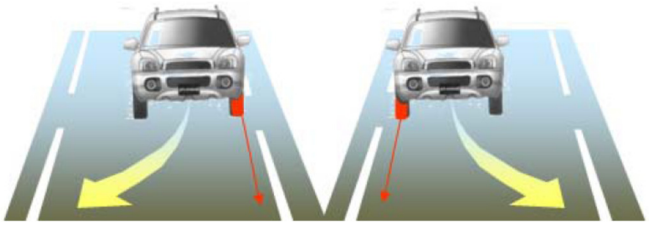
HYUNDAI Technical Service Bulletin	GROUP	NUMBER
	SUSPENSION	**20-SS-001H**
	DATE	MODEL(S)
	FEBRUARY 2020	**ALL**

SUBJECT WHEEL ALIGNMENT REQUIREMENTS AND BEST PRACTICES

THIS TSB SUPERSEDES 16-SS-001 TO UPDATE THE VEHICLE ALIGNMENT DATA SHEET AND THE VEHICLE ALIGNMENT DIAGNOSTIC FLOWCHART.

Description: This bulletin describes the requirements for all wheel alignment and/or vehicle tracking claims and best practices when diagnosing and conducting alignment-related repairs for all models and model years.



Applicable Vehicles: All

★ NOTES

- ★ **Aligner Calibration/Maintenance Schedule** - All dealer alignment racks must be calibrated by a representative every six months. This frequency allows the representative to update vehicle specifications, and inspect and maintain equipment.
- The Vehicle Alignment Data Sheet located at the end this TSB **MUST** be stored with the RO for **ALL** alignment and/or vehicle tracking claims. (All models and model years)
- Additionally, if an alignment is performed, a before and after measurements printout **MUST** be stored with the RO for **ALL** alignment and/or vehicle tracking claims. (All models and model years)
  - **The VIN MUST be included on the alignment printout.**
- **Always refer to the applicable vehicle shop manual for alignment specifications.**
- For all alignment-related conditions, Dealers and Sublet Vendors must adhere to the Vehicle Alignment Diagnostic Flowchart located on Page 2, and at the end of this TSB.
- Test drives should be performed without passengers or excessive cargo in the vehicle.
- The Absolute Steering Position (ASP) calibration must be performed using GDS on vehicles equipped with Electric Power Steering (EPS/MDPS) after an alignment has been completed.
- To perform a proper vehicle drift/pull diagnosis, use a Hunter GSP 9700 equipped with StraightTrak.

Warranty Information:

Model	Op. Code	Operation	Op. Time	Causal Part	Nature Code	Cause Code
ALL	52903A00	Alignment Diagnosis/Repair	1.1	ALIGN-00000	D44	ZZ5

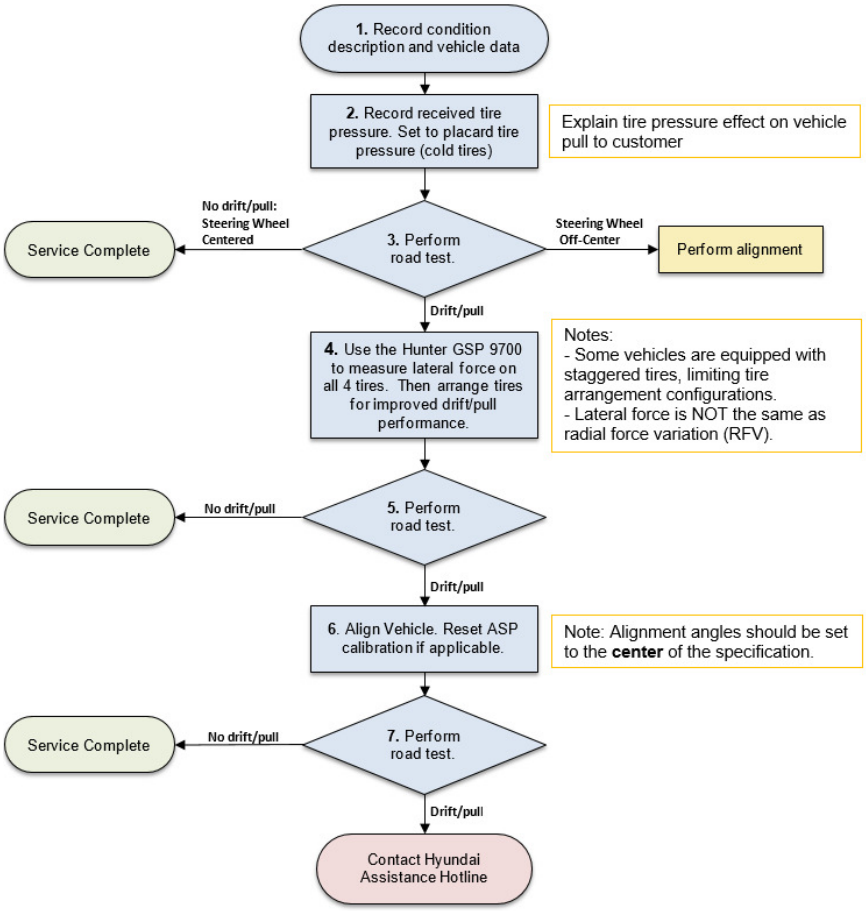
The Vehicle Alignment Data Sheet must be completely filled and attached to the RO for any vehicle drift/pull and/or alignment warranty claims.

