Understanding Steering and Wheel Alignment Angles

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Remember:- Tyre Wear Patterns Tell The Technician A Story

• Provide Vital Information For Determining Final Alignment Settings
Steering Angles Affecting A Vehicles Alignment

- Caster
  - Camber
    - S.A.I.
  - Included Angle
    - Thrust Angle
  - Toe-In And Toe-Out
Other Factors Related To Tracking, Stability And Tyre Life

• Set Back

• Toe Out On Turns

• Bump Steer

• Scrub Radius And Wheel Offset
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• Caster Is Not A Tyre Wearing Angle
• Caster Assists In the Self Centering Action Of The Steering
• Caster Is The Angle Formed By A Line Through The Pivot Points And A Vertical Line Through The Stub Axle
• Caster Can Be Positive Or Negative
• Excessive Variation Side To Side Vehicle Will Pull To The side Of Least Positive Caster
• Caster Provides Vehicle Stability
Caster Trail Correction For High Caster Angles

- Ford Falcon AU And Commodore VT Run High Caster Angles
- Reducing Caster Trail Prevents Low Speed Shimmy
- Maintains High Speed Stability
Camber

- Camber is a tyre wearing angle
- Camber can be negative or positive
- Positive camber tyre and wheel assembly leans outwards at the top
- Negative camber leans inwards at the top
- Negative camber provides full footprint when cornering
- Camber settings a compromise between good handling and tyre wear
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Effects Of Camber

• Too Much Positive Wears Outside Of Tyre Tread
• Too Much Negative Wears Inside Of Tyre Tread
• Excessive Variation Side To Side Will Pull To Most Positive
• Excessive Negative Camber Stresses Outer Wheel Bearing
• Excessive Positive Camber Stresses Inner Wheel Bearing
Influences Of Camber

• Uneven Loading Of Vehicle
• Body Roll In Turns
• Road Camber
• Conditions Of Suspension
• Ride Height Of Each Spring
• Caster
Variation In Camber With Change In Ride Height
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Steering Axis Inclination [S.A.I.]

- Angle Formed Between Pivot Points And Vertical Line Through Center Of Wheel

- S.A.I. Is Not Adjustable

- S.A.I. Is A Diagnostic Angle

- Assists Steering Returnability
Arc Formed By Stub Axle Traversing Lock To Lock
Included Angle. A Diagnostic Angle

- Included Angle Obtained By:-
  - Adding Positive Camber To S.A.I.
  - Subtracting Negative Camber From S.A.I.
Geometric Centre Line Of Vehicle
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• Thrust Angle Off Centreline Of Vehicle

• Thrust Angle Of Vehicle Must Be on Centreline

• Rear Toe Adjustment Will Correct Thrust Angle
Various Toe Settings

- Zero Toe
- Toe In
- Toe Out
Set Back Is The Variation In Wheel Base Of The Vehicle

- Measured By Modern Wheel Alignment Machines
- Set Back Changes With Caster Change
- Excessive Set Back Can Cause The Vehicle To ‘Run Off’
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Ackerman Angle Provides Correct Toe Out On Turns

- Line Drawn Though:
  - Centre Of Footprint
  - Tie Rod Attaching Point On Steering Arm
  - Meet In Centre Of Line Drawn Through Rear Axle
  - Angle Of Turn Of Front Wheels Will Be Correct
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Ackerman Effect In Corners

• Inside Wheel In turn Requires Greater Angle Of Turn

• Outside Wheel Requires Less Turning Angle

• Lines Projected Will Meet At Intersection Point Outside Vehicle
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Effect on Ackerman Angle When Wheel Base Increased or Extra Axle Added

- Line now drawn midway between rear axles
- Intersection points changed
- Front turn angle not correct
- Tyres will scrub and squeal
Bump Steer

Variation in Toe That Occurs As The Front Suspension Moves Up and Down Without Body Roll and Caused By:-

- Incorrect Steering Linkage Design Or Tie Rod Location
- Bent Steering Linkage
- Toe Adjusted Without Centralising Steering Gear
- Soft Suspension Bushes and Worn Components
- Misalignment of Rack or Steering Linkage in Frame
Incorrect Attachment Of Tie Rod End

- Change in Toe With Rod End Too Short
- Bump Steer With Tie Rod Mounted Too High
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Graph Represents Toe change With Tie Rod Too Short
Graph Represents Toe Change Caused By Outer Tie Rod Being Higher Than Inner Tie Rod
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Positive and Negative Scrub Radius

- Positive Scrub Radius Lines Meet Below Road Surface
- Usually Rear Wheel Drive With Front Wheel Toe In
- S.A.I. Usually Less Than 10 Degrees
- Negative Scrub Radius Lines Meet Above Road Surface
- Used On Front Wheel Drive With Front Wheel Toe Out Or Zero Toe
- S.A.I. Usually Greater Than 10 Degrees
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Calculating the Roll Centre

INSTANTANEOUS CENTER

GROUND

ROLL CENTER

90°
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Lowered Vehicle After Roll Centre Adjuster Fitted

Standard Lowered Vehicle
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Rear Toe Steer Through Bump and Rebound
Variation In Rear Toe With Axial Thrust – Importance of good suspension and bushing compliance control

- Axial Force At ‘A’ Moves Arm Obliquely
- Bushes at Point ‘C’ are Compressed
- Point ‘B’ Is Displaced Towards Center Of Vehicle
Variation In Rear Toe With Longitudinal Input – Importance of good suspension and bushing compliance control

• Compliance Steer Generated By Road Surface Or Braking

• Toe-In State Maintained By Action Of Arms
For Additional Information including solutions for better suspension and bushing compliance control contact SuperPro or connect to

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