LAB – Wheel Alignment (Toe Plates)

Stability, Handling, & Tire Wear *DRAFT DOCUMENT*

Students: 1. _____ Date: _____
2. _____ Block: _____

Wheel alignment is critical to the HANDLING and TIREWEAR of a vehicle. Get it right, and the heavens part and the angels sing. Get it wrong, and the car can become **LETHAL**. You should be an **ABOVE AVERAGE STUDENT** if you are taking this lab on.

I've been doing my own wheel alignments for years, with relatively basic tools. Yes, it will take longer than with a machine, but it can be done very acceptably precise. This lab follows how I do my own alignments at home. **YOU SHOULD CONSULT ME A LOT!**

NEED
Toe Plates
Length(s) of
square tubing
2 tape measures
Camber/caster gauge
(or angle finder)

PRE-INSPECTION	
DO FIRST	**You CANNOT perform a good alignment if the car is WORN OUT! GO AND COMPLETE THE CHASSIS INSPECTION LAB FIRST**

STOP! ***INSTRUCTOR'S INITIALS:***

WHY ARE WE HERE? ***(THE ANSWER TO MEANING OF LIFE, THE UNIVERSE, AND EVERYTHING IN IT)*** **42**

VEHICLE COMPLAINT

- ☐ **No complaint**
  - Then why are you here?
- ☐ **PULLS to EITHER left OR right**
  - Camber or Caster difference side-to-side
- ☐ **PULLS under BRAKING**
  - Caster difference side-to-side
- ☐ **DARTY or TWITCHY Steering**
  - Toe
- ☐ **UNSTABLE at SPEED**
  - Caster or Toe
- ☐ **JERKY over BUMPS (Changes lanes?)**
  - Ball Joints?!

"PULL" – where the vehicle always want to turn to one side, even if you're wanting to go straight. If you let go of the wheel – it immediately heads in that direction.

RULE OUT chassis issues: Before worrying about alignment, first make sure everything is in good shape.

Find and record the factory recommended alignment specifications for your vehicle.

You can use All Data, Mitchell On Demand, a Service Manual, the Factory Service Manual ("FSM"), or even vehicle-specific Forums if you trust them.

For a time, I did alignments with this machine at home

FRONT

Caster (Left): _____

Caster (Right): _____

Camber (Left): _____

Camber (Right): _____

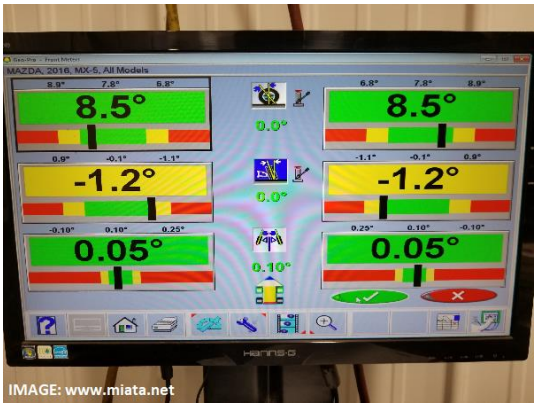
Toe: _____

REAR

Camber (Left): _____

Camber (Right): _____

Toe: _____



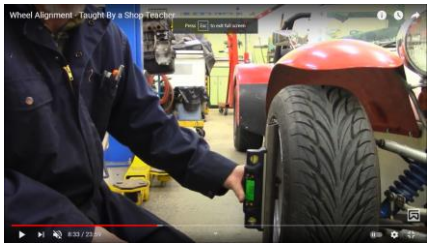
It usually takes me 2 to 3 hours to do a full four-wheel alignment like this.

Expect 4 to 6 hours for you, maybe longer.

STOP!	***INSTRUCTOR'S INITIALS:***	

MEASURING WHAT YOU HAVE

Drive the vehicle into the shop, ***preferably on the 4-post hoist***, and make sure the suspension is fully settled. It is ideal to have your weight in the driver's seat for all of this (not always practical; I use sand bags at home).



We will measure what we have.

EXISTING CAMBER

Using a camber gauge or an angle finder stuck to a length of square tube that you can hold against the wheel, measure what you HAVE:

If it's out of spec, and CANNOT be adjusted, something is likely BENT

FRONT

Camber (Left): _____ Camber (Right): _____

How much does it need to change to be in spec? (spec minus reality):

REAR

Camber (Left): _____ Camber (Right): _____

How much does it need to change to be in spec? (spec minus reality):

If you are using an ANGLE FINDER and NOT a true CAMBER/ CASTER gauge, you need to subtract the SMALL angle reading from the BIG angle, then MULTIPLY BY 2 to get your caster

If it's out of spec, and CANNOT be adjusted, something is likely BENT

TOE is ALWAYS adjustable in the FRONT

EXISTING CASTER

Caster is measured a little weird.

Turn the steering wheel 20° to the left (about one full turn). Level the camber/caster gauge, and zero the caster level.

Now turn the steering wheel past center and 20° to the right (about one full turn). Level the camber/caster gauge again, and read the caster reading.

Do this for both sides. Caster is not measured in the rear.

FRONT

Caster (Left): _____ Caster (Right): _____

How much does it need to change to be in spec? (spec minus reality):

EXISTING TOE

Toe is measured with toe plates and two tape measures. Read the tape measure as accurately as possible.

FRONT Toe: _____

REAR Toe: _____

How much does it need to change to be in spec? (spec minus reality):

STOP! ***INSTRUCTOR'S INITIALS:***

REAR CAMBER ADJUSTMENT (SKIP IF NOT ADJUSTABLE)

INITIAL SETUP

The direction your vehicle points down the road is determined entirely by the back wheels. We will start there first.

