# **SharkEye** Laser Wheel Alignment System Operational Manual

This manual provides detailed instruction for the proper use of your new ***SharkEye*** Laser Wheel Alignment System. Proper use will obtain professional, accurate results. This manual will also provide the user with a basic understanding of wheel alignment theory.

*Figure 1: **SharkEye** Standard Size 4-Wheel System for Passenger Cars, SUVs, Pickups, and Vans, Shown With Optional Drive On Turntables*

Manual Rev 3.95

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## Section 1 - Introduction and Usage Notes

Thank you for your purchase of the ***SharkEye*** Laser Wheel Alignment System from ***Alignment Team USA***, the factory authorized USA sales, service, technical support, and warranty center. Designed for professional use, but affordably priced to allow anyone to do their own wheel alignments.

These laser toe gauges are a quality product manufactured in the United Kingdom. They are sensitive instruments that will provide accurate results and should be handled with care. When handled with the care they deserve, they will provide many years of trouble-free service. They can be used with a vehicle placed on an alignment rack, portable alignment stands, or directly on the floor using turntables under the front wheels. Turntables or slip-plates should be used under the rear wheels of fully adjustable rear axles if they are to be adjusted. This type of rear axle is found on many front wheel drive passenger cars and SUVs.

***Please read this manual in its entirety*** before contacting us for technical support as many of your questions will be answered.

You will notice ***instances of duplicated information*** as you read this manual from cover to cover. This was done intentionally to allow the manual to be used by experienced users as a quick reference for individual sections, without having to go back and search for text in other sections.

## Section 2 - System Warranty – *UP TO TEN YEARS!*

When purchased directly through the ***Alignment Team USA*** website, or directly from ***Alignment Team USA*** by phone, all ***SharkEye*** laser alignment systems carry a ***TEN*** year manufacturers' parts warranty against defects in materials and workmanship.

All systems purchased non-directly from ***Alignment Team USA*** carry a ***Three*** year manufacturers' parts warranty against defects in materials and workmanship. Examples of non-direct purchases are purchases made through eBay, Amazon, or other vendors outside of ***Alignment Team USA.***

Labor, when performed by ***Alignment Team USA,*** is covered by a ***One*** year warranty regardless of direct or non-direct purchase. Labor performed by anyone other than ***Alignment Team USA*** is not covered.

Product technical support is available from ***Alignment Team USA*** at no charge for a period of one year from the date of purchase. After that time charges for technical support will be assessed at the current rate.

Batteries are considered consumables and are not included in the standard warranty. Batteries are covered for a period of ***90 Days***.

Warranty associated shipping cost is covered for the first ***30*** days from receipt of the product for items determined by ***Alignment Team USA*** as required to be shipped in for repair. After 30 days shipping is solely the responsibility of the purchaser. Packaging for shipment to ***Alignment Team USA*** and damage which may occur during shipment is always the responsibility of the user.

***Alignment Team USA*** fully supports all products it sells. Parts and service for non-warranty product repair is available from ***Alignment Team USA*** and will be assessed at the current rate.

## Section 3 - System Configuration Options

The ***SharkEye*** laser system is available in multiple configurations of two different alignment systems and we would very much like you to fully understand the differences. Both systems come in two sizes. A standard size for passenger cars, SUVs, pickups, and vans. A similar larger sized system is available for multi-axle heavy-duty trucks and buses. The larger heavy-duty systems also work well for light vehicles that have been fitted with oversize tires larger than 33” diameter or having a tire sidewall taller than 7" (180mm).

### Entry Level Alignment System

The entry-level 2-wheel only system is designed to measure total toe on a single axle without regard to the other vehicle axle (or axles). It cannot measure individual toe on each side. *See toe description page 10.*

This system uses one laser on one side, with a mirror on the opposing side. The mirror reflects the beam back to a total toe scale on the laser side. It is available as a standard size for passenger cars, SUVs, light trucks, and vans. *See Figure 2.*
And a similar but larger sized system for multi-axle heavy-duty trucks and buses.

This system does an excellent job of accurately setting total toe, however, it is unable to measure or correct individual side-to-side toe without toe scales and lasers on each side as our 4-wheel system incorporates. It would also need a reference to the rear axle (or axles) as our 4-wheel system incorporates. See our ***TIP*** *in section 8, page 19* of this manual to get the most out of your 2-wheel only system and improve your results.

***NOTE:*** *Camber may be measured using your smartphone with a "level" app by holding the phone directly against the main horizontal sheet metal of the hanger structure (next to the vertical slot, just above the black adjustment knob), or with an optional gauge purchased separately from the* ***SharkEye*** *alignment system.*

*Figure 2: Two-Wheel Standard Size System*

**Advanced Alignment System**

When purchased as the more capable 4-wheel alignment system a total of four lasers are incorporated into the system. The system includes toe scales and toe lasers on each side to measure and correct individual side-to-side toe. *See toe description page 10.* It also includes rear lasers and flag scales for measurement and compensation / correction of rear axle toe and tracking / thrust angles. *See thrust angle and four-wheel description pages 22-23.*

It is available as a standard size for passenger cars, SUVs, light trucks, and vans *See Figure 1 and Figure 3,* and a similar but larger sized system for multi-axle heavy-duty trucks and buses *See Figure 12, page 36.*

By using the 4-wheel alignment system, and referencing the rear axle, the front wheels can be made parallel with the rear wheels thereby creating a centered steering wheel and a vehicle that handles properly with minimal tire wear. Aligning the front axle to the rear axle is the preferred method of alignment and will provide the best results. This does require the 4-wheel alignment system.

***NOTE:*** *Camber may be measured using your smartphone with a "level" app by holding the phone directly against the main horizontal sheet metal of the hanger structure (next to the vertical slot, just above the black adjustment knob), or with an optional gauge purchased separately from the* ***SharkEye*** *alignment system.*

*Figure 3: Four-Wheel Standard Size System With Wall Bracket Storage*

## Section 4 - Optional Equipment

The following optional pieces of equipment are just some of what we have available to make your job easier and expand your systems capabilities. These may be purchased from our website at ***AlignmentTeamUSA.com*** or by contacting us:

**Turntables:**

**Entry Level Style:** The entry-level style turntables are a simple maintenance-free single piece dished plate ideal for toe-only adjustments. These rotate easily on any hard surface. However, they are not ideal for sideways movement such as when adjusting camber. They do not incorporate radius gauges required for some additional measurements. As with all turntables, care is required when placing them under the wheels. It is important during placement that suspension geometry remains in its normal position for alignment. Jouncing the vehicle by pushing down on the bumper area will normally settle out the suspension before alignment.

**Advanced Style:** The advanced style turntables are full-floating bearing style plates with radius angle gauges. These are ideal for toe measurements and adjustments. They are required for caster measurements and caster and camber adjustments. They are also required for making toe-out on turns and maximum turning angle measurements. A detailed description of each of these angles can be found in section 5.
These turntables allow rotational, as well as side to side and fore and aft movement. All movement occurs on low resistance bearing surfaces. By allowing the steering and suspension to always be in a normal plane of geometry, this style is best at allowing the wheels to simulate actual road conditions. After placement jouncing the vehicle by pushing down on the bumper is recommended to settle out the suspension before alignment.

**Slip-plates:** Portable greased slip-plates made of steel are an option to turntables for rear-wheel adjustments.

**Steering Wheel Level Indicator:** Provides quick "at a glance" visual verification of a level centered steering wheel without having to get back in the vehicle and sit behind the wheel.

**Steering Wheel Lock:** Provides a method of locking the steering wheel in a level centered position during the front wheel toe setting.

**Brake Pedal Lock:** Provides a method of applying the brakes to prevent wheel roll during caster measurements. Preventing wheel roll is necessary to get an accurate caster reading.

**Camber, Caster, SAI, and Included Angle Gauge:** This gauge provides a means to make caster, SAI, and Included Angle measurements. Additionally it provides a camber reading. A detailed description of each of these angles can be found in section 5.

> ***NOTE:*** *Camber may be measured using your smartphone with a "level" app by holding the phone directly against the main horizontal sheet metal of the hanger structure (next to the vertical slot, just above the black adjustment knob), or with an optional gauge purchased separately from the* ***SharkEye*** *alignment system.*

**Toe Out On Turns and Maximum Steering Angle Gauge:** These are included with our optional bearing type turntables when equipped with radius angle gauges. A detailed description of each of these angles can be found in section 5.

**System Calibration Fixture:** The ***SharkEye*** laser alignment system when handled properly with care will maintain calibration and provide accurate alignment measurements. However, it is still advisable to periodically check and correct calibration as a routine maintenance item.

A system calibration fixture may be purchased to allow user calibration checks and corrections or the system may be returned to ***Alignment Team USA*** for this service at a nominal cost plus shipping.

