inflation pressure on each axle pair
- New tires, how many and their position on the vehicle
- Vehicle loading or signs of overloading
- Any accident damage or recently repaired accident damage including body panel fit and finish

It is important to only note your findings and **not attempt any repairs prior** to the test drive, unless you find obvious safety concerns. The visual inspection is only a brief information-gathering step to identify any obvious problems. Any changes or repairs made at this point may influence the results of the test drive and prevent accurate duplication of the customer complaint.



**Test Drive** The test drive is critically important for two reasons. First, it provides an opportunity to see, feel, and hear the handling characteristics of the vehicle, which will allow you to confirm the condition and the success of your repairs. Secondly, you may notice problems that may have come on so slowly that the customer is unaware of them. Whether the customer is requesting an alignment for maintenance reasons or concerned about a handling problem, a test drive is always necessary to **verify the condition of the vehicle both before and after the service and repair.**

A thorough test drive should include all of the following conditions in addition to all of the complaint conditions described by the customer.

1. While **accelerating from a stop**, check for pulling, abnormal noise, excessive rear squat, and vibration.
2. Drive the vehicle on a **level road at a constant cruising speed** and check for steering wheel position, steering system play, pulling, drifting, or wander and shimmy.
3. While **decelerating and braking**, check for pulling, brake dive, abnormal noises, and vibration.
4. **Turn the vehicle both left and right** and check for steering assist and response, returnability, body roll, tire squeal, and abnormal noise.
5. Drive the vehicle on a **rough surface** and check for excessive suspension oscillation, suspension travel, road shock, bump steer, noise, and vibration.

A good test route allows you to inspect the vehicle's operation under all of these conditions. It should also be consistent and close to your service facility. Thorough and consistent test driving allows you to accurately compare the performance of specific models and become familiar with their responses under similar conditions.



## Unverifiable Complaints

### Do Not Repair What Cannot Be Duplicated

#### Normal Characteristic of Vehicle



#### Insufficient Information From Customer

#### *Unverifiable Complaints*

If the customer complaint cannot be verified during the test drive, further information should be gathered before any repairs are attempted. Perhaps the conditions required for duplicating the conditions were not fully understood or the concern is a normal characteristic of the vehicle.

Customer satisfaction may only require consultation and education, rather than diagnosis and repair. You should **never attempt to fix a concern that cannot be duplicated** or worse yet is a normal condition of the vehicle. Keeping this in mind, remember the problem is important to the customer or they would not have brought the vehicle to you for service. Your job is to alleviate the customer's concern by repair or education.

Proper verification of the complaint cannot be stressed enough. If you do not confirm how the vehicle was operating before your repair, you have no valid basis for your post-repair expectations.



## Classify the Complaint – Step Two

- ☐ Pulling
- ☐ Wander/Directional Stability
- ☐ Returnability
- ☐ SWOC (steering wheel off center)
- ☐ Hard Steering
- ☐ Loose Steering
- ☐ Excessive Road Shock
- ☐ Premature Tire Wear
- ☐ Shimmy
- ☐ Body Shake
- ☐ Cabin Stability



### Classify the Complaint – Step Two

Classifying the complaint begins with an accurate description of the symptom. Customer or Service Advisor descriptions of a vehicle's symptoms may be unclear and can therefore be misleading to your diagnosis. After verifying the complaint personally, you should have the necessary information to accurately describe the symptom or symptoms and classify them accordingly.

Symptom classification is not a diagnosis; rather, it is a complete and accurate description of the handling complaint. Accurate classification directs you to those areas that can be causing the complaint and eliminates testing and inspecting those areas that cannot. This process of elimination helps determine the pinpoint diagnosis methods you will select.

The following list of symptoms and their definitions describes the majority of handling complaints faced by suspension and alignment technicians. By evaluating the information gathered during the complaint verification and road test procedures, you should be able to classify the complaint as one or more of these symptoms.

- **Pulling** is a condition where steering effort is required to keep the vehicle traveling straight.
- **Wander/Directional Stability** is a condition in which the vehicle requires continuous driver correction to maintain straight line traveling.
- **Returnability** is the tendency of the front wheels to seek a straight-ahead position following a turn. Returnability problems can be either poor returnability or excessive returnability.

