



GROUP
Chassis

MODEL
All

NUMBER
032 [Rev 1, 6/21/2013]

DATE
March 2011

TECHNICAL SERVICE BULLETIN

SUBJECT:

DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS

*NOTICE

This bulletin has been revised to include additional information. New/revised sections of this bulletin are indicated by a black bar in the margin.

This bulletin provides 2011 model year alignment specifications as well as diagnosis and best practices tips.

This TSB contains the following sections:

1. New Model Specifications
2. Alignment Basics
3. How to Determine Vehicle Drift or Pull
4. Alignment Rack Tips
5. Road Force Balance Tips
6. Wheel Balance Form (New)

IMPORTANT:

- Before and after alignment print outs are required to be submitted with all vehicle drift or pull warranty alignment claims.
- Before performing an alignment, check to ensure all tires are set to the specified pressure.
- Ensure the vehicle is carrying a typical load (not heavily loaded, which will alter alignment once the load is removed or changed).
- Optima (TF), Sportage (SL) and Forte (TD) vehicles are equipped with electric power steering (MDPS - Motor Driven Power Steering). Perform an absolute steering position (ASP) calibration using GDS after the alignment is completed.
- Refer to the following alignment specifications or KGIS for 2011 model year specifications.

File Under: <Chassis>

Circulate To: ☒ General Manager ☒ Service Manager ☒ Parts Manager
☒ Service Advisor(s) ☒ Technician(s) ☒ Body Shop Manager ☒ Fleet Repair

SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS****Alignment Specifications:****2011 Sorento (XM)**

Item		Specification	
		Front	Rear
Toe-in	Total	$0^{\circ} \pm 0.2^{\circ}$	$0.2^{\circ} \pm 0.2^{\circ}$
	Individual	$0^{\circ} \pm 0.1^{\circ}$	$0.1^{\circ} \pm 0.1^{\circ}$
Camber angle		$-0.63^{\circ} \pm 0.5^{\circ}$	$-1^{\circ} \pm 0.5^{\circ}$
Caster angle		$4.82^{\circ} \pm 0.5^{\circ}$	-
King-pin angle		$12.98^{\circ} \pm 0.5^{\circ}$	-

2011 Sportage (SL)

Item		Specification	
		Front	Rear
Toe-in	Total	$0^{\circ} \pm 0.1^{\circ}$	$0.1^{\circ} \pm 0.1^{\circ}$
	Individual	$0^{\circ} \pm 0.2^{\circ}$	$0.2^{\circ} \pm 0.2^{\circ}$
Camber angle		$-0.5^{\circ} \pm 0.5^{\circ}$	$-1^{\circ} \pm 0.5^{\circ}$
Caster angle		$4.0^{\circ} \pm 0.5^{\circ}$	-
King-pin angle		$12.91^{\circ} \pm 0.5^{\circ}$	-

2011 Optima (TF)**Before 11/29/2011**

Item		Specification	
		Front	Rear
Toe-in	Total	$0.16^{\circ} \pm 0.2^{\circ}$	$0.17^{\circ} \pm 0.2^{\circ}$
	Individual	$0.08^{\circ} \pm 0.1^{\circ}$	$0.085^{\circ} \pm 0.1^{\circ}$
Camber angle		$-0.5^{\circ} \pm 0.5^{\circ}$	$-1^{\circ} \pm 0.5^{\circ}$
Caster angle		$4.44^{\circ} \pm 0.5^{\circ}$ *	-
King-pin angle		$12.73^{\circ} \pm 0.5^{\circ}$	-

***Specification shown in standard format. Actual lower limit is 3.64° .**

After 11/29/2011

Item		Specification	
		Front	Rear
Toe-in	Total	$0.16^{\circ} \pm 0.2^{\circ}$	$0.17^{\circ} \pm 0.2^{\circ}$
	Individual	$0.08^{\circ} \pm 0.1^{\circ}$	$0.085^{\circ} \pm 0.1^{\circ}$
Camber angle		$-0.5^{\circ} \pm 0.5^{\circ}$	$-1^{\circ} \pm 0.5^{\circ}$
Caster angle		$3.99^{\circ} \pm 0.5^{\circ}$	-
King-pin angle		$12.73^{\circ} \pm 0.5^{\circ}$	-

SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS****Alignment Specifications (Continued):****2011 Forte (TD)**

Item		Specification			
		Front		Rear	
		4DR	2DR	4DR	2DR
Toe-in	Total	$0.12^{\circ} \pm 0.18^{\circ}$	$0.4^{\circ} \pm 0.2^{\circ}$	$0.4^{\circ} \pm 0.2^{\circ}$	$0.4^{\circ} \pm 0.2^{\circ}$
	Individual	$0.06^{\circ} \pm 0.09^{\circ}$	$0.2^{\circ} \pm 0.1^{\circ}$	$0.2^{\circ} \pm 0.1^{\circ}$	$0.2^{\circ} \pm 0.1^{\circ}$
Camber angle		$-0.64^{\circ} \pm 0.5^{\circ}$	$-0.81^{\circ} \pm 0.5^{\circ}$	$-1.5^{\circ} \pm 0.5^{\circ}$	$-1.5^{\circ} \pm 0.5^{\circ}$
Caster angle		$4.38^{\circ} \pm 0.5^{\circ}$	$4.94^{\circ} \pm 0.5^{\circ}$	-	-
King-pin angle		$13.61^{\circ} \pm 0.5^{\circ}$	$14.01^{\circ} \pm 0.5^{\circ}$	-	-

2011 Soul (AM)

Item		Specification	
		Front	Rear
Toe-in	Total	$-0.2^{\circ} \sim 0.2^{\circ}$	$0.4^{\circ} \pm 0.2^{\circ}$
	Individual	$-0.1^{\circ} \sim 0.1^{\circ}$	$0.2^{\circ} \pm 0.1^{\circ}$
Camber angle		$-0.5^{\circ} \pm 0.5^{\circ}$	$-1.5^{\circ} \pm 0.5^{\circ}$
Caster angle		$3.4^{\circ} \pm 0.5^{\circ}$	-
King-pin angle		$12.53^{\circ} \pm 0.5^{\circ}$	-

2011 Rio (JB)

Item		Specification	
		Front	Rear
Toe-in	Total	$-0.2^{\circ} \sim 0.2^{\circ}$	$0.2^{\circ} \sim 0.6^{\circ}$
	Individual	$-0.1^{\circ} \sim 0.1^{\circ}$	$0.1^{\circ} \sim 0.3$
Camber angle		$0^{\circ} \pm 0.5^{\circ}$	$-1^{\circ} \pm 0.5^{\circ}$
Caster angle – to Ground		$4^{\circ} \pm 0.5^{\circ}$	-
Caster angle – to Body		PS: 4.5° / Manual: 4.07°	
King-pin angle		$13^{\circ} \pm 0.5^{\circ}$	-

2011 Sedona (VQ)

Item		Specification	
		Front	Rear
Toe-in	Total	$0^{\circ} \pm 0.2^{\circ}$	$0.26^{\circ} \pm 0.2^{\circ}$
	Individual	$0^{\circ} \pm 0.1^{\circ}$	$0.17^{\circ} \pm 0.1^{\circ}$
Camber angle		$0^{\circ} \pm 0.5^{\circ}$	$0.1^{\circ} \pm 0.5^{\circ}$
Caster angle		$3.77^{\circ} \pm 0.5^{\circ}$	-
King-pin angle		$12.45^{\circ} \pm 0.5^{\circ}$	-

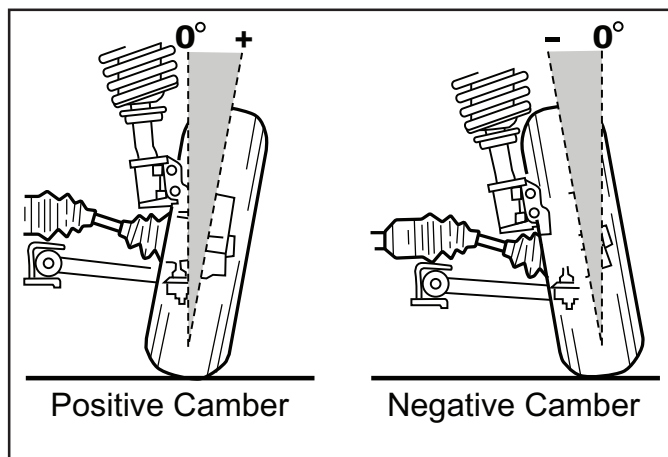
SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS****CAMBER:**

Camber is the inclination of the centerline of the wheel from the vertical as viewed from the front of the vehicle. The camber angle will affect the wear on the inner or outer edge of the tire.