## Section 5 - Wheel Alignment – A Quick Overview Of The Basics

Wheel alignment is part of standard vehicle maintenance. The procedure consists of adjusting the geometric angles of the vehicle's road wheels so that they travel in a straight and true manner. This reduces excessive and premature tire wear and provides the best handling characteristics for the vehicle.

Periodic inspection and adjustment of these angles is required. Normal wear and tear, and steering component replacement, will cause these geometric angles to move out of vehicle manufacturer tolerances.

Industry recommendations are to check wheel alignment annually. The ***SharkEye*** system provides a quick, easy, and accurate method of doing so.

There are a great deal of wheel alignment angles, and there is much to understand about wheel alignment. But don't get overwhelmed. Toe, Rear Axle Thrust Angle, and Camber are the common angles that you will be most concerned with for the average wheel alignment job. There is no better teacher than jumping right in and doing it. You will be surprised at how quickly you become proficient at it. Each alignment job will become easier as you grow in the understanding of alignment theory and the use of the equipment.

> ***Note:*** *Not all of the angles described have been provided with factory adjustments on every wheel on every vehicle. Some vehicles are provided with more factory provisions for adjustments than others. Aftermarket adjustment kits available from many auto parts stores and online retailers are available to provide a means of adjustment in most situations requiring them. These would include angles such as camber, caster, and rear toe. In other cases, bent or damaged parts must be located and replaced.*

## The Most Commonly Measured Front Wheel Angles

**TOE** when viewed from above the vehicle is the difference in the distance across the front edge of tires, compared to the back edge of the tires on an axle. This would be considered "total toe". *See Figure 4.* Individual toe for one wheel may also be measured. Individual toe is viewed from above the vehicle. It is the difference in the distance from the vehicle center-line to the front edge of a tire, compared to the vehicle center-line to the back edge of the same tire. *See Figure 5.*

***NOTE:** Incorrect toe is the most common cause of excessive tire wear.*

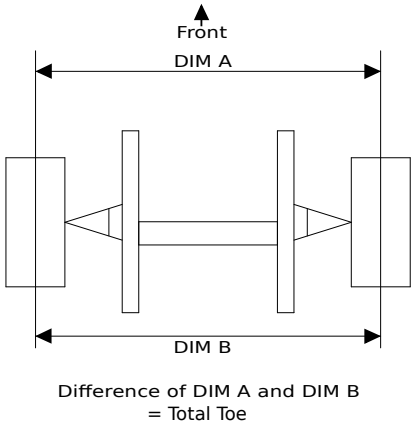


*Figure 4: Total Toe Angle*

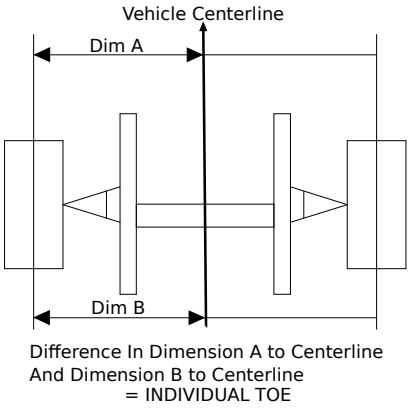


*Figure 5: Individual Toe Angle*

**CAMBER** when viewed from ahead or behind the vehicle is the angle formed when the top of the tire leans out away from the vehicle (positive) or in toward the vehicle (negative). *See Figure 6.*

Front-wheel camber is a tire wear angle (camber wear occurs primarily during turning) and it can induce a pull, typically toward the side with more positive camber. A side to side difference of more than ½ degree will normally result in a pull. Some suspension designs are more sensitive to camber variance than others. Equal camber is generally ideal for most situations although it can be used to correct for drift caused by a high road crown or to act against a caster pull. This can be helpful when a vehicle does not have a provision for caster adjustment.

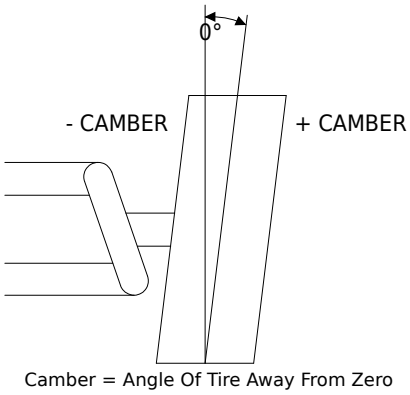


*Figure 6: Camber Angle*

**Example:** The left wheel has 3 degrees of positive caster. The right wheel has 3½ degrees of positive caster. Assuming that camber is equal, this will induce a pull left. A camber angle set to ½ degree higher on the right side than the left side could be used to neutralize the induced pull.

> ***NOTE:*** *Adjustment changes in camber will change toe, therefore any required camber changes should be made before final toe adjustments.*
>
> ***NOTE:*** *Camber may be measured using your smartphone with a "level" app by holding the phone directly against the main horizontal sheet metal of the hanger structure (next to the vertical slot, just above the black adjustment knob), or with an optional gauge purchased separately from the* ***SharkEye*** *alignment system.*

**CASTER** is the tilt of the steering axis of each front wheel as viewed from the side of the vehicle. If the upper ball joint or strut mounting plate is behind the lower ball joint, or the steering axis otherwise tilts backward in this manner, it is considered positive caster. The opposite is negative caster. *See Figure 7.*

Caster is not considered a tire wear angle, is non-adjustable on many modern vehicles, but it can induce a pull. The vehicle will tend to pull toward the side with the least amount of caster. Almost all road vehicles have been designed for positive caster. Very few vehicles have been produced with a negative caster design but it can be found on some earlier vehicle designs. More than ½ degree side to side variation can induce a pull depending on vehicle design. Most strut-type front suspension systems have a high SAI angle (see SAI description page 14) designed into the suspension. These vehicles are less prone to a caster-induced pull unless the side to side variance is significantly greater than ½ degree. A higher caster adds resistance to turning and reduces the tendency for a vehicle to wander. Too much caster can make slow speed turning too difficult. Manual steering vehicles generally have less caster than power steering vehicles for this reason.

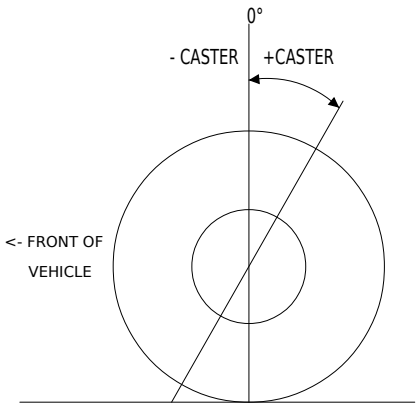

*Figure 7: Caster Angle*

Equal caster is generally ideal for most situations although it can be used to correct for drift caused by a high road crown or to act against a camber pull. This can be helpful in situations where it is easier to make a caster adjustment than a camber adjustment.

**Example:** The left wheel has zero camber. The right wheel has ½ degree positive camber. Assuming caster is equal, this will induce a pull right. A caster angle could be set to ½ degree lower on the left side than the right side to neutralize the induced camber pull.

> ***NOTE:*** *Changes in the caster can affect camber and toe depending on design, therefore any required caster changes should be made before camber and final toe adjustments.*
>
> *Caster readings require an optional gauge purchased separately from the* ***SharkEye*** *alignment system.*

**Four-Wheel or Thrust Angle Alignment Adds:**

**Rear Axle Toe** when viewed from above the vehicle is the difference in the distance across the front edge of tires, compared to the back edge of the tires on an axle. This would be considered “total toe”. *See Figure 4, on page 10.* Individual toe for one wheel may also be measured. Individual toe is viewed from above the vehicle. It is the difference in the distance from the vehicle center-line to the front edge of a tire, compared to the vehicle center-line to the back edge of the same tire. *See Figure 5, on page 10.*

> ***NOTE:*** *Incorrect toe is the most common cause of excessive tire wear. Incorrect rear toe can result in a thrust angle "push" where the rear of the vehicle is steering the back end one way or the other. This can occur when one side of a solid rear axle is ahead or behind the other side or when a fully adjustable independent type rear axle is mis-adjusted.*

**Rear Axle Camber** when viewed from ahead or behind the vehicle is the angle formed when the top of the tire leans out away from the vehicle (positive) or in toward the vehicle (negative). *See Figure 6, on page 10.* The rear axle camber is not a tire wear angle. Changes in camber can change toe depending on the rear suspension design, therefore any required camber changes should be made before final toe adjustments.

> ***NOTE:*** *Camber may be measured using your smartphone with a "level" app by holding the phone directly against the main horizontal sheet metal of the hanger structure (next to the vertical slot, just above the black adjustment knob), or with an optional gauge purchased separately from the* ***SharkEye*** *alignment system.*

**Rear Axle Thrust Angle** is the angle formed between the vehicle's geometric center-line and the direction in which the rear wheels are aimed. *See Figure 8, on page 13.* Zero thrust angle is ideal. This is where the rear axle is exactly perpendicular to the vehicle center-line and both wheels are parallel to each other. However, due to manufacturing tolerances the ideal thrust angle of zero is seldom achieved during assembly on solid non-adjustable rear axle vehicles.

