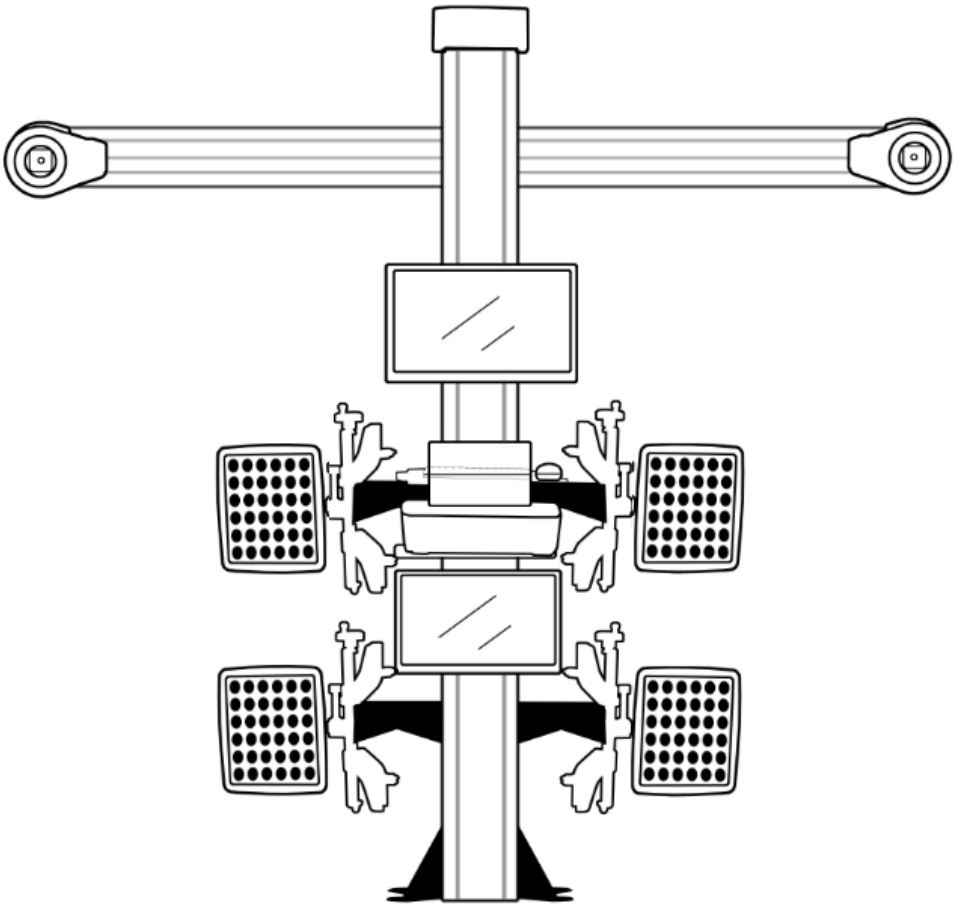
Service Manual

3D Wheel Aligner



Safety Instructions

Only well-trained skillful automotive technicians are supposed to operate this equipment. Operators ought to wear safety glasses to prevent debris, dirt or fluids from injuring their eyes.

Before installing and operating this equipment, please read this manual thoroughly to avoid unexpected injuries occurred to operators.

The operators are responsible to be knowledgeable of the vehicles and all related tools and equipment, assuring his/her safety as well as that of others in the operation area.

Keep every part of the body, such as hair, finger, clothes away from the moving parts of the equipment to avoid crushing and pinching.

Do not operate the equipment if any power cord has been damaged until examined carefully by qualified electricians.

If a cord needs to be replaced, cord with same or higher current load should be used to avoid over-heat.

No one should step on or place anything on the power cords and keep the cord away from heated sources.

Never expose the unit to rain or any wet place.

The plug of this equipment shall not be shared with other electrical equipment

Wet hands are prohibited to touch the equipment, plug and socket when the power is on.

Do not remove the antistatic needle after well set.

The wall socket or outlet should be fixed near the unit and easily accessible. Grasp the plug instead of the cord and pull to disconnect when not in use.

Sufficient medical supplies shall be well prepared for emergencies, like burns, pinching, crushing etc.

Frequently inspect, clean and lubricate (if recommended) all tools and use the correct tools for the task.

CONTENTS

Chapter 1 Introduction

1.1 Technical parameter

Power Voltage:	220V±5%	Storage Temperature:	-25～65℃
Power Output:	≈0.4kW	Relative Humidity:	10%～95% (non-condensing)
Operating Temperature:	0～70℃	Max. Altitude:	6100m

1.2 Dimensions

Packing:	One unit in 2~3 non-fumigation wooden cases, around 2m^3		
Column:	2.4m	Net Weight:	≈230kg
Camera Beam:	2.7m	Gross Weight:	≈260kg

1.3 Measuring range and precision

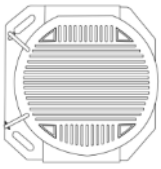
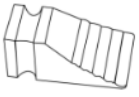
Main Items	Measuring Range	Measuring Precision
Camber/ Toe	±30°	±1′
Caster/ Kingpin Inclination	±40°	±1′
Chassis	0-3000mm	±1mm

1.4 Configurations

1.4.1 Main unit (eg. B3+)

- Targets
- Wheel adaptors
- Cameras
- Aluminum camera crossbeam
- AIO aluminum column
- LCD monitor 21.5 in+18.5 in
- Computer, Keyboard, Mouse
- Printer
- Drive-on camera

1.4.2 Accessories

		
Turnplate*2	Antistatic needle*1	Steering wheel holder*1
		
Bridge*2	Wheel chock*2	Brake pedal depressor*1

1.5 Packing List

No.	Items	B4+/B4	B3+/B3	B2+/B2	B1+/B1
1	Camera Crossbeam	√	√	√	√
2	Targets	√	√	√	√
3	Adaptor & Adaptor Base	√	√	√	√
4	Adaptor Hook	√	√	√	√
5	Computer	√	√	√	√
6	Software	√	√	√	√
7	Monitor	21.5+18.5in/ 21.5in			
8	Printer	√	√	√	√
9	Mouse & Keyboard	√	√	√	√
10	Console	√		√	
11	Column	√	√	√	√
12	Turnplates & Bridges & Wheel Chocks	√	√	√	√
13	Steering Wheel Holder & Brake Pedal Depressor	√	√	√	√
14	Antistatic Needle	√	√	√	√
15	PC Camera	√	√		
16	Speaker	√	√		

Chapter 2 Installation

2.1 Prior notices

- Upon arrival, unpack and check as per the packing list.
- **In case two or more machines are purchased, be cautious that each machine is unique. Installer shall not mix using the camera beam, targets and computers.**
- Take care of every part and avoid lose.
- Follow the guidance. Avoid unnecessary damage.
- Operate properly. Be aware of electric leakage and short circuit.
- Operation space: length≥7m; width≥4m; height≥3m. Clear out the obstructions.
- Column position: 20~30cm from the wall is suggested
- If four-post lift used, distance between left and right column is suggested to set min. 2.8 meters to avoid possible block of light.
- At least two installers are required.

2.2 Power checkup and electrostatic prevention

Use a multimeter to check the voltage. If it's not stable, add a voltage stabilizer.

Use a power polarity detector to check whether the earth wire is valid or existing. Repair it or install the anti-static needle provided by Lawrence if needed.

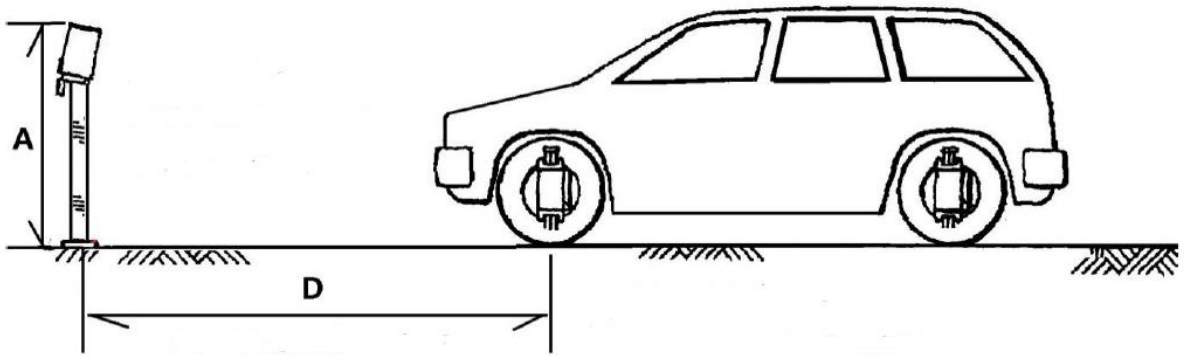
If there is frequent electric cut, install a UPS.

Power polality dector. Only when the left and the right lamps light up, it's correct.

Note: Method to install the antistatic needle

Hammer the needle vertically into the ground beside the console, then fix the end of the wire to any screw at the back side of the computer.

2.3 Decide the relative position of the column and beam

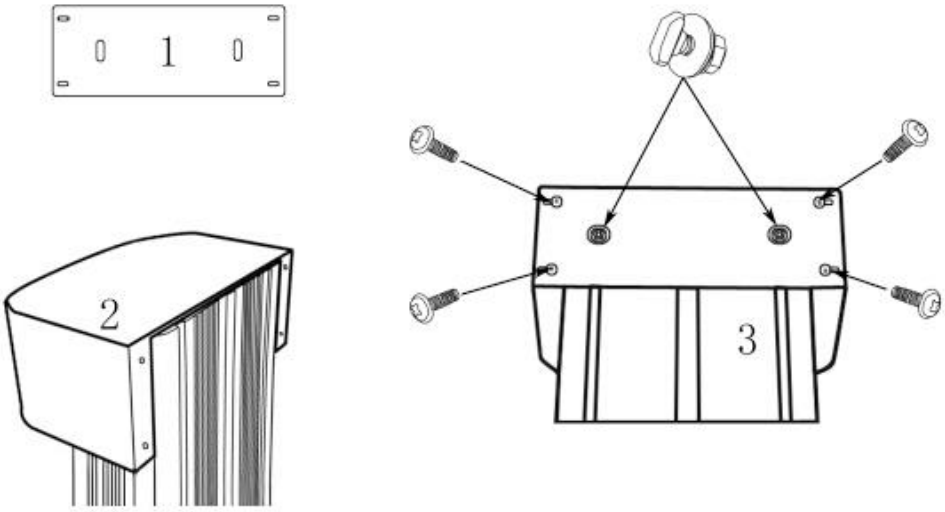


D=Level distance between the column and the turnplate center
A=Vertical height between camera lens and the test platform

Units: mm

D	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600
A	912	933	955	976	997	1018	1039	1061	1082	1103	1125	1146

