

Aumark alignment™

**WHEEL
ALIGNMENT
INSTRUCTION
BOOK**

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Preface

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The instruction is only for professionals and repairmen!

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Notice:

People who are responsible for the operation of the equipment should accept training of relative technologies and be qualified.

Operators must acquire basic knowledge of the computer and know 5D wheel alignment well.

The reliability and safety of power cable should be checked regularly. Please allocate ac voltage stabilizer if the voltage of power supply is unstable.

Before installing, lifting machine should be installed according to the requirement. For the correctness of tests and safety of staff, fastness of the check and levelness of lifting machine should be paid much attention, cleaning barriers around the lifting machine for the operation. For the sake of safety, all the loose bolts and other components should be fixed as requirement.

It should not be installed on vibrating objects or inclined plane. Besides, it

should avoid direct sunlight and moist.

Four-wheel alignment is equipment for precision test. There are sensitive elements inside, thus it should be handled gently otherwise it will not work well with its cover deformed, even worse the breakdown of its elements inside.

The surface of the equipment should be away from liquid, or the system will be damaged forever.

When everything is done, please cut off all power.

The test method of four-wheel alignment is by the use of images, so sensors cannot be interfered by strong light and any objects that block the light.

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1. For two-post lift: the distance between the sensor and the ground is 133.8 inch (3400mm) and the distance between two sensors are 2700mm.

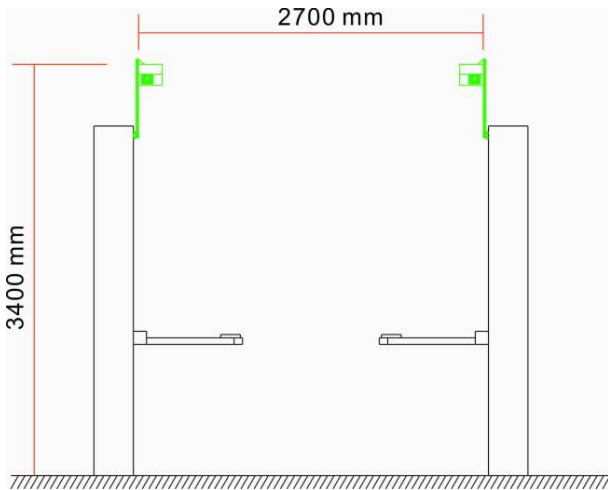


figure : 1-1

2. For double gantry lift: the distance between the sensor and the ground is 133.8inch(3400mm), and the distance between two sensors are 2700mm.