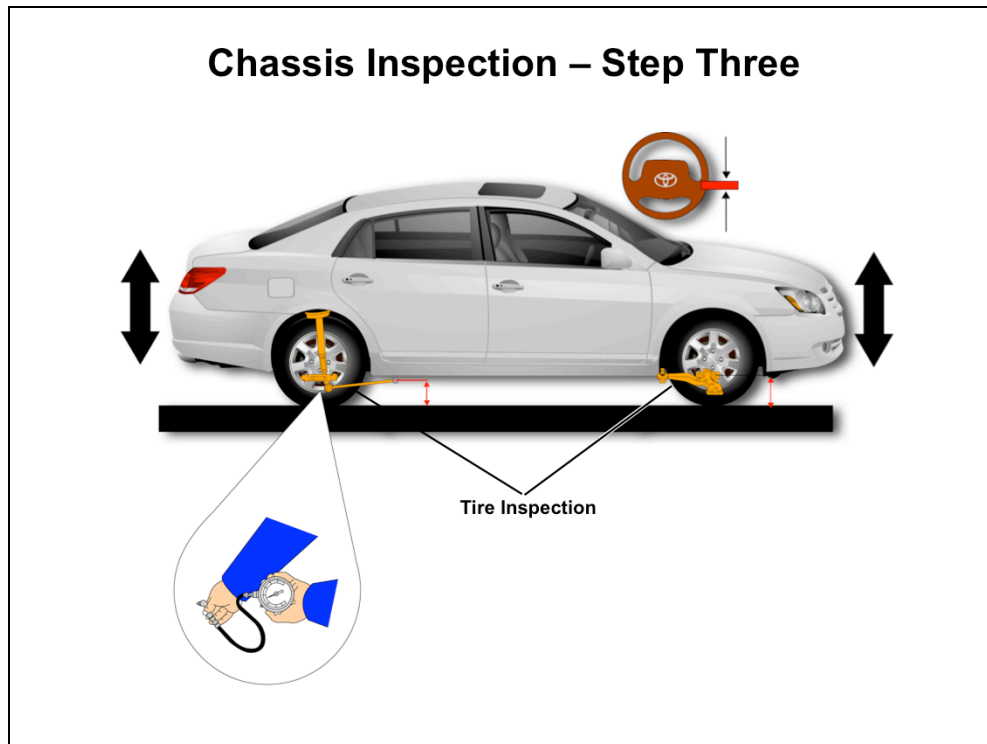
## 453 Suspension, Steering and Handling

### Classify the Complaint – Step Two (cont'd)

- **SWOC (steering wheel off center)** is a condition in which the steering wheel is off center to the left or to the right when the vehicle is traveling straight ahead.
- **Hard Steering** is a condition where excessive effort is required to turn the vehicle.
- **Loose Steering** is a condition where vehicle reaction to steering input is sluggish and unresponsive.
- **Excessive Road Shock** is a condition where road forces are transmitted to the chassis and passenger compartment.
- **Premature Tire Wear** is a condition where tread life is shorter than expected or wear is localized to one area of the tread surface.
- **Shimmy** is a condition where the front wheels of the vehicle oscillate laterally, resulting in rotational movement at the steering wheel.
- **Body Shake** is a major vertical and/or lateral vibration of the body, seats and steering wheel.
- **Cabin Stability** conditions include body roll when turning, excessive squat on acceleration or dive on deceleration and excessive bouncing when traveling over bumps.

If necessary, qualify your classification with the applicable conditions under which the complaint occurs. For example, the vehicle pulls to the right under braking or shimmy occurs at 55 mph. in overdrive.

Following complaint verification and classification, the next step in the diagnosis of handling complaints is a chassis inspection. This step verifies the general condition of the suspension components, steering linkage and tires. The results of these inspections will determine your course of action for pinpoint diagnosis, as well as allow you to identify any additional items that may be in need of service.