If an alignment is performed, the machine printout displaying the before and after measurements must also be attached to the RO, and the measurements must be included in the technician's comment section of the warranty claim.

Vehicle Alignment Diagnostic Flowchart

★ NOTES

- When a vehicle is received with an alignment/drift/pull/steering wheel off-center condition, the service writer should document the customer comments on the Vehicle Alignment Data Sheet.
- Refer to the last 2 pages of this TSB for the detailed flowchart and data sheet.
- Many issues can contribute to vehicle drift or pull, including tire pressure, tire uniformity, wheel alignment, brake drag, road crown, cross winds, spring sag resulting in ride height differences, cargo load/weight distribution, and more.
- Consider all potential effects when diagnosing and confirming a vehicle drift or pull condition.

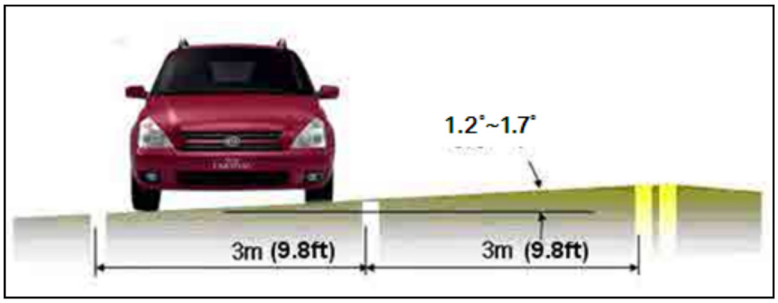


Road Test Procedure

★ NOTE

Perform road testing without passengers (driver only) and excessive weight.

1. Locate an acceptable vehicle testing road which meets the following criteria:



Recommendations	- Road is straight for at least 250m (820 ft). - Road grade: 1.2 to 1.7 degrees maximum. The flatter the better. - Lane width: 3 to 3.5 meters (10-11.5 feet).
Cautions	- Conduct the test on a smooth, even road without bumps or grooves. - Do not test on a road with excessive grade/crown. - Conduct the test on an uncrowded road. - Do not test when strong winds are present.

2. Before test driving, verify that all tires are OEM, correctly installed (directional tires, correct placement for staggered sizes, etc), and set to the correct inflation pressure.

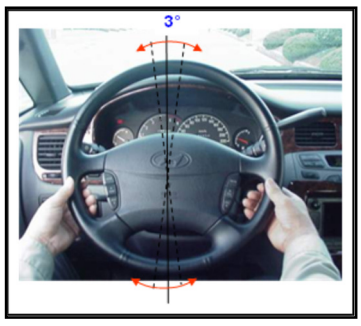
★ NOTE

For best accuracy, use the GDS to measure tire pressures under TPMS system: Current Data.

