

# **WATKINS** **SMARTSTRINGS™**



## ***Owner's Manual***

## Welcome!

Thank you for purchasing our SmartStrings alignment kit. You are now the owner of what we believe to be the best and most universal way to quickly perform accurate four-wheel alignments on virtually any car anywhere.

Why SmartStrings? The number one design premise was to allow all four wheels to be aligned with one simple, accurate, portable and affordable tool. Just so you know, some of the fastest cars in the world - including Indy style cars, 200 mph road racing cars and NASCARs etc are aligned with strings (or wire in some cases).

As with our SmartCamber gauge, SmartStrings were designed to be used on as wide a variety of cars as possible; its telescoping design in all three planes assures that. The attaching or hooking features on the Attaching Arms have also been carefully thought out to be as versatile as possible.

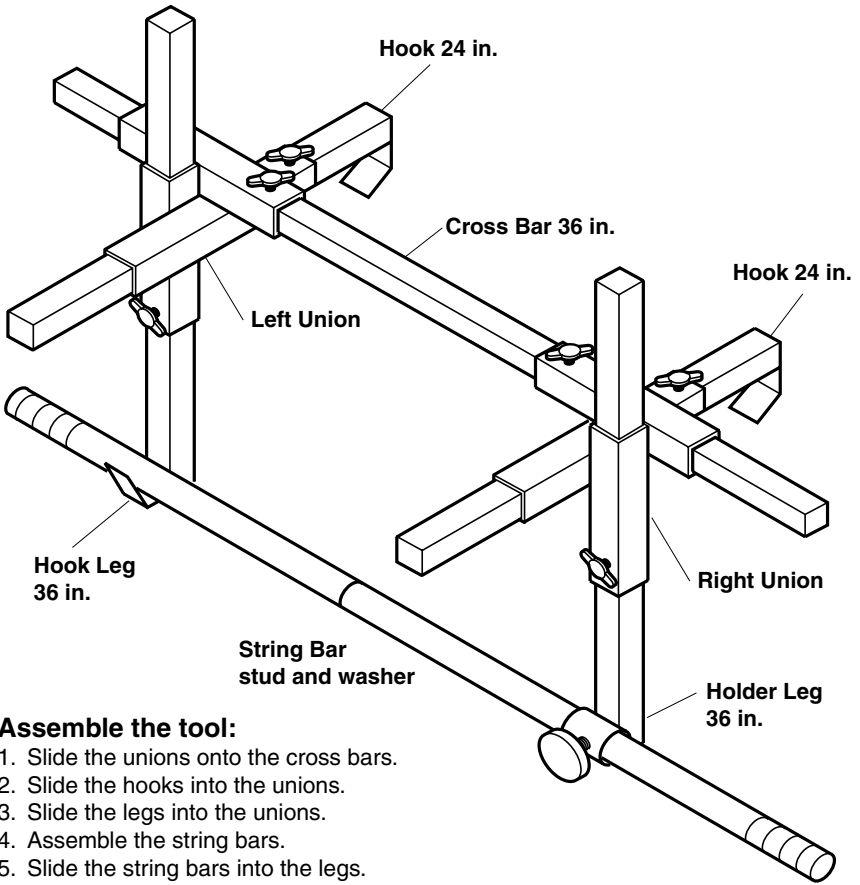
Unlike nearly all other toe measuring gauges on the market today, our SmartStrings allow you to simultaneously align and “square” the car, that is, insuring that the rear axle is running true and parallel to the front axle. Also, since our strings attach to the car, they move with the car so when adjustments are made, the vehicle can be rolled to settle the settings without the worry or bother of the gauge having to be recalibrated. Since you can adjust all four wheels relative to one another, you can set the car up however you like, or however track conditions require. Properly installed, the parallel strings form a perfect parallelogram around the car’s own centerline!

Combined with our SmartCamber camber/caster tool, you can perform a full four-wheel alignment and know for yourself that the numbers are correct and to your individual needs or liking. If you have any questions or concerns at any time, please do not hesitate to contact me by any of the means listed on the back cover. The team here at Smart Racing Products are all here to help you in any way we can.