Positive camber is the outward tilt of the top of the tire.

Negative camber is the inward tilt of the top of the tire.

A tire with positive camber can influence the vehicle with a directional pull. The vehicle will go towards the side that has the tire with the most positive camber.

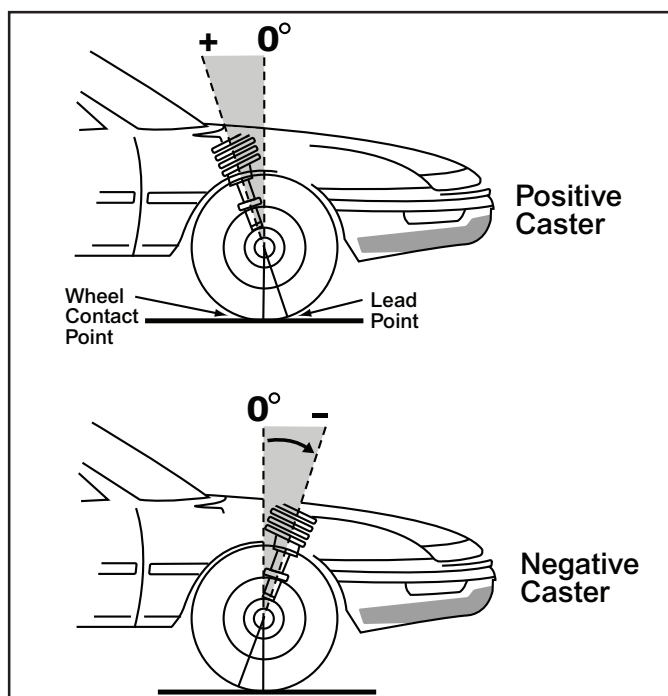
**CASTER:**

Caster is the angle between an imaginary line drawn through the upper and lower steering pivots and a line perpendicular to the road surface (viewed from side of vehicle).

If the top of the line tilts rearward, the vehicle is said to have “POSITIVE” caster.

If the top of the line tilts forward, the vehicle is said to have “NEGATIVE” caster.

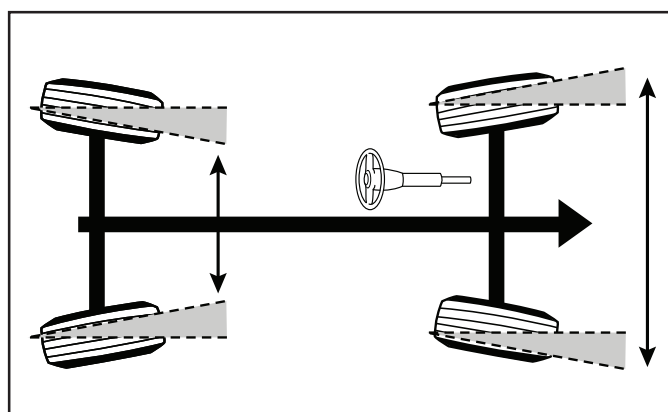
Caster will not cause tire wear unless extreme maladjustment or worn parts are involved.

**TOE:**

Toe is the difference between the leading edge (or front) and trailing edge (or rear) of the tires.

Toe-in is the measurement in fractions of an inch, millimeters or decimal of degrees that the tires are closer together in the front than they are in the back.

Toe-out is the same measurement, except the tires are further apart in the front than in the rear.



SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS****FACTORS THAT INFLUENCE VEHICLE DRIFT OR PULL**

Vehicle drift or pull can be attributed to several factors. Understanding what can affect it is imperative for anyone repairing a vehicle with a drift or pull condition. Most of these factors are directly measureable using tools commonly found in any repair shop like tire pressure gauges, alignment racks, and wheel balancers.

