

Alignment Specs and Concepts

This information has been compiled by Gary Clark from various sources, including:

Miata.net **Miata Wheel Alignment By Miq Millman**

Flyin' Miata.com

Moss Miata.com

Hummingbird.net

Multiple Alignment Options

These options are listed in least to most aggressive.

Option 1

Source: Miq's Miata.net Alignment

FRONT

Caster +4.7 to +5.5 (what ever the maximum results from Camber adjustment).

Camber -0.6 to -0.8

Toe 1/16" toe out per side, or 1/8" _total toe out_

REAR

Caster not applicable, there is no adjustment possible.

Camber -1.1

Toe 1/16" per side, or 1/8" _total toe in_ or zero

Option 2

Source: Flyin Miata:

Front Caster: 5.0 degrees

Camber: -1.0 degrees

Toe-in: 1/16", 0.15° or 9 arcminutes total (1/32", 0.075° or 4.5 minutes per side)

Rear

Camber: -1.5 degrees

Toe-in: 1/16", 0.15° or 9 arcminutes total (1/32", 0.075° or 4.5 minutes per side)

Gary Clark uses Option 2 from Flyin' Miata on his car. It has neutral handling with some controllable oversteer on throttle lift so that the car rotates nicely.

Option 3

Source: Hummingbird.net:

Front:

Caster: 5.0 to 6.0 degrees

Camber: -1.2 degrees

Toe IN: 0 to 1/32 inch IN per side

Rear:

Camber -1.75 degrees

Toe In 1/32 inch (0°4.5' or 0.075°) IN per side

Option 4

Source:

Icehawk's Alignment Spec

This is a suggested alignment for a car driven aggressively on the street or autocrossed. It has no bad habits and leads to even wear across the tires, both my street and autocross sets.

Front

Caster: Maximum

Camber: -1.5°

Toe out 1/16" per side

Rear

Caster not applicable, there is no adjustment possible.

Camber: -2°

Toe in 1/16" per side

This was developed from the famed "Lanny" alignment and better suits the aggressive driver. The biggest change is to add toe out in front to provide better turn in as well as dialing in a more aggressive camber setting.

Icehawk

Factory recommended alignment

A conservative alignment to avoid any oversteer or spin out by a Mazda customer.

FRONT

Caster +4.43° +/- 0.75 Camber 0.4° +/- 0.75 Toe Out 1/8" +/- 1/8

REAR

Caster not applicable, there is no adjustment possible. Camber -0.72° +/- 0.5 Toe In 1/8" +/- 1/8"

Alignment is crucial to the well being of your car, its very easy for \$30 of maintenance to destroy \$450 worth of good sticky rubber if not done properly. Before just rattling off some numbers, I'd prefer to share some knowledge, impart some wisdom so that you will know what you're asking for when you tell the guy at Les Schwab's to add 1.1 degrees of negative camber, and not feel like an idiot when he looks at you and goes, "duh?"

What does oversteer mean?

Oversteer is the propensity of the car to want to turn in faster than the input being given to the steering wheel. That is, if you aim the nose of the Miata at a given point (apex of the turn), it will feel as if the rear end is sliding towards the outside of the turn. The results are usually a spin if you have too much oversteer, or at the least a very twitchy feel. This is why all car manufacturers have no oversteer in the initial alignment specifications. The Nascar boys call this feature of a car loose. ("Whal, Dick, Ah'd say that 'tween tha loose an tha pooosh, yer gunna lose. Har har har." --overheard comment to Dick Trickle)

What does understeer mean?

Like oversteer, understeer effects the feel of the car in a turn. Understeer is more frustrating than dangerous in most cases. The car turns in slower in a turn than the amount of steering input would dictate. Another commonly used term for understeer is pushing, because it feels as if the car is pushing the front tires towards the outside of the turn. ("Dang sonny, yore Miata there, plows better 'n my John Deere")

A well handling car should feel neutral with respect to over or understeer, with just a touch of oversteer in high transition moves.

Camber:

What's it do?

Camber is the tilting of the top of the tire in relation to the point it touches the ground (this is called the contact patch). Positive camber is when the tops of the tires are further out than the contact patch: \ / Negative camber is when the tops of the tires are inboard of the contact patch: / \

Having too much camber, positive or negative will cause your Miata to ride on the edge of the tire instead of the flat part of the tread. Needless to say, this is undesirable.

Why do I want it?

When the balance between too much and too little camber has been achieved, the size of the contact patch can be increased during a turn. As the Miata transfers its weight to the outside tire, the suspension travels up, and the car leans over on the edge of the

tire. If there was negative camber to the wheel, then as the car leans into the turn, it will fall onto the flat part of the tread instead of the tire's sidewall.