Thank you,

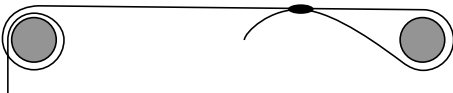


Craig Watkins



**Assemble the tool:**

1. Slide the unions onto the cross bars.
2. Slide the hooks into the unions.
3. Slide the legs into the unions.
4. Assemble the string bars.
5. Slide the string bars into the legs.
6. Attach to the car.
7. Tie a loop on one end of the string and put it around the bar. 
8. The other end of the string will be held in place by pinching the loose end of the string in the groove of the bar with tension from the taught string. Pull the string between the bars taught. Take up the slack around the bar with the loose end and release the top string. The string will now be held tight.





1. When attaching the frames to the vehicle, try to keep the legs that hold the string bar as vertical as possible.
2. Make sure to place the string in the same groove position on all four corners of the string bars so that the strings will be roughly 2" to 4" away from the wheel/tire.
3. Adjust the legs to set the string heights to be even with the axle centers.
4. Center the steering – very important! Double check the number of rotations it takes to turn from full left to full right, then go back half way. You may need to reset the steering wheel to a straight-ahead position. Do not guess this, if you do, then all sorts of things can be thrown off, for example, bump and roll steer (even if you don't know what they are, you don't want to unintentionally create problems). Also, excessive play in the steering system (loose or worn tie rod ends, etc) will affect getting repeatable results.
5. Setup and toe setting sequence should be: set ride height, caster, camber and then toe.
6. It is important to take the measurements on as large a diameter as you can. See figure #3 for the variations in toe angles taken at different diameters.

### **Calibration:**

1. Lock the steering wheel or rack and pinion to the center-steer position. Use Snap-On's steering wheel lock (part #WA-96A) or equivalent to hold the steering wheel in the center-steer position. If the steering wheel moves while you are making adjustments, all of your work and effort will be lost and you get to do the front all over again.
2. Position the string bars so that the distance from the tires to the bar are approximately equal from side to side (see figure 2).
3. Slide the front string bar so that the distance from the center of the wheel to the string is equal side to side (see figure 2, A measurement).
4. Slide the rear string bar so that the distance from the center of the wheel to the string is equal side to side (see figure 2, B measurement).
5. Repeat steps 3 and 4 until they are perfect. Note on a piece of paper what the final measurements are (front and rear) so if someone accidentally bumps or trips on the strings, it is easy to reset them – after you've chased "your friend" around the shop.

6. When satisfied, carefully snug the leg rosette knobs. Remember that the front axle's measurement – side to side – will not be the same as the rear axle, because front and rear track widths are rarely the same. The important thing is that the front measurements (left & right) are equal and the rear measurements are equal. By doing this, you have "squared" the strings around the car. Again, see figure #2.

## Measuring:

1. I use a steel rule with the decimal scale (to 1/32") on one side and metric on the other, roughly 12" long.
2. To determine toe on a given wheel we need two measurements per wheel. One on the leading edge and one on the trailing edge (see figure #2). First measure the leading edge of the wheel then measure the trailing edge. Compare your measurements and determine the amount of toe you have. At first, you may get a little confused – just try to establish your own measuring style and stick to it. In other words, always measure to the inside of the string or to the outside of the string. If you are not consistent, it can get confusing and frustrating.

**Toe-in:** the measurement is longer on the leading edge of the wheel than the trailing edge of the wheel.

**Toe-out:** the measurement is shorter on the leading edge of the wheel than the trailing edge of the wheel.

3. Adjust the toe links/control arms as necessary until you are satisfied with your settings.

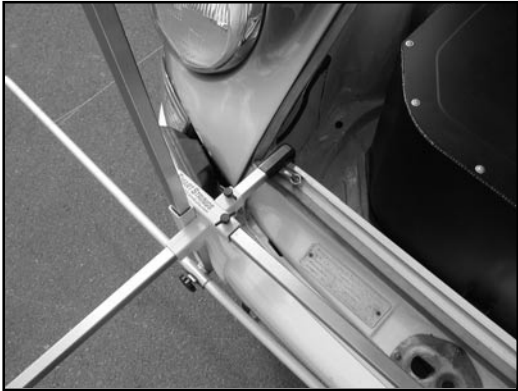
## Toe Setting Factoids:

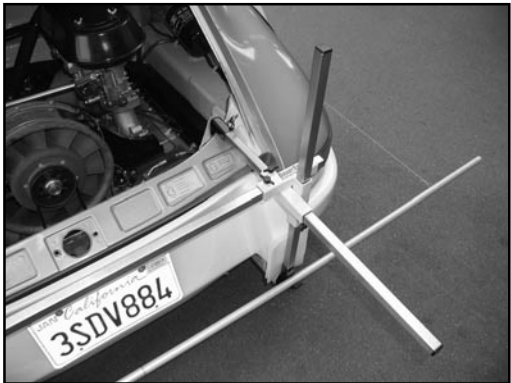
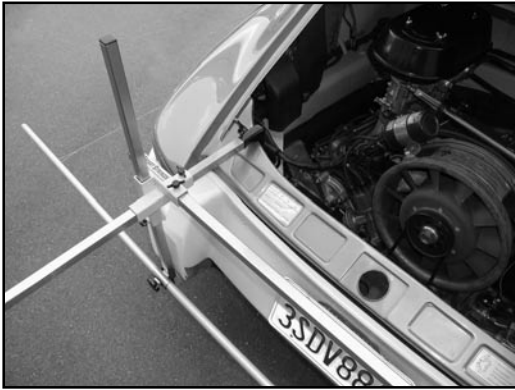
The following are included to give you additional information of the many toe specification types and how you can convert from one unit type to another. This is important to know because there are many variations and subtleties that many people are not aware of. Here are a few:

- 1) Setup and toe setting sequence should be: set ride height, caster, camber and then toe.
- 2) Look at Figure #3, it shows the variation in toe for different diameters - both in decimal and degrees. Note that the toe angle (in degrees) does not change with diameter, but it does with decimal settings. This is why measuring from the same position each time on each tire is crucial - and looking to see what your measuring points diameter is because you may not have the toe setting you think you do!

- 3) Figure #4 is a simple mathematical formula converting rim measurements to the equivalent as if measured at the outside diameter of the tire.
- 4) Toe measuring assumptions and toe machine averages (old machines vs. new): Years ago, if you had your car aligned and asked for 1/8th" of total toe-in in the front for example, they based the 1/16th" per side on an old industry tire diameter standard of 29.5". In the 1970's, that was changed to 28". In the age of computer alignment machines, they enter lots of data into the system, including tire diameters to get more accurate or true settings.
- 5) Thrust angles created by toe: Let's say that the front of the car is set to perfect zero toe, the rear is set to 1/16th" per side or 1/8th" total toe-in. If the front is dead nuts on and the rears do not have precisely the same amount of toe-in, then the point somewhere way out in front of the car where the rear tire's centerlines theoretically intersect, would not be on the same centerline as the car itself. This deviation from the true centerline is called the thrust angle. Some race cars use this thrust angle to help them to be faster around certain corners.
- 6) Measuring from the true centerline: You can measure using your SmartStrings to measure from the true centerline of the car as well and the theoretical centerline, which is the way I have explained it in the procedures above. In order to do this, you must first find a point under the car in the front and rear that is measured to be the true centerline. Then the strings are set equal distance from that line. For 99% of the world's applications, the theoretical centerline method works very well. However, for Indy cars and others that are extremely powerful and only make left hand turns, measuring from the true centerline is crucial because each wheel's toe angle is set individually. Also note that modern computer alignment machines also say they measure toe angles from the true centerline, but they really do not (at least the ones I have seen don't). Rather, they optically surround the car with laser beams and estimate where the centerline is based on reflection averages. It's pretty neat how they work, but if you took the time to check its accuracy, it would be off a bit. There are many variables, including operator competency, machine calibration methods, condition of the machine etc etc. At least you are now aware of the two and can act accordingly for your particular application.
- 7) Downloadable copies of these instructions are available by going to [www.smartracingproducts.com](http://www.smartracingproducts.com), click on Instructions, then on SmartStrings Instructions.