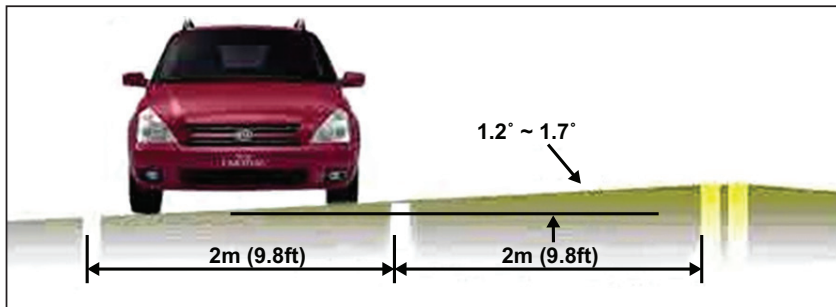
1. **Air pressure** - Low or uneven tire pressure can cause a vehicle to drift or pull towards that tire with the lowest pressure. Remember that cold tires register slightly lower pressure than tires that are warm from usage. Ensure that all tires are correctly inflated.
2. **Alignment**
 - a. **Camber** - A vehicle will drift or pull towards the side with more positive front camber. Camber difference between the front tires greater than 0.5 degrees can lead to a drift pull concern.
 - b. **Caster** - A vehicle will drift or pull towards the side with the least positive caster.
 - c. **Steering Axis Inclination (SAI)** - The angle formed by the line drawn through the steering pivot axis and a line at true vertical when viewed from the front of the vehicle. SAI is designed into a vehicle's suspension and aids straight-line stability. This angle can be measured by the alignment machine. For Hunter units, it is measured during the caster sweep process. It is useful for checking for damaged components when the SAI difference between left and right sides is more than 1 degree. If SAI is lower on one side of the vehicle it may indicate a bent lower control arm. If SAI is higher on one side of the vehicle it may indicate damage to the upper strut mount.
 - d. **Thrust angle** - This is the direction the rear axle is pointing as a result of the rear toe angles and results in the steering wheel being off-center. To avoid this situation, rear camber and toe should be adjusted before the front when performing a four wheel alignment. After the rear is set, center the steering wheel, lock it in place, then adjust the front camber, caster, and toe (if applicable).
3. **Tires** - Tires can have significant effect on vehicle drift or pull for the following reasons:
 - a. **Ply steer** - Ply steer is an inherent characteristic in a tire which results in a lateral force as the tire rolls. Rotating the tires from side to side may aid in cancelling out the effects of ply steer and can aid in diagnosing a ply steer concern.
 - b. **Conicity** - Tire conicity refers to the shape of the tire and how cone shaped it is. This can influence vehicle drift or pull. Conicity can be present in a new tire due to manufacturing, or in a used tire due to camber wear. Rotating tires may reduce a vehicle pull concern due to tire conicity.
4. **Road Crown** – Road Crown is the slope of a road surface to ensure proper drainage. Excessive Road Crown can cause a vehicle to drift to the low side of the crown.
5. **Cross Wind** – Excessive cross winds can cause a vehicle to pull or drift. If the Winds are excessive it can skew the test results.

Other issues can cause vehicle drift or pull, such as brake drag, spring sag resulting in ride height differences, cargo load/weight distribution, and more. It is important to consider all potential effects when diagnosing and confirming a vehicle drift or pull condition. Understanding the factors that affect vehicle drift or pull can help to determine the root cause.

SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS****HOW TO DETERMINE VEHICLE DRIFT OR PULL**

To confirm a vehicle drift or pull, use the following procedure:

1. Before test driving, verify that all tires are OE, correctly installed (directional tires) and set to the correct inflation pressure.
2. Locate an acceptable road for testing which meets these criteria



Recommendation	- One or more lane road - Road is straight for at least 820ft (250m) - Lane width: 10-11.5 feet (3 to 3.5 meters)
Cautions	- Conduct the test on a smooth, even road without bumps or grooves. - Do not test on roads with excessive grade/crown - Conduct the test on an uncrowded road and always ensure proper safety precautions are followed. - Ensure there is not a strong cross wind present during testing

***NOTICE**

For the best accuracy, it is recommended to use the GDS to measure tire pressures under Current Data within TPMS system.