### Chassis Inspection – Step Three

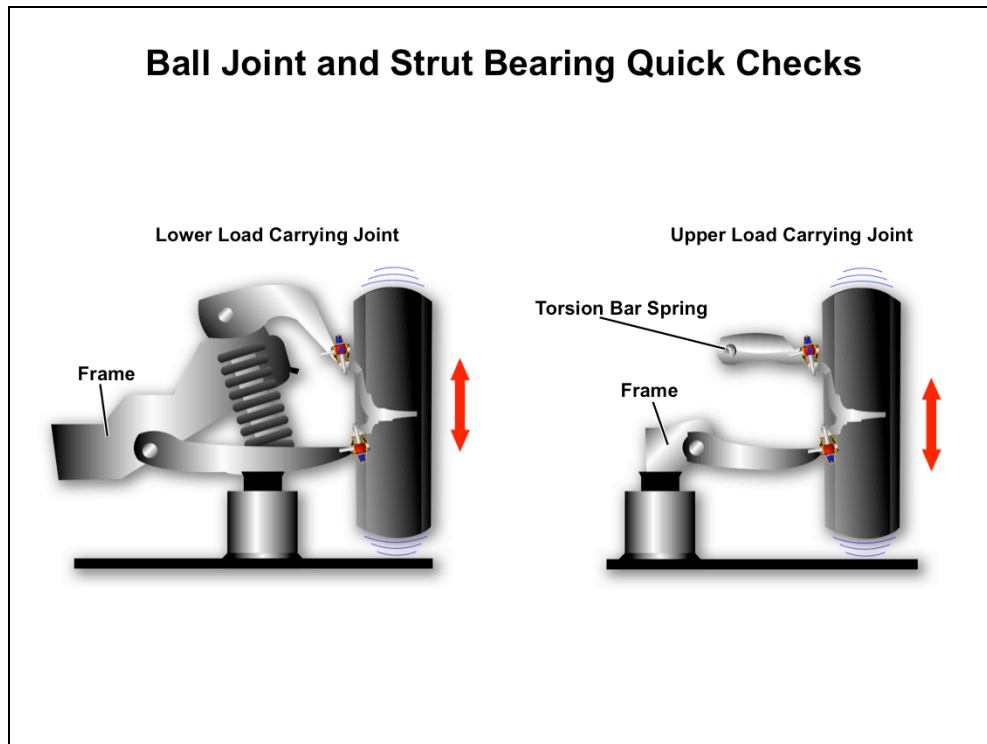
The chassis inspection consists of two stages:

- Vehicle at its normal ride height
- Vehicle raised.

With the wheels on the ground you are concerned with four inspections:

- **Tire Condition:** Check for size, type, and inflation pressure on each axle pair. Also check for excessive, abnormal, or irregular tread wear.
- **Ride Height:** Inspect the ride height using the measuring points specified in the Repair Manual. Be certain the vehicle is not abnormally loaded and is resting on a level surface.
- **Steering System Free Play:** Perform a dry park check. Maximum free-play for most models is 30 mm. With the help of an assistant, observe the steering and suspension joints for wear while the assistant turns the steering wheel back and forth through the resistance.
- **Shock/Strut 'Jounce' Test:** Jounce the vehicle at each corner. Excessive oscillation (generally two or more) indicates worn shocks or struts.

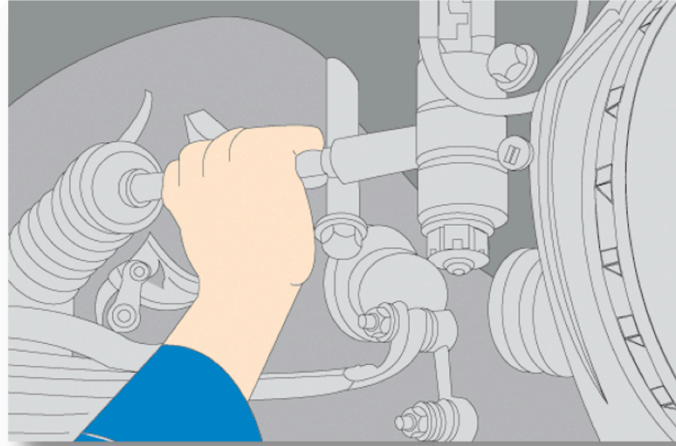
After completing the checks with the vehicle in its normal position, raise the vehicle and support it properly. The preferred method is to support the vehicle with the front suspension ball joints unloaded and the rear of the vehicle raised. This support method allows you to make all of your under car inspections without changing the vehicle's position. Your inspections with the vehicle raised will focus on the condition of the components that can influence the vehicle's alignment geometry and handling.