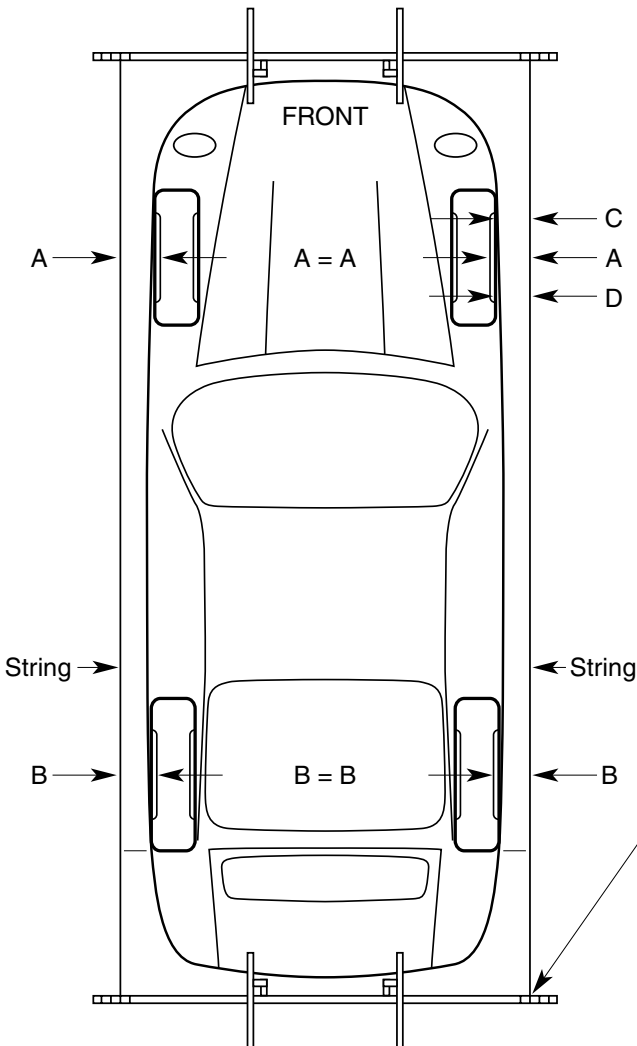
**Figure 1. Photos of Installation Front & Rear**







## Figure 2. String Layout and Measurements



**Toe-in:**  
The measurement is **longer** on the leading edge of the wheel than the trailing edge of the wheel.

**Example:**  
Measurement **C** is **longer** than measurement **D**.

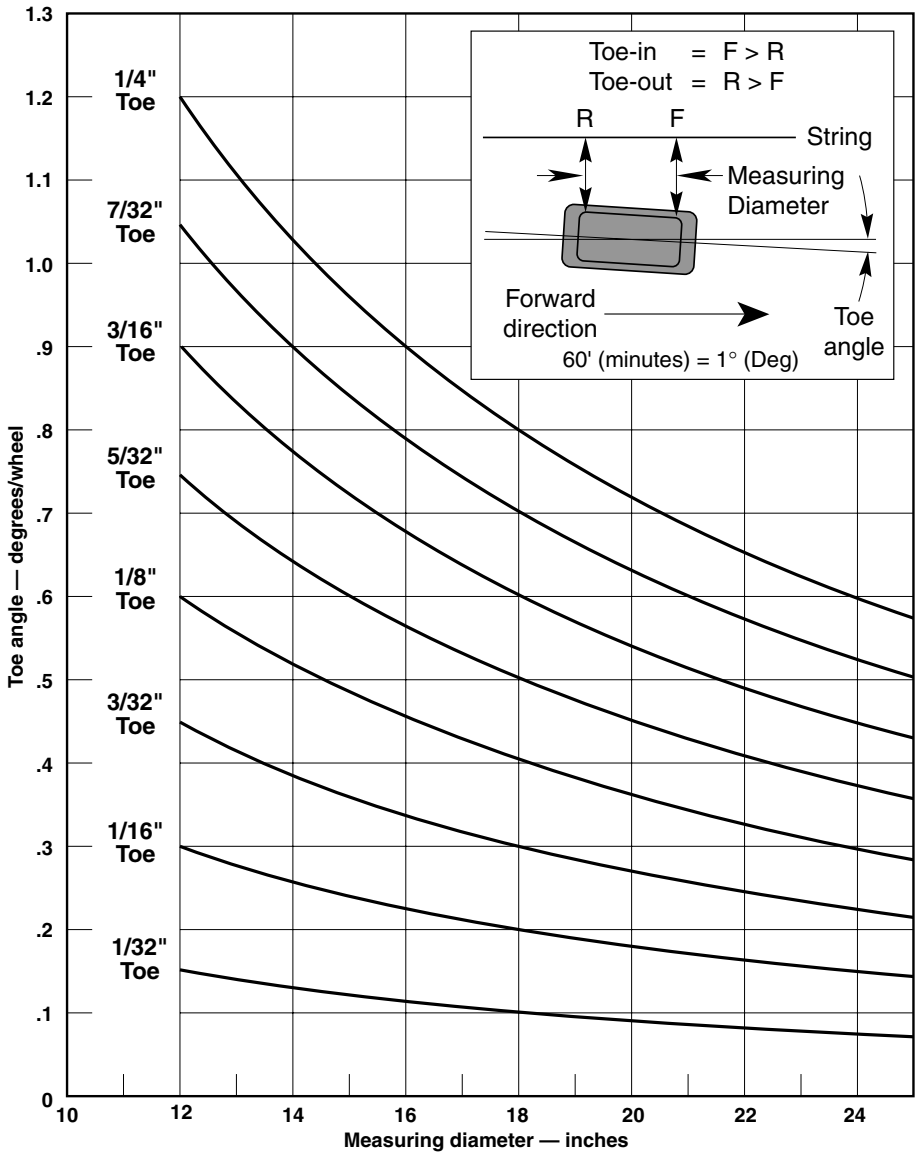
**Toe-out:**  
The measurement is **shorter** on the leading edge of the wheel than the trailing edge of the wheel.