Vehicles with adjustable rear axles should be adjusted to the ideal thrust angle of zero during wheel alignment. Vehicles with non-adjustable rear axles should be measured, and then compensated for thrust angle during wheel alignment. This will maintain proper vehicle handling, maintain a properly centered steering wheel, and reduce potential tire wear issues. Most solid rear axle vehicles will have some thrust angle due to manufacturing tolerances.

A non-adjustable rear axle thrust angle beyond ½ degree typically requires further mechanical repair. Alignment alone cannot fully compensate in these cases. This measurement and compensation procedure requires the use of rear tracking lasers and flag scales, included with all 4-wheel versions of the ***SharkEye*** alignment system. The 2-wheel only version will not perform a thrust angle or four-wheel alignment.

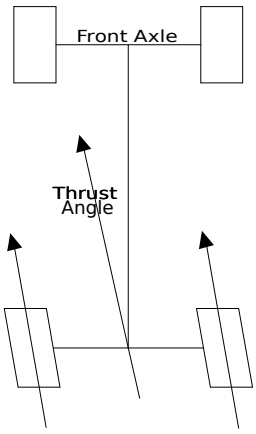


*Figure 8: Thrust Angle*

**Setback** is the difference between the right side and left side wheelbase length. *See Figure 9.* It is built into some vehicles by design, such as the Ford twin I-beam design found mainly on older, full-size pickup trucks and vans. Unless setback is excessive, it does not generally affect vehicle handling. Most vehicles using conventional suspension (non-twin I-beam) will allow up to ¼" (or 6mm) of setback. An out-of-spec setback dimension may occur from a difference between right and left caster or from suspension damage. Hitting a pothole or a curb for instance may push a wheel back. A rear axle thrust angle will also affect a setback reading.

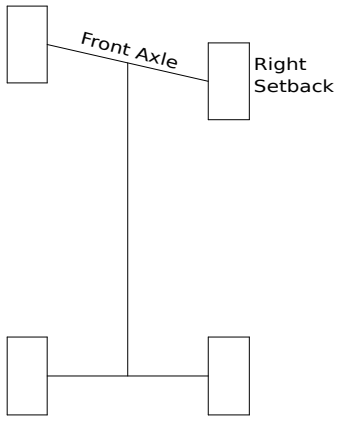


*Figure 9: Setback*

**Diagnostic Measurements and Angles**

**Ride Height** Sagging springs or changes in spring height by installing lift kits, etc. will affect vehicle ride height. Depending on the design, changes in ride height can affect the camber angle which in turn affects the toe. This should be taken into consideration on vehicles using independent or twin I-beam suspensions. Solid axle vehicles are generally unaffected. If for example you are measuring a vehicle with four-wheel independent strut suspension, and you determine camber is negative and requires adjustment at all four wheels, the vehicle most likely has sagging worn-out springs. A quick check is to lift the body to normal ride height with a jack and see if the camber comes into specifications. If so, replace the springs and then align the vehicle.

**Toe Out On Turns** Sometimes referred to as the Ackermann Angle. This is designed into the steering knuckle arm where the outer tie rod attaches. This design allows changes in side-to-side steering angles during turns. During turns it allows the inside wheel to turn a tighter circle than the outside wheel. This reduces tire scuffing, squealing, and excessive tire wear. *See Figure10.*

Applicable on steering axles only. Checked manually this procedure requires the use of optional bearing type turntables with radius gauges.

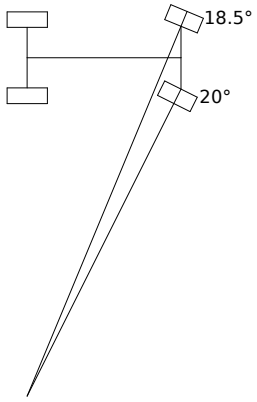


*Figure 10: Toe Out On Turns*

With a tire turned out away from the vehicle to 20 degrees (this would be the inside wheel on a turn), the opposite side (outside wheel on a turn) should normally be about 1 ½ degrees lower, so about 18 ½ degrees. Verify by checking both sides as the difference in readings varies between designs but each vehicle should have the same reading side to side. This is normally only a problem if a collision bent a steering arm. A bent steering arm will result in toe type tire wear even though straight ahead total toe is correct because the problem only occurs during turns.

**SAI - Steering Axis Inclination** (sometimes referred to as KPI, or King Pin Inclination), is applicable on steering axles only. SAI is the tilt of the steering axis from vertical as viewed from ahead or behind the vehicle. It is the angle formed by drawing a line from the center of the lower ball joint up through the center of the upper ball joint or strut mount and compared to vertical. *See Figure 10.*

Think of it as spreading your legs apart while standing. This adds stability to the vehicle, especially while turning.

SAI readings are useful in diagnosing a mis-adjusted engine cradle assembly on front-wheel drive vehicles and for diagnosing collision damage. SAI readings require an optional gauge.

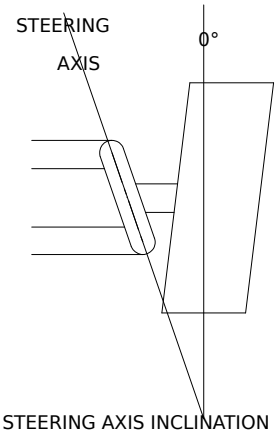


*Figure 10: SAI*

**Included Angle** is created by adding together the SAI and Camber angle measurements, applicable on steering axles only. *See Figure 11.* This is useful for diagnosing bent or damaged steering components after a collision. Included angle readings require an optional SAI gauge.

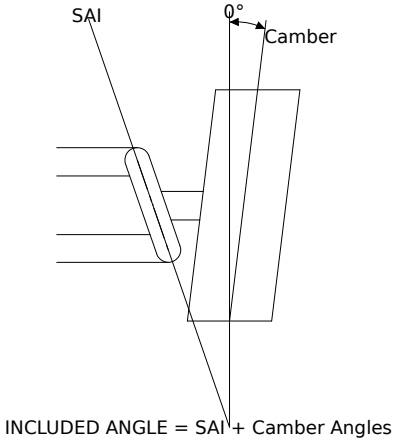


*Figure 11: Included Angle*

**Maximum Turn Angle** is the lock to lock steering angle. This is when the steering wheel is turned all the way one direction until it stops, and then all the way the other direction until it stops. It is applicable on steering axles only. Useful to determine side-to-side difference from the true center of steering gear to check for bent, damaged, or miss-adjusted steering components. Requires the use of optional bearing type turntables with radius gauges.

**Track Width** compares the difference between the front and rear axle width. Built into some vehicles by the manufacturer in which case it is evenly split side to side. Seldom used during an alignment routine, but it can be useful in collision repair to determine if it is no longer evenly split side to side. Can be mechanically measured however the use of computerized equipment is the most common method of measurement today.

## Section 6 - Pre-Alignment Checks

**Tire Inflation** Verify proper tire pressure, a soft tire affects alignment and can induce a vehicle pull just from the additional rolling resistance.

**Ride Height** If a specification is known the vehicle should be checked for proper ride height to determine spring condition (not all manufacturers publish a vehicle ride height specification).

**Shocks and Struts** play an important role in proper vehicle handling and tire life and are often overlooked. Shocks and struts maintain firm tire contact with the road surface. When worn they will allow the tire to bounce slightly on and off of the road surface. This results in a cupping type of wear pattern throughout the tire's tread surface. Shocks and struts also act to dampen and absorb road impacts, protecting expensive front-end components from those road impacts. Worn shocks and struts allow road impacts to instead be absorbed by the vehicle's ball joints, tie rod ends, steering gear, bushings, and other expensive to replace items.

Shocks and struts should be visually inspected for leaks or damage. They should also be checked for proper rebound dampening by jouncing each end of the vehicle while monitoring the effectiveness of the shocks to stop vehicle movement quickly. A similar test can be performed on vehicles with stiff suspension by standing beside the vehicle and pushing on a solid area of the roof above the doors. The object is to get the vehicle rocking sideways and monitor how quickly the vehicle movement stops when you quit pushing on the vehicle. Purchase only high-quality replacement shocks and struts, they perform a very important job.

**Inspect All Steering And Suspension Components** for wear or damage. Replace questionable items before vehicle alignment. A small amount of movement at a tie rod end is greatly exaggerated at the edge of the tire. It is impossible to properly set and maintain a toe setting when excessive wear exists in components. An 1/8" (or 3.175mm) of incorrect toe is equivalent to dragging a tire sideways for twenty-eight feet (8.5 meters) per mile driven. This is based on an average diameter tire of 28.5" (or 724mm).

