

TOYO TIRE TALK

No. : 04-003 (TTT-160)

Technical Service Department Japan

Technical tips and information that may allow you to provide better customer service.



We would appreciate your input, please contact us.
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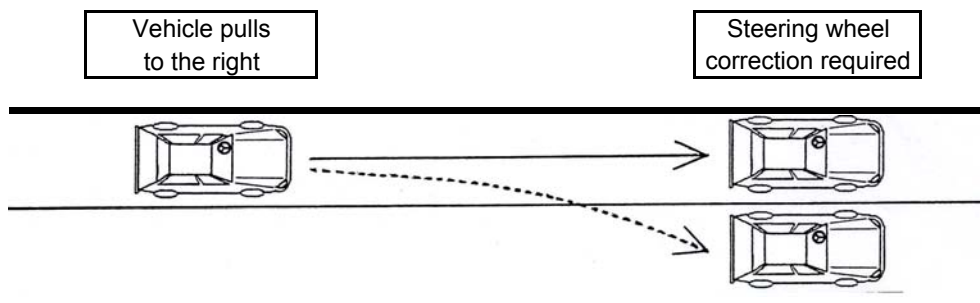
Date : 8th March, 2004

Subject : Steer Pull Process and possible Corrective Action

1. INTRODUCTION

Steer pull is a constant slight movement of a vehicle towards the right or left side of a road while running on a straight patch, without any steering input by the driver. The driver is required to constantly correct the steering wheel to maintain the vehicle in a straight line.

Steer pull has become a common concern of drivers of recent automobiles with rack and pinion steering and radial tires with high stiffness and cornering characteristics.



2. CAUSES OF STEER PULL

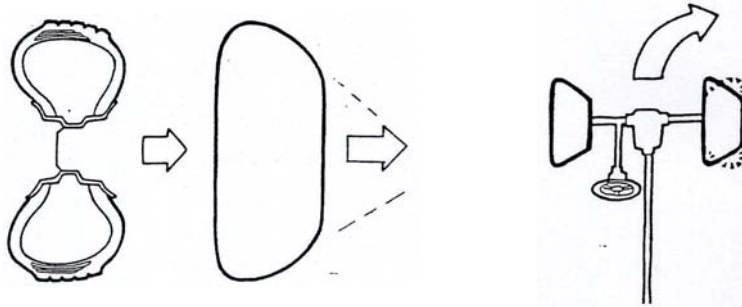
- Vehicle Axle Alignment** : Toe-in, camber angle and wheel parallelism drag vehicles to one side if misaligned.
- Tire Uniformity** : Conicity and ply steer-force generate lateral force.
- Road Crown** : All roads have a certain slope for drainage purposes - high at the centre and low at the shoulders. This tends to push vehicles to right side in countries with right side traffic.
- Irregular Tire Wear** : Irregularly worn tires generate side force.

In this Toyo Tire Talk we will talk about vehicle axle alignment and tire uniformity, as these two items are the primary causes of steer pull.