3. If equipped, turn OFF all driver's assist systems.
4. Drive through the vehicle testing road at 40 MPH. Center the steering wheel, then slightly turn the wheel ~3 degrees to the left and ~3 degrees to the right to identify the steering center. With a light touch, center the steering wheel with the vehicle tracking as straight as possible.

★ NOTE

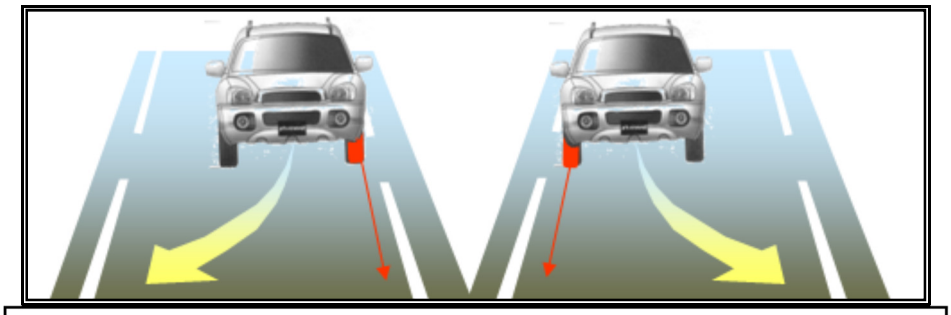
If the vehicle drives straight but the steering wheel is off-center, perform an alignment to correct the condition.



5. Note which direction the vehicle has a tendency to drift towards. If the vehicle tends towards the left, place the vehicle on the right side of the lane. If the vehicle tends towards the right, place the vehicle on the left side of lane as shown below.

★ NOTE

To ensure accuracy, repeat the test with the vehicle travelling in the opposite direction (on the same road).



<Drifting or Pulling to the Right> <Drifting or Pulling to the Left>

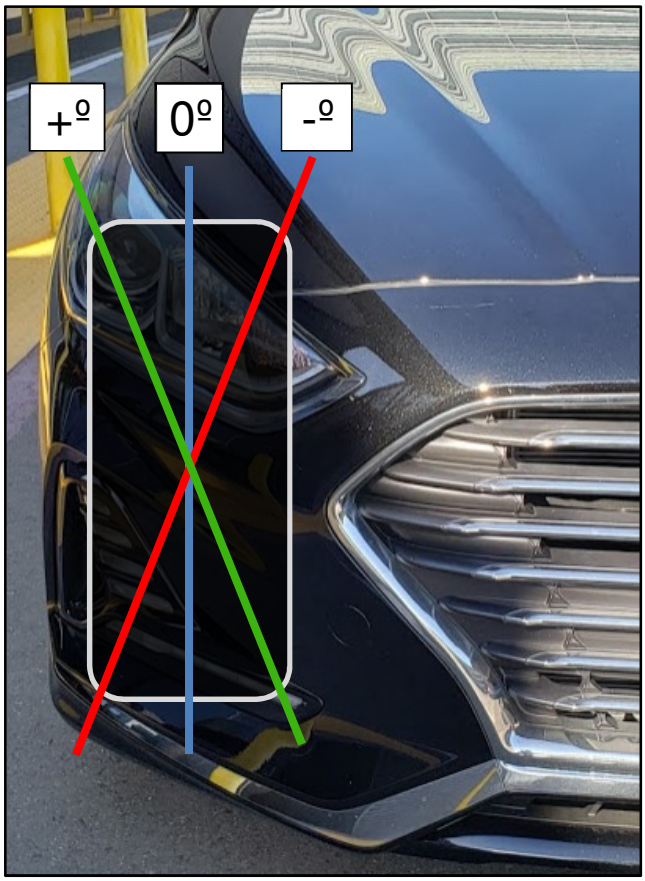
6. Take time measurements to determine how long it takes for the vehicle to move from one side of the lane to the other side (case 1), as shown. Use the conditions in the table below to confirm drifting or pulling condition.

Condition	Drift/Pull Criteria	
The vehicle moves from one side of the lane to the other side of the lane (about 1m or 3.3 feet).	Pass	The movement takes more than 6 seconds at 40 MPH.
	Fail	The movement takes 6 seconds or less at 40 MPH.