*Inspections with  
Vehicle Raised*

- **Under Car Visual:** After raising the vehicle, your first inspection should be a visual check. Look for obvious physical damage to any suspension or steering component, fluid leakage, the condition of all grease boots, and the condition of engine and transmission mounts.
- **Ball Joints:** Lift and support the vehicle correctly to unload the ball joints and inspect them for free play. Check for vertical play in the load carrying joint by trying to raise the tire with a pry bar. Any perceptible play in the joint will require you to closely inspect the joint following the specific procedures recommended in the Repair Manual. On strut suspensions this same inspection will identify any vertical play in the upper strut bearing (zero play is allowed) and the lower ball joint.
- Rocking the tire from top to bottom (twelve and six o'clock positions) will often indicate any horizontal play in the non-load carrying joint or the upper strut bearing. Differentiating between wheel bearing play and play in the upper strut bearing or ball joints only requires application of the service brakes. If the play is eliminated, the problem is likely the wheel bearing, if not, the ball joints or strut bearing may be the source of the play. Trying to move the control arm while watching for excessive movement at the joint is also an acceptable method for checking non-load carrying joints. Again, any joints that appear questionable must be checked following the procedure outlined in the Repair Manual for the specific vehicle.
- Ball joints should also be inspected for damaged grease boots as this leads to contamination of the joint and accelerated wear.
- **Springs/Shocks/Struts:** Inspect visually for physical damage, mounting problems, missing spring insulators, and any evidence of deformation or misalignment. Shock absorbers and strut assemblies should also be inspected for fluid leakage. Any significant oil leakage may require replacement of the shock or strut.

## Steering System Quick Checks



### *Inspections with Vehicle Raised (Cont'd)*

- **Steering Linkage:** Facing the vehicle, grip both tires and move them laterally. Excessive play may indicate a loose joint in the steering linkage or possibly a loose wheel bearing. Pinpointing the source of the play involves careful examination of each joint in the steering linkage from the steering wheel to the steering arms.
- Inspection of the individual joints involves physically moving each joint attempting to isolate the worn or loose component. Consider all of the following areas when attempting to isolate the source of excessive steering play:
  1. Worn tie rod ends (inner and outer)
  2. Loose linkage mounting (idler arm)
  3. Loose steering shaft joints or flexible coupling
  4. Loose steering gear mounts
  5. Loose steering wheel
  6. Loose wheel bearings
  7. Steering gear lash
- **Bushings and Links:** Look closely at each bushing, identifying any decay, damage, or excessive play. Small hairline cracks are acceptable in rubber bushings as long as the bushing is not disintegrating. Using a pry bar, inspect for play at the mounting points of the control arms, strut rods, stabilizer bars, and lateral control rods, at both the front and rear of the vehicle, as equipped. Play at these locations may be caused by loose mounting or by worn bushings. Ball and socket joints used for anti-roll bar links should show little or no play.

---

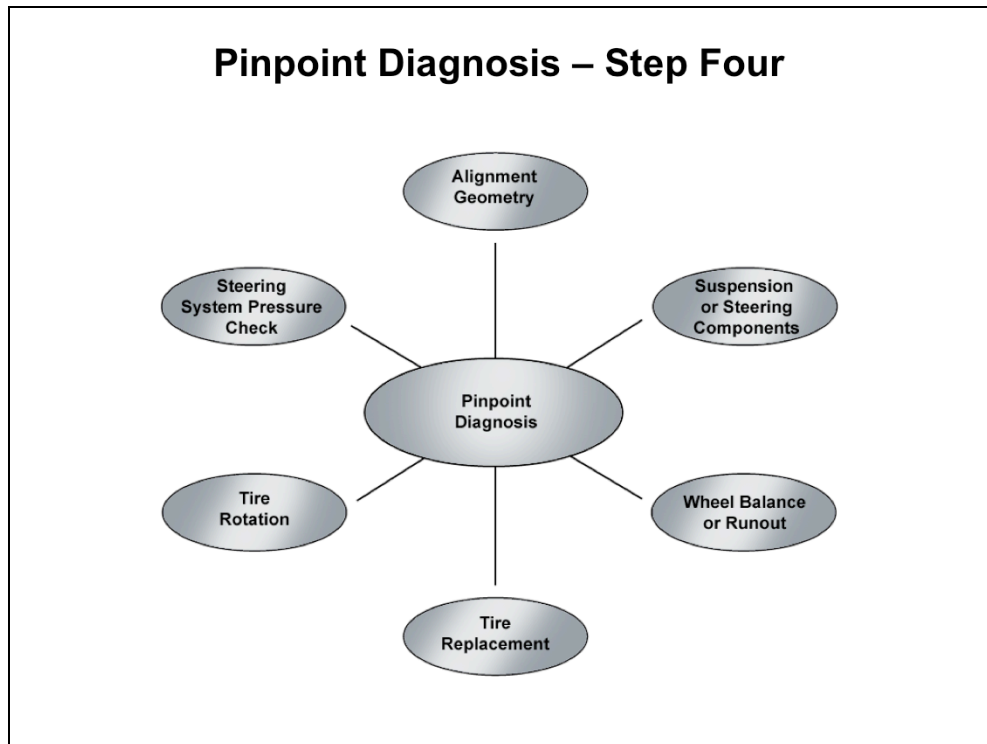
**453 Suspension, Steering and Handling***Inspections with Vehicle  
Raised (Cont'd)*