The best way to inspect steering linkage (tie rods and related) is with a helper performing a "loaded" test. With normal vehicle weight on the front tires while on a firm surface to resist turning (not on turntables), have the helper move the steering wheel back and forth a small distance beyond the point of when resistance is felt at the steering wheel. This should be done at a slow to medium speed as rapid movement will make the task more difficult. The "inspector" can watch and feel for movement at each

joint in the steering assembly. On earlier vehicles using center-link style linkage with idler arms, be sure to watch for up and down movement in the idler arm where it attaches to the center-link. This will affect a change in the toe. In rack and pinion systems pinch the rubber boots at the outer ends of the housing and feel for any movement in the inner socket joint inside where it attaches to the rack. This is a common point of wear and will affect a change in the toe.

Suspension components include control arms, radius arms (or strut rods), mounting bushings, ball joints, struts, and strut mounting systems. Many of these items must be "unloaded' from spring pressure while in their normal plane of geometry to properly check for excessive play. Due to many variances in vehicle design, it is best to reference inspection procedures for the specific vehicle being inspected.

Often a rubber bushing can be visually inspected. Inspect for heavy cracking on bushings and also whether or not the item supported by the bushing is still supported in the center of the bushing. As bushings wear they will often sag allowing the supported component to be out of its normally designed position. The normal direction of pressure applied against the bushing will indicate whether this pressure caused the sag over time or if possibly the bushing was meant to be other than centered. Additionally, bushings can be inspected where they contact the metal arms or rods that they support by looking for "large rubbed clean" areas indicating that uncontrolled movement is commonly occurring in this area.

**Install Turntables or Slip-plates** with care to avoid binding the suspension outside of its normal geometry. During alignment we are trying to replicate the vehicle's geometry as if it were driving down the road. Bearing style turntables can be damaged by driving onto or off of them without plate locking pins installed and the use of some type of ramp for a smooth roll onto or off of the table. Lifting the wheel by jacking under the lower control arm or axle is often the best method of turntable placement. Place the jack in a position to maintain as much as of the normal geometry of the control arm as possible.

**Jounce The Vehicle** by pushing down at the bumper areas. This will help settle out the suspension by putting it back into its normal geometry. This should be done anytime the vehicle is jacked up whether to install turntables or when required for making adjustments.

## Section 7 - Performing An Alignment With The *SharkEye* System

***CAUTION: The lasers used in this equipment are low-power lasers and meet safety standards, however, the lasers are very bright and one should never look directly into the lasers.***

All wheels to be adjusted *MUST* be on turntables or slip plates for proper adjustments to be made. It is best to use turntables for front axle adjustments and turntables work equally well for rear axle adjustments. Slip plates may be used for rear axle adjustments. Attempting adjustments without these will result in improper adjustments and improper readings after adjustments because the tires will stretch (as rubber does) rather than move fully into the position being measured. This applies to *ANY* brand of wheel alignment equipment.

Due to road forces while driving, the front wheels will automatically turn into the direction needed to become parallel with the rear wheels and match any thrust in the rear axle. All-wheel alignments, regardless of the equipment used, should be referenced in some manner off of the rear axle.

> ***NOTE:*** *See our* ***TIP*** *in section 8 on how to reference the other axle (or axles) when using the 2-wheel only laser alignment system. By referencing the rear axle the front wheels can be made parallel with the rear wheels thereby creating a centered steering wheel and a vehicle that handles properly with minimal tire wear.*

If a non-compensated thrust angle exists, a crooked steering wheel is a result even though the steering wheel was straight when the vehicle toe was set. If any rear wheel adjustments are to be made, they should always be made before the final alignment of the front steering axle.

> ***NOTE:*** *Adjustment changes in camber and caster will change toe, therefore any required camber or caster changes should be made before final toe adjustments.*

## *Section 8 - OPERATION - SharkEye* 2-Wheel Only Laser Alignment System

This 2-wheel only system is designed to measure total toe on a single axle without regard to the other vehicle axle (or axles). It cannot measure individual toe on each side. *See toe description page 10.* It uses a laser on one side, with a mirror on the opposing side, to reflect back to a total toe scale on the laser side.

This system does an excellent job of accurately setting total toe, but is unable to measure or correct individual side-to-side toe without a reference to the other axle (or axles).

Install the laser sensors as follows. When using the 2-wheel only system, whenever possible, the sensors should be placed on the vehicle with the toe scale and mirror ends pointing toward the front of the vehicle. This is regardless of which axle they are installed on. This allows the toe scales to be read in a normal manner. If vehicle clearance will not allow this on the rear axle, the sensors may be installed with the toe scale and mirror ends extending rearward away from the vehicle. In this case, the toe scale must be read in reverse. Indicated toe-in will actually be toe-out, and indicated toe-out will actually be toe-in, as the scale is being viewed in an opposite manner.

> ***NOTE:*** *This is different than when using the 4-wheel system on the rear axle where the scales always extend out away from the vehicle and are read in reverse of what is indicated for toe-in and toe-out.*

The laser sensor hangs from the top of the tire's tread surface. When installing the laser sensor, adjust the position of the sensor so that the level vial has a centered bubble while at the same time positioning all three aluminum stand-off pins firmly against the wheel's edge. The sensor should be exactly parallel with the tire sidewall. The two lower aluminum stand-off pins are for toe while the single upper pin is for camber.

Although not normally required, it may be helpful on some tire and wheel assemblies to use a "bungee" type rubber strap to keep the sensor firmly in position. Be careful not to over-tighten and distort the sensor body, just light pressure is all that is needed.

### A Tip To Achieve Better Results Using 2-Wheel Only System

When using the 2-wheel only laser alignment system here is a **TIP:** To reference the other axle (or axles) tie a string snugly around the entire vehicle across the mid-point of all tires. This should locate the string at approximately wheel hub height. The string can be used as a visual guide to determine if the front and rear tires are roughly parallel to each other by carefully determining how evenly the string touches or spaces away

from the tire sidewalls. Turn the steering wheel back and forth to obtain even pressure and distance of the string from all tire sidewalls. It will not be as accurate as the ***SharkEye*** 4-wheel laser system, but when done properly it will perform an adequate job.

If the rear axle is to be adjusted, start in the rear first, if not skip ahead to the next paragraph. Place the sensors in position on the rear tires over the top of the string, leaving the string in position. Read the toe scale and adjust for proper total toe setting while maintaining even sidewall pressure and distance on the string to keep all tires parallel. This completes the rear axle adjustment.

Place the sensors on the front axle, leaving the string in position. Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered verify equal steering wheel play side to side and shut off the vehicle. If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the wheel during and after toe adjustments.

Visually inspect how the string contacts the front tire sidewalls. You will adjust the toe to specification while at the same time correcting and maintaining the front tires parallel to the rear tires using the string as a guide.

Vehicles with individual tie rods for each steerable wheel may require adjustment on one side more than the other. On single adjustable tie rod vehicles, you will adjust for total toe, and then if the vehicle has an adjustable drag-link use this to move the wheels into a parallel alignment with the rear axle while maintaining the steering wheel in the centered position.

After setting total toe on older single tie rod adjustment vehicles without an adjustable drag link, move the front wheels back and forth until even pressure and distance are applied to the string without regard to the steering wheel centering. Then remove the steering wheel and reinstall it in the centered position.

> ***NOTE:*** *this will only work on older vehicles (primarily vehicles manufactured before 1980) with non-indexed steering shafts where the steering wheel attaches. Modern vehicles have indexed steering shafts allowing steering wheel installation in one position only.*
>
> ***CAUTION: Never remove a steering wheel that incorporates an airbag deployment system without following the vehicle manufacturer's instructions to deactivate the system or serious personal injury could result.***

## *Section 9 - OPERATION - SharkEye* 4-Wheel Laser Alignment System

- **Operation Overview**

Three different wheel alignment methods can be performed with the 4-wheel laser alignment system as follows:

- Center-line Alignment
- Thrust Angle Alignment
- Four-Wheel Alignment

Choose the appropriate method from the following descriptions that will provide the results you desire.

Installation of the equipment is the same regardless of which alignment method is used. The laser sensors are installed with the toe scales extending away from the vehicle regardless of which axle they are placed on. When installed on the rear axle in this manner, they must be read in reverse of what is indicated. Indicated toe-in will actually be toe-out, and indicated toe-out will actually be toe-in, as the scales are being viewed in an opposite manner of the front axle.

Each laser sensor hangs from the top of the tire's tread surface. When installing the laser sensor, adjust the position of the sensor so that the level vial has a centered bubble while at the same time positioning all three aluminum stand-off pins firmly against the wheel's edge. When properly installed the sensor should be exactly parallel with the tire sidewall. The two lower aluminum stand-off pins are for toe while the single upper pin is for camber.