2.4 Install the column cap and find the midpoint for the column

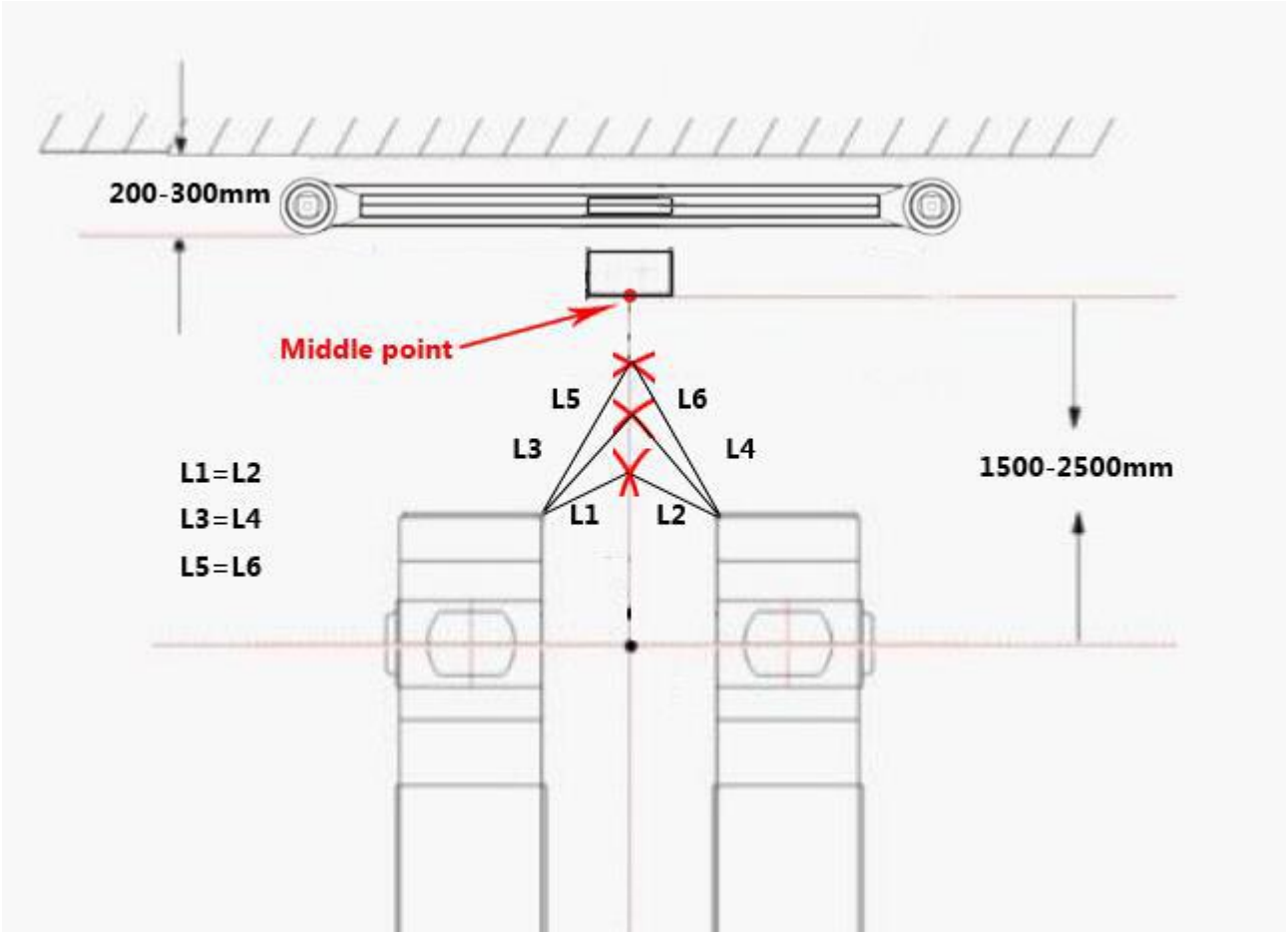


Tools：Wrench, Flower screwdriver

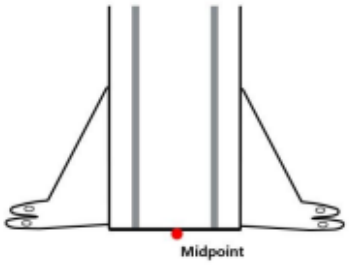
Fittings：Beam screws *2, Round head screws**4

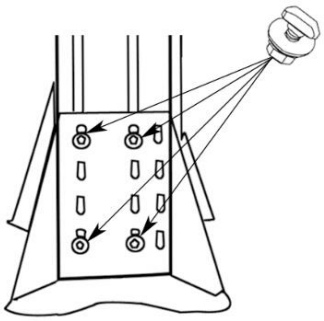
Find the midpoint of the column and stand it upright.

The fastest way to find the midpoint is by drawing six intersecting arcs, two two of with the same radius. Link the three intersections and find the midpoint with the length D decided on point 2.3.



2.5 Install the camera beam to the column temperately



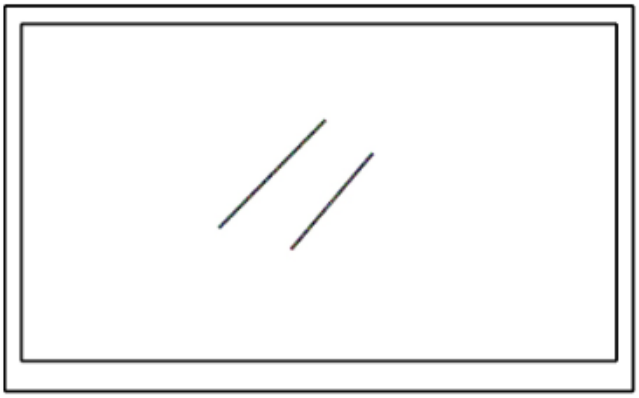


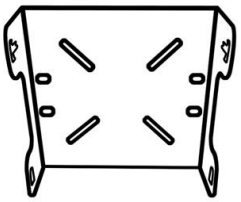
Tool: Wrench
Fittings: Beam screws*8

Note:
Move the column to the midpoint. Attach the camera beam to the column temperately at height A decided on point 2.3.

2.6 Install the main monitor to the column (for models with monitor attached to the column)

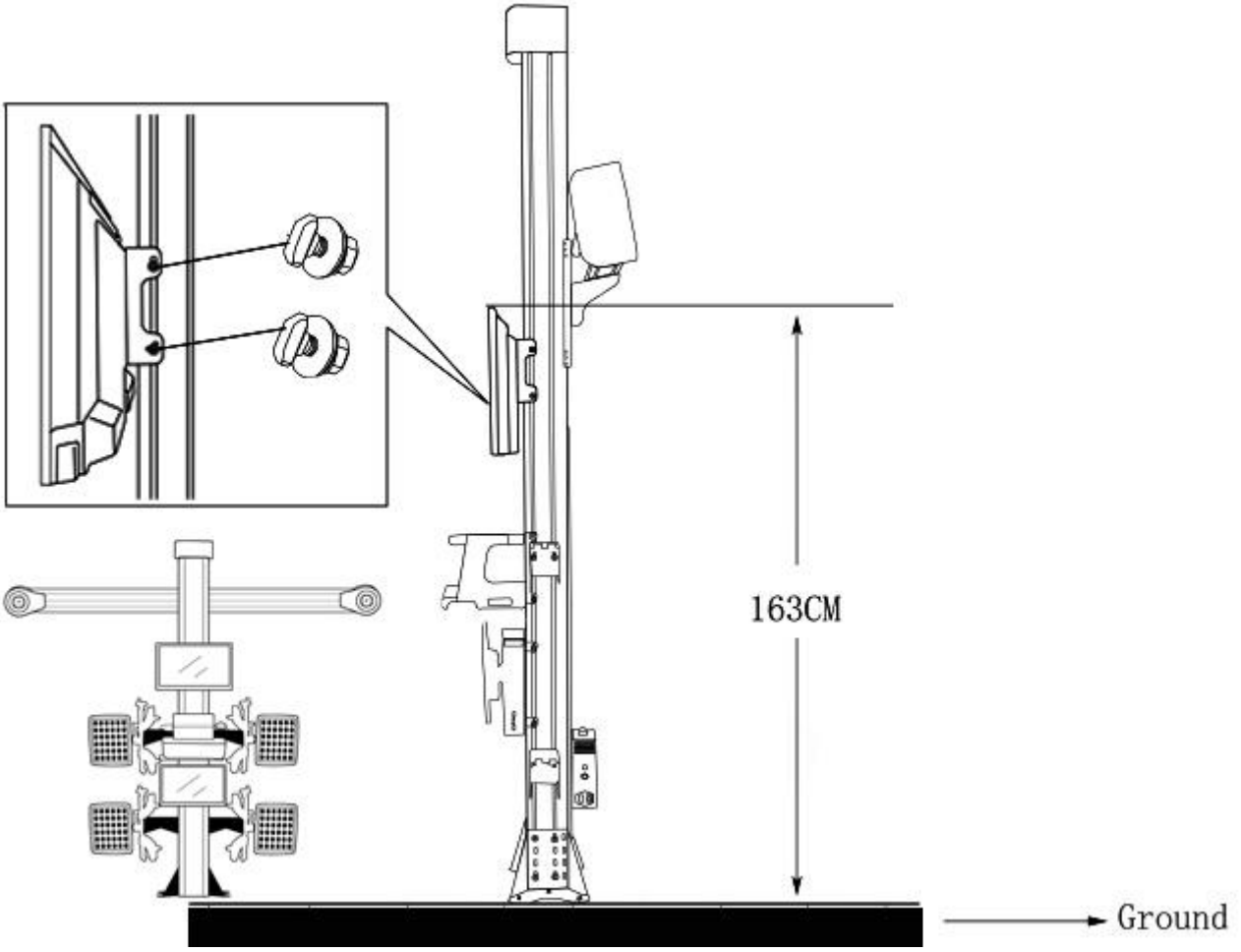
For models with monitor attached to the column





Attach the monitor to the monitor rack.

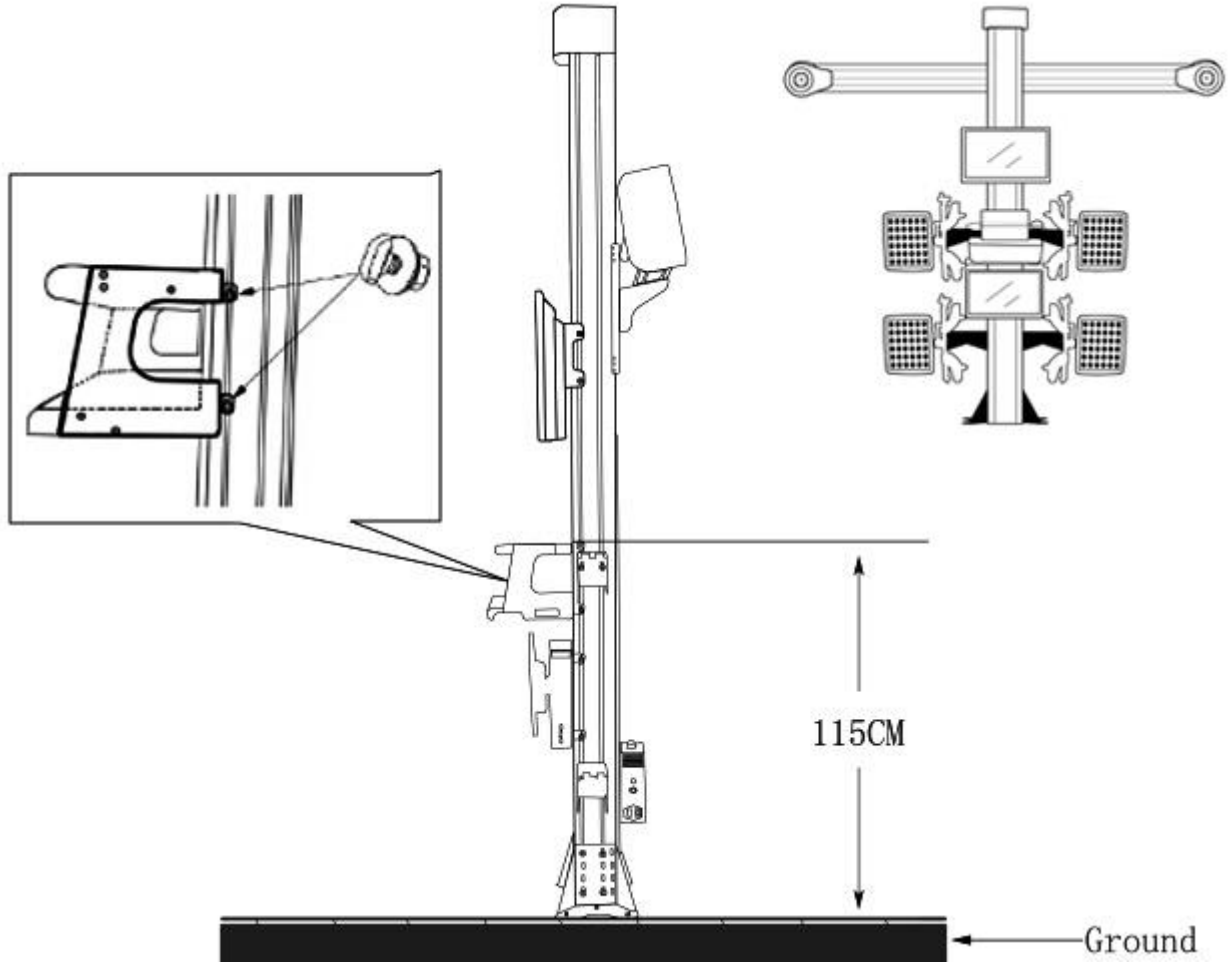
Attach the monitor to the column at height 163cm.



Tool: Wrench
Fittings: Beam screws*4, M8 screws*4

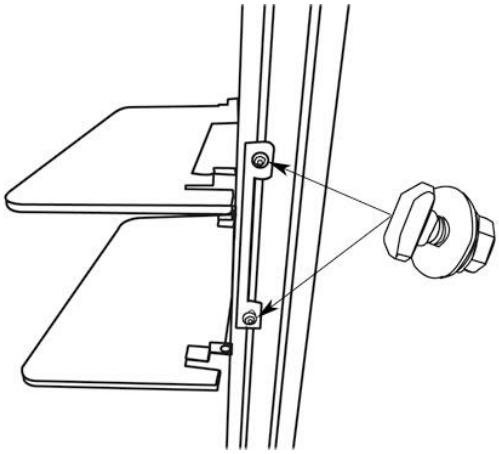
2.7 Install the printer rack (for models of AIO design)

2.7.1 Metal Racks



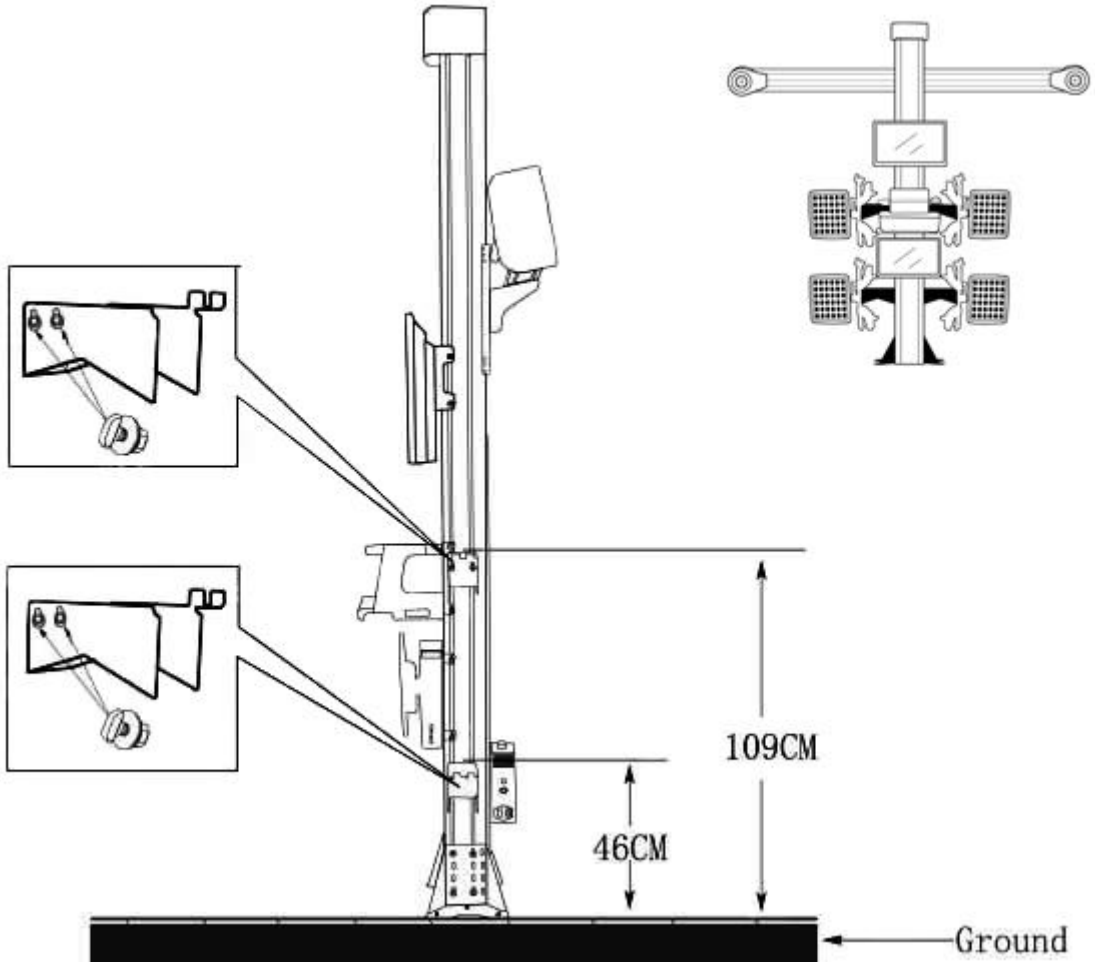
Tool: Wrench
Fittings: Beam screws*4

2.7.2 Plastic racks



2.8 Install the clamp racks

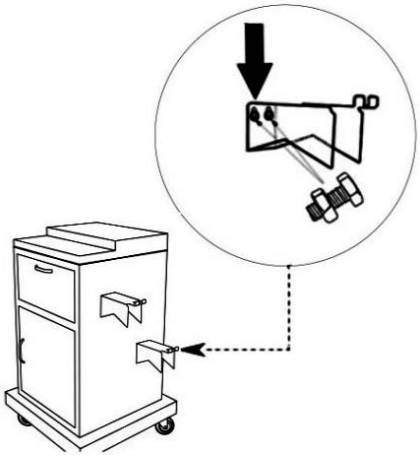
2.8.1 Models of AIO design



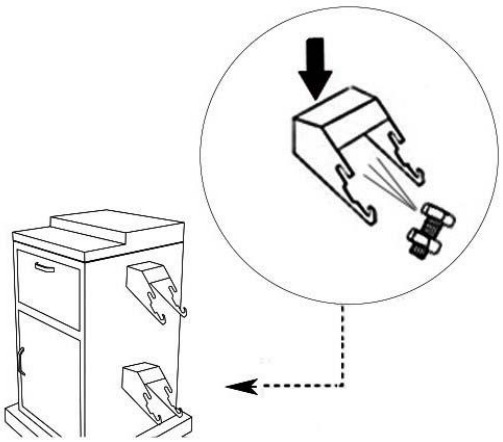
Tool: Wrench **Fittings:** Beam screws*8

2.8.2 Models with console

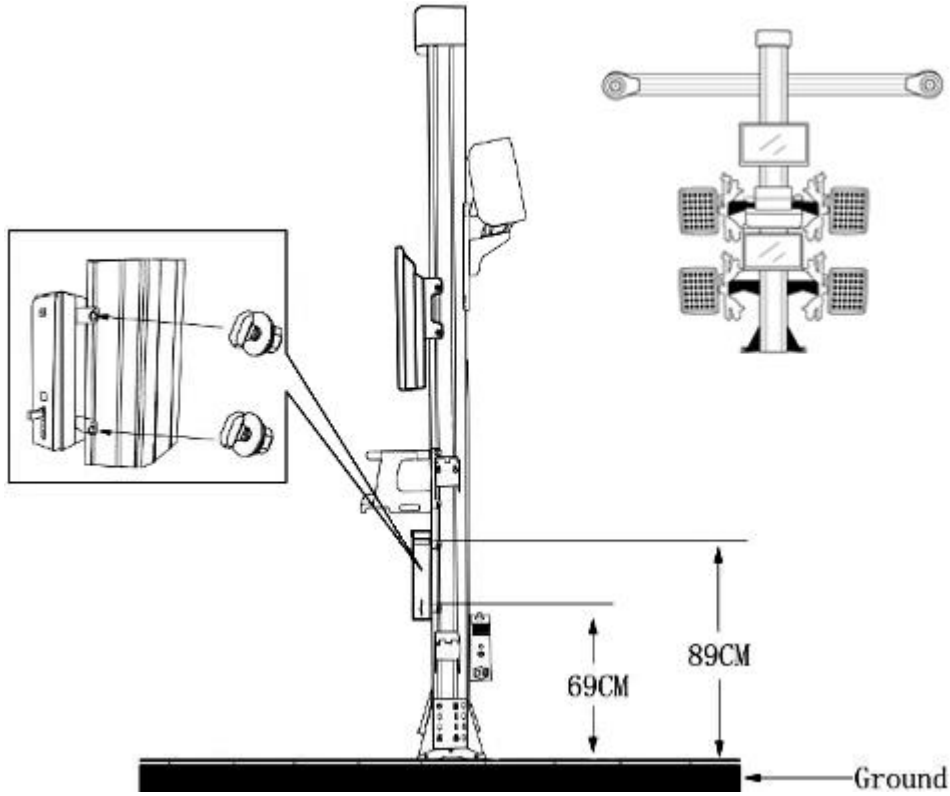
Model A **Fittings:** Hex screws*8



Model B **Fittings:** Hex screws*12

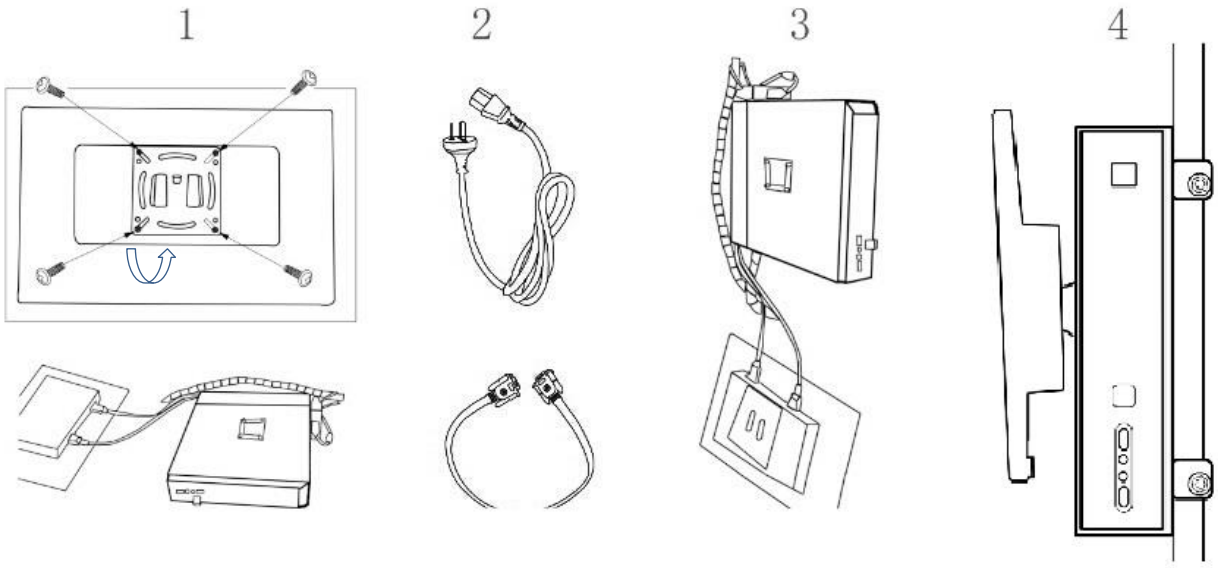


2.9 Install the pc rack (for model of AIO design)



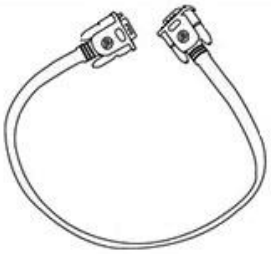
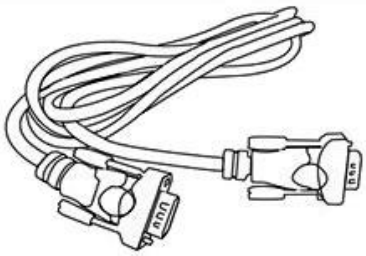
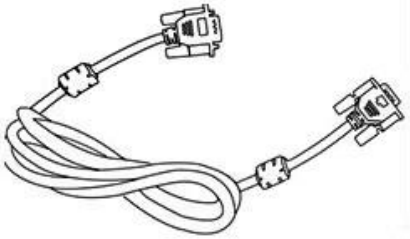
Tool: wrench **Fitting:** Beam screws*4

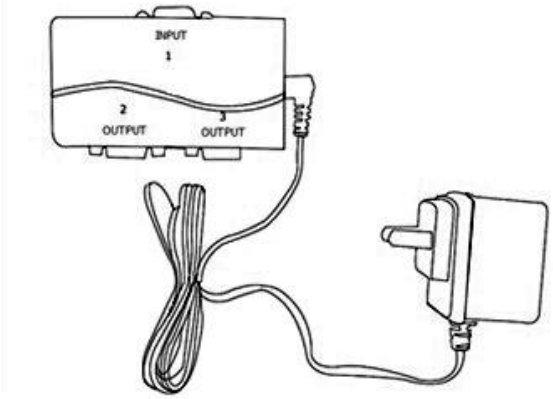
2.10 Connect the pc to the second monitor (for models with second monitor)