3. Two passes should be made to validate the concern at different speeds. Approach the test road section and drive through at 40 and at 50 MPH. Center the steering wheel, then slightly turn (~3 degrees) steering wheel to the left and to the right to get a feel for centeredness. Hold the steering wheel with a light touch on center.

***NOTICE**

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



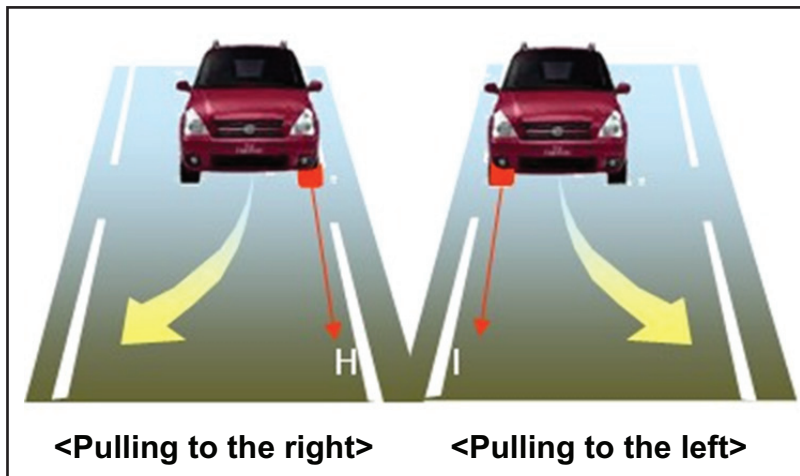
SUBJECT:

DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS

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

***NOTICE**

To ensure accuracy, it is recommended that the test be repeated with the vehicle travelling in the opposite direction on the same road multiple times.



⚠ CAUTION

At this time, use only moderate pressure to hold the steering wheel, but do not let it go. Softly but safely hold the steering wheel with your palms. **DO NOT** ever compromise your safety while performing this test.



Good Hand Position with palms touching the wheel

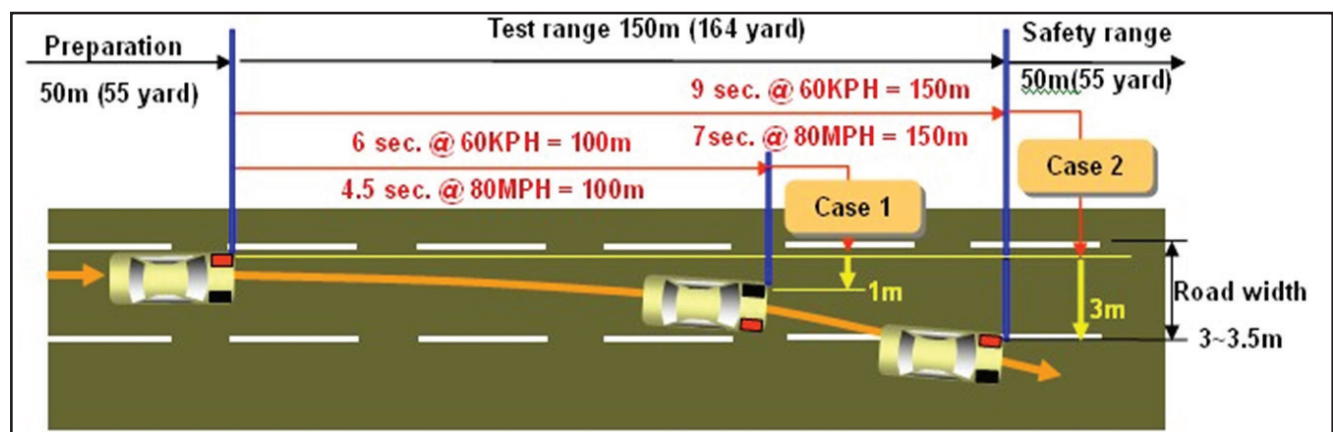
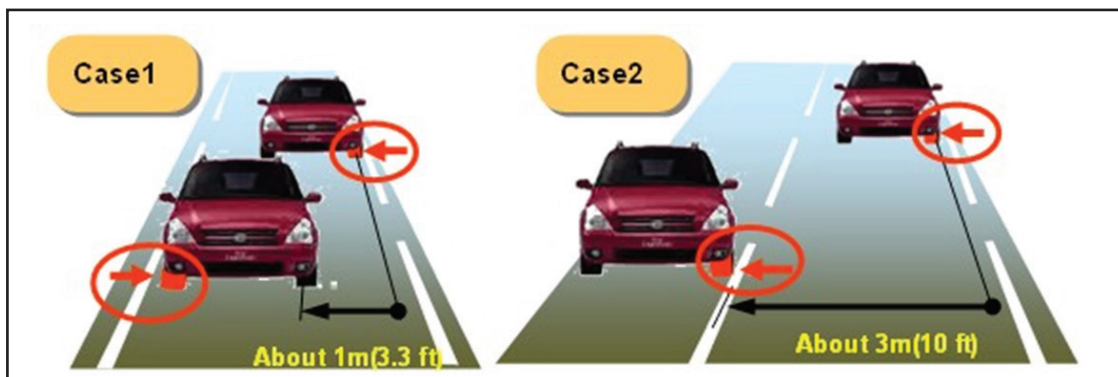
SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS**

5. Take two time measurements. First, time how long it takes for the vehicle to move from one edge to the other edge (case 1), as shown. Second, time how long it takes for the vehicle to move across one complete lane (case 2), as shown. Use the conditions in the table below to confirm drifting or pulling condition.

	CONDITION	Pull Criteria
Case 1	The vehicle moves from one edge of the lane to the other edge (about 1m or 3.3 feet).	It takes 6 seconds or less at 40 MPH, or 4.5 seconds or less at 50 MPH.
Case 2	The vehicle moves across one full lane (about 3m or 10 feet).	It takes 9 seconds or less at 40 MPH, or 7 seconds or less at 50 MPH.

*NOTICE

When strong wind blows during road test, retest the vehicle at a later date.



SUBJECT:

DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS

ALIGNMENT RACK TIPS

***NOTICE**

These tips apply to Hunter Engineering Alignment Racks.

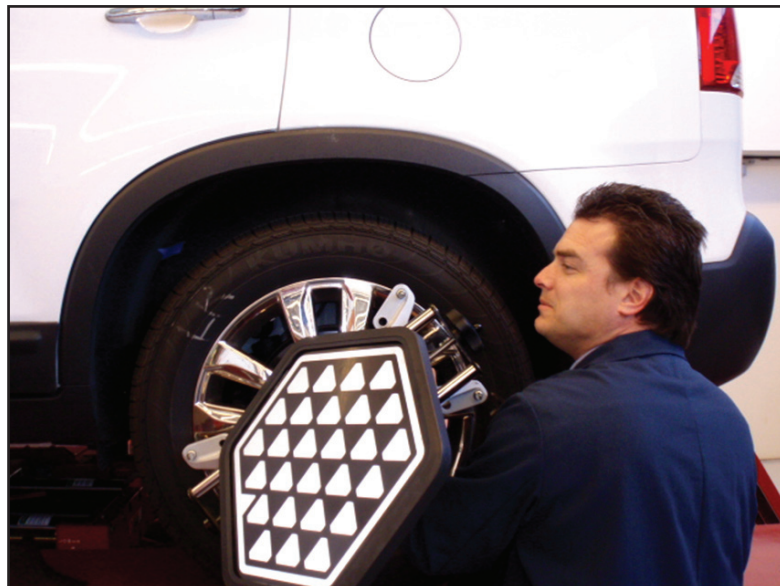
***NOTICE**

It is imperative that the following items be followed to ensure accurate alignment readings. Updated alignment specifications are available on KGIS.

Aligner Calibration/Maintenance Schedule - It is recommended that all dealer alignment racks be calibrated by a manufacturer's representative every 6 months. This allows the representative to update vehicle specs and inspect and maintain equipment.

