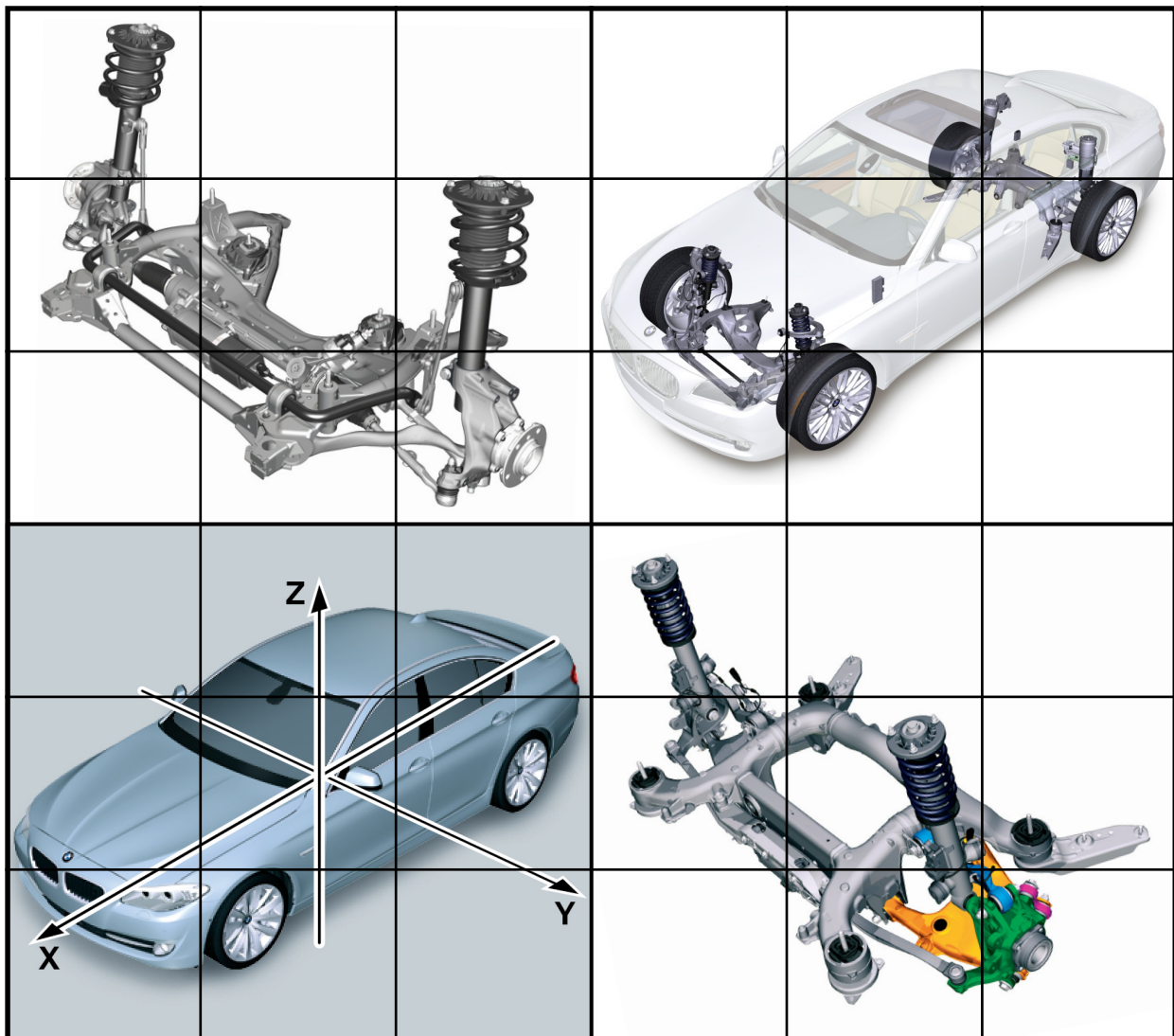




BMW Technical Training

Chassis Dynamics



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Course Code: ST1115 Chassis Dynamics

The information contained in the training course materials is solely intended for participants in this training course conducted by BMW Group Technical Training Centers, or BMW Group Contract Training Facilities.

This training manual or any attached publication is not intended to be a complete and all inclusive source for repair and maintenance data. It is only part of a training information system designed to assure that uniform procedures and information are presented to all participants.

For changes/additions to the technical data, repair procedures, please refer to the current information issued by BMW of North America, LLC, Technical Service Department.

This information is available by accessing TIS at www.bmwcenternet.com.

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Wheel Alignment

Model: All

Production: All

OBJECTIVES

After completion of this module you will be able to:

- Recognize the various alignment angles and their influence on tire wear and handling concerns.
- Document the proper alignment procedures.
- Properly read the alignment angles and if need be, make the conversion from decimal degrees into degrees, minutes and seconds.
- Predict what type of handling concerns and/or type of tire wear will occur by analyzing the alignment measurements.

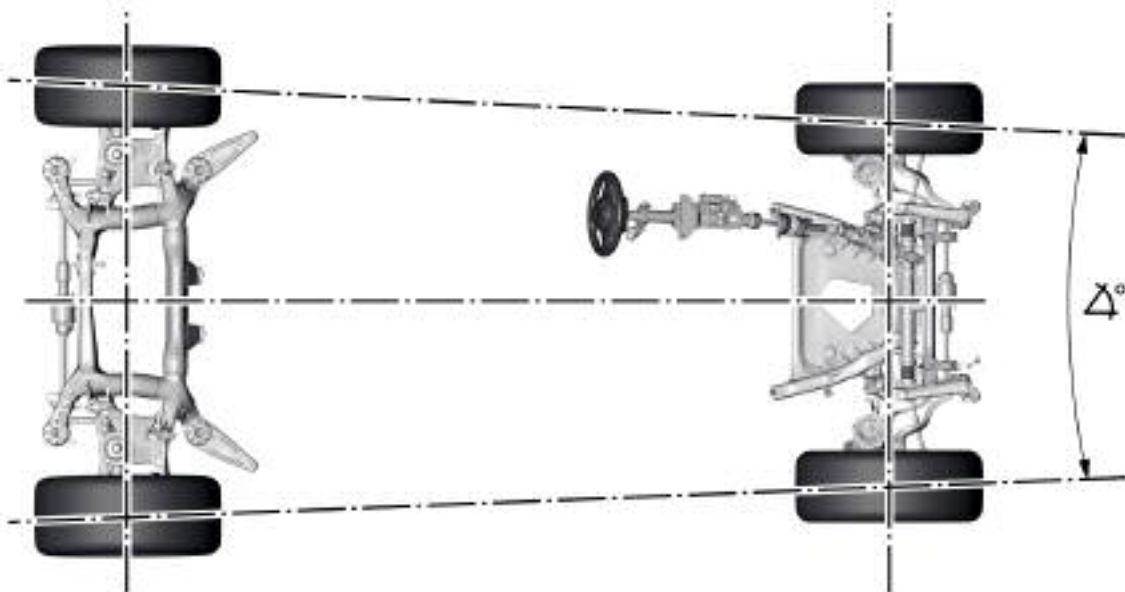
Introduction

In this training module, the proper techniques for wheel alignment will be discussed and practically applied. In previous training modules, the fundamentals of basic suspension geometry and BMW suspension systems were learned. These skills, along with the objectives in this training module, should allow the technician to achieve accurate and consistent alignment results.

It is crucial, when performing an alignment, that the vehicle tracks in a straight line and the steering wheel is properly centered. This can only be accomplished by following the proper procedures and taking the necessary precautions during the alignment process.

Before starting any alignment, it is also crucial to perform a road test and a comprehensive vehicle inspection. During the road test, any irregularities should be noted. Check for any “pulling” or “wandering”. Note any excessive play in the steering wheel etc. Also, check for any unusual behavior during braking.

Most importantly, this is an opportunity to verify any customer complaints. After the alignment is complete, perform a final road test to make sure that all complaints have been rectified.



The intent of this training module is to emphasize proper BMW alignment procedures. There is no specific reference to any particular brand of alignment equipment. Additional training (by the equipment manufacturer) may be necessary to complete a successful alignment with the equipment used.

Alignment Procedures

The following procedure is an outline to follow based on BMW procedures. The actual alignment procedures will vary depending upon the alignment equipment being used. Refer to the alignment equipment manufacturers procedures for specific information. The steps listed below should be followed as closely as possible to perform a quality alignment.

- 1. Vehicle Inspection** - The vehicle inspection should include a road test before and after the alignment. Note any concerns during the pre-alignment road test and verify that the concern has been rectified during the post-alignment road test.
- 2. Install Specified Weight** - Check Group 32 Technical Data in ISTA to determine the “Normal Position/ Inspection Conditions”. Install Specified weight in vehicle and compensate for fuel by adding extra weight if needed.
- 3. Install Alignment Sensors** - Install the necessary alignment sensors as per the recommended procedures outlined by the alignment equipment manufacturer.
- 4. Compensate Sensors** - Depending upon the type of alignment sensors being used, compensation may not be necessary. Compensation may require the vehicle to be lifted from the alignment rack. If so, be sure to remove the pins from the front and rear slip plates. If the sensors do not need to be compensated, the next step can be ignored.
- 5. Lower Vehicle and Jounce** - Make sure the pins are removed from the slip plates. Lower the vehicle back onto the alignment rack and jounce the vehicle. This will insure that the suspension has settled.
- 6. Check Ride Height** - Check ride height using metric tape measure. Ride height specifications can be found in Technical Data in ISTA. Front ride height specs can be found under Group 31 and rear can be found under Group 33. Always check ride height after compensating the sensors. This will avoid having to check the ride height twice.
- 7. Perform Alignment** - There are various types of alignment equipment used in BMW workshops. Refer to the equipment manufacturers instructions for the next steps of the alignment.

When performing an alignment of a vehicle equipped with air suspension (EHC), disable the system by removing the fuse for the air supply system. This will insure that the ride height will stay consistent.

Also, there will be additional steps required for vehicles equipped with Dynamic Stability Control (DSC). The steering angle sensors must be calibrated (adjusted). Failure to do so will cause DSC fault lamps to illuminate.



There are also special procedures for vehicles equipped with Active Steering. Active Steering in an optional system which is currently available on E82/E88; F30; E92/E93; E7x; F01/F02; F10/F12/F13. As the availability of the options constantly changes, make sure to check the SA of the vehicle you are working on.

Vehicle Inspection

Before attempting to align any vehicle, it is important to inspect the vehicle completely to insure there are no damaged or loose suspension components. Regardless of the age or mileage of the vehicle, a complete inspection should be performed. The following items should be checked thoroughly:

Tires and Wheels

- Check tires for wear patterns that could indicate suspension problems.
- Make sure the tires are the correct size and type.
- Check for the correct inflation pressures and look for wheel/rim damage which could indicate possible impact damage.

Wheel Bearings

- Check to make sure there is no excessive wheel bearing play. This needs to be addressed for safety reasons, but loose wheel bearings will affect the quality of the alignment as well.

Steering Linkage

- Check the tie rods, center link, idler arm and pitman arm. On vehicles with rack and pinion steering, check for loose inner/outer tie rods etc.
- On vehicles with a center link, make sure the center link is level (see BMW ISTA Repair Instructions). Check flexible coupling between steering shaft and rack and pinion assembly (or steering box).

Suspension Components

- Check Struts/Shocks for leakage or damage.
- Check springs and perform ride height measurements.

Subframe

- Check the front and rear axle carriers.
- Look for bent/twisted subframes and check the crossmembers for evidence of shifting or displacement.
- Check the mounting bolts for “clean spots” which could indicate shifting or movement.

Brakes

- Check braking system by road testing the vehicle. A road test could help to identify brake related issues such as pulling or brake induced vibrations.

Drivetrain

- While road testing the vehicle, observe vibrations and/or noises and try to isolate the cause. Noises and vibrations under acceleration (rather than coasting) may be an indication of drivetrain issues.

Road Testing

Whenever possible, a vehicle should be road tested before and after an alignment. If time allows, drive on various road surfaces and note the vehicle behavior. Check for brake pull when stopping. And most importantly, note the position of the steering wheel before and after the alignment. These are important steps to avoid comebacks and unnecessary return visits.

Identification of Suspension

When performing an alignment, the suspension variant. This insures that the correct alignment specifications are used and the ride height is correct. There are numerous suspension variants, there is the standard “series” production suspension, the “low slung” sports suspension, “M Sport Package” and the “Poor Road Surface” package. The latter term is for Eastern Europe and it is not used in the US.

There are various methods for determining the suspension variant used. Refer to repair instructions in Group 32 for more information.

The following is a summary of some common older models:

- **E38** - The “Sports” suspension variant is identified by paint markings on the front springs or by a front sway bar diameter of greater than 21.5 mm.
- **E65/E66** - There is no additional identification needed to determine suspension variant (at this time). Check option codes to determine Sport suspension option.
- **E39** - There is a symbol (or code) located on the front strut assembly. There is a chart in repair instructions to match to the symbol found.
- **E36** - There is an auxiliary spring located on the front strut assembly. There is a measurement that needs to be made to determine suspension variant. Refer to repair instructions for additional details.
- **E46** - There is a symbol (or code) located on the front strut assembly. There is a chart in repair instructions to match to the symbol found.
- **E83** - The sway bar diameter differs between “Sport” and “Non-Sport” versions. The “Non-Sport” sway bar is 23.5mm and the “Sport” version is 24.5mm.
- **E60/E61** - There is no additional identification needed to determine suspension variant (at this time). Check option codes to determine Sport suspension option.
- **E63/E64** - There is no additional identification needed to determine suspension variant (at this time). Check option codes to determine Sport suspension option.
- **E90 (E9X)** - There is no additional identification needed to determine suspension variant (at this time). Check option codes to determine Sport suspension option.
- **E53 (X5)** - There is no additional identification needed to determine suspension variant (at this time). Check option codes to determine Sport suspension option.
- **E70 (X5)** - There is no additional identification needed to determine suspension variant (at this time). Check option codes to determine Sport suspension option.

Ride Height Measurement

When performing alignments on a BMW vehicle, the ride height must be set and checked before proceeding with any measurement or adjustments. Ride height is measured from the lower edge of the wheel rim to the lower edge of the wheel housing. Ride height specifications are in millimeters. The specifications can be found in Technical Data. The front axle ride height is in Group 31 and the rear axle ride height is in Group 33. In order to obtain the correct specification, the vehicle and suspension type must be identified.

Ride height specifications depend upon rim size (15", 16 ", 17 " etc.), engine size and the type of suspension. Depending upon the year and models, there can be several types of suspension packages:

- **Series** - Standard production vehicle
- **Low Slung Sports Suspension** - This is used on vehicle with Sports Package Option.
- **Rough Road Package** - For Eastern European Rough roads. Not used in US.
- **M Sports Package** - Used on Motorsport vehicles or those with M Package Option.

The example shown below is the front ride height specification for an F30. This Technical Data is available on ISTA. The rear ride height can be found under Group 33.

Sample Ride Height Chart for F30		
Series		
16" Rim	mm +/- 10	595
17" Rim	mm +/- 10	610
18" Rim	mm +/- 10	623
19" Rim	mm +/- 10	636
20" Rim	mm +/- 10	648
Sports Suspension with Low-Slung		
16" Rim	mm +/- 10	585
17" Rim	mm +/- 10	600
18" Rim	mm +/- 10	613
19" Rim	mm +/- 10	625
20" Rim	mm +/- 10	638

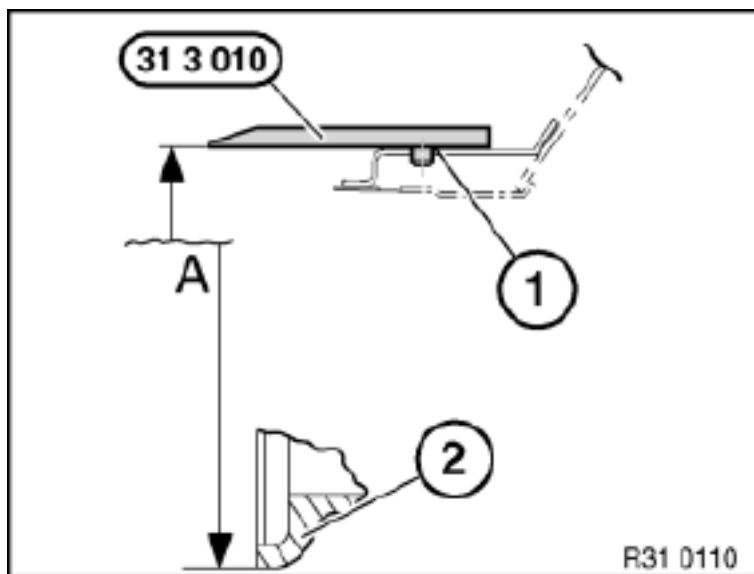
Ride Height

When measuring ride height, measure from the lower edge of the wheel rim to the lower edge of the wheel opening. Use a metric tape measure with divisions of 1 mm.



E36/7 Z3 Ride Height

When checking the ride height on the Z3, use special tool **31 3 010** to check the front ride height. The special tool is a substitute for the lower edge of the wheel opening. Since the hood on the Z3 makes up part of the wheel opening, this tool is needed for more accurate results.



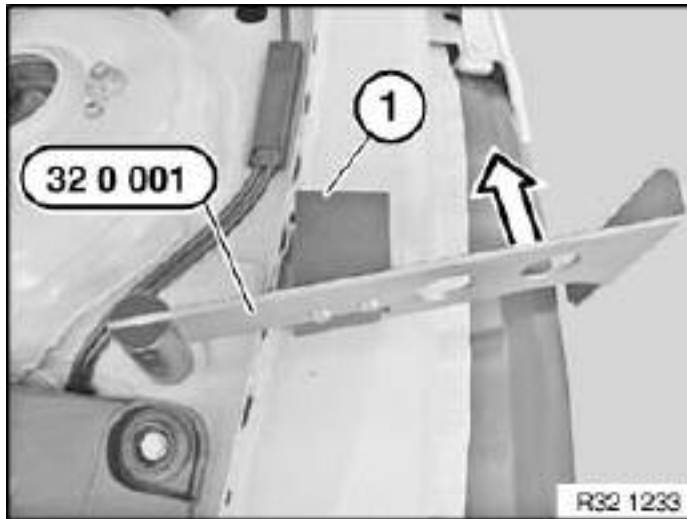
E89 Z4 Ride Height

When checking the ride height on the Z4, use special tool **31 3 010** to check the front ride height. The special tool is a substitute for the lower edge of the wheel opening **if the hood on the Z4 is damaged or not installed.**

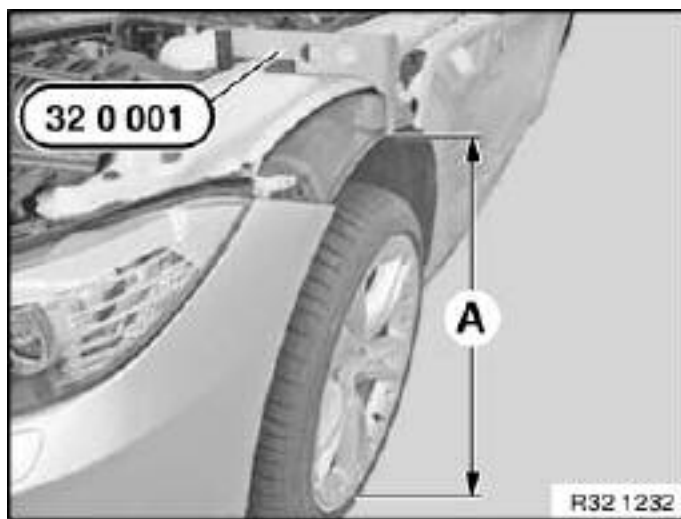


E89 with a hood in good condition.

If engine compartment lid is removed or damaged, use special tool **32 0 001**.



Remove rubber plug next to spring strut dome. Fasten special tool 32 0 001 in bore hole and turn in opposite direction to direction of travel (see arrow) up to stop (1).



Determining actual ride height (A): Attach tape measure to rim flange at bottom middle and measure to lower edge of special tool 32 0 001.



SWZ 32 0 001 is not used in the US market!