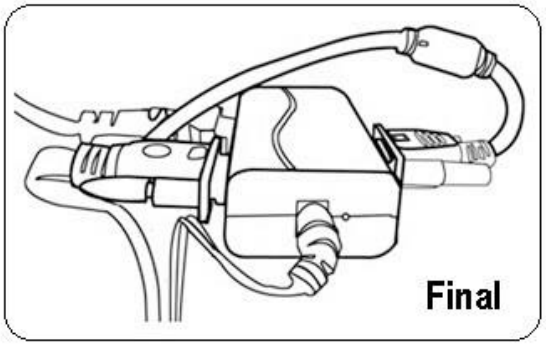


Tools: Flower screwdriver
Fittings: Round head bolt*4; power cable*1; VGA cable*1

2.11 Install the deconcentrator (for models with second monitor)

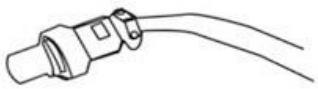
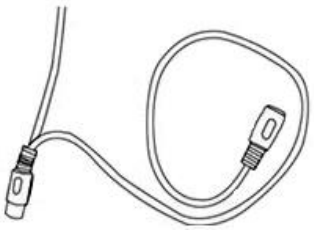
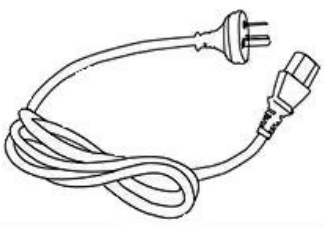
Input 1/ Connect Host	Output 2/ Connect Monitor	Output 3/ Connect Monitor
		

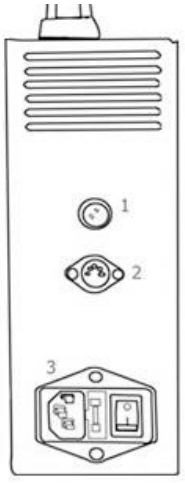


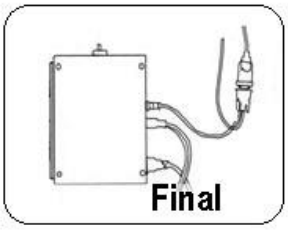


2.12 Connect the power control box

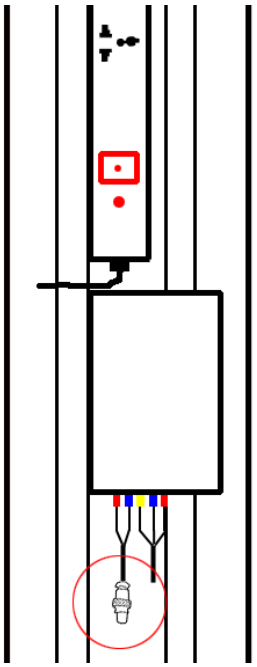
2.12.1 Auto lifting models

Crossbeam Power Cable-1	
Lifting Cable 2	
Power Cable 3	



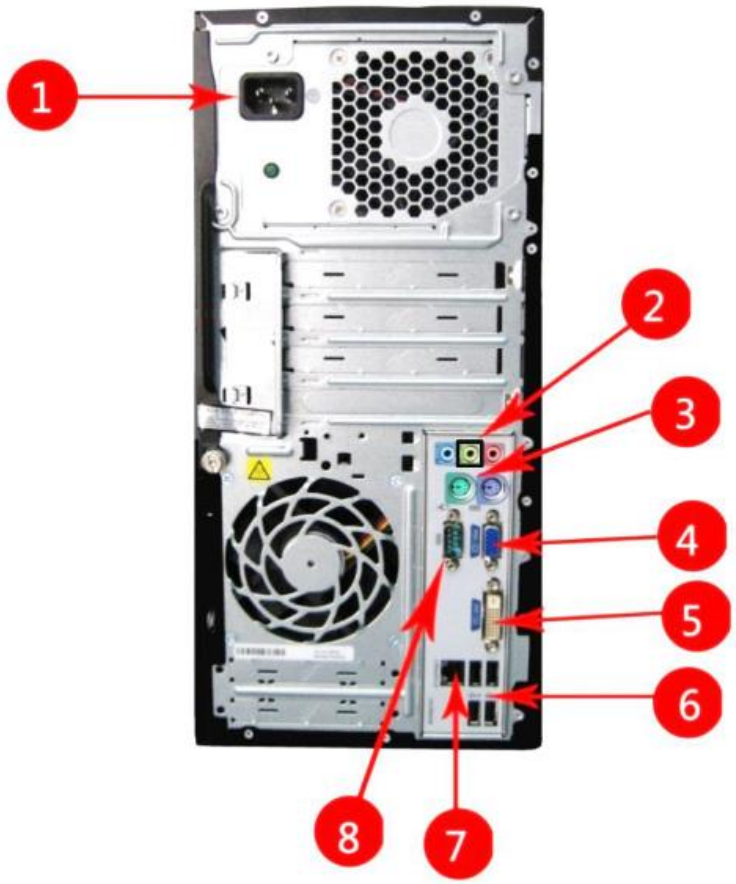


2.12.2 Fixed-beam models

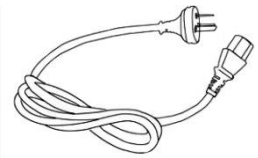
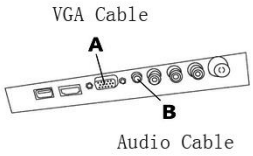
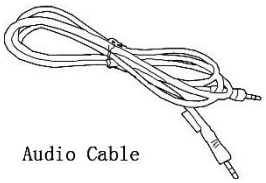
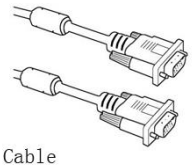
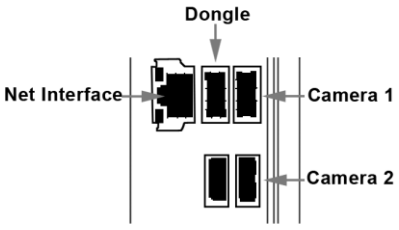


Connect cable one to the interface.

2.13 PC connections



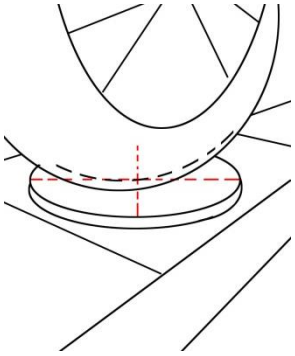
Note: Small PC and normal PC share the same interfaces.

No.	Name	Connection
1	Power Socket	 Power Line
2	Audio input and output *Note: If a 32 in. monitor is used, an audio cable will be provided. One end connected to the PC, while the other end connected to the LCD.*  . I*nterfaces of 32" LCD*	 Audio Cable
3	PS/2 interface	 Keyboard & Mouse
4	VGA display interface Connect host with monitor	 VGA Cable
5	DVI-D display interface	N/A
6	USB2.0 interface Camera beam port & Dongle & Any USB port	
7	Net interface	N/A
8	Serial port	N/A

2.14 Other connections

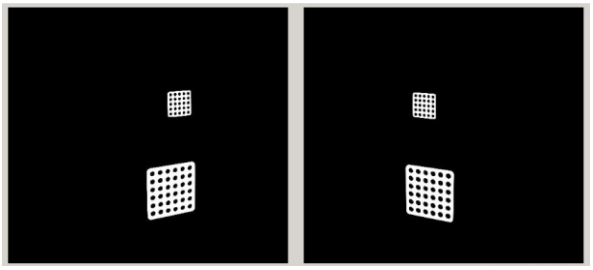
Connect the printer, the PC camera to the alignment computer.
Connect all the power cables to the sockets at the back of the column.
Connect the socket to the electricity for running the machine.

2.15 Decide the final location of the column



1. Drive a vehicle onto the test platform. Park the car at the center of the lift, with the two front wheels contacted with the right center of both turnplates.

2. Install the four clamps with targets

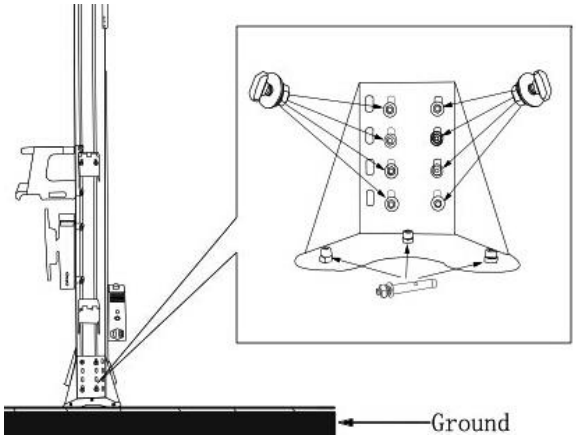


Turn on the computer, and run the alignment program. Open *Setting* → *Camera setting* → *Test*

Rotate the column to find the best position as per the image displayed in this interface. Mark the points on the ground.

2.16 Fix the column

Remove the camera beam carefully from the column. Place it well.
Then begin to fix the column with screws to the ground. Drill one hole and fix it first. Then re-locate the other positions so as to avoid misaligning.

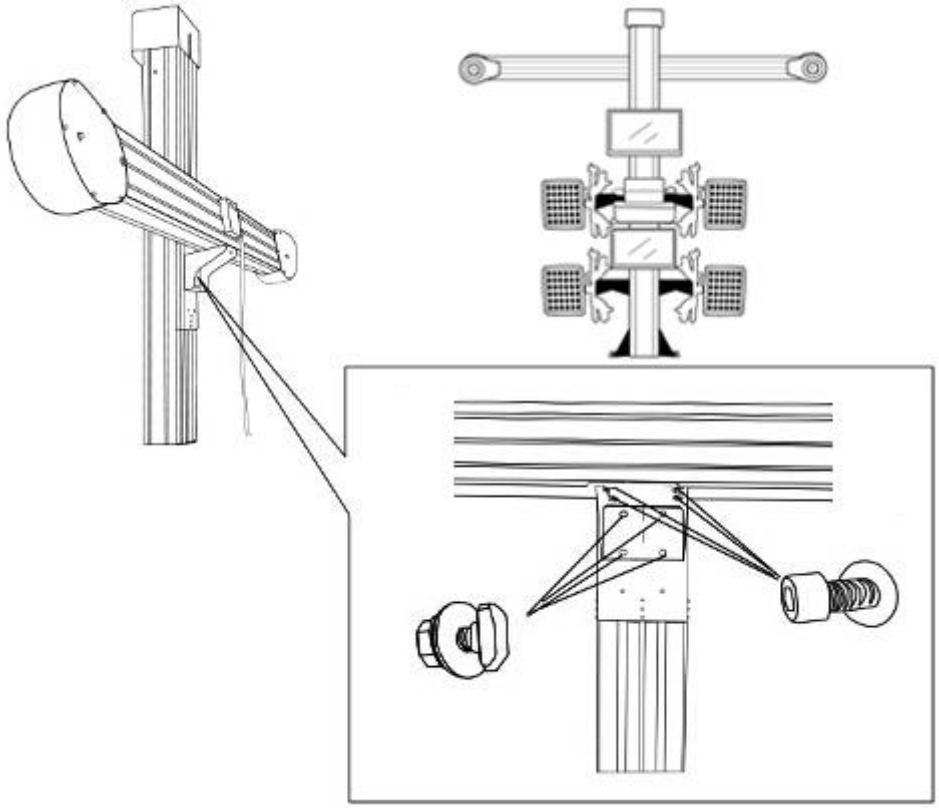


Tools: electric drill, hammer, safety glasses, wrench

Fittings：
Beam screws*16
Anchor bolts*6

2.17 Install the camera beam to the column

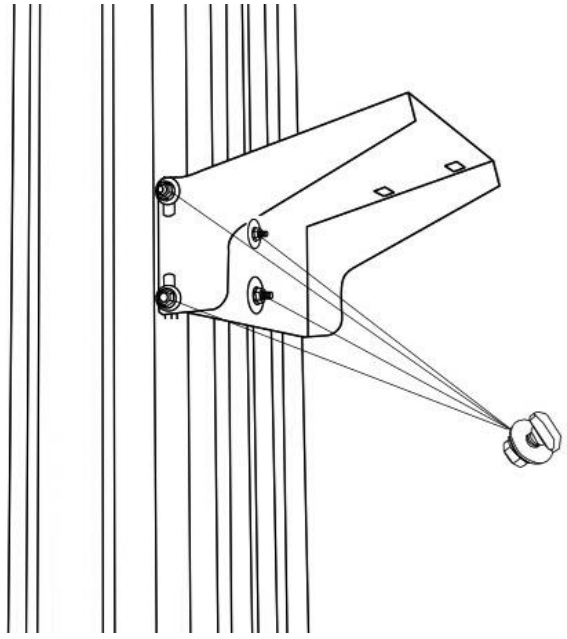
Models of auto lifting



Tool: Wrench

Fittings:
Beam screws*4
Hex socket screws*4

Model of manual lifting



Tool: Wrench

Fittings:
Beam screws*6

Part 2 Software Guidance

Introduction

Alignment program

A wheel alignment consists of making adjustments to the wheels of your vehicle.

The program can work in XP, Windows 7 and 8 computer systems. It is equipped with essential functions for alignment. The technological platform applied is the most scientific and advanced one, ensuring high precise measurement results. The open background caters for different requirements in displaying language, company information and printout, etc.

Dongle

Dongle is a key part of the machine. For standard machines, it's packed and hanged at the back side of the computer.

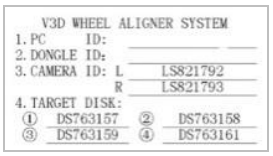
User of the machine shall always keep plugging the dongle in the computer so as to run the alignment program. The user is responsible for keeping the dongle safe. In case of loss, it'll be high cost and time-consuming to buy a new one.

Machine codes and labels

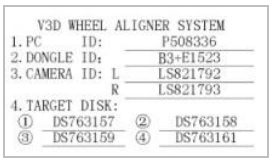
There are four types of labels that differentiate each machine. These labels show numbers of the key components. Every machine is unique. In case two more machines are purchased, users shall not mix using them.

The first one is the dongle label. B5 refers to models with fixed beam while B9 refers to models of auto beam. The written number on the label shows its identity.

The second one is the beam label which sticks at the back side of the camera beam. It often shows only the Camera ID and Targets ID which means they should work together. If mixed up, the measuring result will be incorrect.

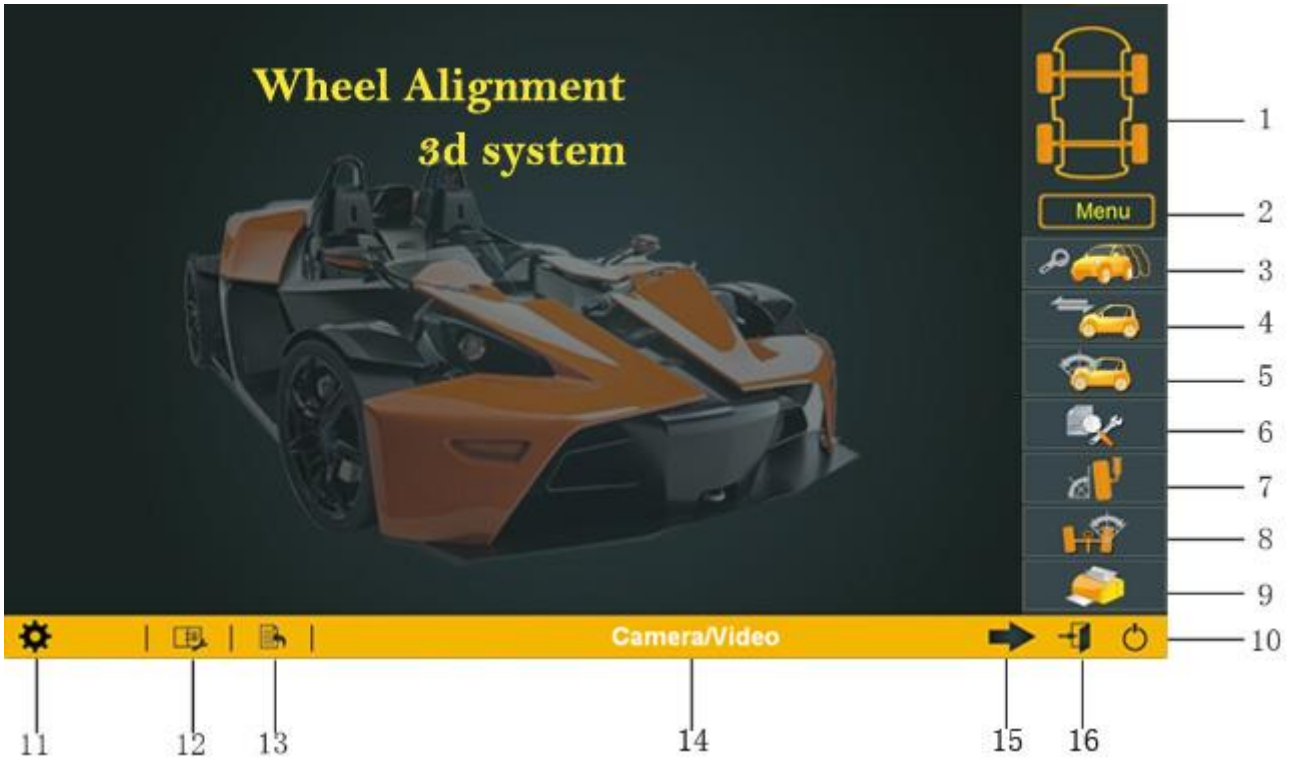

V3D WHEEL ALIGNER SYSTEM
1. PC ID:
2. DONGLE ID:
3. CAMERA ID: L LS821792
R LS821793
4. TARGET DISK:
① DS763157 ② DS763158
③ DS763159 ④ DS763161

The third one is the PC label which sticks at the PC cover. It shows full information, including PC ID, dongle ID, camera ID and targets ID. It means this computer will work only with the dongle, camera beam and targets of these IDs.


V3D WHEEL ALIGNER SYSTEM
1. PC ID: P508336
2. DONGLE ID: B3+E1523
3. CAMERA ID: L LS821792
R LS821793
4. TARGET DISK:
① DS763157 ② DS763158
③ DS763159 ④ DS763161

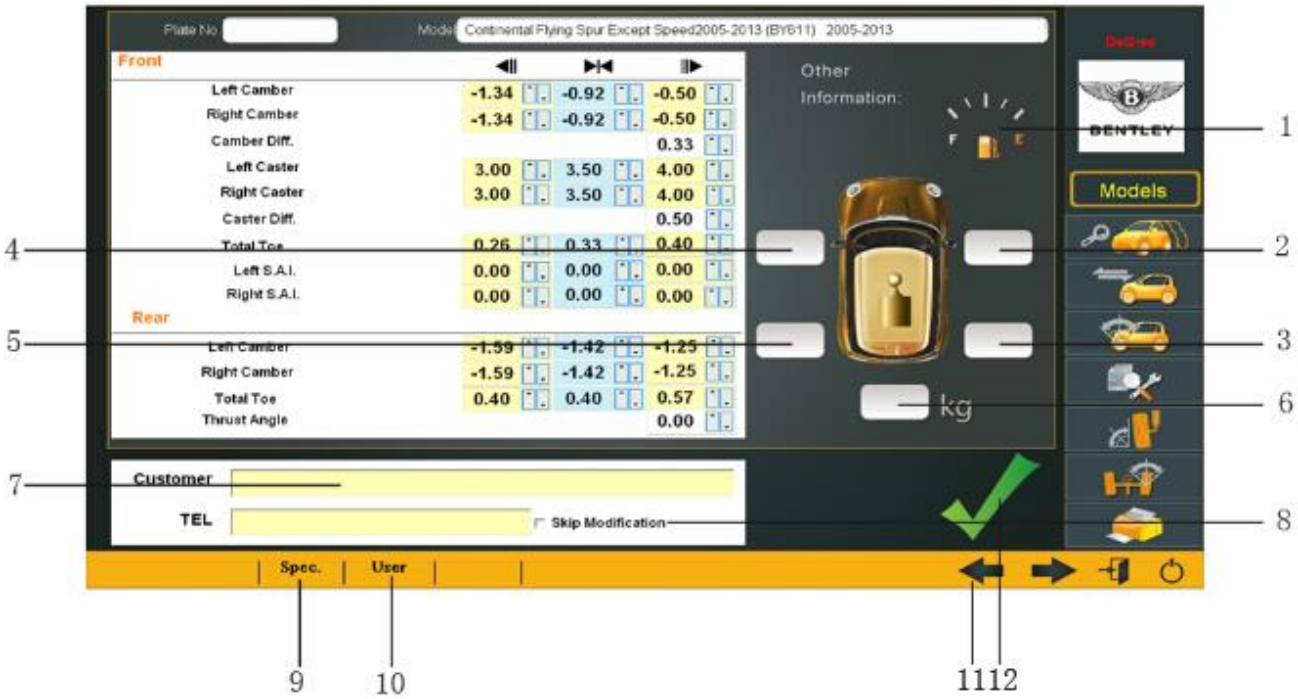
The forth one is the target label. It shows only the target ID.

Screen layout and toolbar buttons



No.	Button Name	No.	Button Name
1	Instruction Window	9	Print Report
2	Current Chosen	10	Exit System/ Program
3	Vehicle Model	11	Setting
4	Push Measurement	12	Alignment History & Appointment record
5	Kingpin Measurement	13	Add/Delete/Modify data

6	Data Preview	14	Open/Close Drive-on Aid
7	Camber Measurement and Adjustment	15	Next Step
8	Toe Measurement and Adjustment	16	Go Back to Home Screen



No.	Button Name	No.	Button Name
1	Fuel level required	7	Customer name & double click for appointment
2	Weight on front right seat	8	Choose if not to put customer information
3	Weight on rear right seat	9	Vehicle models supplied by the manufacturer
4	Weight on front left seat	10	Vehicle models added by the user
5	Weight on rear left seat	11	Go back to the last step
6	Weight on trunk	12	Confirm the chosen model

Perform a 4-wheel alignment

Reasons for wheel alignment

There are many reasons why wheel alignment shall be performed in a vehicle, for example:

- Non-center steering wheel during driving
- Get a new tire for the vehicle
- Collision
- Steering or suspension parts such as tie rods, control arms, bushings or idler arm have been changed.
- First 3,000 km drive for a new car

- Trans-axial repair for a front-wheel-drive car
- Vehicle pulling from one side to another
- One or more tires showing signs of premature or uneven wear

Basic wheel alignment procedures

1. Gather information from the vehicle owner – ask about any symptoms of misalignment. Inquire if the vehicle has been in a collision or has had any parts replaced recently.
2. Perform a test drive to verify owner's complaint – try to recreate the problem. If unable to duplicate, have the vehicle owner explain further or have him/her drive with you.
3. Place vehicle on the alignment lift – center the vehicle on the lift and turnplates. Raise the lift to a solid, level lock position.
4. Inspect the tires for any signs of abnormal wear – tires often reflect many misalignment conditions.
5. Perform a thorough component inspection. Replace defective parts prior to performing the alignment. Always check tire pressure and ride height.
6. Mount measuring targets to the vehicles wheels. Use the safety straps in the event of grip failure.
7. Begin the alignment procedure for the vehicle.
8. Perform rolling compensation – the purpose of performing compensation is to eliminate measurement errors due to the wheel runout and clamp mounting error.
9. Measure caster, camber, and toe.
10. Determine what needs to be done – Examine the vehicle and any reference materials to determine the procedures for angle corrections. Determine what items are needed to correct any problems (i.e. aftermarket kits, special tools, etc.).
11. Make any needed angle corrections – center the steering wheel carefully when prompted. Use this order of adjustment:
    a. Rear camber
    b. Rear toe
    c. Front caster
    d. Front camber
    e. Front toe
12. Re-center the steering wheel and readjust front toe if needed – crooked steering wheels are the leading cause of customer dissatisfaction with wheel alignments.
13. Print the results – the printout is useful for showing the customer before and after results. Many shops keep a printout on file for future reference.
14. Perform a test drive to verify proper alignment.

Begin procedure

On starting the computer, the alignment program will run automatically.
If user does not prefer the auto run-up of the program, delete the setting in the computer system first. (START→Start-up)

Open the PC camera

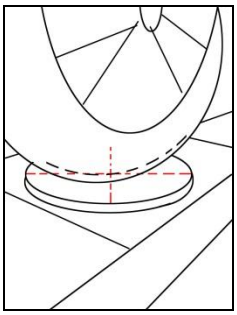
By clicking on the button in home screen, the PC camera will open and assist as the drive-on aid of driving the vehicle onto the lift before alignment.

To close it, click the button or F5.