Rolling Compensation - The rolling compensation procedure is critical to ensuring an accurate alignment. When performing the rolling compensation, be sure to do the following:

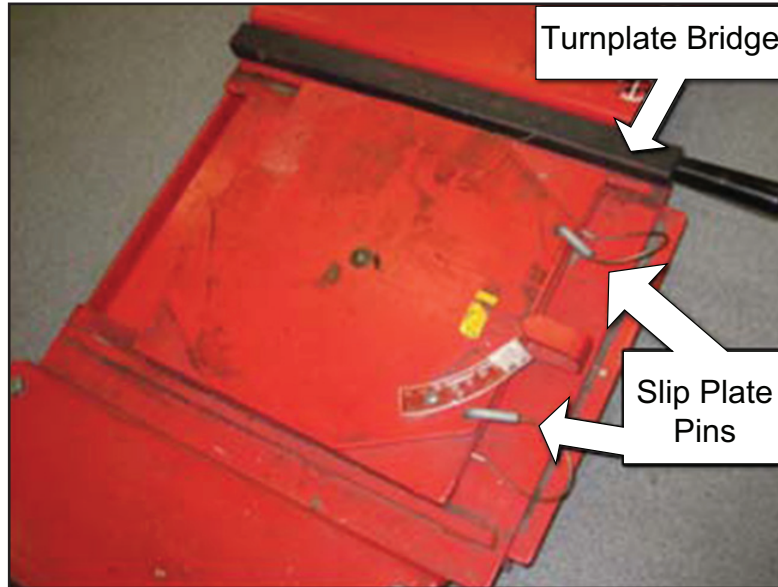
1. Set tire pressure to factory specification.
2. Ensure the lift is level so vehicle's suspension and steering are in a neutral position.
3. Set the target levels before rolling compensation. After completing the compensation, **do not re-level the targets.**
4. Roll the vehicle by turning the left rear tire. This will not disturb the vehicle's suspension and steering systems. Do not roll the vehicle by pushing or pulling on body parts, bumpers, etc.



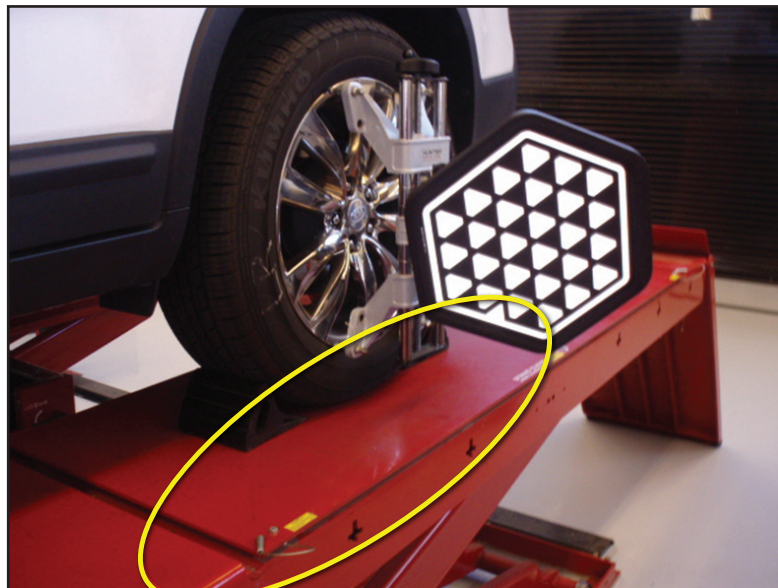
SUBJECT:

DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS

5. Ensure the pins are in the slip plates, and the Turnplate Bridge is 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 they move freely and do not bind. Periodically clean the area underneath the slip plates by blowing compressed air through to remove any debris. If this does not free a binding plate, contact your local Hunter representative for cleaning and lubrication recommendations.