We start by making sure the rear wheels are pointing in the same direction.

Set a length of square tube against the wheel (I set these on top of my toe plate), and measure the distance to a repeatable point on the rocker panel of the car. Ideally, both wheels are pointing the same.

If needed, adjust the rear toe to make them THE SAME on both sides. Doesn't matter yet what it IS right now, just make them the SAME.

NOTE: Many rear suspensions adjust Camber and Toe AT THE SAME TIME – this can be annoying! Try to nail both these steps

STOP! ***INSTRUCTOR'S INITIALS:***

ADJUST

RE-CHECK YOUR REAR CAMBER (it may have changed if you corrected the toe in the step above).

ADJUST the rear camber to where it needs to be.

- Adding/subtracting shims
- Turning eccentric cams
- Slotted holes
- Threaded linkages
- In worst cases: brutal violent and questionably-legal bending.

Once the camber is set, adjusting TOE will likely change your camber. Be prepared to go back and forth perfecting this.

STOP! ***INSTRUCTOR'S INITIALS:***

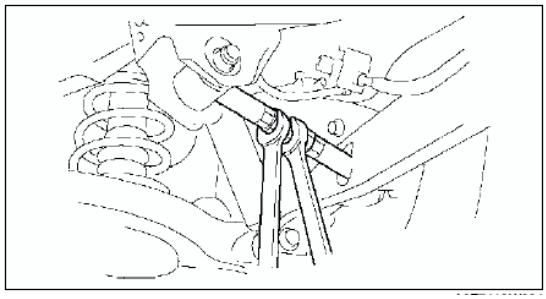
REAR TOE ADJUSTMENT (SKIP IF NOT ADJUSTABLE)

IF YOU <u>CAN</u> ADJUST REAR TOE

REAR TOE IS CRITICAL

ANY TOE-OUT CAN MAKE FOR A LITERALLY LETHAL-HANDLING CAR!

MOST vehicles call for a touch of toe IN.



TOE-IN IS STABLE

<u>ANY</u> REAR TOE-OUT IS DEATH

ADJUST BOTH left and right **TOE** exactly the same amount.

- Adding/subtracting shims
- Turning eccentric cams
- Slotted holes
- Threaded linkages
- In worst cases: brutal violent questionably-legal bending.

CONFIRM that the **LEFT** and **RIGHT** rear toe is the **SAME**, referencing the mark on the rocker panel. Adjust if necessary.

CONFIRM that both rear **CAMBER** and rear **TOE** are correct. Do not trust your memory, your partner, or that guy who lives in a van down by the river.

STOP! ***INSTRUCTOR'S INITIALS:***

FRONT CASTER & CAMBER ADJUSTMENT (SKIP IF NOT ADJUSTABLE)

STEP 1
CASTER

CASTER is adjusted first.

CONFIRM the steering wheel is pointing straight ahead.

Some people adjust a bit more positive caster on the right front to make the car pull left to counter "road crown." ***I don't,*** because unequal caster up front may cause an imbalance under braking.

ADJUST the front caster to where it needs to be.

- Adding/subtracting shims
- Turning eccentric cams
- Slotted holes
- Threaded linkages
- In worst cases: brutal violent bending.
-

INCREASE CASTER:

Move upper ball joint rearward
Move lower ball joint forward

REDUCE CASTER:

Move upper balljoint forward
Move lower ball joint rearward

NOTE:
Many front suspensions adjust Caster and Camber at the SAME TIME – this can be annoying! Try to nail both these steps

STOP! ***INSTRUCTOR'S INITIALS:***

STEP 2
CAMBER

CONFIRM the steering wheel is pointing straight ahead.

RE-CHECK YOUR FRONT CAMBER (it may have changed when you changed the caster).

I add about a 1/4° more negative camber on the right side to counter road crown. I find it does not affect braking.

ADJUST the front camber to where it needs to be.

- Adding/subtracting shims
- Turning eccentric cams
- Slotted holes
- Threaded linkages
- In worst cases: brutal violent bending.

POSITIVE CAMBER:

Top of wheel tipped outward

NEGATIVE CAMBER:

Top of wheel tipped inward

STOP! ***INSTRUCTOR'S INITIALS:***

FRONT TOE ADJUSTMENT (ALWAYS ADJUSTABLE)

STEP 3
TOE

CONFIRM that **Caster** and **Camber** have not changed.

CONFIRM the steering wheel is pointing straight ahead.

ADJUST BOTH left and right **TOE** exactly the same amount.

- Threaded linkages, always

Typically, most Front Wheel Drive (FWD) vehicles use some toe OUT, and most Rear Wheel Drive (RWD) vehicles use some toe IN, But NOT ALWAYS.

Test drive THROUGH THE COMPOUND ONLY and confirm that the steering wheel is centered.

If the vehicle drives straight, but the wheel is crooked, you need to shorten one tie rod and lengthen the other THE SAME AMOUNT (ie: "one flat" or "half-a-turn" or something).

Example: If the wheel is crooked to the left, and you have turn the wheel to the right to straighten it, if the steering linkage is BEHIND the axle, you need to lengthen the RIGHT tie rod, and shorten the LEFT tie rod.

KNOWLEDGE TEST

MAYBE YOU SHOULD WATCH THE VIDEO NOW?

What is our GOAL with TOE SETTINGS??

What is our GOAL with CAMBER SETTINGS?

What is our GOAL with CASTER SETTINGS?

THE INSTRUCTOR MUST DRIVE THE CAR BEFORE IT LEAVES!

STOP!	***INSTRUCTOR'S INITIALS:***	