Alignment Angle Definitions

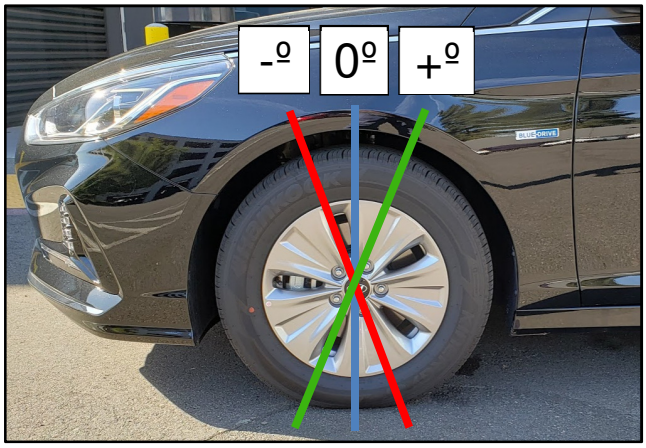
Camber The angle between the vertical axis of the wheel and the vertical axis of the vehicle when viewed from the front or rear.

- **Positive** (green line): The upper sidewall of the tire is tilted away from the center of the vehicle.
- **Negative** (red line): The upper sidewall of the tire is tilted towards the center of the vehicle.



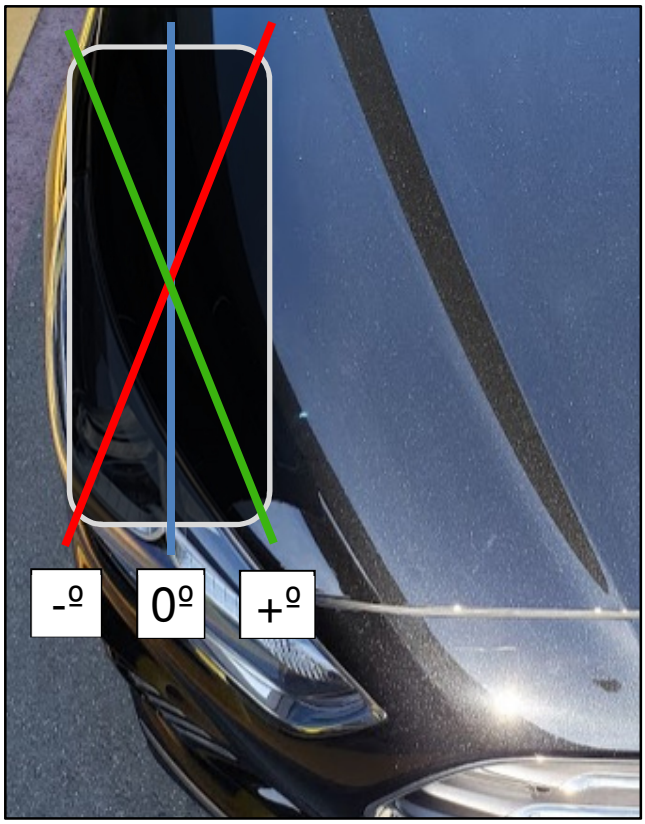
Caster When viewing a vehicle from the side, the angle of the steering axis is defined by drawing a line through the upper and lower ball joints (for a double wishbone front suspension), or through the strut tower mount and the lower ball joint (for a MacPherson strut front suspension).

- **Positive** (green line): The line leans towards the rear of the car.
- **Negative** (red line): The line leans towards the front of the car.



Toe The amount the tires point inwards or outwards when viewing the car from above.

- **Positive** (green line): Toe-in – the tires point inwards towards the center of the vehicle.
- **Negative** (red line): Toe-out – the tires point outwards away from the center of the vehicle.



Factors that Influence Vehicle Drift/Pull

Vehicle drift or pull can be attributed to several factors. Understanding what can affect drift/pull is necessary to repair a vehicle with a drift or pull condition.

Air pressure – A front tire with low pressure can cause a vehicle to drift or pull towards that tire.