Because the front tires turn, less camber is desired on them as it effects other characteristics, a good aggressive setup would have about 1.0 degrees of negative camber on the front tires. Maintain .5 degrees difference front vs rear negative camber for a neutral handling car with a little oversteer on throttle lift (-1.2 front, -1.75 rear OR -1.0 front, -1.5 rear). More than .5 degree difference eliminates understeer and .75 causes understeer. Factory specs are conservative.

Rear tires are stationary with respect to the direction of travel, thus they can get away with, and can use more negative camber. A good compromise between tire life and traction would be 1.1 degrees of negative camber on the rear tires.

Caster:

Positive vs. Negative

Imagine if you will a signpost up ahead...no cancel that, think about how a shopping cart's front wheels work versus a Harley Davidson chopper. The shopping cart has negative caster, where the contact patch is rearward of the axis of rotation. The chopper (or a wheelbarrow works the same way if you are not motorcycle inclined) has positive caster, where the contact patch is further (sometimes much further) forward than the point about which the wheels turn.

Positives vs. Negatives

Positive caster helps recenter the wheels after they have been turned. However it also makes turning efforts higher because you now have to fight to propensity of the wheel to want to stay straight. The downsides are pretty minor for positive caster, but negative caster will also make the miata very dicey, almost impossible to hold in a straight line. It is impossible to get negative caster and negative camber at the same time on a Miata, so you really have little to worry about.

The best way to set up caster and camber on the front wheels of the Miata is to have the shop give you as much positive caster as physically possible, then dial in the maximum negative camber while keeping the caster. It is possible to see numbers like 4.7 to 5.5 degrees positive caster depending on the year and ride height of the Miata.

Toe:

Pigeons vs. Ducks (or what's just ducky for the front is for the birds in the back)

The toe of a tire, or how the front sits in relation to the rear is one of those adjustments where a little really goes a long way. Toe can drastically alter whether a car has

understeer or oversteer--a lot more effect than any other adjustment. Toe can also drastically effect the wear patterns on your tires, especially the rear ones.

If you like having tires that are sticky and still want them to last more than a few thousand miles, only minor adjustments should be done to the toe. But with all that is at risk, why is toe in or toe out desirable at all? Because it allows the other changes you are going to make have a greater effect on the cars handling. With negative camber, the contact patch's shape has been altered ever so slightly. Tossing in a bit of toe will help correct this.

In the rear, toe out is bad, it won't help the car any, even to understeer. The only thing that will become apparent is that it really causes the tires to scrub.

Toe in on the rears on the other hand is quite nice in moderation. It can help offset a number of things, primarily the tendency of heavy rear swaybars to induce oversteer (see section 4 in tips from the garage). somewhere between 1/16" and 1/8" total toe in for the rears is a good number. I say somewhere because some shops can't measure toe with such a degree of accuracy, or they don't use inches (although if they have a computerized alignment rack, they should be able to measure things in darn near any unit, even leagues)

The front wheels actually like a bit of toe out, about the same measurements. This helps to counteract the effects of all that positive caster.

0-1/32" toe-out for faster turn-in.

If you decide that tire life should not be sacrificed for magnificent handling, then setting toe fore and aft to zero is a good safe route to go.

Some other useful recourses:

<http://www.fizzindi.demon.co.uk/wheelalign.htm>

<http://www.miata.net/garage/align.html>

<http://www.hummingbirds.net/alignment.html>

<http://www.fizzindi.demon.co.uk/mk2align.doc>

http://www.quadesl.com/miata_alignment.html

[http://en.wikipedia.org/wiki/Suspension_\(vehicle\)](http://en.wikipedia.org/wiki/Suspension_(vehicle))

http://www.tampabaymiatas.net/Misc_Pages/Miata_Suspension.htm

http://en.wikipedia.org/wiki/Caster_angle

http://en.wikipedia.org/wiki/Camber_angle

[http://en.wikipedia.org/wiki/Toe_\(automotive\)](http://en.wikipedia.org/wiki/Toe_(automotive))

http://en.wikipedia.org/wiki/Ackermann_steering_geometry
<http://www.youtube.com/watch?v=9HbkslChoBY>
<http://www.youtube.com/watch?v=TrWkgJzYfQ4>
<http://www.familycar.com/Alignment.htm> Thrust Angle
http://autorepair.about.com/od/glossary/a/glossary_new.htm
<http://www.miata.net/sport/Physics/>
http://en.wikipedia.org/wiki/Multi-link_suspension
<http://en.wikipedia.org/wiki/Understeer>
<http://en.wikipedia.org/wiki/Oversteer>