2. TIRE UNIFORMITY

2.1. CONICITY FORCE

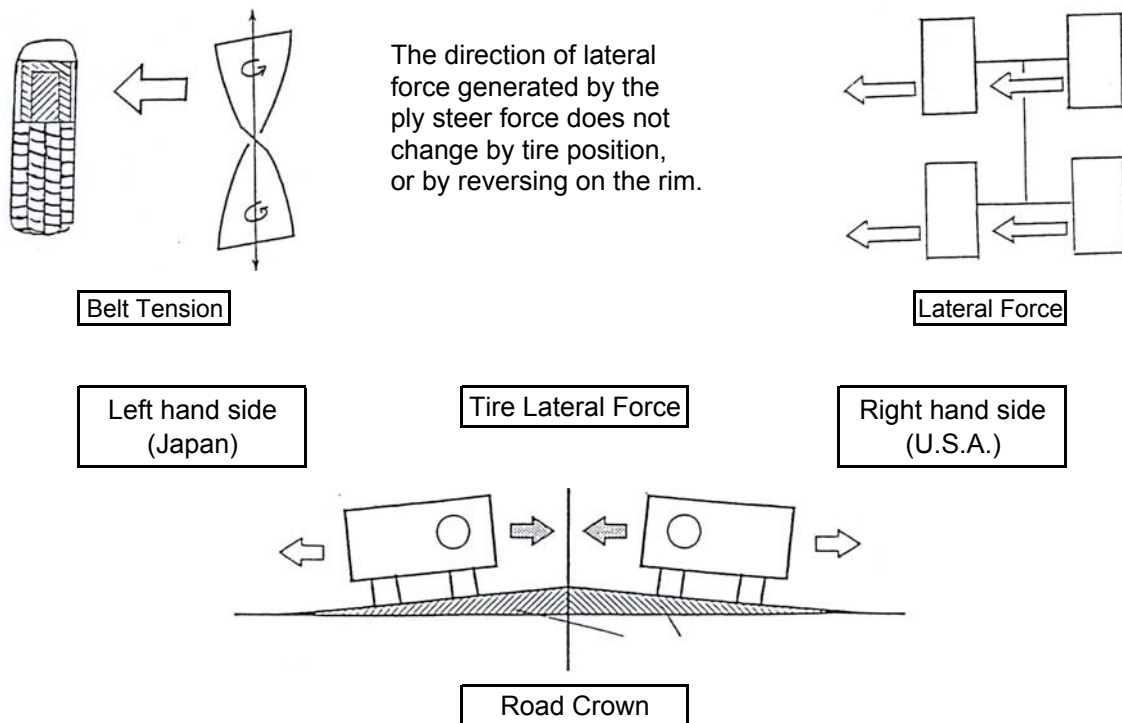
Conicity is one of the dimensional non-uniformity conditions formed during the tire building process in the factory. This condition is best described as the conical shape which generates lateral forces when the tire is rolling.



In the case above, the right front tire would have to be dismantled, reversed on the rim, and then remounted on the vehicle. The conicity forces of both right and left tires would cancel out each other, with the vehicle running straight as a result.

2.2. PLY STEER FORCE

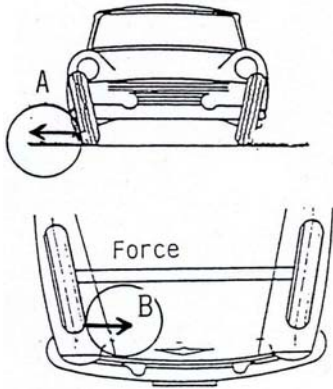
Ply Steer Force is a lateral force generated by the placement of components within the tire decided by the tire specification. Since the direction of the force is determined by the direction of the belt placement or other components, tires are designed to have a built-in lateral force which is to cancel out the force generated by the road crown.



3. AXLE ALIGNMENT

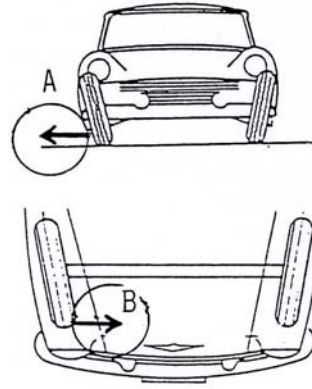
3.1. CAMBER / TOE-IN RELATION

Case 1



$A = B$ (cancel each other out)

Case 2



$A \neq B$ (generates sideforce)

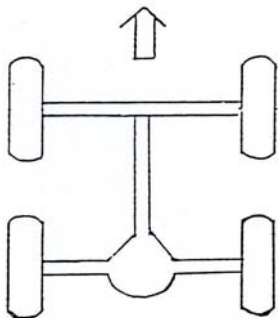
- If the positive camber steer pull force equals the toe-in steer pull force, these steer pull forces will cancel each other out.
- Similarly if the negative camber steer pull force equals the toe-out steer pull force, these steer pull forces will cancel each other out.

Sideforce pulls vehicles to one side

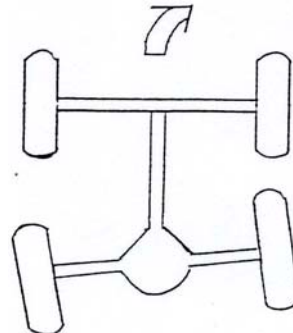
Note : All misalignment problems should always be corrected, as any misalignment will cause irregular and rapid tread wear, and reduce the design safety features and performance characteristics of the tire.

3.2. AXLE PARALLELISM

Parallel

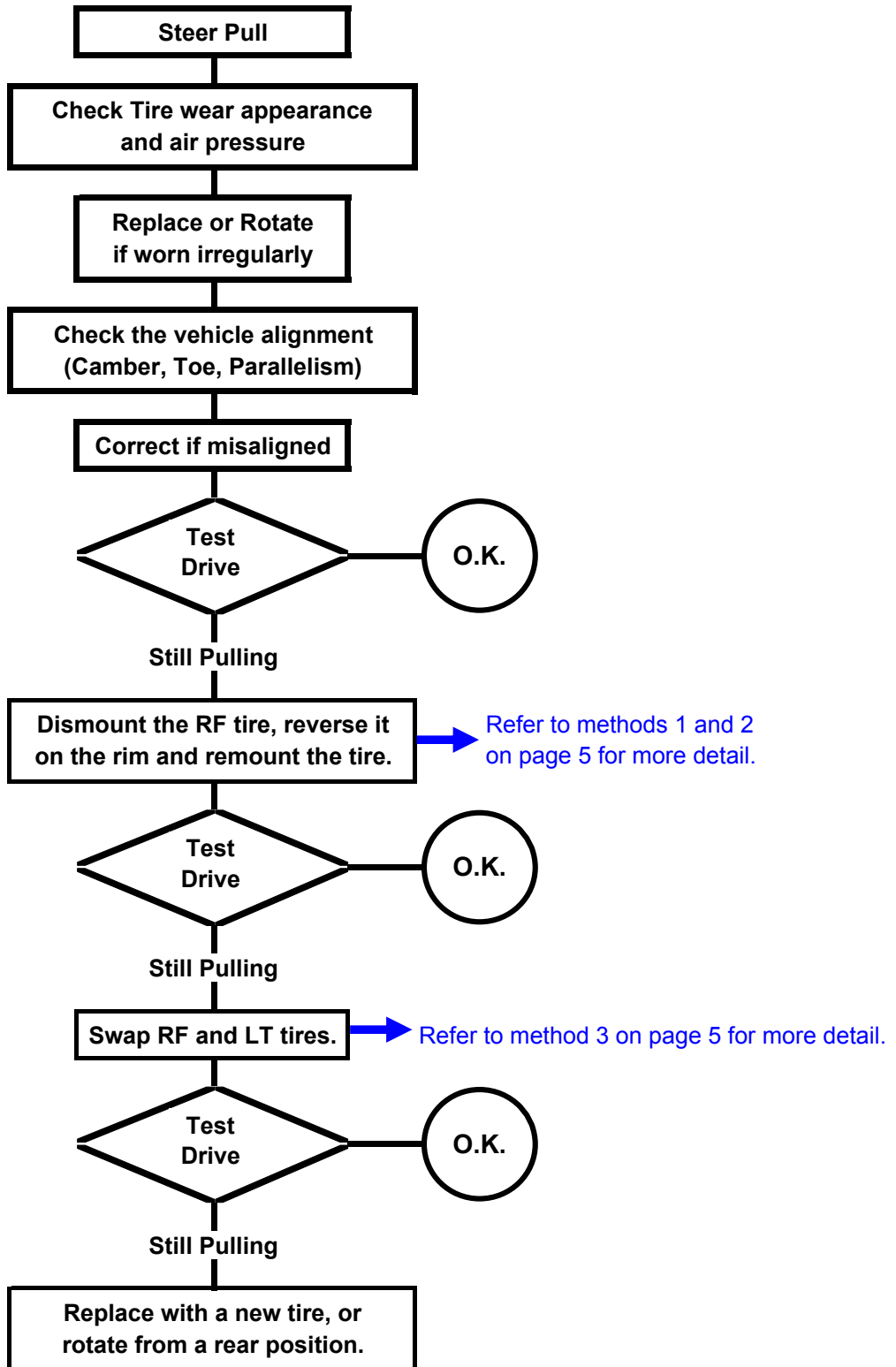


Not Parallel



Rear axle is not perpendicular to the chassis centre line. (Often seen on trucks and rear drive autos.)


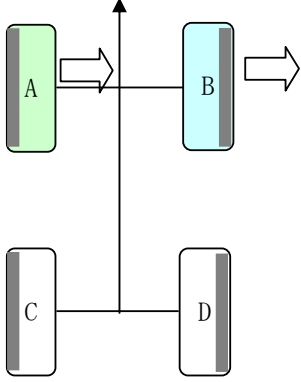
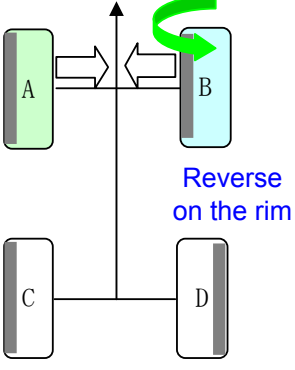
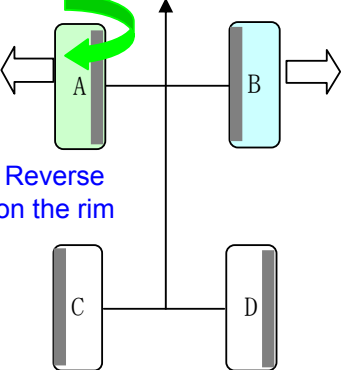
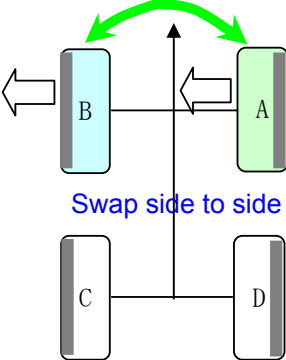
4. RECOMMENDED PROCEDURE FOR RECTIFYING STEER PULL


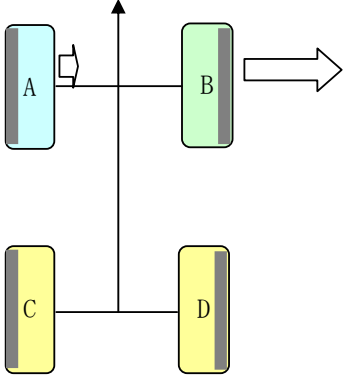
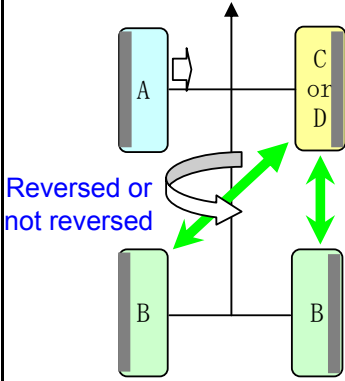


5. RECOMMENDED TIRE ROTATION CORRECTIVE ACTION FOR RECTIFYING STEER PULL

Steer pull is mainly influenced by the front tires, so we will consider front axle rotation only for an easy solution of the problem.

In the case of steer pull to the right, possibly due to lateral force, the following rotation methods are recommended.

Possible Scenario	Possible Lateral Force in each front tire  Lateral Force	Rotation Method and Result	Direction of Steer Pull after Rotation
<p>Case 1</p>	<p>A and B have almost the same lateral force</p> 	<p>Method 1</p>  <p>Reverse on the rim</p>	<p>Opposing Steer Pull cancel out to almost zero.</p>
		<p>Method 2</p>  <p>Reverse on the rim</p>	<p>Opposing Steer Pull cancel out to almost zero.</p>
		<p>Method 3</p>  <p>Swap side to side</p>	<p>In the case of driving on the right hand side of the road, the lateral force cancels out the force generated by the road crown. The opposing forces cancel to almost zero.</p>

Possible Scenario	Possible Lateral Force in each front tire  Lateral Force	Rotation Method and Result	Direction of Steer Pull after Rotation
<p>Case 2</p>	<p>B has larger lateral force than A.</p> 	<p>Method 4</p>  <p>Reversed or not reversed</p>	<p>The B tire with the large lateral force is moved to the rear axle. Rotate the remaining tires to minimise the steer pull.</p>