Alignment

- **Camber** – A vehicle will drift or pull towards the side with more positive front camber. The camber difference between the front tires should be less than 0.5 degrees.
- **Caster** – A vehicle will tend to drift or pull towards the side with less positive caster.
- **Toe** – **Front and rear toe alignment will not affect vehicle drift or pull performance.** Front and rear toe alignment can cause conditions including steering wheel being off center, dog-tracking, tire wear issues, and altered vehicle handling characteristics.
- **Steering Axis Inclination (SAI)** – When viewed from the front of the vehicle, the angle formed by a line drawn through the steering pivot axis with a line at true vertical. SAI is designed into the suspension and aids in straight-line stability. This angle can be measured by an alignment machine. For Hunter units, SAI is measured during the caster sweep process. When the SAI difference between left and right sides is more than 1 degree, check for damaged components.
    - If SAI is lower on one side of the vehicle, this may indicate a bent lower control arm.
    - If SAI is higher on one side of the vehicle, this may indicate damage to the upper strut mount.

- **Thrust angle** – The direction the rear axle is pointing as a result of the rear toe angles. This can result in an off-center steering wheel. To avoid this condition when performing an alignment, rear camber and toe should be adjusted before adjusting the front alignment. After the rear camber and toe are adjusted, center the steering wheel, lock the wheel in place, then adjust the front camber, caster, and toe (if applicable).

Tires – Tires can have a significant effect on vehicle drift or pull. Arranging tires on a vehicle based on the StraightTrak results can help improve a vehicle drift or pull condition. Tires contribute to vehicle drift or pull through ply steer and conicity:

- **Ply steer** – Ply steer is an inherent characteristic in a tire which creates a lateral force as the tire rolls. Rotating the tires may aid in cancelling ply steer effects.

Conicity – Tire conicity refers to the shape of the tire, and how cone-shaped the tire is. This can influence vehicle drift or pull. Conicity can be present in a new tire due to a manufacturing condition, or in a used tire due to camber wear.

Weight – The amount of weight and where the weight is placed alters a vehicle's alignment angles, changing the drift/pull tendency. It is important to consider this when diagnosing a vehicle drift or pull.

Road Crown – Every vehicle has the tendency to follow road crown towards the low side of the crown. It is important to road test a vehicle for a drift/pull condition on as flat a road as possible.

Brake Drag – If one side of the vehicle brakes are dragging, the vehicle can have a drift or pull tendency towards that side. Inspect the brake system to ensure brake drag not a contributing factor to drift or pull performance.

Cross Winds – Cross winds can push a vehicle towards one side of the road. Conduct road testing by driving a vehicle in opposite directions to verify the effects of cross winds.

Proper Alignment Rack Usage and Maintenance

✶ NOTE

- **Aligner Calibration/Maintenance Schedule** - All dealer alignment racks must be calibrated by a representative every six months. This frequency allows the representative to update vehicle specifications, and inspect and maintain equipment.
- These guidelines apply to Hunter Engineering alignment racks and wheel balancers that feature StraightTrak.
- The following items must be followed to ensure accurate alignment readings.

Rolling Compensation - The rolling compensation procedure is critical for ensuring an accurate alignment. When performing rolling compensation, perform the following actions:

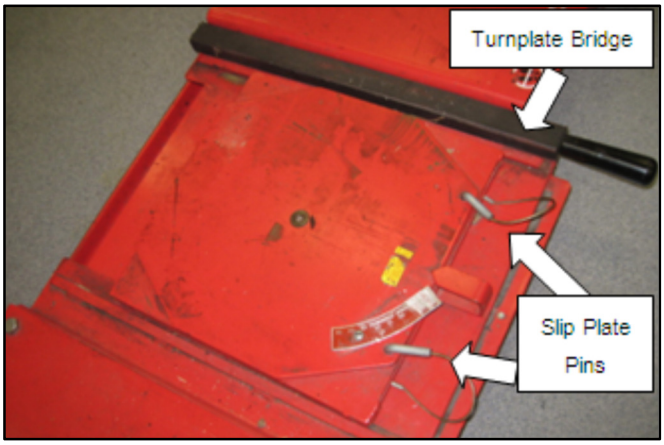
1. Set tire pressure to factory specification.
2. Verify that the vehicle is not excessively loaded. Remove any heavy items.
3. Ensure the lift is level so that the suspension and steering are in a neutral position.
4. Set the target levels before rolling compensation. After completing the compensation, do not re-level the targets.