- **Other Systems:** Moving the wheels side to side, similar to the inspection for the upper strut bearing, will help identify any excessive wheel bearing play. Rotate each wheel several times after making this inspection to check the rotation condition of the wheel bearings as well as identify any brake problems. Also visually check the condition of engine and transmission mounts.

*Document Inspection Results*

Document the results of your inspection on the repair order. If the chassis inspection reveals the cause of the customer complaint, further pinpoint diagnosis is not necessary. Move ahead with the repair or replacement of necessary components. Remember, wheel alignment correction is necessary if you replace any suspension or steering components that effects the position of the wheels.

The first three steps of this diagnostic process determine your course of action for identifying and repairing the cause of the customer complaint. Following a consistent, systematic process for each diagnosis will enable you to repair more handling complaints, faster.



**Pinpoint Diagnosis – Step Four**

The fourth step of the diagnostic process is pinpoint diagnosis. At this point in your diagnosis you must make several decisions about how to approach this customer concern. In this step you will **determine what you need to do** to the car.

Diagnosis is a process of elimination. By identifying what is not causing a concern, you can direct your energy towards the items that could be the cause. Pinpoint diagnosis is a **process of focusing your efforts** to determine a strategy for finding the root cause of the handling complaint.

Selecting where to focus your diagnosis depends upon the likely causes of the complaint and which of those can be easily eliminated as possibilities. For example, consider a customer complaint of a significant pull to the right on level roads under a steady cruise condition. After verifying the complaint, you find no other related symptoms or qualifying conditions and classify the complaint as Pulling.

Next, compare the results of a chassis inspection to the symptom matrix. Tire pressure, ride height, worn suspension, and steering components, major physical damage and environmental influences can all be eliminated as causes by the test drive and chassis inspection. In this case, alignment geometry or tire concerns would then stand out as the most logical areas for further inspection.

Note that not every possible cause for a specific complaint is listed in the causes section of the matrix. Your understanding of how the tires, suspension, steering, and other vehicle systems influence handling should allow you to narrow your search for a root cause.

After making the repairing (**Step 5**) don't forget to complete Step 6 (**verifying the resolution**) to confirm that the cause of the complaint has been resolved under the same conditions as the original complaint.

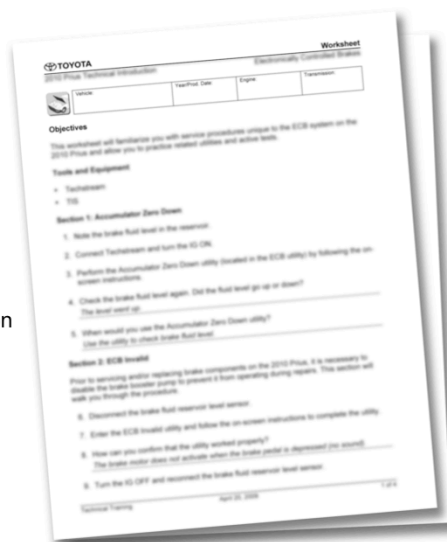


## Worksheet

### Test Drive (In Vehicle)

In this worksheet you will:

- Perform a test drive to verify and classify a concern
- List several possible causes for a classified concern
- Perform a thorough chassis inspection



*Use this space to write any questions you may have for your instructor.*

### NOTES: