Diagnostics Alignment Angles



Training Supplement Technician Reference Guide

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Diagnostic Process

The first step in a diagnostic process is collecting information

Sources of Information

- Customer interview
- Diagnostic road testing
- Vehicle inspection
- Alignment Measurements

Basic Angles

The following angles should be made with every alignment:

- Camber
- Cross camber
- Caster
- Cross caster
- Total toe front and rear
- Individual toe front and rear
- Thrust angle

Vehicle Measurements and Adjustments and Adjustments	ents			
Front		Left		Right
Camber		2.9°		-0.8° 🗸
Cross Camber			3.8	<mark>}°</mark>
Caster		5.1°		5.1°
Cross Caster			0.0	
SAI		4.1°		7.7° [
Cross SAI			-3.5	
Тое		<u>-0.51°</u>		
Total Toe			-1.01	<u> </u>
Rear		Left		Right
Camber		-1.2°		-1.3°
Cross Camber			0.1	<u>•</u>
Тое		0.00°		0.00°
Total Toe			0.00	
Thrust Angle			0.00)°
	Adjust rea	r camber and to	e.	
	Show Bar Graphs	Show Se Measure		Adjust Rear Camber & Toe

Diagnostic Angles

Check these additional measurements when a vehicle has been involved in an accident, exhibits unusual handling problems, or abnormal tire wear.

Steering Axis Inclination

Used to diagnose structural damage:

- Control arms
- Frame / Uni-body
- Axle

Included angle

Used to diagnose parts damage:

- Steering knuckle
- Spindle
- Strut
- Ball joint studs

Front wheel setback

Use to diagnosis damaged control arms and diamond frames. Low caster and high set back is usually bent lower arm.

Maximum steering measurement (steering lock-to-lock)

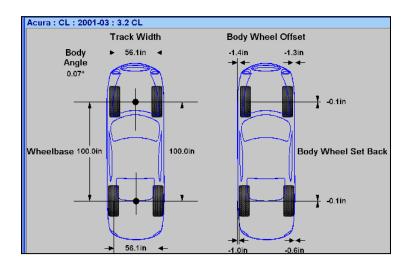
- Use to verify steering wheel-to-gear alignment. Checks for:
- Jumped rack teeth
- Bent pitman arm
- Lateral movement of gearbox at frame mounting
- Steering stop adjustment

Turning angle

Use to diagnose bent steering arms. A bent steering arm may cause tire wear and drivability problems when turning.

Wheelbase

Useful in diagnosing excessive thrust angle problems.



ne: Vehicle:						
Indicate the problem:						
Pull Drift Tire wear Vibration Shimmy						
Which way does the vehicle pull or drift? Left \Box Right \Box Doesn't pull \Box						
Check the box or boxes which best describe the tire wear problem.						
Center tread wear Inner and outer shoulder wear other						
Outside shoulder wear Inside shoulder wear Diagonal tread wear						
When does the vibration or pull problem occur?						
When the vehicle is at highway speeds.						
During cruising						
During acceleration hard medium light						
During braking hard medium light						
During deceleration hard medium light						
During or after turning the vehicle.						
What speed does the problem occur? to mph doesn't matter						
What accessories are being used when the vibration occurs? A/C \square 4WD \square doesn't matter \square						
Does it occur in a certain gear? Yes No if yes, what gear?						
Does the problem occur with certain loads? Number of people Pounds in trunk						
Road Conditions						
Paved road (smooth) Paved roads (rough) 2-lane highways Bumps						
How often does it occur?						
Always Sometimes Rarely Just started Since new Only in morning						
Has any mechanical work been done to the vehicle recently? Yes No No If yes, what was done?						
Have the tires been recently rotated or replaced? Yes No						

Diagnostic Measurements

Frant		l off		Dialat
Front		Left		Right 0.3
Camber		2.9°		-0.8° 🧊
Cross Camber			<u>3.8°</u>	E 10
Caster		5.1°		5.1° 🦉
Cross Caster			0.0°	
SAI		4.1°		7 . 7° [
Cross SAI			-3.5°	-0.3 1-11-
Тое		-0.51°		-0.51°
Total Toe			-1.01°	L D
Rear		Left		Right 👸
Camber		-1.2°		-1.3°
Cross Camber			0.1°	iii
Тое		0.00°		0.00° 🗏
Total Toe			0.00°	0e
Thrust Angle			0.00°	(Fei
	Adjust rea	r camber and t	oe.	
	Show	🚔 Show Se	econdary	Adjust Rear
	Bar Graphs 🧮 Measurements Camber & Toe			

A proper diagnosis requires gathering as much information as possible.

"Primary Alignment Measurements"

Stephicle Measurements and Adjustments				
Front		Left		Right 🔐
Included Angle Steer Ahead Set Back		7.1°	<mark>0.0</mark> -0.1	6.9° ன
Turning Angle Diff. Cross Turn Diff.		-2.36°	-1.0	0° -1.36° 🛒
Ride Height Maximum Left Steer Maximum Right Steer		25.0in -35.44° 35.08°		25.0in 35.20° -35.84°
Wheelbase Difference Track Width Difference Lateral Offset		-0.52°	0.1 -0.6	8° 4° -0.12°
Rear		Left		Right 📆
Set Back Ride Height Axle Offset		24.6in	0.0 0.2	24.6in 🕅
	Adjust rear o	camber and toe.		
	Show Bar Graphs	Show Be Measuren		Adjust Rear Camber & Toe

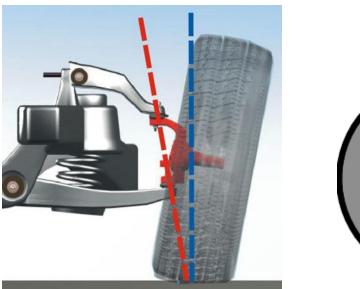
"Secondary Alignment Measurements"

Vehicle Measurements and Adjustme	nts		
Front	Left		Right 🔝
Body Angle			100.0in
Wheelbase	100 . Oir	י ו	100 . Oin 🖄
Track Width		55.4in	16
Body Wheel Offs			•••••
Body Wheel Set	Back	• • • • •	
Body Roll		• • • • •	
Rear	Left		Right
Track Width		55 . 4in	
Body Wheel Offs	et		🖺
Body Wheel Set	Back		
Body Roll			, in the second s
	Adjust rear camb	er and toe.	
	Show Bar Graphs	Show Primary Measurements	Adjust Rear Camber & Toe

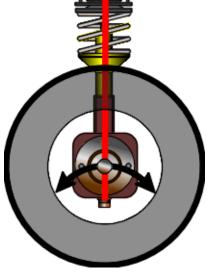
"Body Measurements"

Steering Axis Inclination and Included Angle

Steering Axis Inclination or **SAI** for short is the angle formed by a line drawn through the upper and lower pivot points of the spindle and a vertical line drawn from the lower pivot point.



Steering Axis Inclination (SAI)



SAI Spindle Arc

Steering Axis Inclination's primary function is to:

- Enhance directional stability
 - \Rightarrow Spindle travels in an upside down arc causing vehicle weight to be lifted when the knuckle is steered an either direction.
 - \Rightarrow S.A.I. doesn't need the opposing side to balance forces
 - \Rightarrow S.A.I. is not known to cause a pull
- Enhanced returnability is created because vehicle weight helps return the spindle to the straight ahead position when steering wheel pressure is released.
- Reduce the need for positive camber by moving weight inboard on the spindle.

S.A.I. and caster combine to supply high speed directional stability and returnability of the front wheels back to equal front toe. S.A.I. and I.A. measurements are useful diagnostics tools.

Measuring S.A.I. and Included Angle



Press "Measure Caster" on the "Vehicle Measurements and Adjustments" primary screen. The "Caster Measurement" popup screen will appear.

Press "Select Measurement," to access "Measurement Selection".

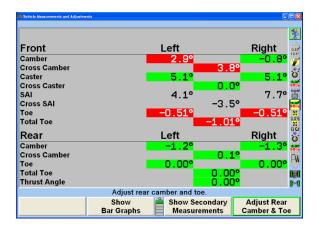
Measuring "SAI / IA Only"

This selection asks for the front wheels to be lifted, sensors to be locked and the brakes to be locked. The measurement is complete once the vehicle is lowered.

Measuring Faster Caster (Caster and SAI/IA)

This selection asks for the front wheels to stay on the turn plates. Lock the front brakes using a brake pedal depressor and level and lock sensors.

The SAI/IA measurement relies on the front brakes holding the wheel from rotating as they are steered. Should the front brakes slip, the measurement will be falsified.



				200
Front		Left		Right 0.33
Included Angle		7.1°		6.9° 👸
Steer Ahead			0.0	0° 炎
Set Back			-0.1	<u>ن</u> 7°
Turning Angle Diff.		-2.36°		1.36° 🕷
Cross Turn Diff.			-1.0	0° 📲
Ride Height		25 . Oin		25.0in
Maximum Left Steer		-35.44		35.20
Maximum Right Steer		35.08°		
Wheelbase Difference Track Width Difference			0.1	
Lateral Offset		-0.52°	-0.0	-0.12°
Lateral Onset				144
Rear		Left		Right 👸
Set Back			0.0	
Ride Height		24.6in		24.6in 📗
Axle Offset			0.2	0° 📔
	Adjust rear	camber and toe.		
	Show	Show B	ody	Adjust Rear
	Bar Graphs	Measuren	nents	Camber & Toe

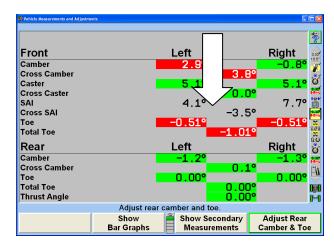
S.A.I. measurements are displayed on the "Primary Measurement" display.

Included Angle is displayed on the "Secondary Measurement" display.

S.A.I. Diagnosis

Cross S.A.I. equal to or greater than 1.5° may indicate a:

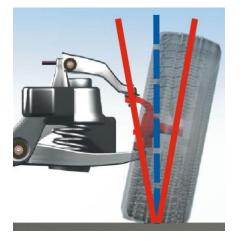
- Bent control arm
- Damaged strut tower
- Damaged frame or sub-frame
- Bent axle

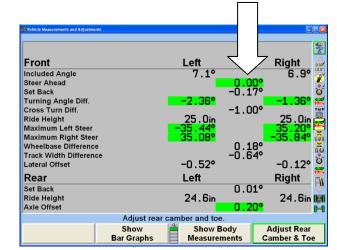


Included Angle

Included angle, or I.A. for short, is the combination of S.A.I and camber.

SAI + Camber = Included Angle





Cross Included Angle = Left IA – Right IA

Included angle diagnosis

Cross Included Angle equal to or greater than 1.5° generally may indicate a:

- Bent spindle
- Bent knuckle
- Bent ball joint stud

S.A.I. and I.A. Diagnostic Example

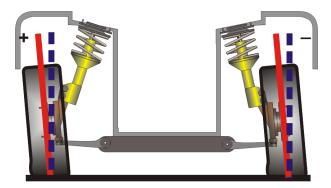
- Left camber is within specifications.
- Right camber is -1.8° low of specifications
- Cross S.A.I is only 0.2°.
- Cross Included Angle is 1.6°

Camber spec is 0.30°	Left	Right	Compare damaged side to good side
Camber	0.3°	-1.8°	Low
S.A.I.	12.0°	12.2°	OK
Included Angle	12.3°	10.4°	Low

Use the table below to find the combination of low camber, OK S.A.I. and low IA.

	Camber	SAI	IA	Check
	High	Low	OK	Bent lower control arm or frame.
E P V	Low	High	OK	Strut tower in at top
	High	OK	High	Bent strut, knuckle, or ball joint
	Low	OK	Low	Bent strut, knuckle or ball joint
				Bent lower control arm or frame
	High	Low	High	and
Transfer				Bent strut, knuckle or ball joint
				Strut tower in at top
\cup	Low	High	Low	and
				Bent strut, knuckle or ball joint

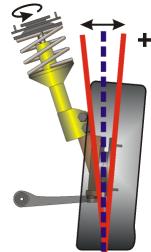
More tests may be needed now that the damaged are is isolated.



Check for a bent strut piston rod

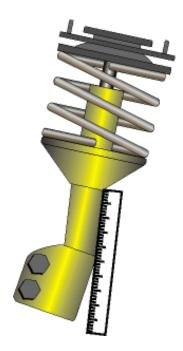
Loosen the strut piston rod nut. The strut piston rod is bent if camber changes as you rotate the strut piston rod 360°.





Check for a bent strut housing

Place a straight edge against the strut housing. Check for distortion near the bottom of the housing. Look for paint cracks where the strut tube enters the collar.

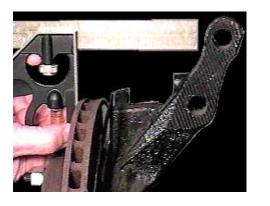


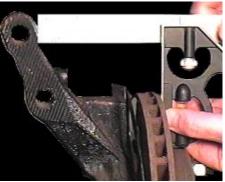


Check for a bent knuckle

Use a carpenter's square to check for a bent knuckle.

Set the base against the brake rotor or hub and slide the ruler until it touches the top of the knuckle. Compare one side to the other.





Be sure to check the bottom of the knuckle as well. Set the carpenter's square's base against the bottom of the knuckle and slide the ruler until it touches the brake rotor. Compare one side to the other.

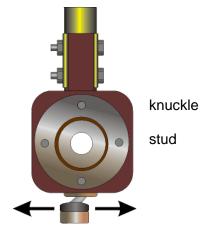
Check for bent ball joint stud

Disconnect the outer tie rod end from the steering arm.

Steer the wheels left and right. Look for back and forth movement between the ball joint and the steering knuckle.

If you find a bent stud, carefully inspect the knuckle. If the hole is tapered to fit the stud, damage to the stud may have distorted the hole, also. Industry standard is to replace both the and the knuckle.

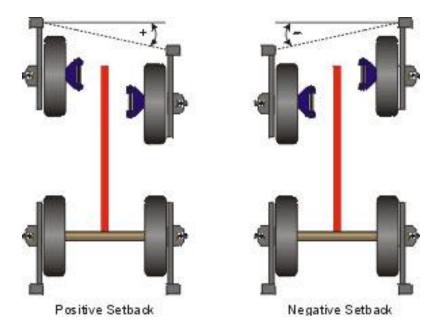
Note: Pinch bolt type knuckles are not machine fitted, so generally damage to one doesn't necessarily affect other."



NOTES:

Setback

Front setback

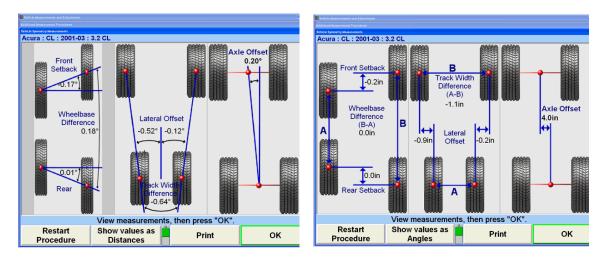


Front setback is an angle formed by a line drawn perpendicular to the centerline and a line connecting the centers of the front wheels.

Positive setback indicates the right front wheel is behind the left front wheel.

Negative setback indicates the left front wheel is behind the right front wheel.

Setback is measured as an angle but can be displayed in inches or millimeters if front track width is available in the vehicle specifications.



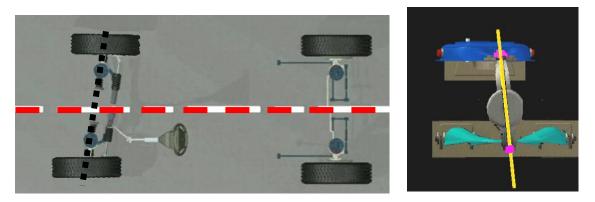
The preferred setback measurement is assumed to be zero.

Setback may exist because of manufacturing tolerances, collision, frame repair or parts installation.

Use setback to help determine the cause of side-to-side caster differences and turning radius problems.

Cross caster measurements exceeding ±0.5° may be caused by a setback condition.

If a lower control arm has been moved rearward, caster is changed in a negative direction.



Low caster and high setback may indicate a bent lower control arm.

Compare the setback measurement to the caster measurement to determine if the lower control arm may be moved to reduce cross caster and setback measurements.

Extreme setback conditions may affect turning angle due to the repositioning of the steering arm when the lower control arm is moved forward or rearward.

Setback is not known to cause a vehicle to pull.

Setback diagnostic example

A FWD vehicle pulls left after the vehicle struck a curb. The caster specification is 3.3°. Right front caster is -3.0° low of specification and front setback is -1.01°.

	Left	Right	
Caster	0.3°	3.2°	
Setback	<u>-1.01°</u>		

Low caster and high setback may indicate a bent control arm

Many technicians check for accident damage by comparing the distance between the front and rear of the tire to the wheel opening.



Verify the left control arm is bent with a tape measure.

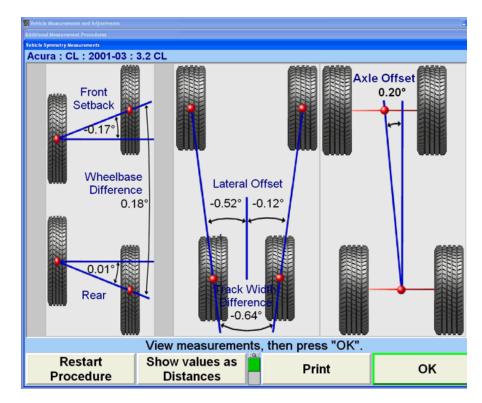
Rule of thumb for front setback:

- \Rightarrow 0° ± 0.40° = damage unlikely, possible cradle/axle position problem
- \Rightarrow 0.41° to 0.75° or -0.41° to -0.75° = damage likely or severe component shift
- \Rightarrow Above 0.75° or lower than -0.75° = frame rail, subframe or control arm damage

Rear setback

Rear setback is an angle formed by a line drawn perpendicular to the centerline and a line connecting the centers of the rear wheels.

Positive rear setback - right rear wheel trails the left rear wheel



Negative rear setback -left rear wheel trails the right rear wheel

Rear setback is measured in degrees but can be displayed in inches or millimeters, if a rear track width specification is available.

Rear setback may be useful when diagnosing rear thrust angle problems.

	Left	Right	
Rear toe	-0.85°	0.90°	
Thrust angle	-0.88°		
Rear Setback	-1.13°		

The rear total toe on a rear fixed axle is 0.05°, which indicates the axle housing is not bent. The negative setback and thrust angle indicate a shifted axle housing to the left.

Turning angle

Turning angle is the difference in the angles of the front wheels when turned. The angle difference is determined by the steering arm design.

When turning a corner, the outside wheel must travel a greater distance and a wider turn than the inside wheel.

The most common approach in turning angle design is where the difference in the turning angles is symmetrical (equal).

Turning angle measurements outside manufacturer's specifications may cause front tire shoulder wear and improper handling.

Symmetrical example:

Specification 20°/18° ±1.50°

When the left wheel is steered to the left 20°, the right wheel should be at $18^{\circ} \pm 1.50^{\circ}$.

When the right wheel is steered to the right 20° , the left wheel should be at $18^{\circ} \pm 1.50^{\circ}$.

The non-symmetrical design produces unequal turning angles. This design is found on various makes and models of vehicles to assist in controlling torque steer and various other problems.

Non-symmetrical example:

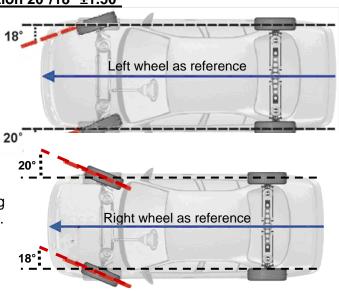
Specification

Left turn: 20°/18° ±1.50° When the

left wheel is steered left 20°, the right wheel should be at $18^{\circ} \pm 1.50^{\circ}$.

Right turn: 20°/20° ±1.50°

When the right wheel is steered right 20°, the left wheel should be at $20^{\circ} \pm 1.50^{\circ}$.



Always use the manufacturer's turning angle specifications if possible. If a specification is not available, use the default spec of $20^{\circ}/18^{\circ} \pm 1.50^{\circ}$.

Turning angle measurements that vary more than 1.5° from specification generally indicate a bent steering arm.

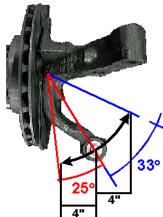
The steering arms of the vehicle are designed to predetermine the relationship between the left and right front wheels when the vehicle is steered left or right.

The steering arm connects the outer tie rod to the steering knuckle. The steering arm on most vehicles is an integral part of the steering knuckle.



How turning angle works

The steering arm moves equal distance laterally as the rack moves back and forth. The steering arm must move farther up its curve when the wheel is steered left than when the wheel is steered right.



In this example, the rack moves laterally 4" in each direction and the steer arm is behind the spindle on the driver's-side knuckle.

The left wheel turns left 33° outward as the arm climbs the arc.

The left wheel turns right only 25° as the arm move slightly down and across the arc.

Turning Angle Measurement

4 The aligner can measure toe-out-on-turns ("turning angle difference") if the alignment system is equipped with electronic turn plates, encoders and elastic lines, or DSP 300, 400, 500 or 600 sensors.

A mechanical method is available by using turn plates with turning angle scales. A specification must be available on the secondary specification display for the measurement process to work properly when measuring electronically.

In many cases the specification must be added to the existing factory specification.

Vehicle Specifications		EI	📲 🎇 Vehicle Specifica	itions		
Acura : CL : 2001-03 : 3.2 CL			Toyota : Camry	: 2002-04 : 3.0L (except Sport) : \	vith 15" Wheel	
Front	Spec.	Tol.	Front	Spec.	Tol	1
Left Turn Diff.	-7.48°	1.00*		<u> </u>		2.00°
Right Turn Diff.	-7.48°	1.00°	Left Turn Diff.			
Cross Turn Diff.		•	Right Turn Dif			
Turn Reference	31.05°		Turn Reference Max Left Steel		070	2.00°
Max Left Steer-Left	•	8	Max Left Steel			2.00°
Max Left Steer-Right		•	Max Right Ste			2.00° 2.00° 2.00°
Max Right Steer-Left	, in the second		Max Right Ste			2.00°
Max Right Steer-Right Wheelbase			Wheelbase		in	
Track Width	in		Track Width		in	
Left Lateral Offset	in o	•	Left Lateral Of		0	•
Right Lateral Offset	0	0	Right Lateral (0	•
Wheelbase Difference	•	0	Wheelbase Dr		°	° 8
Track Width Diff.	0	0	Track Width D	iff.	•	
Set Back		0	Set Back			č
Rear			Rear			4
			Track Width		in	
Track Width	in		,	View or edit t	he specifications.	
	View or edit the specificati	ons.			(0)	
	Recall 📄 Show F	Primary Measurements	;	Recall	Show Primary	Mount
Spe	cifications 📃 Specifi	cations & Adjustments	;	Specifications	Specifications	Sensors

With turning angle spec

Without turning angle spec

If turning angle specs are not available, it is recommended to use the default specification of 20° / 18° \pm 2°.

WinAlign® secondary specification screen should be filled in as follows:

Front	Spec.	Tol.	
	-2 °	1.5°	
Left Turn Diff. Right Turn Diff. Turn Reference	-2°	1.5°	
Turn Reference	-20 °		

Front total toe must be within specified tolerances before measuring turning angle.

Locate the "Make Additional Measurements" soft key. Locate and select "Toe-Out-On-Turns" from the list of measurements.

🗱 Pedicle Absessments and Adjustments	Measure Tee Out On Terms
Additional Neuronnent Provedures	Acura : CL : 2001-03 : 3.2 CL
Acura : CL : 2001-03 : 3.2 CL	
Use this procedure to measure the difference in toe between the left	-39.53° -37.53° 31.25° -0.16° 30.85°
and right wheels when steered to a specified turn angle.	Steer this wheel
Frame Angle Ride Height Symmetry Measurements / Set Back Toe-Out-On-Turns Maximum Steering Angle Tire Condition	Ri H
Select the desired measurement procedure, then press "OK".	Steer the "Reference Wheel" as directed.
Cancel 🕇 🖡 V	Cancel Bypass Measurement

Steer the wheels as directed by the bar graphs. The "Steer this wheel" bar graph and the graphics above the bar graphs indicate which way to steer. Note: Do not pause for more than 2 seconds once the wheels are steered beyond 10 degrees.

Turning angle Diagnosis

Problem

A 2002 Acura 3.2CL hit a guard rail with the left front wheel and fender. A local body shop replaced the damaged sheet metal. The car drives straight and the steering wheel is level; however, when making a left "U-turn" the tires squeal excessively and the car shudders.

Inspect the steering linkage. Normally, the exposed tie rod threads on each tie rod should be virtually equal. Note the lack of exposed threads on the left tie rod assembly.





The left tie rod no exposed tie rod threads.

The specification calls for the reference wheel to be steered 31.05°. The opposing wheel should have a steer angle of $31.05^{\circ} - 7.48^{\circ}$ or $23.57^{\circ} \pm 1^{\circ}$

Vehicle Specifications Acura : CL : 2001-03 : 3.2	CL		
Front	Spec.	Tol.	₽~
Left Turn Diff. Right Turn Diff.	-7.48°	1.00° 1.00°	₩ ©
Cross Turn Diff. Turn Reference	31.05°	1.00	0° 100 100 100 100

Turning angle was measured with the mechanical turning angle gauges first by steering the left wheel to the left 31°. The right wheel measured 23.5°.

The right wheel was then steered to the right 31°. The left wheel measured 29°. This is outside the allowable range of $23.57^{\circ} \pm 1^{\circ}$.

Turning angle specifications

Acura's specifications states the difference in turning angle should be 7.48° with an allowable tolerance of 6.48° to 8.48°.

	Left Wheel	Right Wheel	Turning Angle Difference
Left Turn	Reference 31.00°	23.00°	7.00° OK
Right Turn	29.00°	Reference 31.00°	<u>4.00° Not OK</u>

This chart shows the "turning angle difference" for a left and right turn.

The test using the left front wheel as the reference was within specifications as the right wheel was within $23.53^{\circ} \pm 1^{\circ}$.

The test using the right front wheel as the reference was not within tolerances as the left wheel measured 29°, well beyond the $23.53^{\circ} \pm 1^{\circ}$ specifications.

On symmetrical steering systems, use your fingers to verify the distance from the steering arm to the wheel is equal side-to-side.

Note: On this Acura, the left steering arm is bent slightly causing the -4.00° out of specification measurement.





Left side Right side A "T square" may also be used to check for a bent steering arm. Compare one side to the other.

A nonsymmetrical steering system was used on a few vehicles. (e.g. 1986 Ford Escort)



The length and angle of these steering arms may vary side-to-side.

Maximum Steering Angle

Maximum steering angle is the angle of the front wheels when turned to the inward and outward lock position.

In some cases, the steering limit may be adjusted. Most vehicles use a mechanical limit such as control arms or steering gear stops.



A wheel that turns beyond the maximum steering angle may create hazardous conditions when driving and cause premature tire wear.

Measurement

Maximum steering angle may be measured using the following methods:

- Standard front turn plate with scale and pointer
- Electronic turn plates
- DSP sensor with TOOT option
- Sensors using camera technology.



A specification must be available on the secondary specification display for the measurement process to work properly when using electronic measuring equipment. In many cases, the specification must be added manually.

Vehicle Specifications				Provide Specifications			
	2.01 (Acura : CL : 2001-03 : 3.2 C	L		
	: 3.0L (except Sport) : with 15" Whee		2	Front	Spec.	Tol.	••••••••••••••••••••••••••••••••••••••
Front	Spec.	Tol.	0,3%	Left Turn Diff.	-7.48°	1.00°	9
Left Turn Diff.	0	•		Right Turn Diff.	-7.48°	1.00°	
Right Turn Diff.	•	0	0.33	Cross Turn Diff.			ě.
Turn Reference	0		:0.5*	Turn Reference	31.05°		191
Max Left Steer-Left	-39.07°	2.00°	6	Max Left Steer-Left	0	0	
Max Left Steer-Right	33.73°	2.00°	0.30	Max Left Steer-Right	•	0	
Max Right Steer-Left	33.73°	2.00°		Max Right Steer-Left	0	0	
Max Right Steer-Right	-39.07°	2.00°	0	Max Right Steer-Right	•	0	-
Wheelbase Track Width	in			Wheelbase	in		
Left Lateral Offset	in	0	10.00 140.46	Track Width	in		
Right Lateral Offset	0	0		Left Lateral Offset	•	°	
Wheelbase Difference	0	0	100	Right Lateral Offset Wheelbase Difference			
Track Width Diff.	0	0	2	Track Width Diff.			
Set Back		•	al.	Set Back		0	
Rear				Rear			
Track Width	in			Track Width	in		
	View or edit the specific	cations.			View or edit the sp	ecifications.	
		v Primary	Mount			Show Primary Measurer	nents
	Specifications Spec	ifications	Sensors	S	pecifications	Specifications & Adjust	nents
						<u>Q</u> i	

With Max Steer spec

Without Max Steer spec

WinAlign's® secondary specification should be filled in as follows:

Front		Spec.	Tol.	<u>Front</u>
Left Turn D)iff.	•	•	<u>total</u>
Right Turn	Diff.	0	0	<u>toe</u>
Turn Refer	ence	0		must
Max Left S	teer-Left	-39.07°	2.00°	be
Max Left S	teer-Right	33.73°	2.00°	<u></u>
Max Right	Steer-Left	33.73°	2.00°	
Right Turn Turn Refer Max Left S Max Left S Max Right Max Right	Steer-Right	-39.07°	2.00°	

within specified tolerances before measuring turning angle.

Locate the "Make Additional Measurements" soft key. Locate and select "Maximum Steering Angle" from the list of measurements.

	Adjust To Zero	Measure Caster		Make Additional Measurements	Make Additional Adjustments	
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Vehicle Heasurements and Adjustments Additional Measurement Procedures Acura : CL : 2001-03 :	3.2 CL				
		×~~~			¥®: <mark>}</mark> e¢} 0 ⊪{~9
).	
	edure to measure the maximum po			en steered	
Toe-Out-On	easurements / Set Turns	Back		^	
Maximum St Tire Condition				~	
Select the	desired measure	ment proced	ure, then pr	ess "OK".	
Cancel	↑		↓	ок	

Steer the wheels as directed by the bar graph display.

Maximum steering angle diagnosis:

- Look for symmetrical negative numbers on each side.
- Large differences side to side (over 2 degrees) may indicate:
 - \Rightarrow Steering stops out of adjustment
 - $\Rightarrow\,$ Steering wheel is not centered on the steering column when the rack or center-link is centered
 - \Rightarrow Steering column to gear mismatch at the steering coupler
 - \Rightarrow Damaged steering linkage

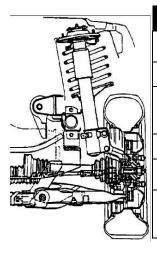
Vehicle Measurements and Adjus Hyundai: Santa Fe: Fi	ont Wheel Drive : 2005-06 (11/	09/2004-)		×
Front	Left		Righ	53
Included Angle	• • •	• •	••	0.33 ⁴ ±0.5°
Steer Ahead		0.0) <mark>0°</mark>	2
Set Back			••	ڰ
Turning Angle	iff2.0		-2.	
Cross Turn Dif	f.	-0.0)8°	
Ride Height		••		🦉
Maximum Left		6°	30.	90° 🖗
Maximum Righ	t Steer 30.5	6°	-35.	264
Rear	Left		Righ	nt 🛛
Set Back			• •	00
Ride Height		••	• •	®0 ⊫1 • • •
	Save the "before" aligr	ment measurer	nents.	00
Adjust	Measure	Make Additio		
To Zero	Caster	Measuremer	nts Adjust	ments

SAI / Included Angle Charts

Short Long Arm & Double Wishbone

	Camber	SAI	IA	Check
	Positive	Negative	ОК	Bent lower control arm or frame
	Positive	OK	Positive	Bent knuckle or ball joint
	Positive	Negative	Positive	Bent lower control arm or frame and Bent knuckle or ball joint
STELS	Negative	Positive	OK	Bent upper control arm or frame
	Negative	OK	Negative	Bent knuckle or ball joint
	Negative	Positive	Negative	Bent upper control arm or frame and Bent knuckle or ball joint

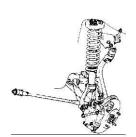
Strut



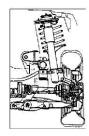
Camber	SAI	IA	Check
Positive	Negative	ОК	Bent lower control arm or frame
Positive	ОК	Positive	Bent strut, knuckle or ball joint
Positive	Negative	Positive	Bent lower control arm or frame and Bent strut, knuckle or ball joint
Negative	Positive	OK	Strut tower in at top
Negative	ОК	Negative	Bent strut, knuckle or ball joint
Negative	Positive	Negative	Strut tower in at top and Bent strut, knuckle or ball joint

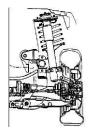
	Camber	SAI	IA	Check
	Positive	Negative	ОК	Bent Axle
	Positive	OK	Positive	Bent knuckle or ball joint
	Positive	Negative	Positive	Bent axle, knuckle or ball joint
	Negative	Positive	OK	Bent Axle
	Negative	OK	Negative	Bent knuckle or ball joint
	Negative	Positive	Negative	Bent axle, knuckle or ball joint

Caster Diagnostic Chart









Short-Long Arm Driver side

Caster	Setback	Check
Negative	Negative	Lower control arm too far back
Negative	Positive	Upper control arm too far forward
Positive	Negative	Upper control arm too far back
Positive	Positive	Lower control arm too far forward

Short-Long Arm Passenger side

Caster	Setback	Check
Negative	Positive	Lower control arm too far back
Negative	Negative	Upper control arm too far forward
Positive	Negative	Lower control arm too far forward
Positive	Positive	Upper control arm too far back

Strut Driver side

Caster	Setback	Check
Negative	Negative	Lower control arm too far back
Negative	Positive	Strut tower too far forward
Positive	Negative	Strut tower too far back
Positive	Positive	Lower control arm too far forward

Strut Passenger side

Caster	Setback	Check
Negative	Positive	Lower control arm too far back
Negative	Negative	Strut tower too far forward
Positive	Negative	Lower control arm too far forward
Positive	Positive	Strut tower too far back