Roll the vehicle by turning the left rear tire. This action will not disturb the suspension and steering systems.

✶ NOTE

Do not roll the vehicle by pushing or pulling on body surfaces, bumpers, etc.

If equipped, ensure the pins are in the slip plates, and the turnplate bridge is oriented so that the bridge is level/flush with the rolling surface to minimize the vehicle's suspension movement.



Slip Plates - The slip plates of a Hunter alignment rack are designed to move smoothly and freely to provide accurate measurements.

Before pulling a vehicle onto the rack, check that the slip plates move freely and do not bind. Periodically clean the area underneath the slip plates by blowing compressed air through the area to remove any debris. If this action does not free a binding slip plate, contact your local Hunter representative for cleaning and lubrication recommendations.

Hunter StraightTrak LFM

StraightTrak is a required feature for Hunter's GSP9700 wheel balancer. This feature measures tire lateral force caused by ply steer, conicity, and other issues which may contribute to vehicle drift or pull.

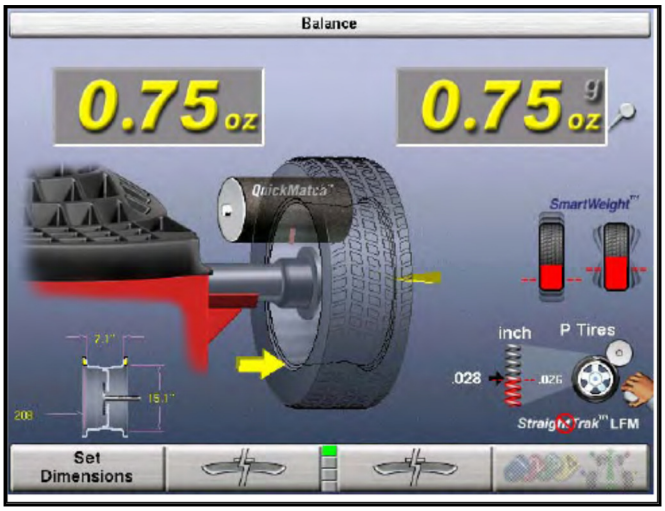
Use the StraightTrak feature to address tire induced vehicle pull.

StraightTrak will arrange the four wheel/tire assemblies of a vehicle in a configuration which will result in the lowest drifting or pulling force.

* NOTES

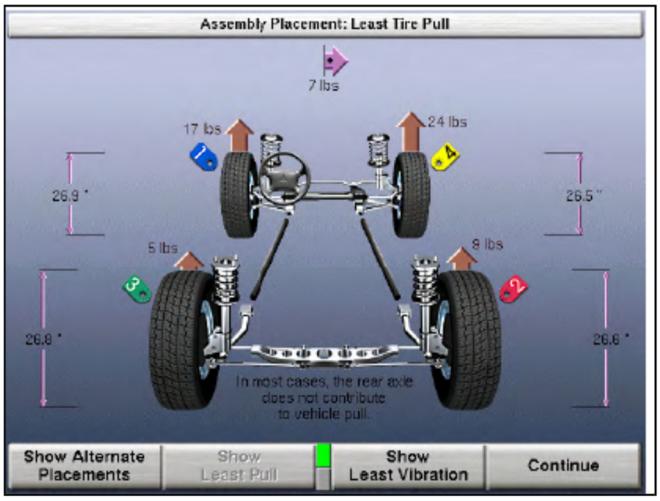
- **Some vehicles have staggered size tires (front vs. rear), and have limited tire configuration options.**
- **Different software versions may have different screens than what is shown in this TSB. Contact your Hunter representative for detailed information on proper StraightTrak operation.**
- **When deciding on a configuration for least drift/pull, some thoughtful consideration is required. Depending on the severity of the drift/pull, a configuration that results in the best tracking performance may differ from the Hunter StraightTrak recommendations.**

Use StraightTrak to arrange the four wheel/tire assemblies in a configuration which will result in the lowest drifting or pulling force by performing the following actions:



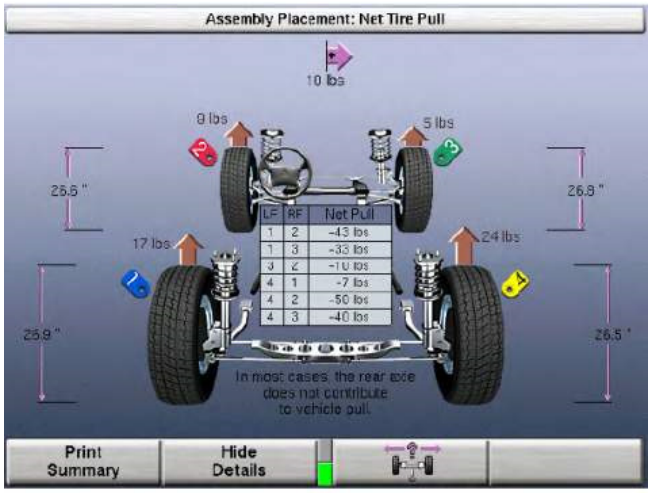
1. Remove all wheel/tire assemblies from the vehicle.
2. Balance the front left assembly on the Hunter GSP9700 with StraightTrak feature. An icon located in the lower right corner will display whether or not StraightTrak is enabled.

3. After balancing, press the tire tag button located at the bottom right of the screen to assign a number to that assembly. Label the assembly accordingly with a tag or chalk mark.



4. Continue to balance and tag all four assemblies. After all assemblies are completed, the screen will show display positioning and the effect on vehicle drift/pull or vibration. The purple horizontal arrow at the top of the screen displays overall pulling force and direction due to tire effects. The brown vertical arrows above each tire displays the RFV (road force variation) of each assembly.
    - Select "**Show Least Pull**" for lowest tire effects on pulling.
    - Select "**Show Least Vibration**" for the smoothest ride.

- Select "**Show Alternate Placements**" for other configurations.



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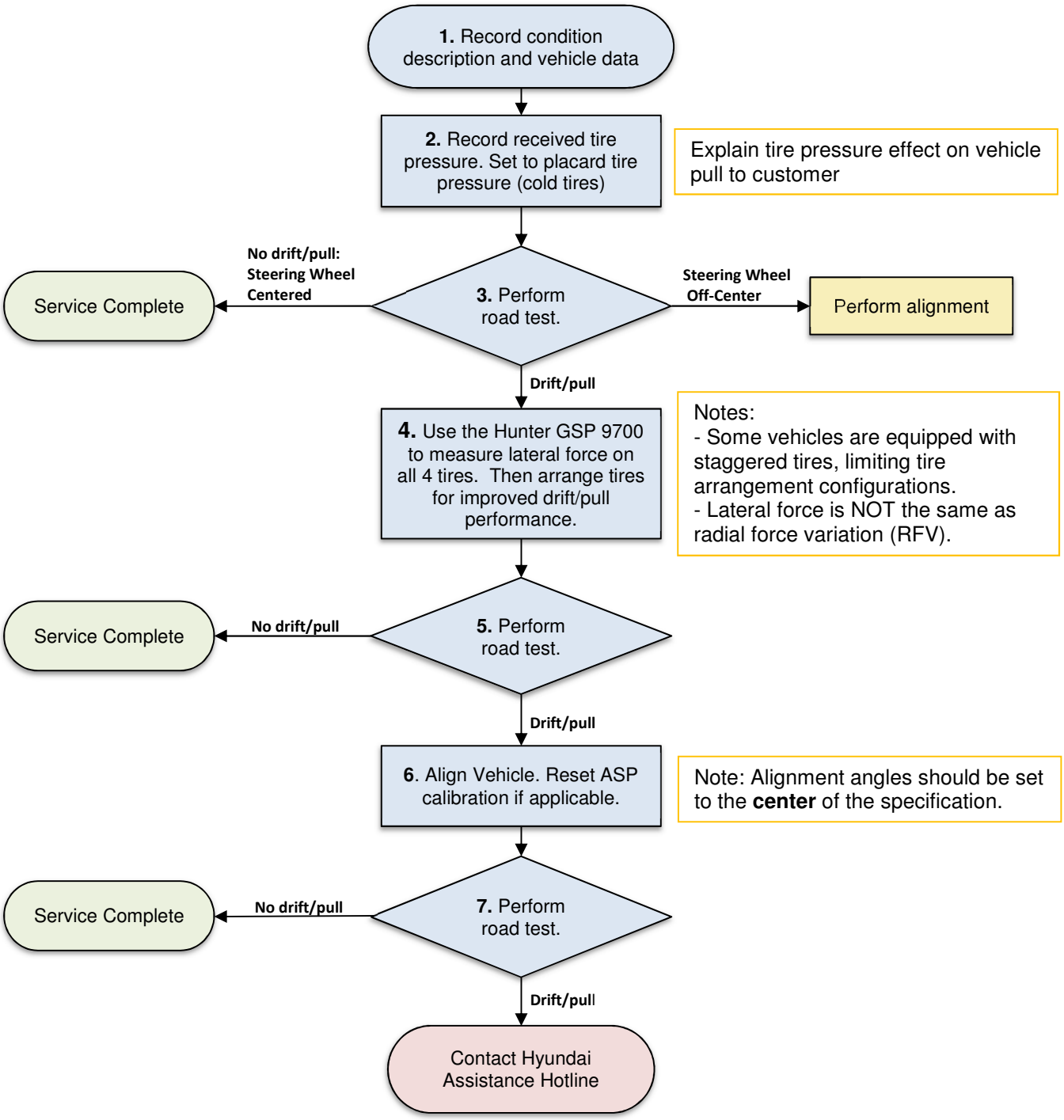
Vehicle Alignment Diagnostic Flowchart

Road Test Case #1 – 3.3 ft	Repair Procedure Notes
 Use minimal throttle input and do not vary throttle input during testing **PASS Criteria: More than 6 seconds 40MPH**	• The Vehicle Alignment Diagnostic Flowchart must be followed for all alignment/drift/pull/off-center repairs. • The Vehicle Alignment Data Sheet is **REQUIRED** to be filled out completely and stored with the RO. • Perform all road testing using Road Test Case #1 criteria, at 40 MPH with no passengers or excessive cargo in the vehicle. • Following an alignment, ASP must be performed on vehicles equpped with electric power steering



Vehicle Alignment Data Sheet

Repair Procedure Notes
• The Vehicle Alignment Diagnostic Flowchart must be followed for all alignment/drift/pull/off-center repairs.   ○ Refer to the Vehicle Diagnostic Flowchart for detailed information on how to correctly complete this form. • The Vehicle Alignment Data Sheet is **REQUIRED** to be filled out completely and stored with the RO.

1. Condition	VIN:						
	Model/Year:			Dealer:			
	Repair Date:			Mileage:			
	Customer Comments:			Tire Wear/Vehicle Condition Comments:			
2. Tire Pressure	Received Tire Pressure: (PSI)				Tire Pressure Set To: (PSI)			
	LF		RF		LF		RF	
	LR		RR		LR		RR	
3. Road Test	Direction vehicle drifts/pulls: (Circle)				LEFT		RIGHT	
	How many seconds the vehicle takes to drift/pull from one side of lane to other:						Fail 1-6 seconds Pass 6-10 seconds	
4. Front Tire Lateral Force (StraightTrak)	Input Initial and Final Front Lateral Force:		Initial lbs:			Final lbs:		
	Front Lateral Force Direction: (Circle)		Initial:	LEFT / RIGHT		Final:	LEFT / RIGHT	
5. Road Test	Direction vehicle drifts/pulls: (Circle)				LEFT		RIGHT	
	How many seconds the vehicle takes to drift/pull from one side of lane to other:						Fail 1-6 seconds Pass 6-10 seconds	
6. Vehicle Alignment	Attach both before and after Alignment Print-Outs to the back of this form and keep with the RO.							
7. Road Test	Direction vehicle drifts/pulls: (Circle)				LEFT		RIGHT	
	How many seconds the vehicle takes to drift/pull from one side of lane to other:						Fail 1-6 seconds Pass 6-10 seconds	
	Final Comments:							