To install the flag scale assembly hang the assembly from the top of the tire's tread surface. The vertical round rod should be visually perpendicular fore and aft to the floor surface. Adjust the two lower aluminum stand-off pins firmly against the wheel's edge. The flag scale should face toward the other axle and be positioned parallel with the tire's tread surface. Move the top of the round vertical rod in toward the sidewall or out away from the sidewall until the level vial bubble is roughly centered. Both aluminum pins on this assembly are used for toe-tracking. The flag scale assembly should not be used to reference camber measurements.

Although not normally required, it may be helpful on some tire and wheel assemblies to use a "bungee" type rubber strap to keep the flag scale firmly in position. Be careful not to over-tighten and distort the flag scale rod, just light pressure is all that is needed.

## 4-Wheel Alignment Methods - Described

- **A Center-line Alignment** assumes that the rear axle is exactly perpendicular to the vehicle's geometric center-line with both rear wheels exactly parallel to each other and parallel to the vehicle's geometric center-line. It does not compensate for any thrust-angle that may be present in the rear axle. Therefore any thrust angle that is present can result in a crooked steering wheel.

  Due to road forces that occur while driving, the front wheels will automatically turn into the direction needed to become parallel with the rear wheels and match any thrust in the rear axle. If a non-compensated thrust angle exists, a crooked steering wheel is a result even though the steering wheel was straight when the vehicle toe was set.

  A crooked steering wheel does not always present a tire wear problem and does not mean that the total toe is incorrect. However, in cases of a severe rear axle thrust angle, excessive tire wear and incorrect vehicle handling will occur. See the Thrust Angle Alignment section next to understand why.

- **A Thrust Angle Alignment** is performed on a solid non-adjustable rear axle. This type of alignment compensates for any normal (less than .4 degree) rear axle thrust angle so that all alignment angles are within specification and the steering wheel is centered while driving. This is done by aligning the front wheels to be parallel with the rear axle wheels rather than referencing the geometric center-line of the vehicle.

  In a large majority of cases, a vehicle's thrust angle will be below .4 degrees and can be compensated for during a "thrust angle" alignment procedure. Thrust angle becomes difficult to compensate for when it exceeds .4 degree and is considered severe when it exceeds .5 degree. A severe thrust angle requires repositioning of the axle before a proper wheel alignment can be performed.

  Tire wear can occur with severe thrust angle. As the front wheel spindle steers into a turn, it moves in an arc. This results in a camber change that occurs throughout the turn. This is designed into the suspension system. Working in conjunction with caster and SAI, this design aids in better handling during turning, and steering wheel return as the turn is completed. If the front wheels have to turn too far to become parallel with the rear axle, an out-of-specification camber angle can exist while driving. In this instance, a steering pull, and excessive tire wear, are normally noted. If you experience this condition after you have properly performed a thrust angle alignment look into the possibility that excessive rear axle thrust angle is present.

- **A Four-Wheel Alignment** is very similar to a thrust angle alignment except that it is performed on vehicles that incorporate an adjustable rear axle. In this case "rear axle thrust" can be reduced and more often eliminated depending on the adjustments available. In this procedure, the rear axle is adjusted first to match the vehicle's geometric center-line as closely as possible. After rear axle adjustment is complete, the front axle wheels are adjusted to be in parallel alignment with the rear axle wheels.

  This procedure can be performed on a vehicle with independent rear suspension that has factory-provided adjustments, or can be adjusted with aftermarket kits. This procedure can be performed on a front-wheel-drive vehicle using a rear axle comprised of a spindle bolted onto an axle tube. Mini-vans commonly have this type of rear axle. Tapered shims are available for these types of rear axles which are inserted between the spindle and the axle tube to correct toe and or camber tolerances.

  This procedure can also be performed on ***Heavy-Duty Trucks and Buses*** with a factory provided means of rear axle thrust angle adjustment which most modern day vehicles of this type have. See page 32, in section 9, for more information on procedures for heavy-duty trucks and buses.

**Performing A Center-line Alignment**

Begin by placing the laser sensors on the front wheels and the flag scales on the rear wheels. Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle. If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the steering wheel during and after toe adjustments.

Adjust the front toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most vehicles, or just under one reference mark for both scales combined. *See page 40 for toe scale usage notes.* Note the readings at the rear flag scales. Add these readings together and divide by two to obtain the "preferred" reading. For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example the “preferred” reading is 11. Adjust the tie rods to obtain the preferred reading on the flag scales while maintaining a centered steering wheel.

Vehicles with individual tie rods for each steerable wheel may require adjustment on one side more than the other. On single adjustable tie rod vehicles, you will adjust for the total toe. Then if the vehicle has an adjustable drag-link use this to obtain the preferred rear flag scale reading while maintaining the steering wheel in the centered position.

> ***NOTE:*** *On single adjustable tie rod vehicles the toe scale readings will not necessarily be on zero, or the preferred setting, once the preferred rear flag scale readings are obtained. This is due to even small amounts of rear axle thrust angle. The toe scale readings should, however, have an equal toe scale reading for toe-in on one side and toe-out on the other side.*

On older single tie rod adjustment vehicles without an adjustable drag link removal of the steering wheel and re-installation in the centered position will be required.

> ***NOTE:*** *this will only work on older vehicles (primarily vehicles manufactured before 1980) with non-indexed steering shafts where the steering wheel attaches. Modern vehicles have indexed steering shafts allowing steering wheel installation in one position only.*

***CAUTION: Never remove a steering wheel that incorporates an airbag deployment system without following the vehicle manufacturer's instructions to deactivate the system or serious personal injury could result.***

When any four-wheel alignment is completed it is recommended to perform the steering wheel centering procedure as described previously one last time to verify all readings.

**Performing A Thrust Angle Alignment**

Begin by placing the laser sensors on the front wheels and the flag scales on the rear wheels. Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle.

Adjust the front toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most vehicles, or just under one reference mark for both scales combined. *See page 40 for toe scale usage notes.* If the vehicle has adjustable tie rods on each side of the vehicle it is preferred to adjust them equally.

> ***NOTE:*** *it is not critical at this point to have the steering wheel centered because further adjustments are going to be performed requiring re-centering of the steering wheel.*

Next we will determine an approximate thrust angle measurement to prepare for thrust angle compensation. Note the readings at the rear flag scales. Add these readings together and divide by two to obtain the "preferred" setting. For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example steer the front wheels until the rear flag scales indicate the “preferred” reading of 11.

After steering the front wheels to obtain the “preferred” flag scale readings as described above, look at either of the toe scales and determine the amount of change. To determine this count how many marks have increased or decreased from zero, or the preferred setting if a small amount of toe-in or toe-out was used. During thrust angle measurement only, each toe scale mark represents approximately .15 of a degree on an average length full size pickup. For example, if a change of two marks is indicated this would indicate approximately .3 degrees of thrust angle. This is approximate and you will be able to determine what is normal and acceptable after several alignments.

A tracking measurement for compensation of rear axle thrust angle will now be taken. It is important at this point that no wheels are moved from their present position. If you have the steering wheel lock tool now is a good time to install it regardless of whether the steering wheel is centered or not. It is important that all wheels maintain their exact position until this procedure is completed.

Carefully remove the laser sensors and the flag scales and reinstall them in reverse without disturbing wheel position. Install the laser sensors on the rear wheels and the flag scales on the front wheels. Note the readings at the flag scales. It is suggested to write them down as "drivers side reading" and "passenger side reading". For example the drivers' side indicates a flag scale reading of 12 and the passenger side indicates a flag scale reading of 10. This indicates a rear axle thrust of two reference marks on the flag scales. This completes the tracking measurement procedure. The next step will compensate for rear axle thrust.

***NOTE:*** *flag scales have reference marks only and are not a unit of measure.*

Now once again remove the laser sensors and the flag scales and reinstall them in reverse. Install the laser sensors on the front wheels and the flag scales on the rear wheels.

Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle. If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the wheel during and after toe adjustments.

***On vehicles with adjustable tie rods for each steerable wheel*** the following procedure should be used.

Adjust the tie rods equally (to maintain the total toe reading) until a reverse reading of the flag scale thrust angle readings are obtained while at the same time maintaining a centered steering wheel. Using the example from the previous step adjust the toe evenly on both sides to obtain a difference of two reference marks on the flag scales with the higher reading now being placed on the opposite side. So in this example, the passenger side would be set to a reading of 12 and the drivers' side would be set to a reading of 10. This procedure will align the front wheels in a parallel line with the rear wheels effectively compensating for rear axle thrust angle.