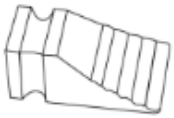
Position the vehicle on the lift

Lower the lift to the ground. Fix the turnplates and insert the bridges.

Drive the vehicle slowly and carefully onto the lift. The vehicle must be center on the lift for alignment. The two front wheels should stop at the turnplate centers.



To ensure safety, block the rear wheels with wheel chocks before rolling compensation.



Attach and hang the targets

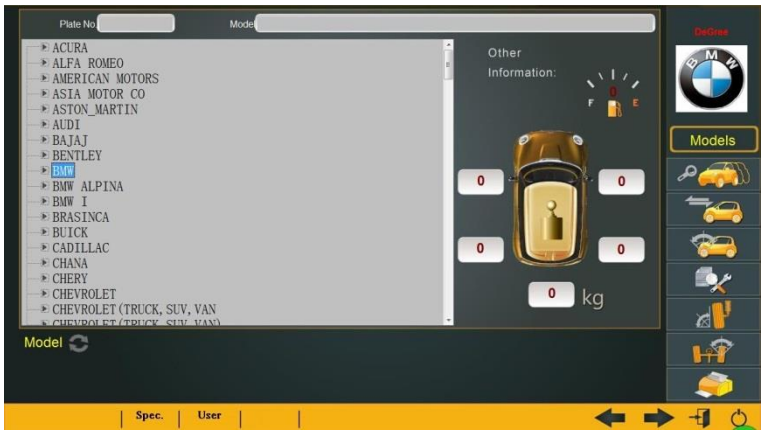
At the back of each target, there is a label showing target ID and which wheel it shall mount. Never mix mounting them.

The targets are suggested to hang at the corresponding racks as stated below.

Left front (No.1)		Left upper rack
Left Rear (No.3)		Left lower rack
Right Front (No.2)		Right upper rack
Right Rear (No.4)		Right lower rack

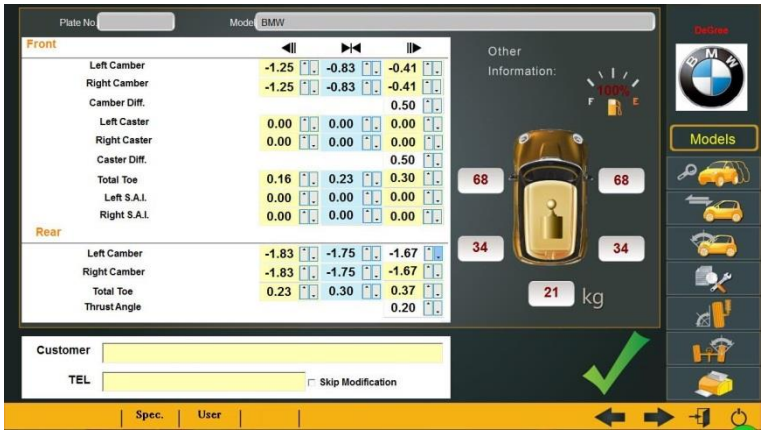
Select vehicle model

Click on this button to choose the vehicle model to be aligned.



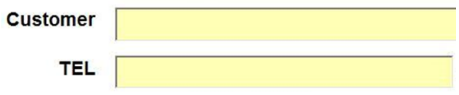
The vehicle logos are arranged in alphabetical order. Move the scroll bar to view more.

Add vehicle information



Input car plate number in the blank.

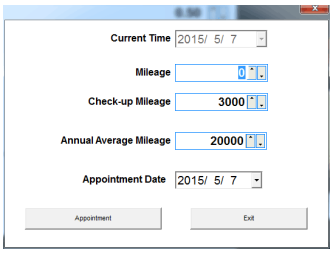
Enter customer information



Input customer name and telephone number for alignment record.

Make appointment

Double click the red area to get the appointment list.



Input the information and the appointment will be recorded in the alignment history.

Users can remind the car owners in advance based on this appointment.

Confirm the selected model

Click on  and the icon will swift to  . The model is selected for alignment.

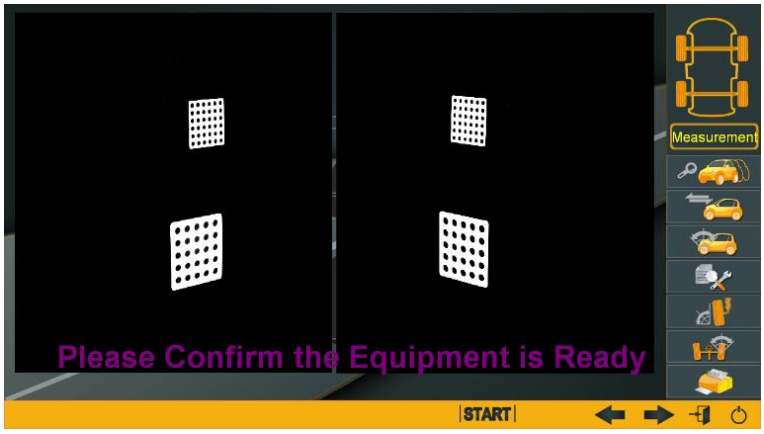
Data preview before rolling compensation

Click on this button  to preview the camber and toe data of the vehicle before rolling compensation.
It's strongly suggested to perform rolling compensation, which is required for obtaining precise measuring results.

Rolling compensation

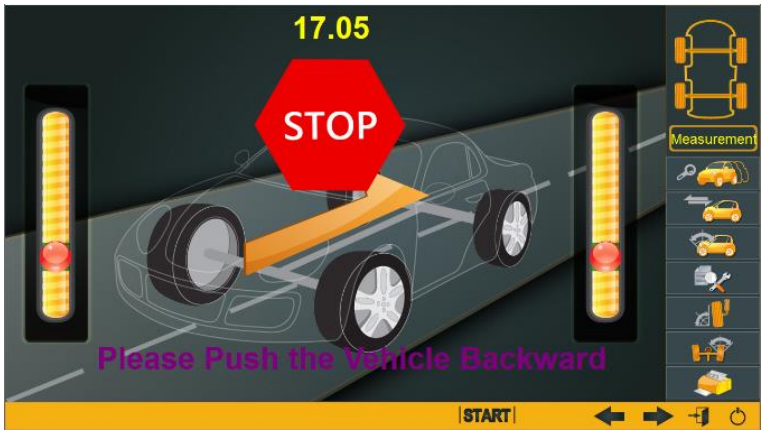
Rolling compensation is only possible after model selected. Click on this button to begin. 

Before rolling compensation, please remove the wheel chocks. The turnplates and wheel bridges must be well fixed. Install the steering wheel lock.



Check on the target status. Make sure it's well laid out.

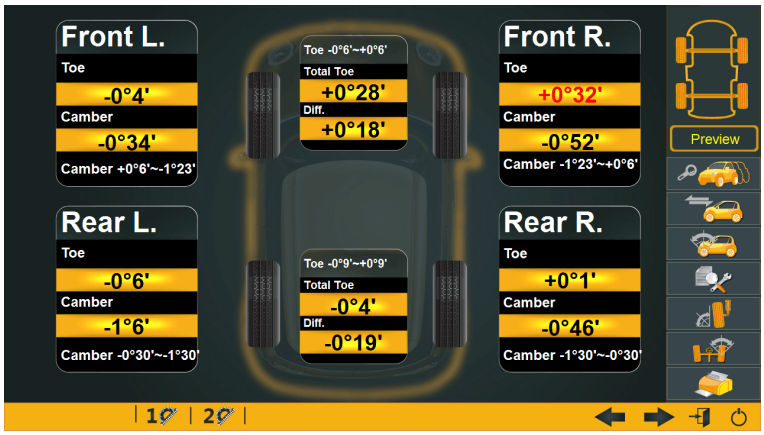
Click START to begin.



Firstly, push the vehicle backward, then forward.

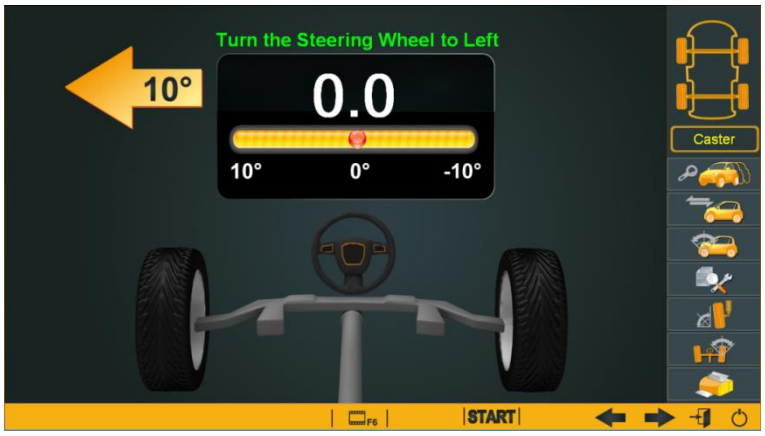
The default degree is 15. In the alignment system, after the degree is equal to or larger than 15 less than 20 , user can stop the push motion at any place.

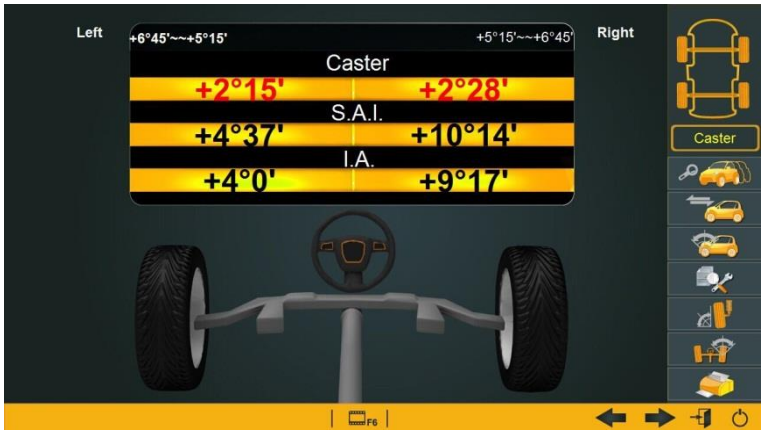
Data preview after rolling compensation



If needed, click on this button  to preview the camber and toe data of the vehicle being aligned.

Kingpin measurement





Click on  to begin kingpin measurement.

Kingpin measurement will help get the result of caster which is essential for repairing the vehicle.

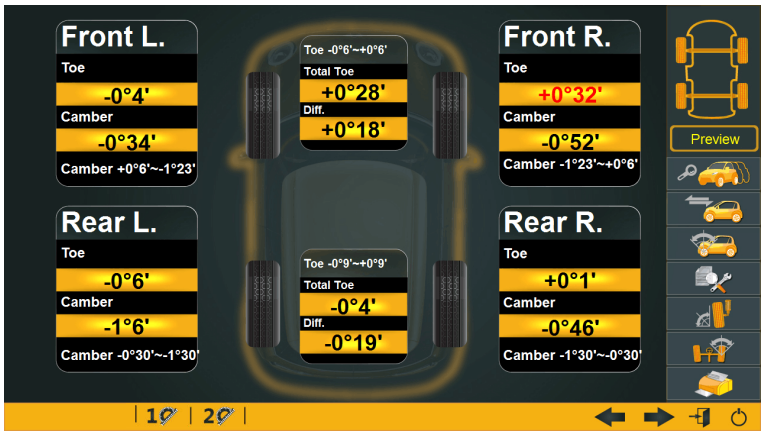
Preparations before turning the steering wheel are:

a. Unlock the turnplates and remove the bridges
b. Block the rear wheels
c. Strain the hand brake and install the brake pedal depressor

Click on  to begin turning the steering wheel; firstly left for 10 degrees, then right for 10 degrees, finally turn back to zero.

The caster result will quickly show on the screen after the turning.

Data preview

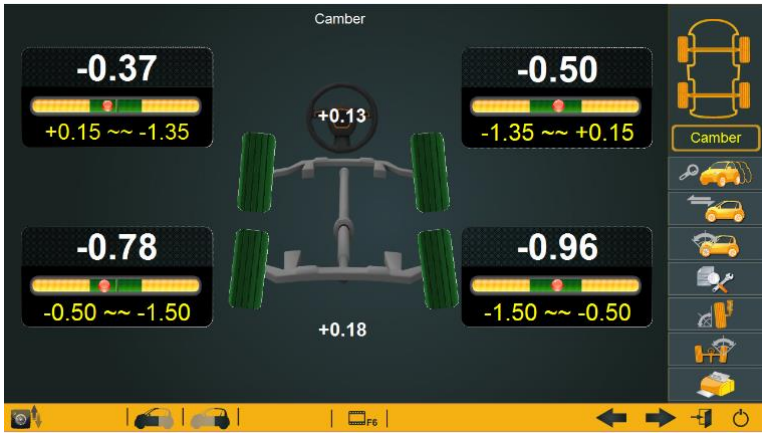


Click on this button  to preview the alignment results.