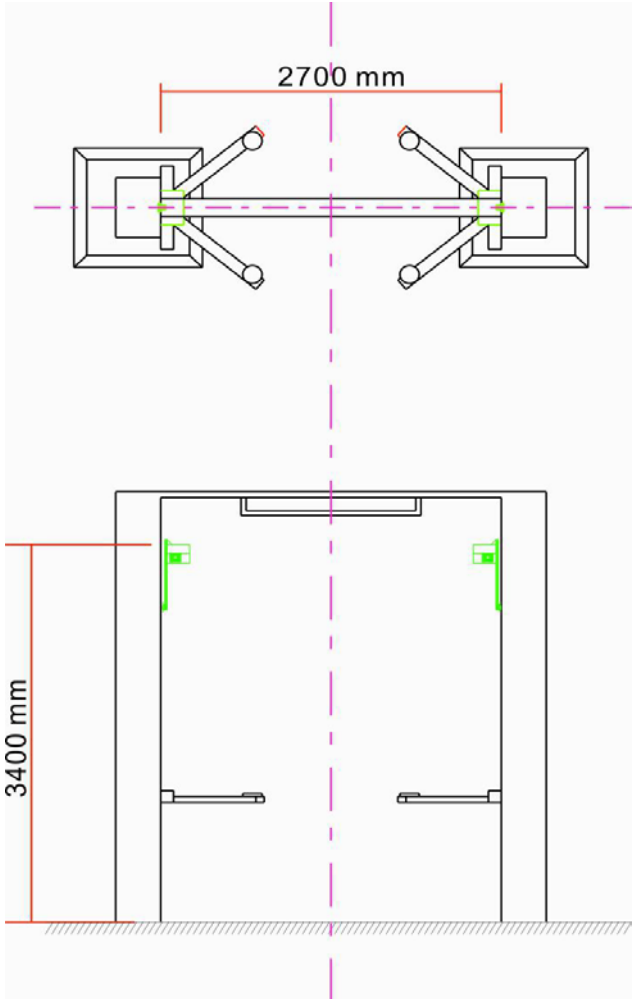


figure : 2-1

3. The way to install sensors.

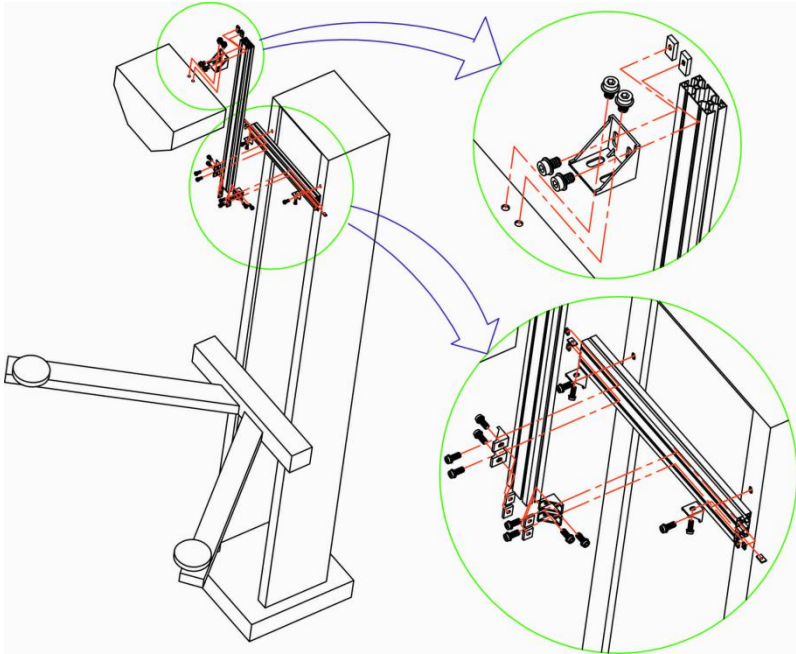


figure : 3-1

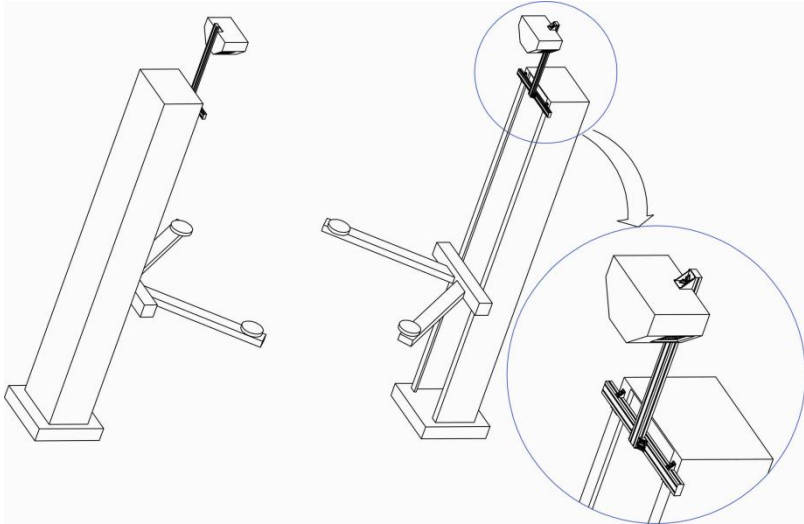


figure: 3-2

4. For scissors lift and small scissors lift—ceiling -mounted

The distance between the sensor and the ground is 3400mm, and the distance between two sensors is 2700mm. Two sensors should be installed over the middle part of the scissors lift.

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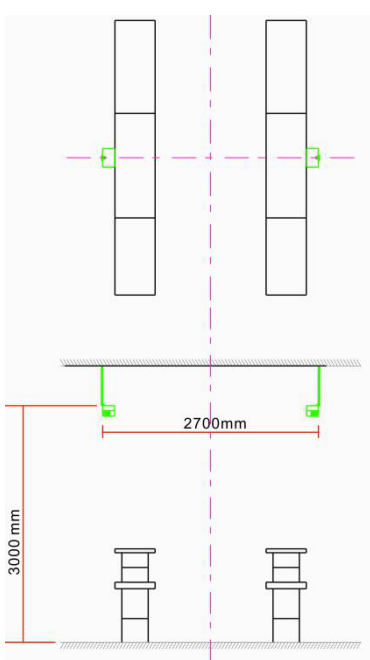


