

INTRODUCTION TO 4 WHEEL DRIVE THE BASICS





Purpose

To enable an individual interested in 4WD to be educated sufficiently so that they are able to go and make an informed purchase of a suitable 4WD vehicle.



Course outline

Four wheel drive

- Front axle
 - Solid / live axle
 - Open Knuckle: U joints / CV Joints
 - Cardan Joints / Double Cardan Joints
 - Closed knuckle: Birfields
 - Independent front suspension [IFS]
 - Constant Velocity Joint
- Rear axle
 - Solid / live axle
 - Independent rear suspension [IRS]: CV / U joint
- Differential
 - Gear ratio



Four wheel drive [4WD]

- High range
- Low range
- Transfer Case
 - Full time
 - Center Differential Lock [Manual vs. Auto]
 - Part time
 - Splits drive between front and rear axles
 - Provides for a reduction to low range



Traction Aids

Axle differential lock

- Automatic
 - Detroit
- Switched / selectable differential lock
 - ARB
- Limited slip
 - Torque sensing
 - Clutch / gear
 - Speed sensing



Terminology

- Free wheeling hubs: Manual & Automatic
- Center axle disconnect
- Differential gear ratio
- Crawl ratio
- Semi floating vs. full floating rear axle



Considerations

Ground clearance

- Axles
 - IFS v. Solid Axle
 - Semi Float vs. Full Float
- Chassis – suspension
 - Wheel Travel
 - Articulation – body roll
- Body
- Chassis
 - Frame
 - Unibody



Considerations

Traction

- Tire choice
 - Black-top, dirt, sand, mud, snow, ice
- Tire inflation
- Tires Sizes
 - 35 12.50 R15
 - 295/75 R16

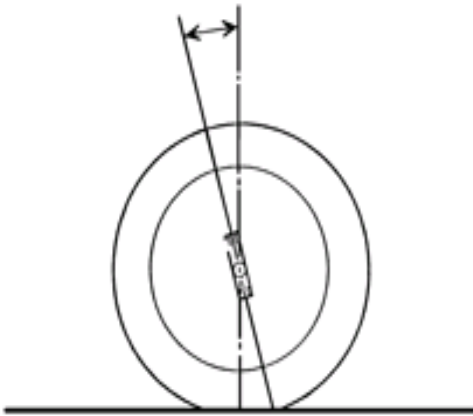


Tire Nomenclature

- Includes:
 - Rim diameter
 - Aspect ratio
 - Tire section width
 - Construction type
- "P215/75R15" tells us about the tire.
 - "P" Denotes the tire size to be classified as "P-metric" which means that it is a passenger tire. If it does not begin with a "P", then the tire is a European metric size.
 - "215" Means that the cross sectional width of the tire is 215 millimeters
 - "/75" Means that the aspect ratio or the height of the sidewall is 75% of the 215 mm width.
 - "R" Means that this is a radial, steel belted, tire.
 - "15" Is the size rim that the tire is to mount to.
- Don't substitute lower, squatter tires on cars whose specifications call for higher aspect ratio tires. Check your car's instruction manual or a dealer's fitment guide and choose a tire that matches or exceeds the load carrying capacity specified.

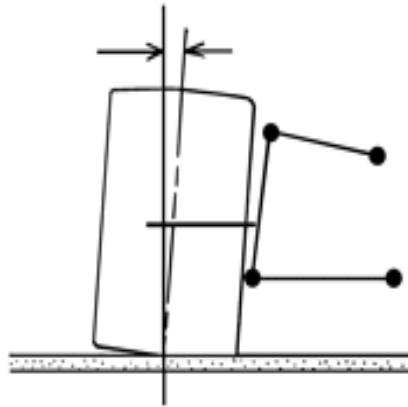
Suspension Geometry

CASTER ANGLE



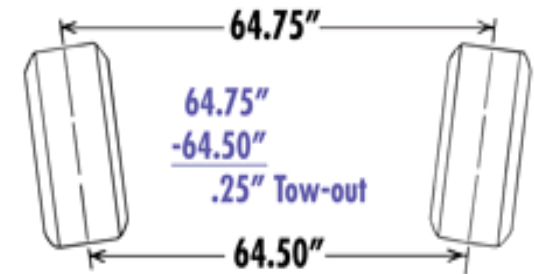
Caster is the inclination of the steering axis from vertical in the longitudinal plane (wheel viewed from the side.) Positive caster is achieved when the steering axis is inclined toward the rear of the vehicle at the top in the side view. Negative caster is when the steering axis is inclined toward the front of the vehicle at the top in the side view.

CAMBER ANGLE



Camber is defined as the inward or outward tilt of a wheel at the top relative to vertical at the center of the wheel in the lateral plane. If the top of the tire is leaning inward toward the center of the car (viewed from the front of the vehicle,) the tire has negative camber. If top of tire is leaning outward, it has positive camber.

TOW-OUT



Tow-out is the difference in distance between the front and rear axle measurements of tires on the same axle in the center of the tread surface at spindle height, where the front measurement is greater than the rear. Tow-in is opposite. Tow-out is a static alignment made to minimize tire scrub and rolling resistance, which develop when a car is cornering.



Considerations

- Transmission
 - Automatic or Manual
- Vehicle Structure
 - Unibody or Full frame
- Steering System
 - Rack and pinion or Recirculating ball
- Brakes
 - Disc or Drum
- Engine size
 - 4 cylinder or 6 cylinder or 8 cylinder
- Fuel choice
 - Gas or diesel



Vehicle choice

- Budget
- Occupant carrying capacity
- Equipment carrying capacity
- Fuel consumption
- General use vs. purpose built
- Towing capacity



Vehicle choice

Aftermarket accessories

- Suspension systems
 - Coil vs. leaf springs
 - Articulation
- Tires and wheels
- Differential gears
- Bumpers
 - Front
 - Winch mount
 - Lights mount
 - Rear
 - Spare wheel mount
 - Equipment mount [high-lift jack, fuel container(s)]



Vehicle choice

Protection

- Skid plates
 - Engine oil pan
 - Drive-train
 - Transmission
 - Transfer case
 - Differentials
 - Fuel tank
 - Steering gear box
- Nerf bars



Vehicle choice

- Approach angle
- Departure angle
- Break-over angle
- Fording depth
- Towing capacity
- Maximum climb angle
 - 100% = 45° based on traction perfect flat surface
- Roll-Over angle
 - $> 40^\circ$ good, $< 35^\circ$ poor