Vehicle Loading

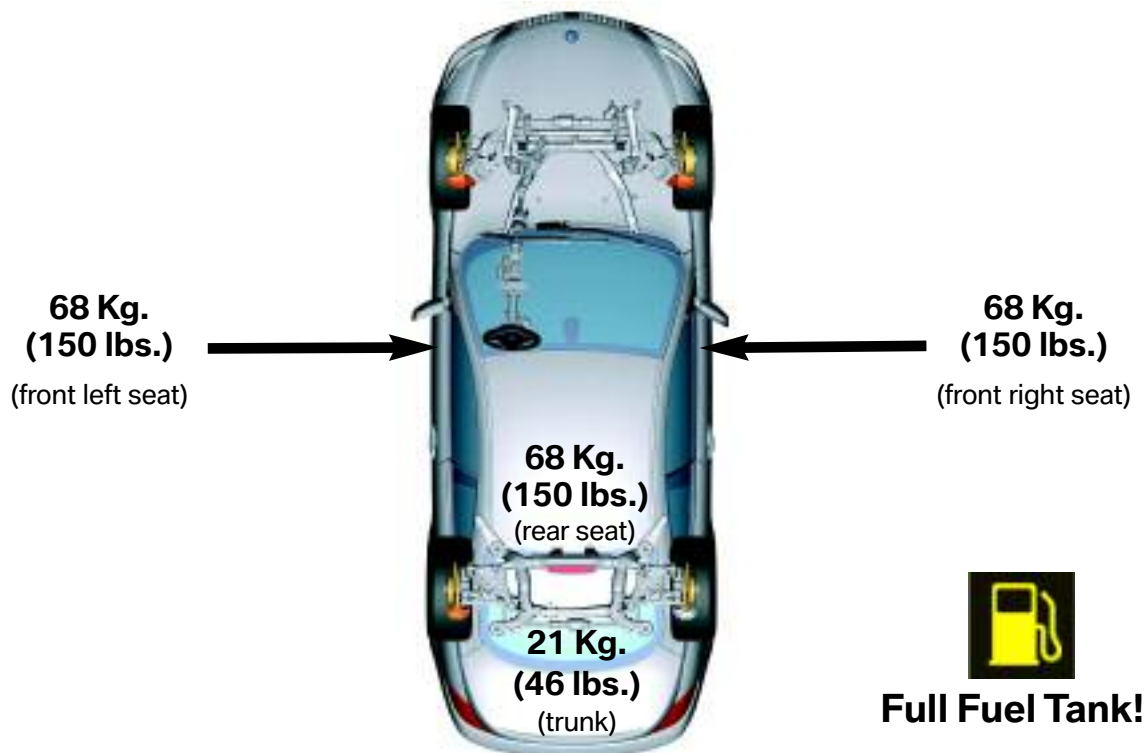
In order to obtain the correct ride height, the vehicle must be loaded with the specified weight. The normal specified weight for **most** vehicles is as follows:

- 68 kg. in each front passenger seat
- 68 kg in the rear seat
- 21 kg in the trunk
- Fuel tank full.

In Technical Data, there are two terms used to describe the position of the vehicle during alignment. There is the “Normal Position” and the “Design Position”. The Normal Position refers to a vehicle without any weight added. The Design Position is a vehicle with the specified weight already added.

Not all vehicle need to be weighed down. Usually, Motorsport vehicles are measured without any weight. Always check ISTA under Group 32. The proper test conditions can be found under “Normal Position/Inspection Conditions”.

If the vehicle fuel tank is not full, compensate by adding weight in the trunk. Fuel is approximately 7 pounds (about 3.2kg) per gallon. For example: If the vehicle has an 18 gallon tank and it is 1/2 full, add about 63 lbs. (about 28kg.)



Be aware that some alignment equipment manufacturer do not require the vehicle to be loaded down with weight. This depends entirely on the type of equipment and software version in use.

Alignment Sensor Mounting

There are two types of alignment sensor mounting, this depends upon equipment used. The first type is the “Rim Clamp” Method which “clamps” on the edge of the wheel rim.

Since this method used the wheel (rim) for reference, the sensor is not “true” to the actual suspension components. Therefore the sensor needs to be “compensated” or adapted to the wheel. This allows any wheel runout or mounting irregularities to be factored into the alignment process and ensure accurate alignments.

The second type is the “Beissbarth” type clamp, this method allows the clamp to be indexed to the rotor hub through holes in the wheel rim. The clamp hold on to the tire tread with a spring loaded clamp. The “Beissbarth” clamping method does not have to be compensated due to the fact that the clamp is actually mounted to the rotor hub, theoretically this method eliminates the need for compensation. Always remember that the holes in the rim should be clean and free of excessive rust, this could cause irregular mounting and inaccurate alignment results.



Older style requires compensation of the head.



**BMW Preferred:
Requires no compensation of the head.**



Alignment Specifications

The alignment specifications can be found in ISTA under Group 32. There is a slight difference in terminology between this information and the information found on most alignment equipment. The following is list of the different terms used. The alignment specifications are shown on the opposing page:

- **Front Toe** - or Total Toe represents the left and right toe specs added together. Total toe is the difference between the leading and trailing edges of both tires with respect to one another. It may be measured in degrees and minutes.
- **Front Camber** - Camber is also measured in degrees and minutes. Camber is adjustable only a some vehicles. The maximum amount of Camber adjustment is approximately .5 +/- degrees.
- **Track Differential Angle with 20° lock on inside wheel** - This angle is also known as “Toe Out on Turns”. With the inside wheel turned to 20 degrees on the front turn plates, the difference in the toe angle should be as specified.
- **Caster** - Caster must be measured by sweeping the wheel through an arc of 10-20 degrees. (Most alignment equipment requires at least 20 degrees). Ride height is crucial to this specification. If the vehicle is too high or low in the rear, the Caster measurement will be affected. Caster is NOT a “live angle”, the wheels must be “re-swept” to check the measurement again. Although Caster is NOT adjustable, it should always be checked to insure there is no “hidden damage”.
- **Front Wheel Displacement** - Also known as “Setback”, this is a measurement of the angle formed between the front axle to the Geometric Axis. The front axle centerline should be at 90 degrees to the Geometric Axis. A quick check of setback is to look to see if the wheel is centered in the wheel opening. Setback is a good diagnostic angle, if the Caster is off, the Setback measurement could indicate the cause. Look for bent suspension components or damaged suspension carrier/subframe.
- **Maximum Wheel Lock** - Also known as “Maximum Steering Angle”. This is the maximum angle of the wheels when turned to the inward and outward lock position. When this measurement is out of specification, check to see if the steering rack or steering box is centered. This can cause a hazardous condition and premature tire wear.
- **Rear Toe** - Just as with front toe, this is the combined measurement of the rear left and right toe. Rear Toe is also measured in Degrees and Minutes.
- **Rear Camber** - Rear Camber is always slightly negative on BMW vehicles. Rear Camber adjustable on some models.
- **Geometrical Axis Deviation** - The Geometrical Axis Deviation is also known as the “Thrust Angle”. The optimum angle is zero degrees. The Thrust Angle is the angle formed between the Geometric Centerline and the Thrust Line which is the imaginary line which bisects the rear toe angle. A Thrust Angle of Zero Degrees is Optimal.

Explanation of Angles

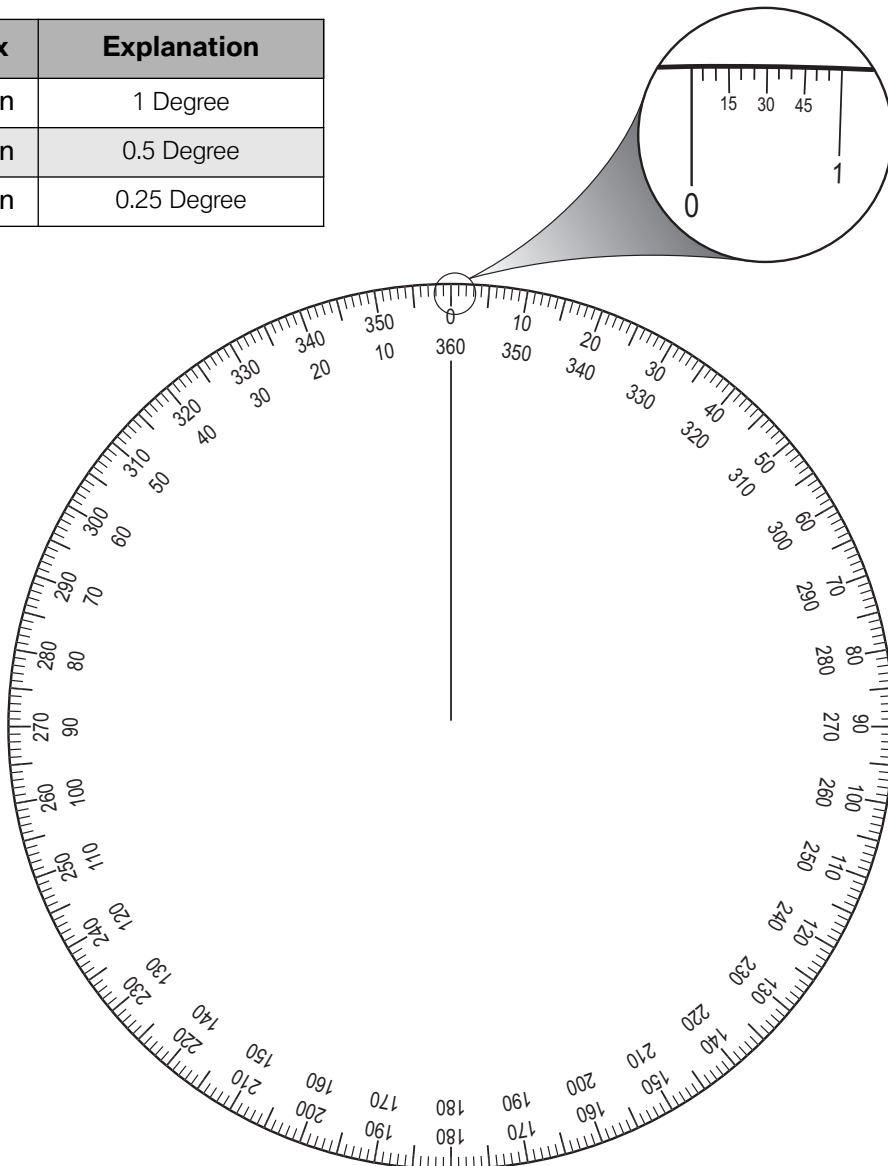
Depending upon the type of alignment equipment used, the specifications can be expressed a number of ways. The specifications for BMW vehicles are in degrees and minutes. Whenever possible, set the alignment equipment to read in degrees and minutes rather than inches etc. Some types of alignment equipment will have this option, this is more desirable than trying to convert from inches to degrees etc.

The alignment angles are expressed in degrees and minutes. For example:

6° 30' is expressed as 6 degrees, 30 minutes.

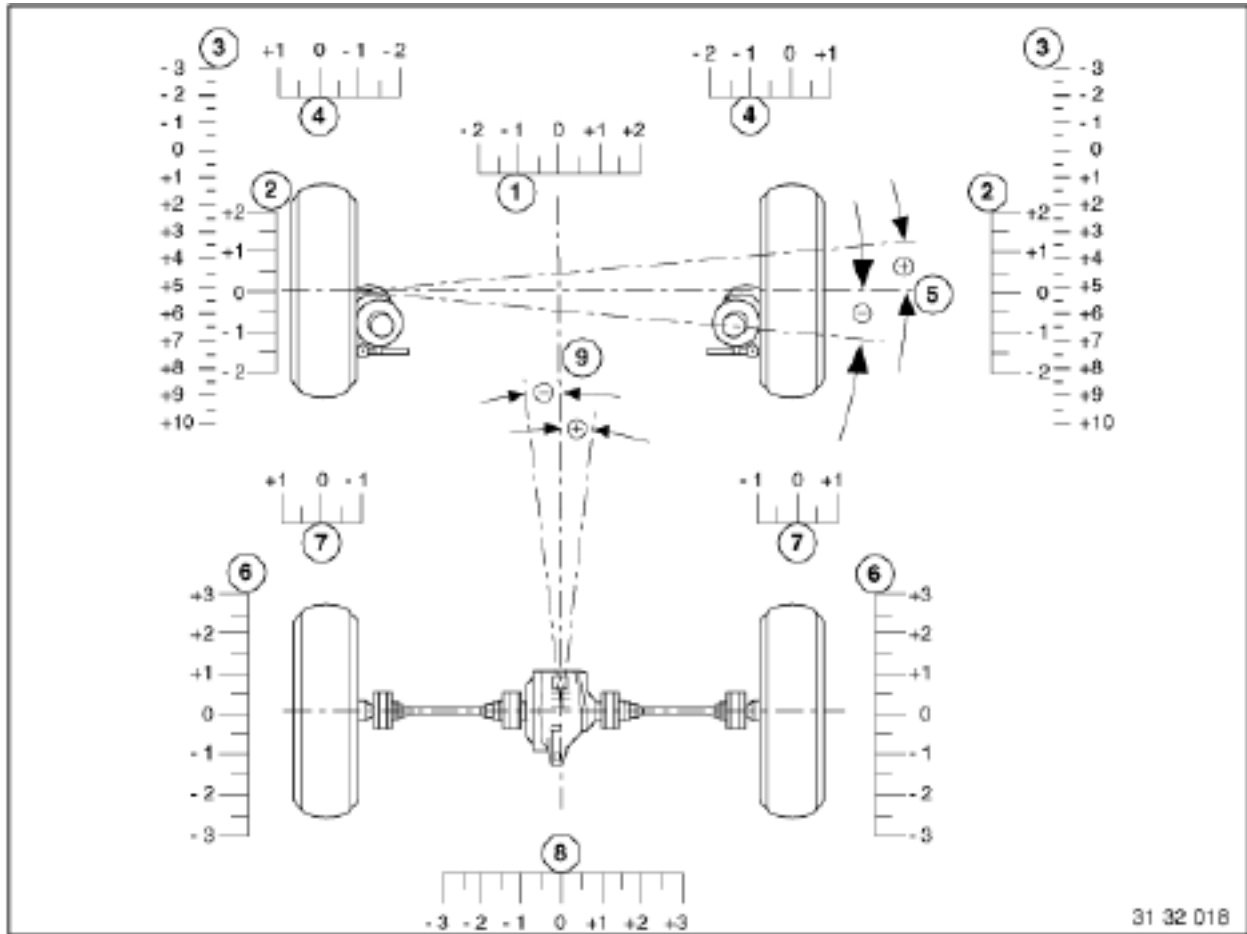
There are 360 degrees in a circle and 60 minutes to each degree. Each minute is also subdivided into increments of 60 seconds, but adjustments this fine are rarely used.

Index	Explanation
60 min	1 Degree
30 min	0.5 Degree
15 min	0.25 Degree



Minutes to Decimal Degree Conversion Chart

Minutes	Degrees	Minutes	Degrees
1	.017	31	.517
2	.033	32	.533
3	.050	33	.550
4	.067	34	.567
5	.083	35	.583
6	.100	36	.600
7	.117	37	.617
8	.134	38	.633
9	.150	39	.650
10	.167	40	.667
11	.184	41	.683
12	.200	42	.700
13	.217	43	.717
14	.234	44	.733
15	.250	45	.750
16	.267	46	.767
17	.284	47	.783
18	.301	48	.800
19	.317	49	.817
20	.334	50	.834
21	.351	51	.850
22	.367	52	.867
23	.384	53	.884
24	.401	54	.900
25	.417	55	.917
26	.434	56	.934
27	.451	57	.950
28	.468	58	.967
29	.484	59	.984
30	.500	60	1.00



31 32 018

Index	Explanation	Index	Explanation
1	Toe	6	Camber (rear)
2	Camber	7	Rear wheel position (toe)
3	Caster (with 10° or 20° wheel lock)	8	Total Toe (rear)
4	Toe angle difference (with 20° wheel lock)	9	Geometric axis/Thrust angle
5	Front wheel displacement (set-back)		

NOTES

PAGE

Alignment Adjustment Summary

The chart below represent a summary of the possible alignment adjustments on all current BMW models. Use the reference footnotes for more information about the individual alignments. Graphics and explanations are provided on the opposing page.

Any of the adjustments which refer to an “eccentric” with no footnote are adjusted with standard hand tools (sockets/wrenches etc).

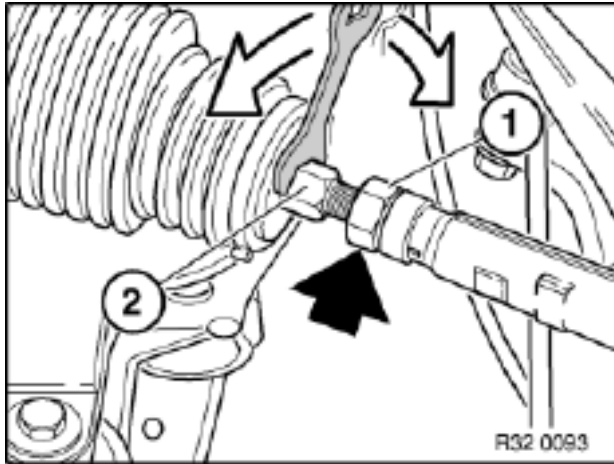
Vehicle	Front Caster	Front Camber	Front Toe	Rear Camber	Rear Toe
E30	No Adjustment	No Adjustment	Yes (1)	No adjustment	No adjustment (2) (Offset Bushing)
E36	No Adjustment	No Adjustment (3)	Yes (1)	Yes (eccentric)	Yes (7) (Tool # 32 3 080)
E36/7 (Z3) E36/5 (318ti)	No Adjustment	No Adjustment	Yes (1)	No adjustment	No adjustment (2) (Offset Bushing)
E46	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (8) (Tool # 32 3 030)
E85	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (8) (Tool # 32 3 030)
E90 (E91/E92)	No Adjustment	Yes (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (eccentric)
E34	No Adjustment	No Adjustment	Yes (1)	No adjustment	No adjustment (2) (Offset Bushing)
E39	No Adjustment	No Adjustment	Yes (1)	Yes (eccentric)	Yes (eccentric)
E60/E61	No Adjustment	Yes (5) (Tool # 32 3 190)	Yes (1)	Yes (eccentric)	Yes (eccentric)
E63/E64	No Adjustment	Yes (5) (Tool # 32 3 190)	Yes (1)	Yes (eccentric)	Yes (eccentric)
E32	No Adjustment	No Adjustment	Yes (1)	No adjustment	No adjustment (2) (Offset Bushing)
E38	No Adjustment	No Adjustment	Yes (1)	Yes (eccentric)	Yes (eccentric)
E65/E66	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (eccentric)
E31	No Adjustment	No Adjustment	Yes (1)	Yes (eccentric)	Yes (eccentric)
E52	No Adjustment	No Adjustment	Yes (1)	Yes (eccentric)	Yes (eccentric)
E53	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (eccentric) (See note 6)
E83	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (8) (Tool # 32 3 030)

Vehicle	Front Caster	Front Camber	Front Toe	Rear Camber	Rear Toe
E70	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
E71/72	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
E82	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes	Yes (eccentric)	Yes (eccentric)
E88	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes	Yes (eccentric)	Yes (eccentric)
E89	No Adjustment	Yes (4) (Tool # 32 3 140)	Yes (1)	Yes (eccentric)	Yes (8) (Tool # 32 3 030)
F01	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
F02	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
F07	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
F10	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
F12/F13	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
F06	No Adjustment	Yes *	Yes	Yes (eccentric)	Yes (eccentric)
F25	No Adjustment	Yes **	Yes	Yes (eccentric)	Yes (eccentric)
E84	No Adjustment	Yes **	Yes	Yes (eccentric)	Yes (eccentric)
F30	No Adjustment	Yes **	Yes	Yes (eccentric)	Yes (eccentric)

*** Front camber can not be adjusted on the double wishbone front axle of E7x, F0x or F1x vehicles. Should the camber need to be adjusted (after an accident) replacement upper control arms are available that enable positive 30' (+5 mm) and negative 30' (-5mm) correction.**

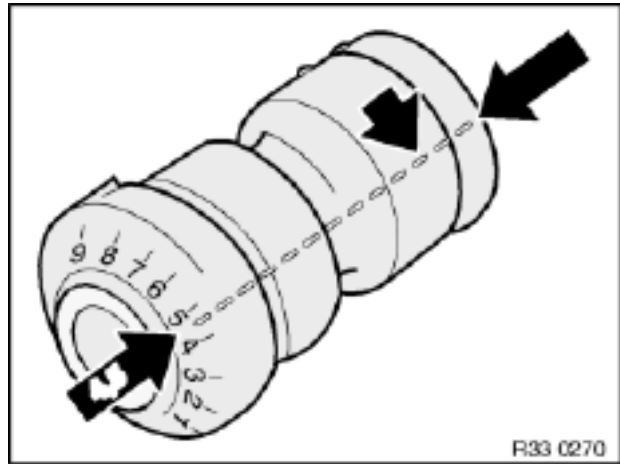
**** Front camber can not be adjusted on the two-joint spring strut front axle of E84, F25, F30 vehicles. Should the camber need to be adjusted (after an accident) replacement swivel bearings are available that enable positive 30' (+5 mm) and negative 30' (-5mm) correction.**

Note 1:
Front Toe Adjustment (all models)



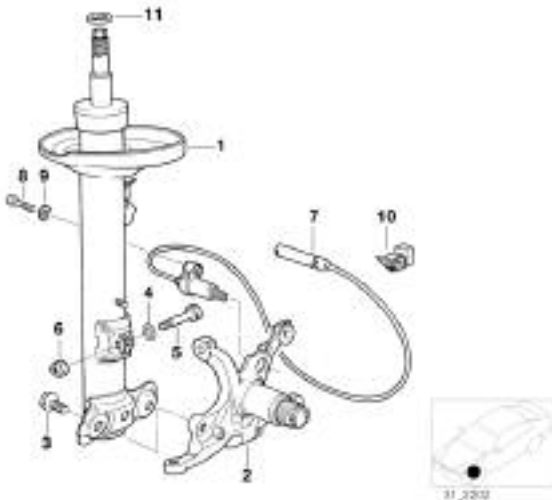
Front toe adjustment is achieved by loosening the lock nut on the tie rod end and turning threaded adjustment. Re-tighten locknut after desired toe value is achieved.

Note 2:
Rear Toe Adjustment (E32/E34,E36/7, E36/5,E30)



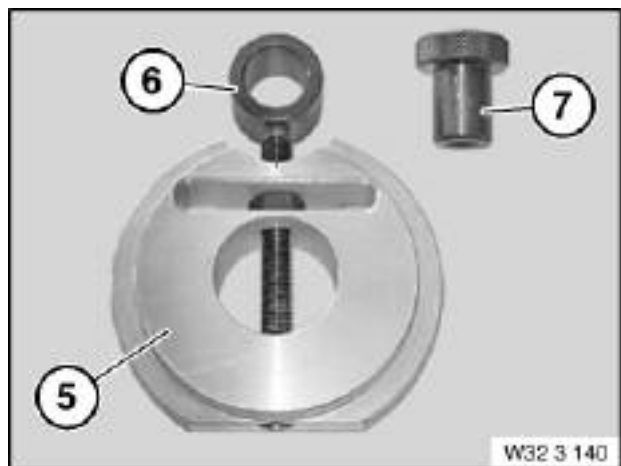
Rear toe adjustment is achieved by installing the off-set bushing shown above in the correct position as per the numerical indication on the bushing. Refer to repair instructions for more detail on tools and installation procedures. Note - This bushing is not intended to correct for damaged components. Inspect and replace any damaged components before using this bushing option.

Note 3:
Front Camber (correction E36)



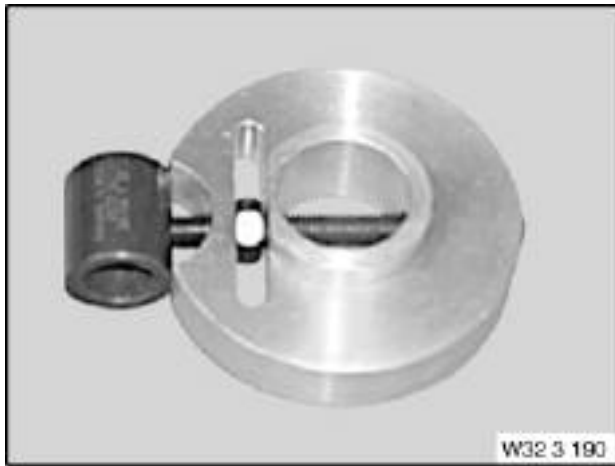
Front camber adjustments on the E36 are not possible by standard means. However, a “camber correction bolt” is available through parts. Note part #5 in the above diagram. A bolt with a smaller shank diameter which allows for a slight correction of the camber if needed. Refer to EPC, see P/N 07 11 9 900 587.

Note 4:
Front Camber Adjustment Tool



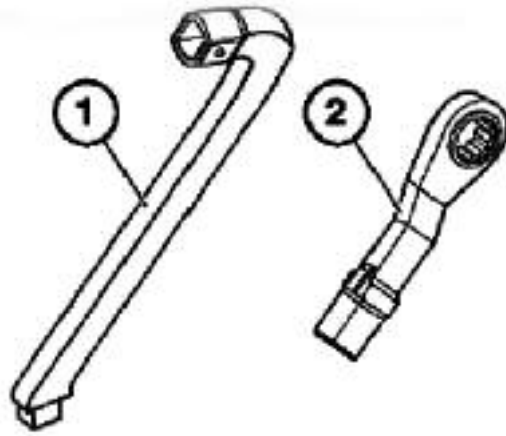
Special tool # 32 3 140 is used to make camber adjustments on the listed vehicles. The centering pin must be removed in order to make any camber changes. Be sure to unload suspension (front wheels off the ground) before making any adjustments. Failure to do so may cause damage special tool.

Note 5:
Front Camber Adjustment Tool



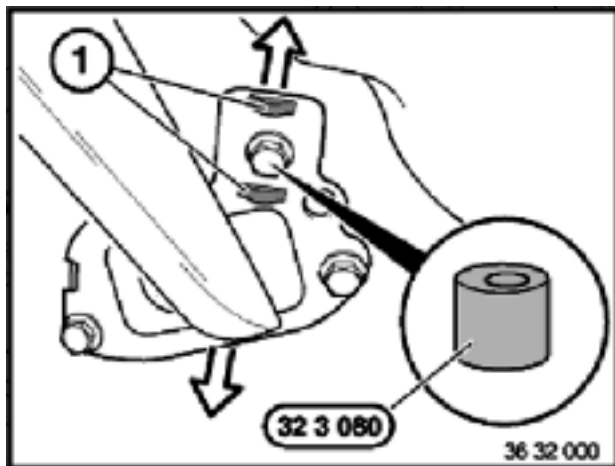
Special tool # 32 3 190 is used to make camber adjustments on the listed vehicles. The centering pin must be removed in order to make any camber changes. Be sure to unload suspension (front wheels off the ground) before making any adjustments. Failure to do so may cause damage special tool.

Note 6:
X5 Rear Axle Adjustment Tools



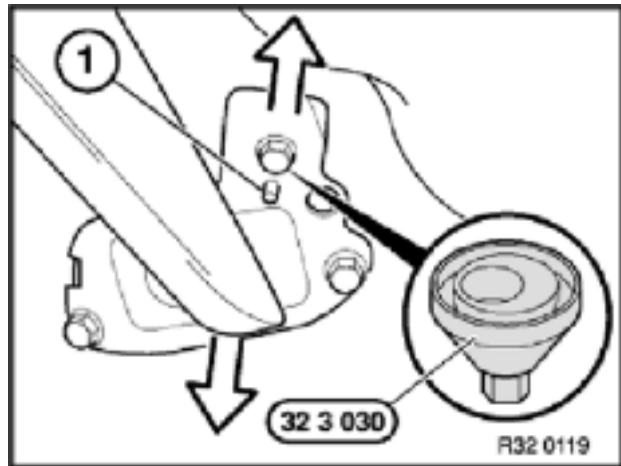
The X5 (E53) rear axle adjustments require these special tools to access the eccentrics. Due to the confined space available, it is necessary to use these tools to properly loosen and tighten the eccentric locknut. These tools use a square drive configuration to be used with a torque wrench.

Note 7:
Rear Toe Adjustment Tool



Special tool # 32 3 080 is used to make rear toe changes on the E36. Loosen the three bolts on the support bracket for the bushing by approx. 1 to 1.5 turns. Attach special tool 32 3 080 to bolt head and pin (1). Turn special tool 32 3 080 to adjust toe to specified value. Tighten down bolts to specified torque. Do not use impact tools to tighten. Threads in body may become damaged.

Note 8:
Rear Toe Adjustment Tool



Special tool # 32 3 030 is used to make rear toe adjustments on the E46, E85 and E83. Special tool # 32 3 080 is used to make rear toe changes on the E36. Loosen the three bolts on the support bracket for the bushing by approx. 1 to 1.5 turns. Attach special tool 32 3 030 to bolt head and pin (1). Turn special tool 32 3 030 to adjust toe to specified value. Tighten down bolts to specified torque. Do not use impact tools to tighten. Threads in body may become damaged.

Double Wishbone Front Axle Adjustments (E7x, F0x)

The toe adjustment on the double wishbone front axle is carried out by means of a tie rod adjustment as on past models.

The Camber adjustment, however, can only be adjusted by a replacement of the upper control arm (wishbone). The control arm is available in three possible part numbers. One of which is the standard (zero) arm, while the other two are offset to effect a small Camber change if needed.

Negative Camber



Standard Camber



Positive Camber



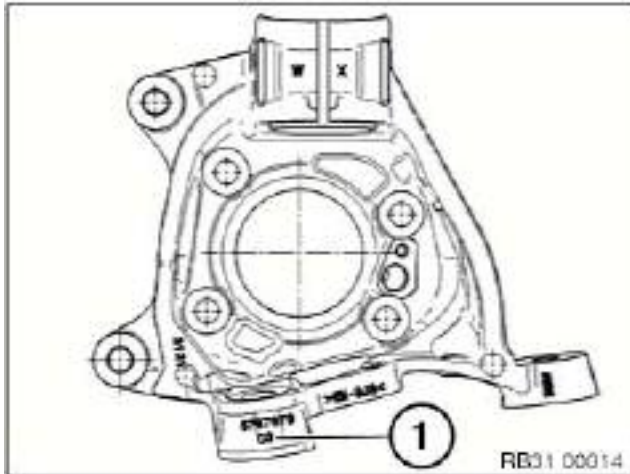
Two-joint Spring Strut Front Axle Adjustments (E84, F25, 30)

The toe adjustment on the double wishbone front axle is carried out by means of a tie rod adjustment as on past models.

The Camber adjustment, however, can only be adjusted by a replacement of the swivel bearing. The swivel bearing is available in three possible part numbers. One of which is the standard (zero) arm, while the other two are offset to effect a small Camber change of +/- 30' if needed.

Two versions of the swivel bearings are available:

- Version 1: camber correction -0° 30'
- Version 2: camber correction 0° 30'.



Version Identification	Color coding
Standard	No color coding
Plus 30' +	Green dot (1)
Minus 30' -	Blue dot (1)

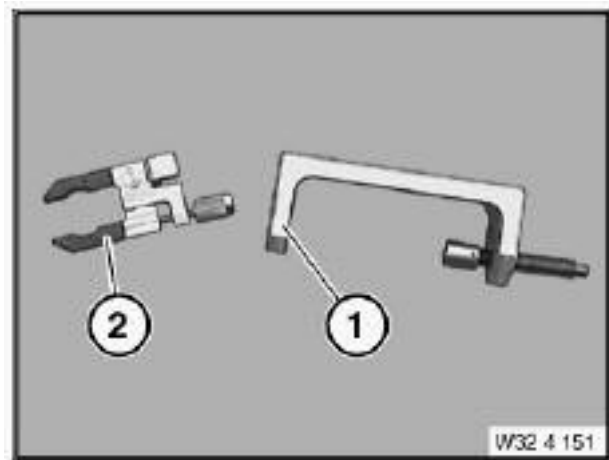


See “BMW Front Suspension Systems” section for more information.

Additional Special Tools

When performing an alignment on a vehicle equipped with AFS (E6X only), the steering shaft needs to be held in place to prevent any movement when setting toe. Initially, a special tool was developed for this procedure. Special tool # 32 4 150 was used to clamp on to a frame rail and then clamp the steering shaft to a fixed position.

Subsequently, this special tool was redesigned and improved. Therefore, the original special tool (32 4 150) was upgraded with the installation of special tools 32 4 154 and 32 4 155. Refer to **SI B04 05 04** for more information.

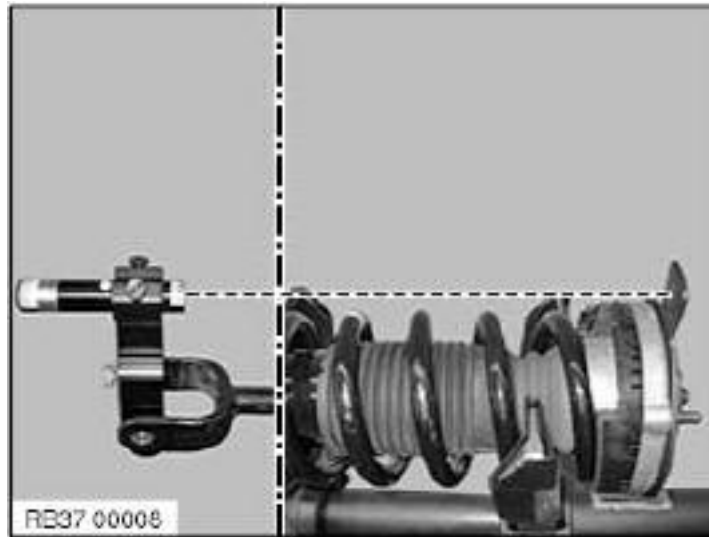


E90 vehicles equipped with AFS do not require the special tool to hold the steering shaft.

When mounting, spring strut and support bearings on (F01, F02, F04, F07, F10, F12, F13) they must be aligned using special tool 83 30 2 210 778 (83 30 2 210 777).



See SI B04 27 11 for more information regarding this tool.



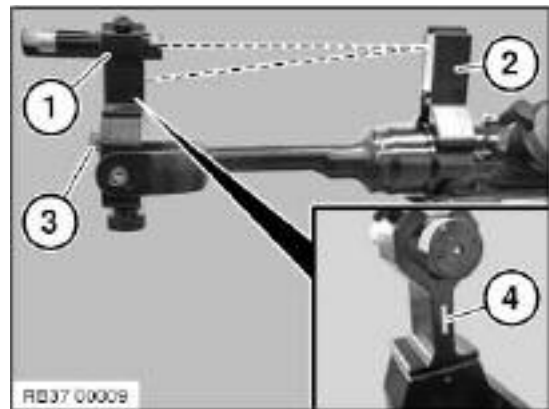
The following procedure must be followed.

Insert shock absorber in tensioned coil spring.

Slide auxiliary damper, protective tube and spring pad onto piston rod.

Align laser (1) with prism mirror (2):

- Mount laser (1) in damper eyelet
- Mount prism mirror (2) vertically onto spring strut!
- Align spring strut with support bearing or with corresponding mark on gauge (1) using laser beam and relieve tension.
- After the spring tension is relieved, the laser beam must point to the specified mark of gauge (1).



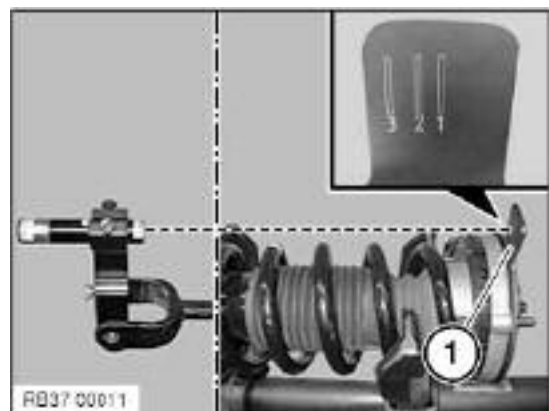
Failure to observe this requirement will result in substantial impairment of handling characteristics.



Vehicles built before 04/2010: Position laser beam on mark "3" of gauge.

On vehicles from 04/2010: Position laser beam on mark "2" of gauge.

For complete repair information on this tool, refer to ISTA Repair Manual section 37 11 032.



NOTES

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