figure : 4-1

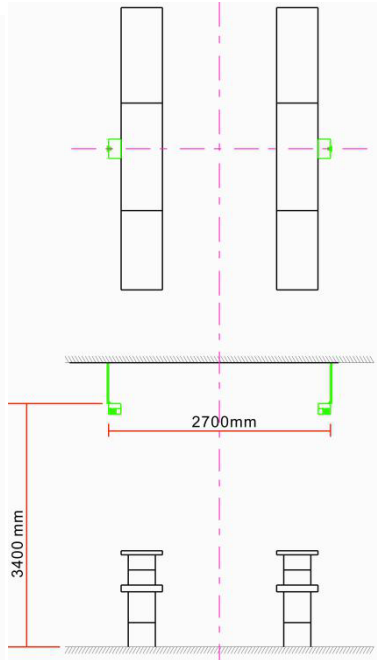


figure : 4-2

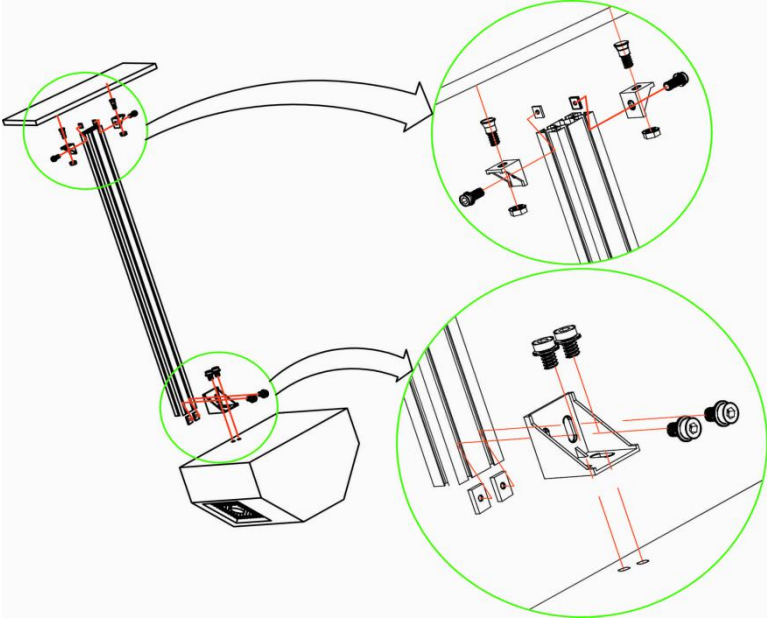


figure: 4-3

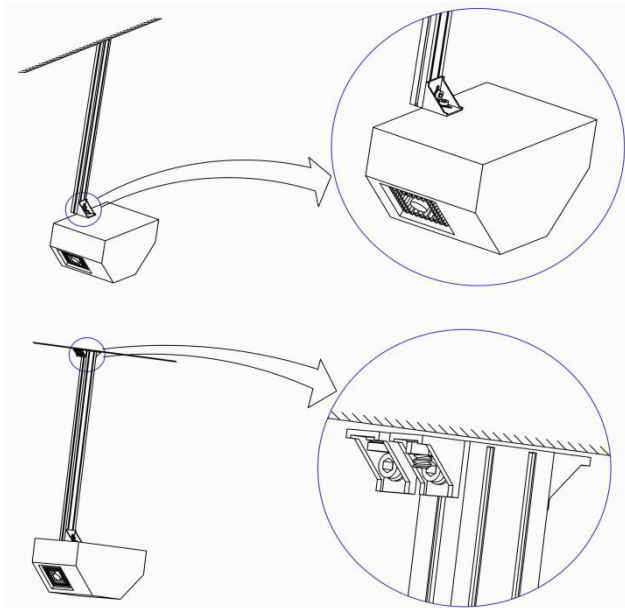


figure: 4-4

1. Positioning detection

Click the icon of positioning



detection on the main interface

and enter the interface as the



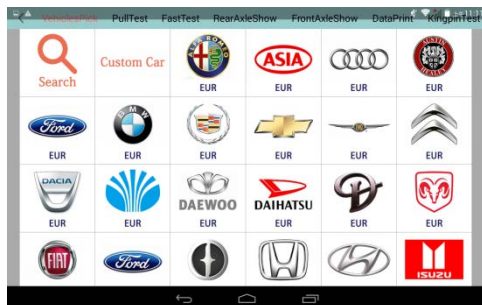
following picture. (There are five

parts in positioningdetection: fast measure, camera monitor, special measure,

user data, started measure .)

2. To choose the type of cars

In the first step, we should introduce standard data of the car. And these data will be used as

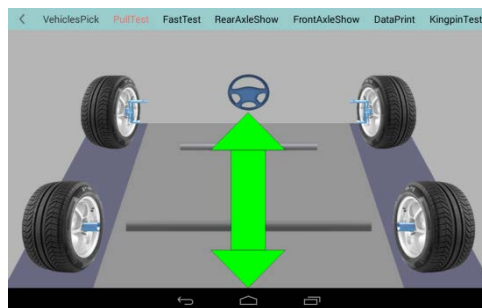


reference during the detection. And then select the right type and click “yes”.

| BMW(宝马)(EJR)-1973-5 Series,(E12) | | | | | | |
|----------------------------------|--------|--------|--------|--------|--------|--------|
| Front | min | Middle | Max | min | Middle | Max |
| Toe | 0°07' | 0°10' | 0°12' | 0°07' | 0°10' | 0°12' |
| Camber | -0°30' | 0°00' | 0°30' | -0°30' | 0°00' | 0°30' |
| Caster | 7°10' | 7°40' | 8°10' | 7°10' | 7°40' | 8°10' |
| KPI | 7°30' | 8°00' | 8°30' | 7°30' | 8°00' | 8°30' |
| TotalToe | 0°14' | 0°19' | 0°24' | | | |
| Rear | min | Middle | Max | min | Middle | Max |
| Toe | 0°06' | 0°10' | 0°13' | 0°06' | 0°10' | 0°13' |
| Camber | -2°30' | -2°00' | -1°30' | -2°30' | -2°00' | -1°30' |
| TotalToe | 0°12' | 0°19' | 0°26' | | | |
| axThrustAngle | - | | | | | |
| Wheelbase | 2636mm | | | | | |
| FrontWheel | 1405mm | | | | | |
| RearWheel | 1442mm | | | | | |

3. Dynamic measurement

The following pictures are the interface of measurement.



The above interface shows:

- A. **The condition of the car:** the car image on the interface moves forward and backward when the car is pushed forward and backward.
- B. **The condition of targets:** if there are errors in some targets,

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there will be warning..

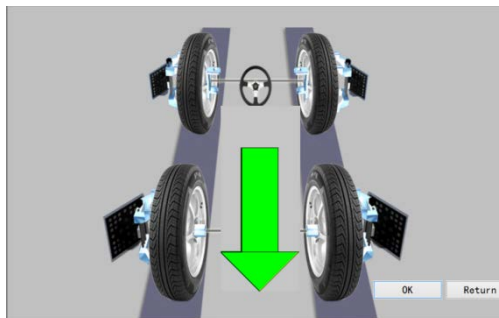
C. **The visual indication when pushing the car:**The visual

indications guide the operator to push the car forward and backward.

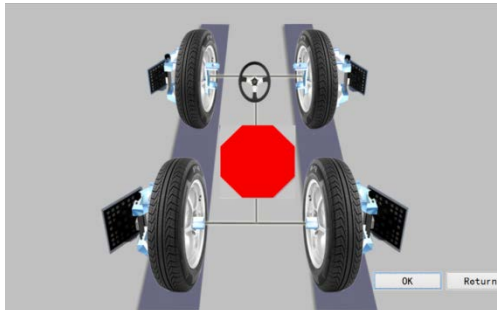
D. **Prompt line**

4. Procedure of Positioning Measurement

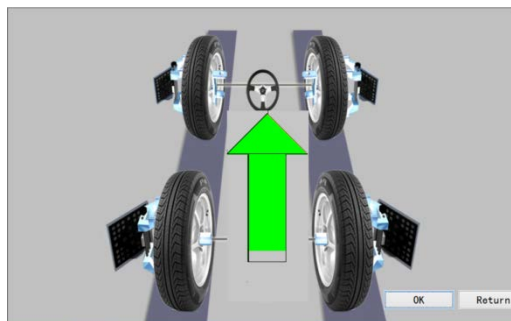
Step1. After entering the interface, push the car backward.



Step2. This interface means that now you can stop .



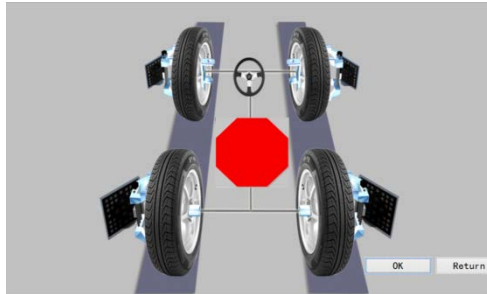
Step3.The following interface means that the car should be pushed forward.



Step4. When step 3 is done, there will be an interface of data processing and

it will take a few minutes, so please wait.

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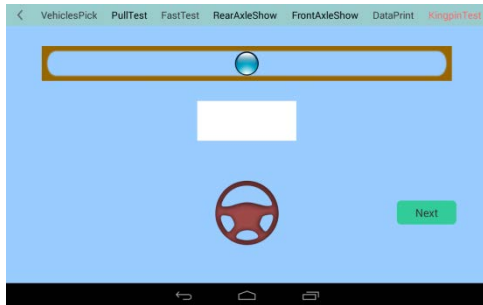
Step5. If the measurement is done, it will be the interface of the result.



Notice:

1. In the process of measurement, objects and people between cameras and targets should be moved away to make sure the result correct.
2. Besides, the steering wheel must be centered and locked firmly.

5. The measurement of kingpin



Information in the above interface:

1. **Scroll bar:** the small red ball will follow the rotation of steering wheel sliding from the left to right. When it turns about 8 degree, the arrow will show reverse direction, vice versa.
2. **The direction of rotation:** it gives a hint of the direction of rotation.
3. **The condition of targets:** if there is any error in targets, there will be warning. (Color in the above interface is normal color)

Notice: Before the measurement, fixing brake pedal depressor, pulling hand brake and taking away steering wheel holder.

6. Adjustment on lift machine

After getting the results, it's time to operate adjustment.(Sucvary cloud 5D wheel aligner can operate adjustment on two-post lift, and only 5D can do

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that.)



Click the following arrow to lift the car on the lift machine.



Notice:

- (1) The car can be lifted within 1.2m. And this is within measuring range.
- (2) After lifting the car, please lock the lift machine.
- (3) After lifting the car, click “yes” for the second measurement.

7. Report Printing

After the measurement, it moves to this interface with all measured data.

Now, if you need print the data, just click "print".



The screenshot shows a mobile application interface with a navigation bar at the top containing: VehiclesPick, PullTest, FastTest, RearAxleShow, FrontAxleShow, DataPrint, and KingpinTest. The main content area is titled "Test Result" and displays a table with the following structure:

| Parameters | After | min | Max | Before |
|-------------------|-------|-----|-----|--------|
| FrontTotalToe | | | | |
| LeftFrontToe | | | | |
| RightFrontToe | | | | |
| LeftFrontCamber | | | | |
| RightFrontCamber | | | | |
| LeftCaster | | | | |
| RightCaster | | | | |
| LeftKPI | | | | |
| RightKPI | | | | |
| RearTotalToe | | | | |
| LeftRearToe | | | | |
| RightRearToe | | | | |
| LeftRearCamber | | | | |
| RightRearCamber | | | | |
| ThrustAngle | | | | |
| WheelbaseCoff | | | | |
| WheelCoff | | | | |
| LeftIncludeAngle | | | | |
| RightIncludeAngle | | | | |

8. System Setup

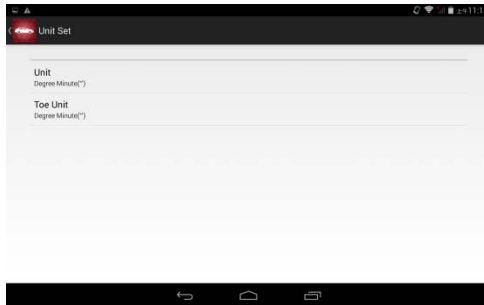
Click the icon of system setting, and then enter the interface. (functions of system settings are for adjusting software system and its effects, offering many options for its users and controlling and maintaining operation.



(1) Unit setting

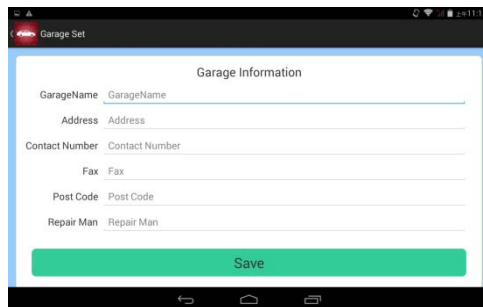
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The angle unit can be changed.



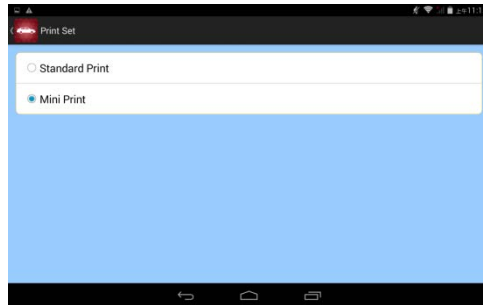
(2) Garage setting

The information of the garage can be inputted and be printed.



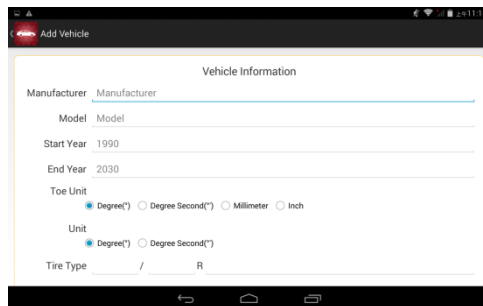
(3) Printing setting

They are original data.



(1) Customized vehicle model

(2) Customers can add more vehicle models which are original and standard data.



(3) maintenance

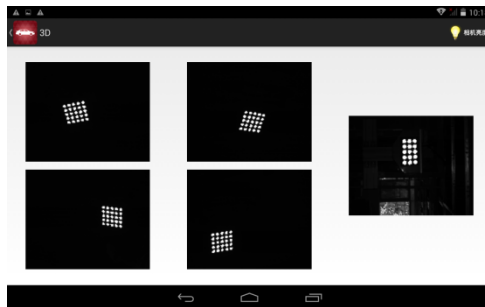
Keep targets in the sight of the wheel aligner.

Monitor system:

The installation of targets and cameras can be checked by seeing the

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original images of targets collected by cameras.



Appendix:

- 1. Formal procedure of four-wheel alignment**
 - 2. Industrial standard of four-wheel alignment**
 - 3. Generalization of four-wheel alignment**
-

1. Formal Procedure of Four-Wheel Alignment

Step1: the inquiry of symptoms and test run

Listen to the symptoms of car described by drivers and record them carefully.

Symptoms caused by improper positioning angle can be found by visual inspection, for example abnormal wear of tires. It is essential to listen to the descriptions of drivers and to check potential faults by test run. Test run is always carried out by lobby managers aboard who should dress properly because drivers, especially those of upscale cars do not like those who wear dirty clothes get in their cars. Moreover, lobby manager should be familiar with the business of four-wheel alignment, and can approximately judge the cause of faults.

Step2: check and maintenance of the system of steering and suspension

After inquiry and test run, visual inspection is the next step. A conception that the problem of steering and wear of tires cannot be solved only by four-wheel

alignment should be kept in mind, and parts of steering and suspension should be checked too.

Technician of four-wheel alignment should setup and follow the procedure of checking them one by one which make technician judge and analyze problems thoroughly and then solve quickly.

Step3: work before the position of deviation

If the symptom is deviation according to the description of driver, then the next step is to judge whether it is caused by sideslip. Methods are as follows.

- (1) If tires are radial tires, then exchange the front wheels first and carry out test run. Now, if the deviation direction is opposite to that before the exchange of tires, then it is sure that sideslip of front tires is factor, always a major one. To solve this problem, there are two methods. The first one is to exchange all tires until the combination that can solve deviation is found out. The second method is that to remove one of the front tires and then install it again after turning it over by 180 °. In most
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cases, it can dramatically reduce deviation caused by sideslip. But if the

effect is not so great, it is better to change a new tire.

- (2) If the deviation direction does not disappear after the exchange of front tires, then rear wheels try the same procedure again. Otherwise, the conclusion is that deviation is not caused by sideslip and it should be measured by four-wheel alignment for further check.

Step4: measurement by four-wheel alignment and result analysis

There are various kinds of aligners, but the basic operation procedure of them is the same.

- (1) The selection of vehicle type.
- (2) Rimcompensation (ROC). In fact, in order to save efforts, many producers may ignore this step, but the prerequisites are the condition of rims is good and the installation of sensors must be checked carefully. Otherwise, an error of 0.1 to 0.2 degree may be a big error in some

circumstances.

- (3) Measurement: read data
- (4) Adjustment of car: the sequence is rear wheels first and front wheels second; camber of rear wheel first and toe-in angle second; kingpin caster of front wheels first, camber second and toe-in last.
- (5) Print the result

Our key point is the analysis of the result; and we have concluded some symptoms here.

Causes of deviation

- (1) Dissymmetry of kingpin caster in the front wheels. If the error is over 0.5° , the direction of deviation is toward the smaller kingpin caster.
 - (2) Dissymmetry of cambers in the front wheels. If the error is over 0.5 degree, the direction of deviation is toward the bigger camber.
 - (3) Dissymmetry of cambers of rear wheels, if the error is over 0.5° , the direction of deviation is toward the smaller camber.
 - (4) The change of wheel base can be measured by flinch angle between
-

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the front axle and rear axle. If the sum of the angle is over 0.2° ,

deviation can be felt and it is toward the smaller wheel base.

There are still some causes that cannot be measured by aligners:

- (5) Sideslip, always caused by tires
- (6) Unevenness of tire pressure
- (7) Asymmetry and slip of the brake
- (8) Imbalance of the power steering
- (9) Wear and maladjustment of suspended components

Notice:

It is common that cars is off tracking slightly or almost not off tracking before adjustment, but is off tracking or even worse after adjusting toe of front wheels. People always think that it is due to adjustment of toe. However, toe-in cannot cause off-tracking because when the car is working, toe of two

wheels are balanced. But if they are imbalanced, friction between tires and the ground is enhanced and it will conceal off-tracking. In fact, off tracking is caused by other factors but is not noticeable. When the fact is covering, abnormal wear of tires is more serious. Thus, it is essential to analyze all factors together but not just toe-in so as to solve problems effectively.

The causes of abnormal wear of tires:

- (1) Wear of inside or outside tires of front wheels and the fault of toe of front wheels.
- (2) One wheel in the front wheels wears and camber is false
- (3) Abnormal wear of rear wheels, camber and toe

There are still some causes that cannot be measured by aligners:

- (4) Bad driving habits
 - (5) Pressure on tires too much and the wear of tire is near the center line of tire.
-

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(6) Pressure on tires is too low and the wear of tires is on its two sides.

(7) There are problems in components of chassis.

The problem of car floating

It is because kingpin caster is near zero or negative.

Steering wheel becomes heavier

(1) Kingpin caster is too big

(2) the fault of camber

(3) Suspended components are slightly deformed and stubbornness after severe bump.

Correction ability of steering wheel is poor

(1) Kingpin caster is too small

(2) Problems of steering

(3) Stubbornness caused by fault of other angles

(4) Problem of tires

Slight bump and loose rear of cars are mostly caused by fault of after the beam angle.

Step5. Repair and adjustment

After taking all factors into consideration, technicians should have a clear prospective and follow the following sequence:

(1) Adjust the rear wheels: camber first and toe second

(2) Adjust the front wheels: if toe on turn is wrong, please change pitman arm, and then move to kingpin caster (if the car has an engine bracket, then please adjust it first). After that we should adjust camber and toe last (please keep the steering wheel locked horizontally.)

2. Transport industry standard of the People's Republic of China for Four-Wheel Alignment (JJF1154-2014)

Excerpt

5.3.6 Parameters, ranges and precision

5.3.6.1 Total toe

Range: $\pm 6^\circ$

precision: precision within the scope of $\pm 2^\circ$ is $\pm 4'$ without the scope is \pm

10'

5.3.6.2 toe of a wheel

Range: $\pm 3^\circ$ precision: within the scope of $\pm 2^\circ$ is $\pm 2'$ without the scope is $\pm 5'$

5.3.6.3 camber angle

range: $\pm 10^\circ$ Precision: within the scope of $\pm 4^\circ$ is $\pm 2'$ without the scope: $\pm 10'$

5.3.6.4 kingpin caster

Range: $\pm 15^\circ$ Precision: within the scope of $\pm 12^\circ$ is $\pm 2'$ without the scope is $\pm 10'$

5.3.6.5 kingpin inclination

Range: $\pm 20^\circ$ Precision: within the scope of $0^\circ - +18^\circ$ is $\pm 6'$ without the scope is $\pm 10'$

5.3.6.6 thrust angle

Range: $\pm 6^\circ$ Precision: within the scope of $\pm 2^\circ$ is $\pm 2'$ without the scope is $\pm 10'$

5.3.6.7 deflection of angle axles

Range: $\pm 6^\circ$ Precision: within the scope of $\pm 2^\circ$ is $\pm 2'$ without the scope

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is $\pm 10'$

5.4 requirements of values

5.4.1 Resolution of values

Resolution of angle is $1'$, and resolution of toe-in value can be expressed as $1'$

or 0.1mm

5.4.2 Zero drift

With the scope of 30minis no more than $4'$

5.4.3 Error of values

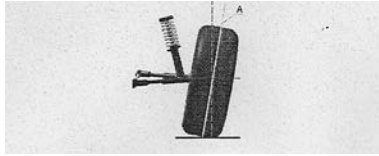
Range: $\pm 4'$

5.4.4 Stability of values

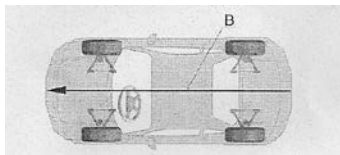
Within the scope of 10s is $\pm 2'$

3. Generalization of four-wheel alignment

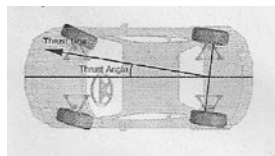
- 3.1 Center line of a tire:** is a line that is the contact between a tire and the ground. (line A)
-



3.2 center line of a car: is a line that bisects the front axle and the rear axle, also called geometric center line. (line B)



3.3 thrust line: is a line that bisects toe of the rear wheel, and the angle between thrust line and center line of the car is thrust angle.

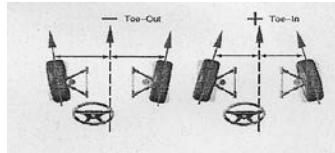


3.4 toe:

The toe of the front wheels is the angle between thrust line and center line of a tire, but the toe of the rear wheels is the angle between center line of the car and that of a tire.

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If center line of a tire deviated from thrust or center line of the car, then it is toe-out, otherwise it is toe-in.



3.4.1 Function of toe is to reduce wear of tires and friction of rolling

3.4.2 Problems of toe

3.4.2.1 toe-in is too big

A: the outside of tires wear fast

- For radial tire, the condition of wear is like that caused by big camber.
- The shape of wear is like saw tooth or blocks.
- If caressing tires from outside to inside, you can feel the inside tire is sharp.

B: steering is unstable

- Poor performance of going straight
 - Dither of tires
-

3.4.2.2 Ways to solve the problem:

A: for toe of the front wheel: adjust track rod

B: for toe of the rear wheel: original adjusters, eccentric concave wheels, eccentric bolts, eccentric bushings and long hole spacers.

3.5 camber angle

It is the angle between center line of a tire and vertical flat of the car. If the inclination is toward outside, then the angle is a positive number, otherwise it is a negative number.