Click on  to observe the vehicle body dimensions and angles

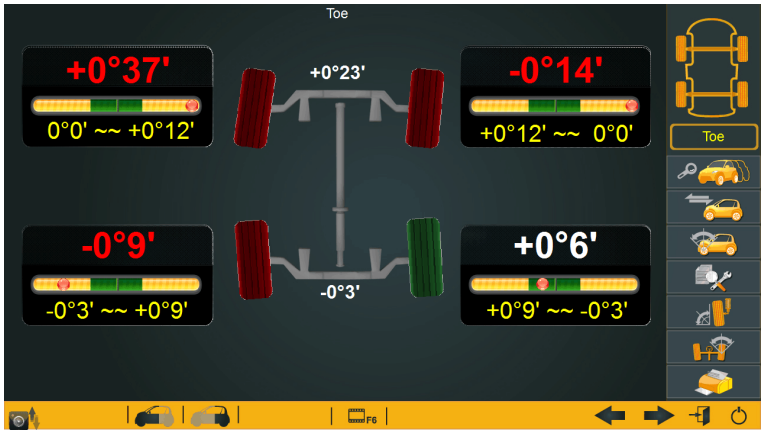
Click on  to observe toe and camber results.

Camber adjustment



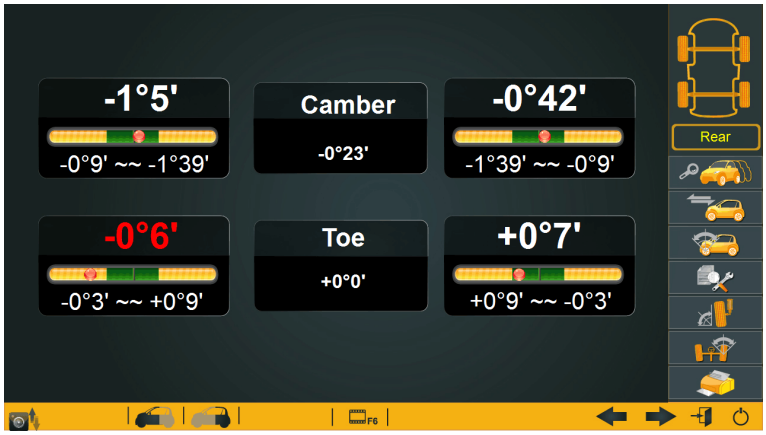
Click on camber measurement and adjustment button  to measure and adjust camber.

Toe adjustment



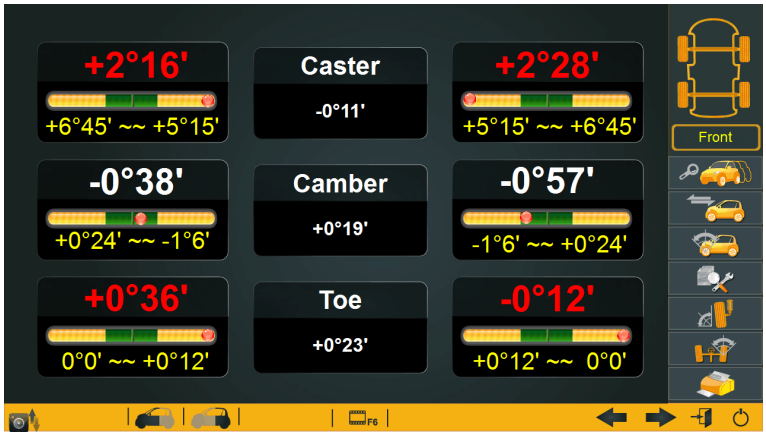
Click on toe measurement and adjustment button  to measure and adjust toe.

Rear wheels adjustment



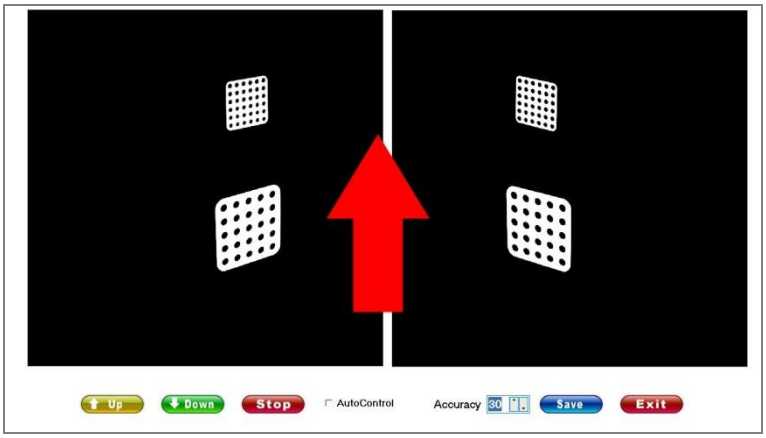
Click on  to view and adjust the rear wheels.

Front wheels adjustment



Click on  to view and adjust the front wheels.

Auto lifting function



Auto lifting function is very useful if a lift is used as the alignment platform. With this function, lift can be at any height for adjustment.

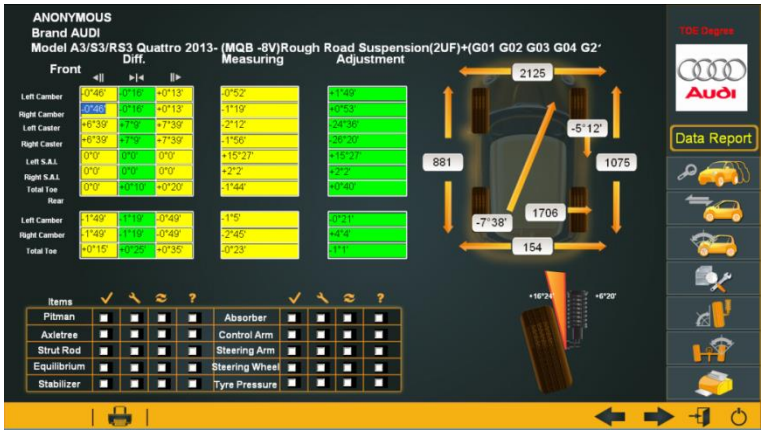
The button  to enter this function appears on the left lower quarter of four interfaces which are toe, camber, front and rear.

Help videos

Press F6 on the keyboard or click on the button 

to watch the help videos. User can input their own help videos if needed.

Print report



After the completion of the adjustment, click on the button  to preview the printout

Icon  from left to right refer to checked, repaired, exchanged and unknown question.

User must click this button  for printing.

Note: if this button is not clicked, only the aligned vehicle information will be recorded by the system, but the print out will not show.

Do a second alignment

If the first alignment is not satisfactory and a second alignment is needed, go directly to the interface of push measurement to begin the second alignment.

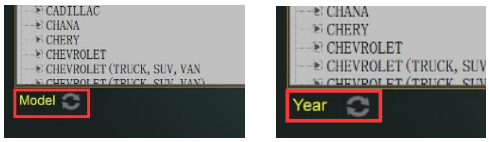
Begin a new alignment

If a new alignment necessary, there is no need to turn off the alignment program and start it again. Just go to the model choose interface. Click on this icon  to cancel the previous chosen vehicle and choose the one to be aligned.

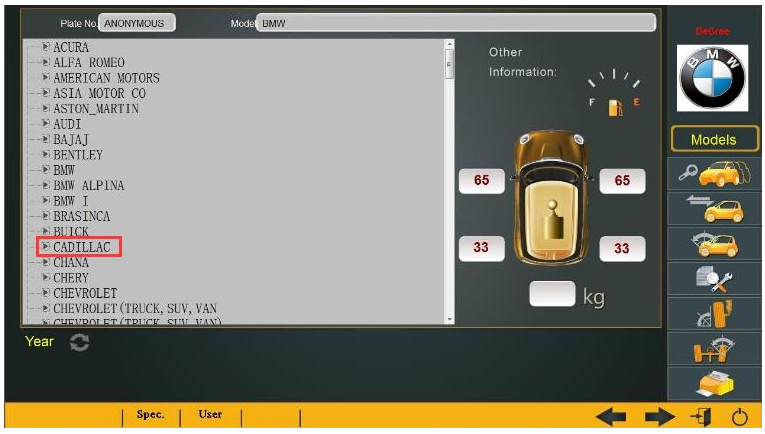
Using tips

Quick search of vehicle model

The vehicle choosing interface is the latest developed one. It looks clear and neat. What's more, it's very quick and convenient to find the needed model. There are some tips for quick search.

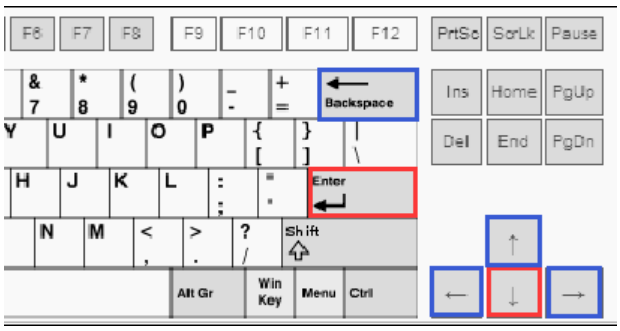


The models can be searched by year or by logo name itself. By model is default. To search by year, just click the icon in the interface.



On opening of the model choose interface, press the initial letter of the target logo. The system will position on all those letters. For example, press the button C on the keyboard, it will position at Cadillac. Press "Enter" to open the detail.

Operator can use the UP and DOWN buttons to move on the brand list.



Enter and Down arrow is the most commonly used button in choosing model.

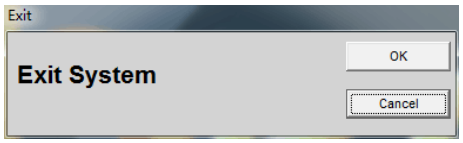
Enter is to confirm. Down is to select the next information.

Backspace, Left and Up buttons mean go back to the last step.

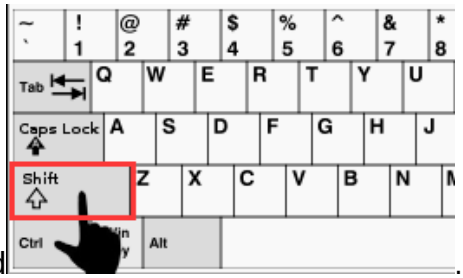
Right button means next information.

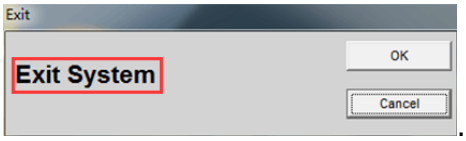
Exit the program

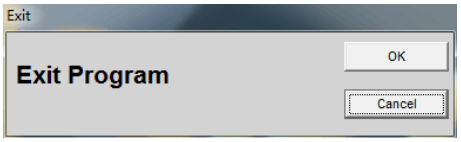
Click the button at the right lower quarter  . The window will show up.



Click OK, both the bee alignment program and the computer will be shut down.

Press Shift button on the keyboard  .

While pressing Shift, click on the area in red. 

. The window will swift to Exit Program. 

Click OK to close the program only.

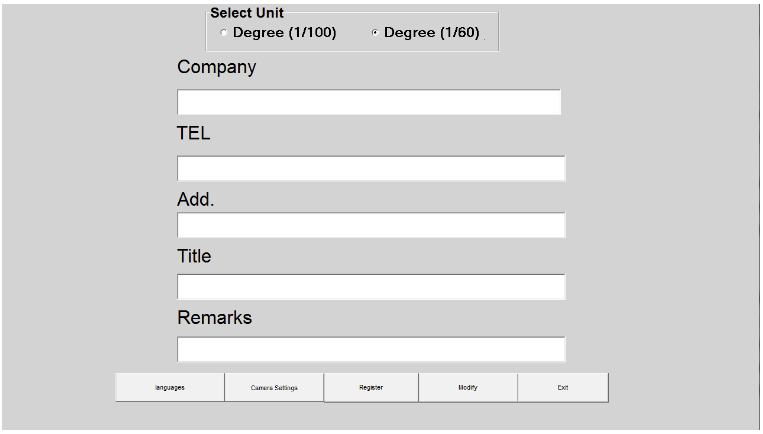
Enter setting

To enter setting, user needs to cancel the model select if it has been done.