**Example:**  
Measurement **C** is **shorter** than measurement **D**.

**Note:**  
This is true for both the front and rear axles.

**Note:**  
By using the same groove in the bar both front and rear, the strings are now parallel to each other. Measurement **A** and **B** will most likely not be the same.

# Figure 3. Toe Settings at Various Tire Diameters Per Wheel



# Figure 4. Mathematical Conversion

To convert a known toe setting (call it  $T_a$ ) and a known tire diameter (call it  $D_a$ ), use this equation to convert to a different tire diameter but using the same toe. For those who hate the math, just use the graph. For those who want the exact number and not interpolate from a graph use this equation:

$$\frac{T_a}{D_a} = \frac{T_b}{D_b}$$

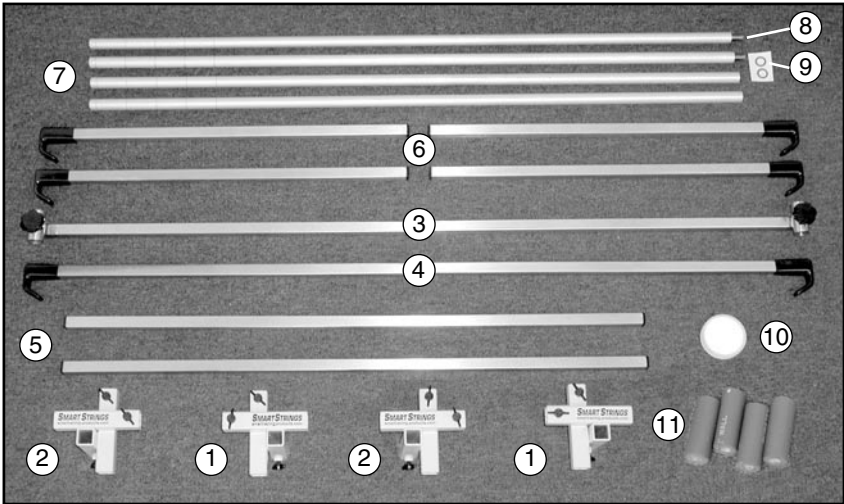
Where  $T_a$  = known toe setting  
 $D_a$  = known tire diameter

If you want the same toe angle with different tire diameters call those  $T_b$  and  $D_b$ . If you do the algebra, you end up with:

$$T_b = T_a \times \frac{D_b}{D_a}$$

You can see that measuring toe accurately is not something that you can take for granted.

# SmartStrings Parts List



Item	Part Name	Quantity
1	Union Right Side	2
2	Union Left Side	2
3	Leg with Holder 36"	2
4	Leg with Hook 36"	2
5	Cross Bar 36"	2
6	Hook 24"	4
7	String Bar	4
8	Stud	2
9	Washer	2
10	String Line	1
11	Pads	4

# WATKINS SMARTCAMBER™



The SmartCamber tool was designed to maximize its measuring potential over a wide variety of wheel/tire combinations. Utilizing repeatable digital technology, the tool allows accurate measuring regardless of where the vehicle is or what angle surface it is on.

There is no misinterpretation with this tool because there are no bubbles or lines to subjectively read. The SmartCamber tool takes all of the guess work out of camber and caster measuring.

Since there are nearly an infinite number of wheel and tire combinations, it was necessary to design a tool that would be quick and easy to use.

The number one design premise was to allow camber and caster to be measured almost anywhere without removing hub caps, lug nuts or jacking the car off of the ground.

Though it is basic in concept, the results are excellent. One fixed and one adjustable standoff allows the owner to use the tool on almost any vehicle.

**Check [smartracingproducts.com](http://smartracingproducts.com) for pricing.**

# Notes

# Notes



**smartracingproducts.com**  
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