***On vehicles with only one adjustable tie rod*** used for setting "total toe" the following procedure should be used.

Steer the front wheels until a reverse reading of the flag scale thrust angle readings are obtained. Using the example from the previous step steer to obtain a difference of two

reference marks on the flag scales with the higher reading being placed on the opposite side. So in this example, the passenger side would be set to a reading of 12 and the drivers' side would be set to a reading of 10. This procedure will align the front wheels in a parallel line with the rear wheels effectively compensating for rear axle thrust angle. To center the steering wheel on vehicles equipped with single tie rod adjustment and an adjustable drag link the following procedure is performed. Adjust the drag link while maintaining road wheel positions, and therefore flag scale reference mark positions, until the steering wheel rotates into a centered position.

> ***NOTE:*** *On single adjustable tie rod vehicles the toe scale readings will not necessarily be on zero, or the preferred setting, once the preferred rear flag scale readings are obtained. This is due to even small amounts of rear axle thrust angle. The toe scale readings should, however, have an equal toe scale reading for toe-in on one side and toe-out on the other side.*

To center the steering wheel on older single tie rod adjustment vehicles without an adjustable drag link removal of the steering wheel and re-installation in the centered position will be required.

> ***NOTE:*** *this will only work on older vehicles (primarily vehicles manufactured before 1980) with non-indexed steering shafts where the steering wheel attaches. Modern vehicles have indexed steering shafts allowing steering wheel installation in one position only.*

> ***CAUTION: Never remove a steering wheel that incorporates an airbag deployment system without following the vehicle manufacturer's instructions to deactivate the system or serious personal injury could result.***

When any four-wheel alignment is completed it is recommended to perform the steering wheel centering procedure as described previously one last time to verify all readings.

**Performing A Four Wheel Alignment**

Begin by placing the laser sensors on the front wheels and the flag scales on the rear wheels. Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle.

If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the wheel during and after toe adjustments.

While maintaining the steering wheel in a centered position, adjust the front toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most vehicles, or just under one reference mark for both scales combined. *See page 40 for toe scale usage notes.*

Note the readings at the rear flag scales. Add these readings together and divide by two to obtain the "preferred" reading. For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example the "preferred" reading is 11. Adjust the tie rods to obtain the preferred reading on the flag scales while maintaining a centered steering wheel.

> ***NOTE:*** *On vehicles with adjustable tie rods for each steerable wheel this will require equal adjustment on each side.*
>
> ***NOTE:*** *it is not critical at this point to have the steering wheel perfectly centered because further adjustments are going to be performed requiring re-centering of the steering wheel.*

A rear axle measurement and adjustment will now be performed. It is important at this point that the front wheels are not moved from their present position. If you have the steering wheel lock tool now is a good time to install it regardless of whether the steering wheel is centered or not. It is important that the front wheels maintain their exact position until the rear axle measurements and adjustments are completed.

Carefully remove the laser sensors and the flag scales and reinstall them in reverse without disturbing wheel position. Install the laser sensors on the rear wheels and the

flag scales on the front wheels. If rear camber adjustments are to be made they should be made before final rear toe adjustments.

> ***NOTE:*** *If the rear toe is severely out of adjustment it is recommended to "rough" the rear toe-in before camber adjustments, see the following paragraph for toe adjustment procedures.*

To measure and adjust the rear axle toe it is necessary to reference rear axle tracking with the flag scale readings. The following procedure will align the rear wheels to the geometric center-line of the vehicle.

Adjust the rear toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most vehicles, or just under one reference mark for both scales combined. *See page 40 for toe scale usage notes.*

> ***NOTE:*** *while the sensors are installed on the rear axle, the toe scales will extend rearward away from the vehicle. In this case, the toe scales must be read in reverse. Indicated toe-in will actually be toe-out, and indicated toe-out will actually be toe-in, as the scales are being viewed in an opposite manner.*

Note the readings at the flag scales. Add them together and divide by two, this is the preferred setting. For example the drivers' side indicates a flag scale reading of 12 and the passenger side indicates a flag scale reading of 10. Added together the result is 22, divided by two is 11. This is the preferred setting.

> ***NOTE:*** *flag scales have reference marks only and are not a unit of measure.*

Adjust rear axle toe on each side in a manner to maintain correct total toe, and as required to obtain the preferred setting on the flag scales. This completes rear axle measurement and adjustment.

> ***NOTE:*** *not all rear axles have factory-provided for adjustments for all required adjustments. If replacement components are not available to provide the necessary adjustments, or if it is decided not to make these final adjustments, then the final front axle adjustments should follow the procedure for Thrust Angle Alignment.*

Next complete the 4-wheel alignment procedure by verifying that the front wheels are in parallel alignment with the rear axle wheels and the vehicle's geometric center-line. This will often require some fine tuning if rear axle adjustments were made.

Once again remove the laser sensors and the flag scales and reinstall them in reverse. Install the laser sensors on the front wheels and the flag scales on the rear wheels.

Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle. If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the steering wheel during and after toe adjustments.

If required, fine tune the front toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most vehicles, or just under one reference mark for both scales combined. *See page 40 for toe scale usage notes.*

Note the readings at the rear flag scales. At this point it is desired to have equal flag scale readings. If these readings are not equal add them together and divide by two to obtain the "preferred" reading. For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example the “preferred” reading is 11. Adjust the steering axle tie rods equally to obtain the preferred reading on the flag scales, while maintaining the desired toe setting, and a centered steering wheel.

When any four-wheel alignment is completed it is recommended to perform the steering wheel centering procedure as described previously one last time to verify all readings.

**Performing A Multi-Axle Heavy-Duty Truck Or Bus Alignment**

The following procedure is for Heavy-Duty Trucks and Buses with a factory provided means of rear axle thrust angle adjustment on all non-steering axles. Most modern day heavy-duty vehicles of this type incorporate this type of adjustment.

If the vehicle does not have any adjustment provisions for non-steering axles, follow the procedure for center-line alignment, *page 24,* or thrust angle alignment, *page 26.*

> ***NOTE:*** *If the vehicle has adjustment provisions for some, but not all non-steering axles, follow the procedure beginning on page 36.*
>
> ***NOTE:*** *It is helpful when making axle thrust angle adjustments that the brakes are released. This will allow the wheels to rotate as the adjustment is made. Wheel chocks should be used on all axles not being adjusted to prevent vehicle movement.*
>
> ***CAUTION: Whenever vehicle brakes are released during alignment procedures such as making axle adjustments, all other axles should be chocked to prevent vehicle movement. Vehicle movement that occurs during axle adjustment may cause serious personal injury or even death.***
>
> ***For Heavy-Duty Trucks and Buses with adjustment provisions on all non-steering axles,*** *the following procedure should be used.*

Begin by placing the laser sensors on the front steering axle wheels and the flag scales on the wheels of the rearward most axle. Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle.

If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the wheel during and after toe adjustments.

Adjust the front toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most heavy-duty vehicles, or just over one reference mark for both scales combined. *See page 40 for toe scale usage notes.*

Next we will determine an approximate thrust angle measurement to prepare for rear axle thrust angle adjustment. Note the readings at the rear flag scales. Add these readings together and divide by two to obtain the "preferred" setting. For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example steer the front wheels until the rear flag scales indicate the “preferred” reading of 11.

After steering the front wheels to obtain the “preferred” flag scale readings as described above, look at either of the toe scales and determine the amount of change. To determine this count how many marks have increased or decreased from zero, or the preferred setting if a small amount of toe-in or toe-out was used. During thrust angle measurement only, each toe scale mark represents approximately .2 of a degree on an average length tractor chassis. For example, if a change of two marks is indicated this would indicate approximately .4 degrees of thrust angle. This is approximate and you will be able to determine what is normal and acceptable after several alignments.

A rear axle tracking measurement and thrust angle adjustment will now be performed. It is important at this point that the front wheels are not moved from their present position. If you have the steering wheel lock tool now is a good time to install it regardless of whether the steering wheel is centered or not. It is important that the front wheels maintain their exact position until the rear axle measurements and adjustments are completed.

> ***NOTE:*** *it is not critical at this point to have the steering wheel perfectly centered because further adjustments are going to be performed requiring re-centering of the steering wheel.*

Carefully remove the laser sensors and the flag scales and reinstall them in reverse without disturbing wheel position. Install the laser sensors on the wheels of the rearward most axle and the flag scales on the front steering axle wheels.

To measure and adjust the rear axle thrust angle it is necessary to reference rear axle tracking with the flag scale readings. The following procedure will align the rear axle to be perpendicular to the geometric center-line of the vehicle.

Note the readings at the flag scales now installed on the front axle. Add these readings together and divide by two to obtain the "preferred" reading. For example the drivers' side indicates a flag scale reading of 12 and the passenger side indicates a flag scale reading of 10. Added together the result is 22, divided by two is 11. This is the

preferred setting. Adjust the rear axle thrust angle in order to obtain the “preferred” reading on the flag scales.