3.5.1 Functions of camber angle are adjusting the load of the car to the center of tires, eliminating off-tracking and reduce wear of tires.

3.5.2 Problems of camber angle

3.5.2.1 The effect of a big positive camber angle

- the outside of a tire is worn
 - The wear of components of suspended system is accelerated
-

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- Direction of off-tracking is towards the side with bigger positive
amber

3.5.2.2 the effect of a big negative camber angle

- the inside of a tire is worn
- The wear of components of suspended system is accelerated
- Direction of off-tracking is towards the side with smaller negative
amber

3.5.3 case

If camber of the front left wheel is 1.0° , and the camber of the front right wheel is 0.5° , and then the direction of off-tracking is towards the left because there is an error between these two wheels.

3.5.4 ways to solve the problem

spacers, eccentric concave wheels, long holes, ball head rotary, prop rotary, wedge-shape spacers, adjustment of bearing bracket, eccentric bolts,

eccentric bushing, set over ball head.

3.6 set-back

Set-back is the angle between the center line that divides the front wheels or the rear wheels and the vertical of thrust

3.6.1 Causes of set-back.

- The design of producer to offset the effect of road bumps
- Result of impact

3.6.2 Problems of set-back

Set-back will lead to the off-tracking of the car, and the direction is towards a smaller.

3.7 kingpin caster

It is watched from the side of the car. The link of upper ball head or the top of the support and lower ball head is kingpin and plumb line. When the

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upper ball head is behind the plumb line, it is positive caster, otherwise it is negative caster.

3.7.1 functions of kingpin caster

Kingpin caster affects the stability of veer and returnable ability of steering wheel.

3.7.2 Problems of kingpin caster

A: if the caster is too small, instability is caused, such as poor returnable ability of steering wheel and the float of car when the speed is high. It should be paid attention when the car is on the high way.

B: off-tracking caused by dissymmetry of caster: if the caster of two wheels is unequal, and then the direction of off-tracking is towards a small one.

3.7.3 Case

If the caster of the left front wheel is $+0.5^\circ$, and the caster of the right front wheel is $+1.5^\circ$, and then the direction of off-tracking is towards the left.

3.7.4 Adjustment of kingpin caster

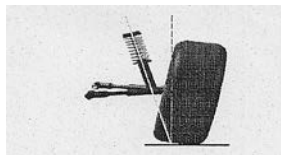
Spacers, eccentric concave wheels, long holes, prop rotary, strut, movement of engine bracket, eccentric ball head.

3.8 kingpin inclination

It is watched from the front of the car. The link of upper ball head or the top of the support and lower ball head is kingpin and plumb line. If the upper ball head is inside, and then it is a positive, or it is a negative one.

3.8.1 Functions of kingpin inclination

It is the angle that caused by the inclination of the front axle. A proper inclination makes the steer of the car easier, and reduces the impact from ground. Besides, it helps the front wheels return automatically. And the angle is bigger, the effect is bigger. However it takes more efforts to turn and the wear of tires is heavier, vice versa.

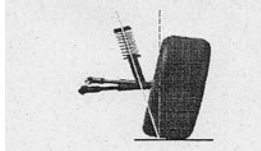


3.9 included angle

Included angle refers to the angle that between the center line of tires

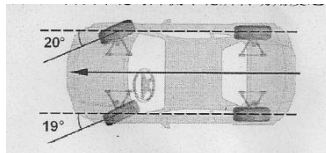
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and the axle of kingpin caster, that is to say, it is the sum of camber and kingpin inclination.



3.10 20° top-out on turns

20° top-out on turns refers to the difference of the turning angle of the inside and outside tires when the car is turning.



4.1 thrust angle

Thrust angle refers to the angle that is between the center line of the car and thrust line. When on the left of the center line of the car, the angle is positive, otherwise it is negative.

Thrust angle lead to the trail of car incline to one side. Thus the front wheels have to move toward the same direction. So it is necessary to adjust

toe and if the toe of the rear wheels can be adjusted, thrust angle should be adjusted to near zero.

The direction of thrust line is the actual direction of the car, and it is determined by the toe of the rear wheel. If the direction of thrust line is different from the center line of the car the imbalance of the steering wheel will be caused. Meanwhile, the rear wheels will not follow the front wheels, and this phenomenon is called "lateral moving". In order to keep the car move ahead straightly, the steering wheel has to lean to one side. It is the reason of imbalance of steering wheel.

4.1.1 Causes of thrust angle

- The emergence of set-back
- The imbalance of the rear toe

4.1.2 Problems caused by thrust angle

- Wear of tires
 - Maladjustment of steering wheel
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- Off-tracking
- The skew of the car when driven forward
- The skew of steering wheel

4.1.3 Ways to solve the problem

- The original regulators
 - Install wedge-shape spacers between wheel axle and tires
 - Concave wheel or other after installation regulators
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