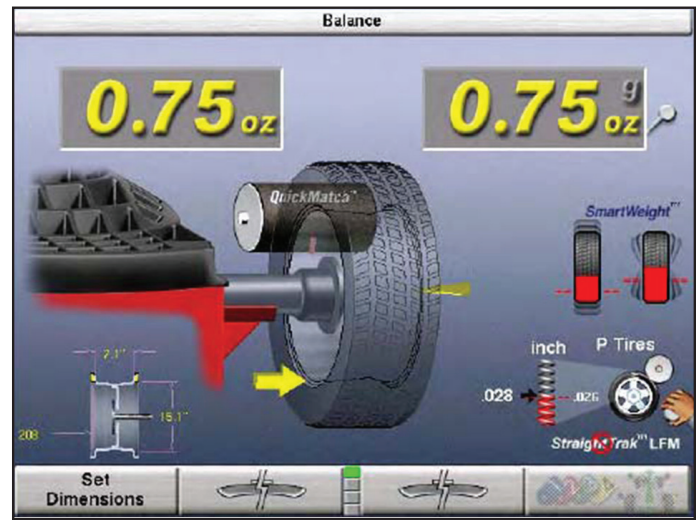


SUBJECT:**DRIFT / PULL DIAGNOSIS AND BEST PRACTICES TIPS**

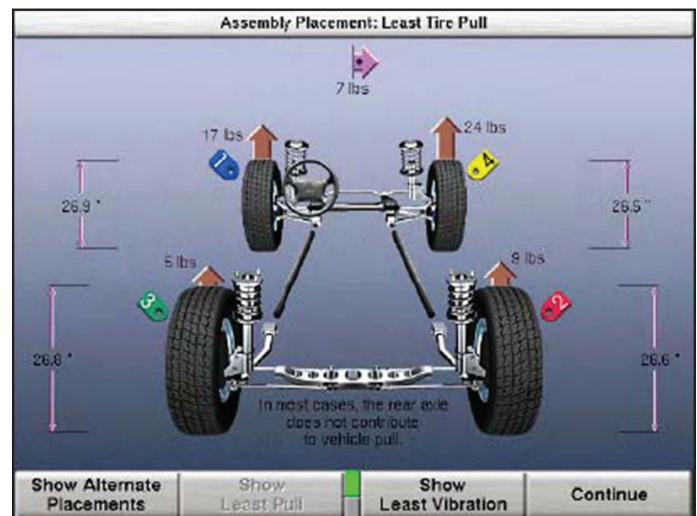
StraightTrak LFM feature (Road Force Balance) - StraightTrak (Road Force Balance) is an optional feature for Hunter's GSP9700 wheel balancer. This feature measures lateral force of a tire due to ply steer, conicity, and other issues which may contribute to vehicle drift or pull. This can be a useful tool for vehicles with multiple conditions.

Use StraightTrak (Road Force Balance) to arrange the 4 wheel/tire assemblies of a vehicle in a configuration which will result in the lowest drifting or pulling force by doing the following:

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 show whether or not StraightTrak is enabled.



3. After balancing, press the tire tag button 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 are completed, the screen will show how different placement positioning of the assemblies will affect vehicle drift or pull or vibration. Select **"Show Least Pull."**
5. The arrow on the top of the screen indicates how much drift or pulling force exists with the tires in that configuration. Install the wheel/tire assemblies to those positions on the vehicle to achieve the least amount of tire-induced drift or pull.

**WARRANTY CLAIM INFORMATION:**

Normal warranty applies.

For all vehicle drift or pull complaints and/or alignment warranty claims, the alignment print out showing before and after measurements must be attached to the repair order.

▣ Tire Balance Check Sheet

Dealer Code: _____

VIN: _____

Production Date: _____

Mileage: _____

Repair Date: _____

Customer Complaint: _____

Tech. Comment: _____

Vibration: What speed? _____

☐ Side to side ☐ Vertical (seat/wheel)

Tire Balance Data (Original):

Measure before removal of OEM weights

Tire Pressure (psi)	LF _____	RF _____	RR _____	LR _____
Balance Results	LF	RF	RR	LR
Inner (Weight: g/oz)				
Outer (Weight: g/oz)				
RFV (lbs)				

Tire Balance Data (Final): Measurement after adjustment

Balance Results	LF	RF	RR	LR
Inner (Weight: g/oz)				
Outer (Weight: g/oz)				
RFV (lbs)				