> ***NOTE:*** *in most cases rear axle toe is non-adjustable on this type of vehicle. If a rear axle toe reading is desired please note the following. While the sensors are installed on the rear axle, the toe scales will extend rearward away from the vehicle. In this case, the toe scales must be read in reverse. Indicated toe-in will actually be toe-out, and indicated toe-out will actually be toe-in, as the scales are being viewed in an opposite manner.*
>
> ***NOTE:*** *flag scales have reference marks only and are not a unit of measure.*

Move the laser sensors from the rearward most axle to the next non-steering axle forward. Continue this rear axle measurement and adjustment procedure on each rear axle until all non-steering axles have been corrected for thrust angle and are parallel to each other and the geometric center-line of the vehicle.

Next complete the multi-axle alignment procedure by verifying that the front wheels are in parallel alignment with the rear axle wheels and the vehicle's geometric center-line. This will often require some fine tuning if rear axle adjustments were made.

Once again remove the laser sensors and the flag scales and reinstall them in reverse. Install the laser sensors on the front steering axle wheels and the flag scales on the rearward most axle’s wheels.

Sit in the vehicle and visually center the steering wheel. It is helpful to start the engine on power steering equipped vehicles during this process. Once centered, verify equal steering wheel free play side to side and shut off the vehicle. If you have the steering wheel lock tool and the steering wheel level indicator tool now is a good time to install them. The steering wheel locking tool is very helpful, but not absolutely required. However, without the steering wheel locking tool, the job will require more frequent re-centering of the steering wheel during and after toe adjustments.

If required, fine tune the front toe to bring both toe scales to zero, or the preferred setting if a small amount of toe-in or toe-out is desired. Total toe-in or total toe-out normally should not exceed .25 degrees on the toe scales for most heavy-duty vehicles, or just over one reference mark for both scales combined. *See page 40 for toe scale usage notes.*

Note the readings at the rear flag scales. At this point it is desired to have equal flag scale readings. If these readings are not equal add them together and divide by two to obtain the "preferred" reading. For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example the “preferred” reading is 11.

> ***On vehicles with adjustable tie rods for each steerable wheel*** the following procedure should be used.

Adjust the tie rods equally (to maintain the total toe reading) until the preferred (equal) reading is obtained on the flag scales. This must be done while at the same time maintaining a centered steering wheel.

> ***On vehicles with only one adjustable tie rod*** used for setting "total toe" the following procedure should be used.

Steer the front wheels until the preferred (equal) reading is obtained on the flag scales.

To center the steering wheel on vehicles equipped with single tie rod adjustment and an adjustable drag link the following procedure is performed. Adjust the drag link until the steering wheel rotates into a centered position while the preferred flag scale readings are maintained.

> ***NOTE:*** *On single adjustable tie rod vehicles the toe scale readings will not necessarily be on zero, or the preferred setting, once the preferred rear flag scale readings are obtained. This is due to even small amounts of rear axle thrust angle. The toe scale readings should, however, have an equal toe scale reading for toe-in on one side and toe-out on the other side.*

To center the steering wheel on older single tie rod adjustment vehicles without an adjustable drag link removal of the steering wheel and re-installation in the centered position will be required.

> ***NOTE:*** *this will only work on older vehicles with non-indexed steering shafts where the steering wheel attaches. Modern vehicles have indexed steering shafts allowing steering wheel installation in one position only.*

> ***CAUTION: Never remove a steering wheel that incorporates an airbag deployment system without following the vehicle manufacturer's instructions to deactivate the system or serious personal injury could result.***

When any four-wheel alignment is completed it is recommended to perform the steering wheel centering procedure as described previously one last time to verify all readings.

*Figure 12: Heavy-Duty Truck and Bus 4-Wheel System. Also works well with light vehicles fitted with over-sized / off-road type tires larger than 33” diameter or having a sidewall taller than 7”.*

***For Heavy-Duty Trucks and Buses with adjustment provisions for some, but not all non-steering axles,*** *the following procedure should be used.*

This arrangement generally consist of one non-adjustable rear axle. In this case the adjustable non-steering axle or axles will be aligned to match the thrust angle of the non-adjustable axle. This will put the rear axles in parallel alignment with each other to prevent excessive wear caused by tire scrub.

Begin by placing the flag scales on the wheels of the non-adjustable axle. Place the laser sensors on the wheels of the first adjustable non-steering axle to be measured and adjusted. If the vehicle has multiple adjustable axles the process can be started at any of them.

Note the readings at the flag scales. Add these readings together and divide by two to obtain the "preferred" setting. Make non-steering axle adjustments to obtain the “preferred” setting on the flag scales.

*For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example, adjust the trailer axle until the flag scales indicate the “preferred” reading of 11.*

Move the laser sensors to the next adjustable non-steering axle and repeat the procedure. Do this until all adjustable non-steering axles have been measured and adjusted. This will align all non-steering axles to be parallel with each other.

At this point all non-steering axles adjustments should be completed. Without making any further non-steering axle adjustments, follow the procedure for center-line alignment, *page 24,* or thrust angle alignment, *page 26, to* complete the vehicle alignment.

**Performing A Trailer Axle Alignment**

The following procedure is primarily for Heavy-Duty Truck Trailers with a factory provided means of rear axle thrust angle adjustment on all axles. Most modern day heavy-duty trailers of this type incorporate this type of adjustment.

This procedure is also applicable to light duty trailers designed for use with passenger cars, SUVs, light trucks, and vans, provided a means for axle adjustment is available.

> ***NOTE:*** *If the trailer does not have adjustment provisions for any of the axles, and no modifications can or will be made to provide adjustments, it cannot be aligned.*
>
> ***NOTE:*** *It is helpful when making axle thrust angle adjustments that the brakes are released. This will allow the wheels to rotate as the adjustment is made. Wheel chocks should be used on all axles not being adjusted to prevent vehicle movement.*
>
> ***CAUTION: Whenever vehicle brakes are released during alignment procedures such as making axle adjustments, all other axles should be chocked to prevent vehicle movement. Vehicle movement that occurs during axle adjustment may cause serious personal injury or even death.***
>
> ***On trailers with adjustment provisions for all axles*** the following procedure should be used.

In preparation for following procedure drive the towing vehicle and the trailer in a straight line for a distance long enough for all wheels to be as parallel as possible.

Begin by placing the laser sensors on the wheels of the trailer's rearward most axle, and the flag scales on the wheels of the towing vehicle's rearward most axle.

Note the readings at the flag scales. Add these readings together and divide by two to obtain the "preferred" setting. Make trailer axle adjustments to obtain the "preferred" setting on the flag scales.

For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example, adjust the trailer axle until the flag scales indicate the "preferred" reading of 11.

Moving the laser sensors forward, to the next closest trailer axle, repeat the procedure. Do this until all trailer axles have been measured and adjusted. This will align all trailer axles to be parallel with each other and parallel to the towing vehicle.

> ***On trailers with adjustment provisions for* some, but not all *axles,*** *the following procedure should be used.*

This arrangement generally consist of one non-adjustable trailer axle. In this case the adjustable axles will be aligned to match the thrust angle of the non-adjustable axle. This will put the trailer axles in parallel alignment with each other to prevent excessive wear caused by tire scrub.

In this case the trailer axles cannot be made parallel to the towing vehicle's axles. A "dog-tracking" or "crab-walking" effect of the trailer behind the towing vehicle may be noticed when following behind. This is entirely dependent on the degree of thrust angle that exist in the non-adjustable axle.

Begin by placing the flag scales on the wheels of the trailer's non-adjustable axle. Place the laser sensors on the wheels of the first adjustable axle to be measured and adjusted. If the trailer has multiple adjustable axles the process can be started at any of them.

Note the readings at the flag scales. Add these readings together and divide by two to obtain the "preferred" setting. Make trailer axle adjustments to obtain the "preferred" setting on the flag scales.

*For example drivers side reads 12 and passenger side reads 10. Added together is 22, divided by two is 11. Using this example, adjust the trailer axle until the flag scales indicate the "preferred" reading of 11.*

Move the laser sensors to the next adjustable trailer axle and repeat the procedure. Do this until all adjustable trailer axles have been measured and adjusted. This will align all trailer axles to be parallel with each other.

## Section 10 – Conversion Information & Toe Scale Usage Notes

| Degrees of Toe | Inches of Toe | Decimal Inch of Toe |
|---|---|---|
| 2.00 | 1" | 1.00 |
| 1.50 | 3/4" | 0.75 |
| 1.00 | 1/2" | 0.5 |
| 0.75 | 3/8" | 0.375 |
| 0.50 | 1/4" | 0.25 |
| 0.25 | 1/8" | 0.125 |
| 0.13 | 1/16" | 0.0625 |
| 0.01 | 5/1000" | 0.005 |

**NOTE: Degree conversion is based on a 28.5" diameter tire**

*Figure 13: Conversion Chart, Degrees to Inches*

**Toe Scale Usage Notes**

The toe scale readings provided as .25 degrees for each segment or reference mark on the toe-in and toe-out scales is approximate and reflects an average full size passenger car axle track width. This approximate measurement changes slightly with different axle track widths. As the track width of the axle decreases from an average size passenger vehicle, the .25 degrees may actually be located closer to ¾ of each segment or reference mark. As the track width of the axle increases, such as with a heavy-duty truck or bus, .25 degrees may actually exceed one segment or reference mark. It is recommended to set the toe as close to zero as possible and if a small amount of toe-in or toe-out is desired set it just past zero. This will provide the best tire wear on all vehicle types.


*Figure 14: Toe Scale*

## Section 11 - System Calibration

The following section will provide instruction for the proper use of the optional ***SharkEye*** system calibration fixture. The same calibration fixture is used for all variations of the ***SharkEye*** Laser Alignment System.

Verification of system calibration is recommended at least annually to assure accurate alignment results. How often your system should be checked, and how often re-calibration might be required, will depend entirely on how much care is taken when handling your system during use. The system will not simply "go out" of calibration. Rough handling however can cause system components to shift in position requiring re-alignment of those components. If a laser sensor is dropped, calibration should be verified before continued use of the system.

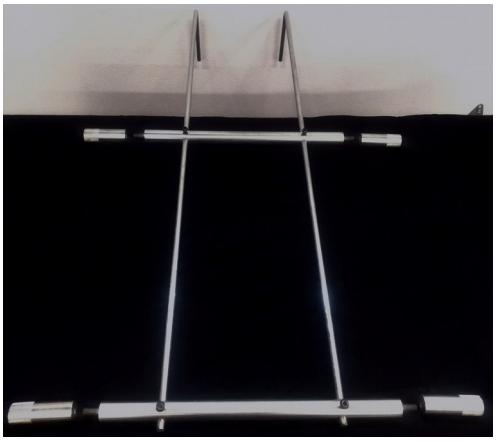

*Figure 15: Cal Fixture Assembled*

The ***SharkEye*** system has been designed with simplicity of service in mind. If required, system re-calibration is easily performed by following the procedure outlined in this section. Each system laser has a provision to allow horizontal left or right laser beam alignment. Additionally, each laser can be rotated to correct the vertical laser beam line to true vertical.

Assemble the calibration fixture, *See Figure 15.* Mount the laser sensors for the ***SharkEye*** laser alignment system. This will require the removal of the sensors' sheet-metal covers. *See Figure 16.* If this is a 4-wheel laser alignment system you will also mount the flag scales on the calibration fixture at this time. When attaching the sensors, the thick crossbars of the calibration fixture should be spread as far apart as possible for the best calibration accuracy. *See Figure 17, page 42.*

*Figure 16: Cover Removed*

Turn on the lasers and verify that the front cross-toe lasers indicate zero on the toe scales. On 4-wheel systems verify that the rear tracking lasers indicate 10 on the flag scale readings. Verify that the vertical line created by each laser is truly vertical by using the toe scales or the flag scales as a reference. If adjustments are required, remove the black square plastic laser tube plugs at all locations requiring adjustment. *See Figure 18, page 42.*

When adjustments are required it is helpful to have the calibration fixture on a surface which allows each laser beam support block area to extend off of that surface. Sawhorses can be a good choice for this purpose and will allow easy access to the adjustment screws located on the bottom of the laser tubes.

*Figure 17:* Cal Setup

Looking at the bottom of each laser tube you will notice one countersunk Allen-head type screw at each laser location. *See Figure 19.*

This countersunk Allen-head screw retains the laser block into the tube and must be loosened to permit left or right horizontal laser adjustments. These adjustment screws are sometimes very tight. A high-quality Allen key that fits the screw properly must be used to avoid damaging the screw head. You may find that a socket wrench type of Allen key tool is easier to use and provides better loosening leverage than a standard L-shape type of Allen key.

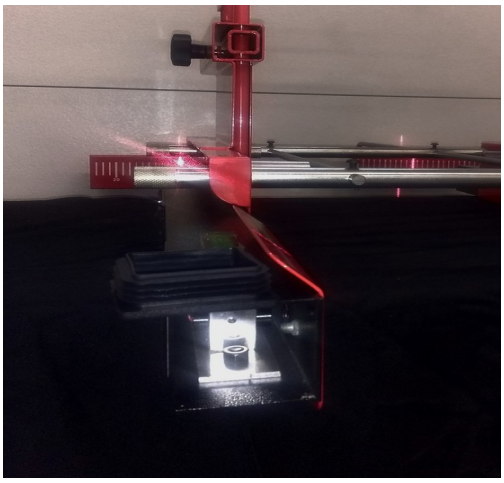

*Figure 18: End Cap*

Each laser is retained in a block of aluminum. An 1/8" round rod or drill bit is helpful to hold the block in position while tightening the countersunk Allen-head retention screw during laser alignment. An 1/8" diameter hole is provided in the block for this purpose. *See Figure 21, page 44.*

**Vertical Laser Line Adjustment**

If a vertical laser line adjustment is required, the countersunk Allen screw on the bottom of the laser tube must be completely removed. *See Figure 19.* Removal of this screw will allow the laser block to be removed from the tube, and provide access to the rotational set screw in the block. Be careful when removing the laser block from the tube as small delicate wires are attached to the rear of the laser. These wires lead to the switch panel/circuit board in the center area of the tube. The wires have enough lead length to permit removal of the block from the laser tube.


*Figure 19: Adjustment Screw*

The block can then be placed on top of the laser tube for vertical beam adjustment. *See Figure 20.*

While holding the block firmly on top of the tube, loosen the small set Allen screw on the block to allow laser rotation. Rotate the laser to provide a true vertical beam using the toe scales or the flag scales as a reference, and gently tighten the rotational locking set screw. Reinstall the laser block assembly into the laser tube. Re-insert the Allen screw from the bottom of the laser tube. Lightly snug the screw. Follow the instructions in the next paragraph, *see page 44*, to complete the horizontal laser beam adjustment.

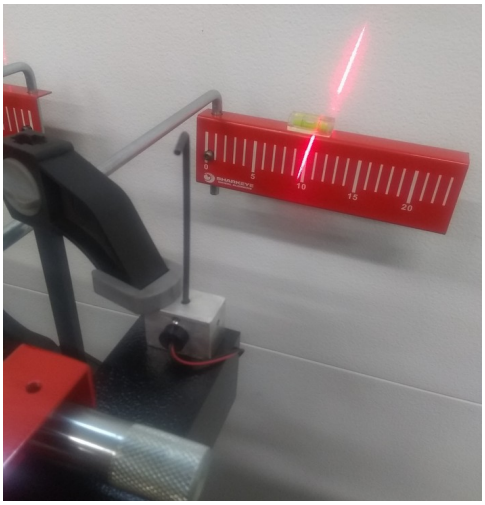

*Figure 20: Vertical Beam Adj*

***NOTE:*** *over-tightening the rotational set screw will cause non-warrantable damage to the laser. A very light pressure between the set screw and the laser is all that is required.*

**Horizontal Laser Beam Adjustment**

> ***CAUTION:*** *During the following procedure, the laser beam should be turned off when installing the block adjustment tool, or at any other time that it is necessary to look toward the adjustment block. You should always avoid looking directly into the laser beam to avoid potential injury to your eyes.*

Loosen the countersunk Allen screw located on the bottom of the laser tube for the laser beam requiring adjustment. *See Figure 19, page 42.* Lightly re-snug the Allen screw just enough to hold the laser block in position while still allowing some movement of the block for re-positioning.

*Figure 21: Block Adj Tool*

Insert an 1/8” round rod or drill bit into the hole provided in the aluminum block as an adjustment tool, *See Figure 21*. *R*e-position the laser block using the adjustment tool to align the laser beam to zero on the toe scale, or to a reading of 10 at the center of the flag scale. Hold the block in position with the round rod adjustment tool, while firmly tightening the Allen screw to retain the block in the correct position.

Perform the above procedures on any lasers requiring adjustment. After all laser beams are correctly positioned, system calibration is complete. The flag scale readings should be vertical, and directly on the number 10 reference marks. The toe scale readings should be vertical, and directly on the zero reference marks. *See Figure 22.* Your system is now ready for wheel alignment use.

*Figure 22: Calibration Complete*

## Section 12 – Contact Information

### USA Sales, Service, Technical support, And Warranty Service

Contact ***Alignment Team USA*** for factory authorized sales, service, technical support, and warranty service in the USA by phone, email, or regular mail here:

Email: 4Info@AlignmentTeamUSA.com

See our website here: **www.AlignmentTeamUSA.com**

**Phone: 406-755-0805 Weekdays from 8am to 5pm Mountain Time Zone**

***Alignment Team USA***
a division of
Northwest Equipment Mfg., Inc.
122 East Reserve Dr
Kalispell, MT 59901

For manual errors, omissions, or suggestions please email details to:
4Info@AlignmentTeamUSA.com