The logo at the left lower quarter is to enter setting which contains setting of the company information, camera parameter, etc.

Click on the icon, the system will ask for password.

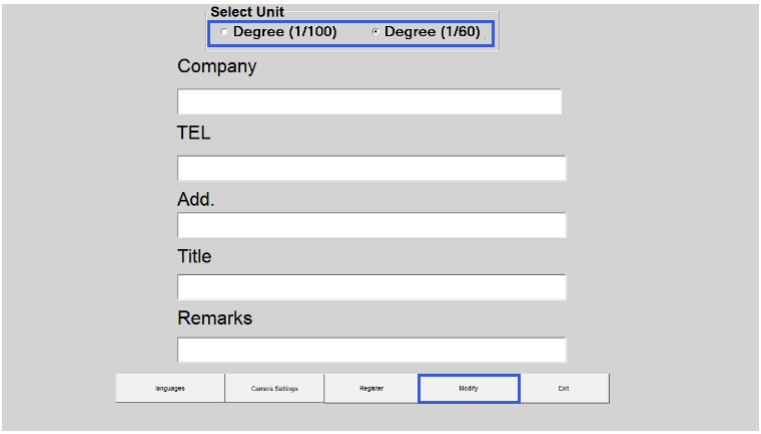
Remark: As it requires often one



time setting, in order to prevent from intended modification of the information and parameter, the password shall not disclose to other people. In case of necessity of setting, please consult the manufacturer for detail of the password.

Click OK to enter the setting interface.

Change measurement unit

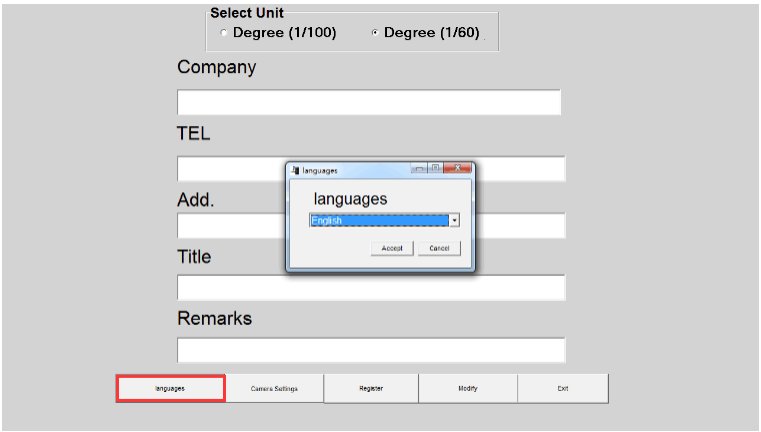


The default unit of the Bee alignment program is Degree(1/100).

If customer prefers the data to show by 1/60, go to setting to make the amendment.

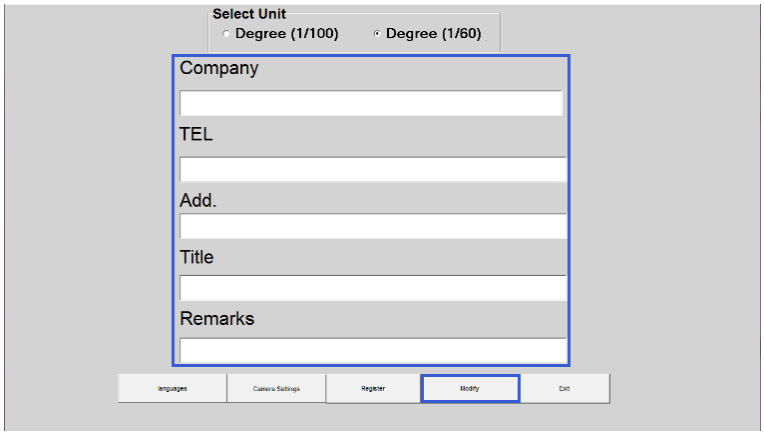
Please do click Modify button to complete.

Change display language



Go to setting. Click Language button and choose the target language.

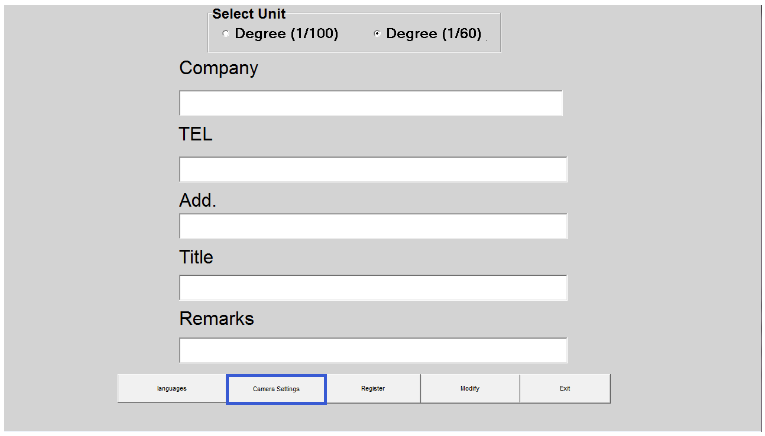
Set company information

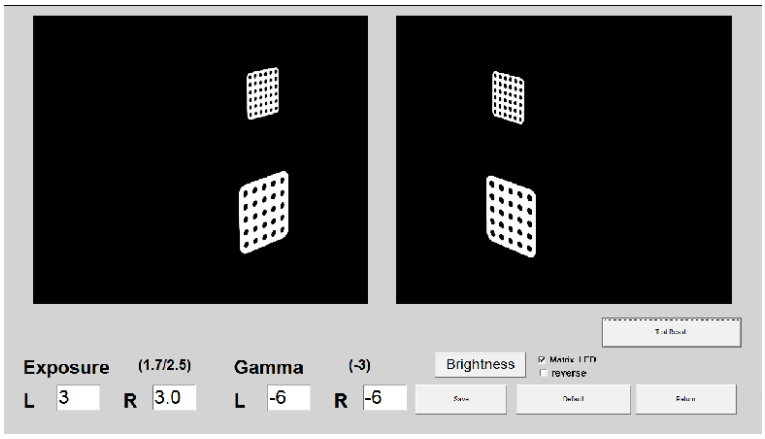


The company information will show in the printing report. Users please go to setting to input the information of the company.

Please do click Modify button to complete.

Set camera parameter





After intimal installation, installer needs to inspect the target status to make sure they appear clear and in position under the common working environment of the machine.

Go to setting. Click on Camera Setting and enter this interface.

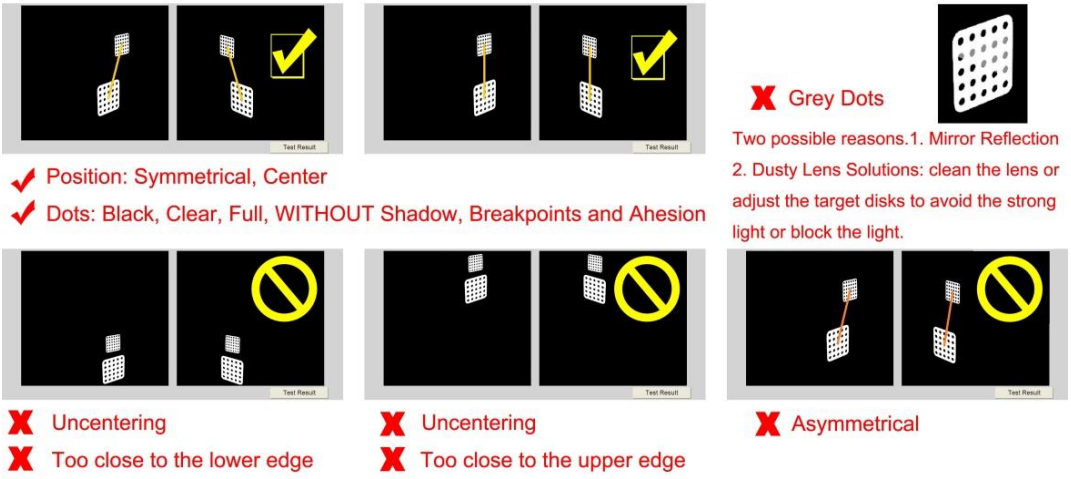
Click Test Result to inspect the target status.
Change exposure of the cameras if necessary.

Click Save before Return to the last step.

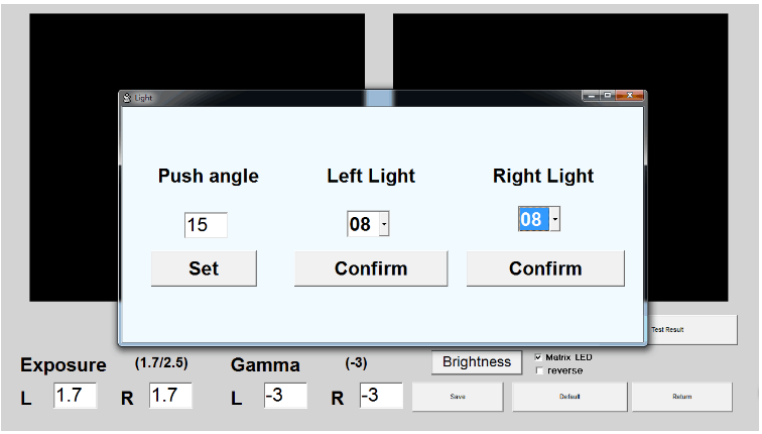
Remark: If the environment is over bright, lower the exposure value. Click Save and then Test Result. Likewise, if the environment is weak, increase the value and check.

Targets requirement

How the targets lay out and what their status are play a great important role in performing good wheel alignment. Installer shall be aware that eventually the targets status will be the standard of where to locate the camera beam. Please refer to the requirements of the targets below.



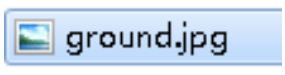
Set infrared lamps brightness and push angle.



Go to Setting, then Camera Setting, then Brightness. The small window for setting brightness of the infrared lights will prompt.

The default push angle is 15. If users would like to have a different one, it can be set also in the window. This setting is valid for one running time of the program. If the program restarts, new setting will be demanded.

Change home screen background and logo

Design a picture in format “jpg”, size 1118×669, name it “ground”. Eg. 

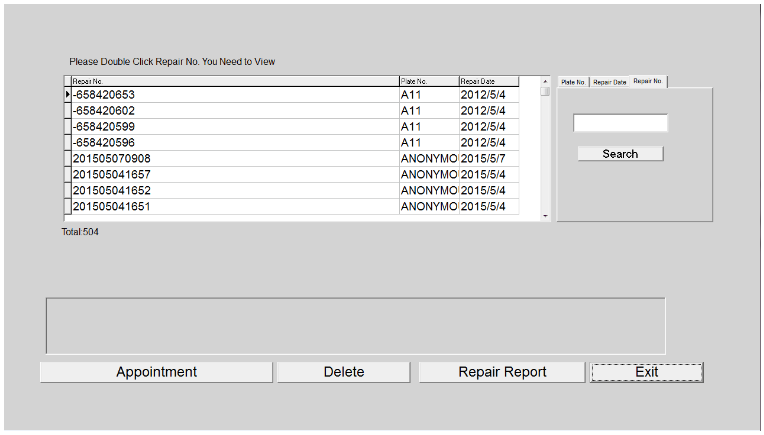
Design a picture in format “bmp”, size 90×44, name it “logo”. Eg. 

Copy these two pictures to the program folder. Replace the old ones.

Check alignment and appointment history

On home screen, click on the icon  and enter the interface of alignment history.

User can check the alignment appointment made with the customers, the alignment history and can delete the history.



Note: If operator does not press the Print button on the printout interface, the alignment report in PDF will not be saved and shown.

Calibration

Preparation of the software data before calibration

Check and confirm the camera in config.ini
Check the Camera ID on the label at the back side of the camera beam. Make sure it's the same with that in config,ini.


```
Z4=322
Z5=517
Z6=562
Z7=30
TagModel=f6B5
reverse=0
[syset]
LZJ14=13
RZJ23=24

PSCS=15
BZCS=0.03

pbmaxvalue=0.03
pbstep=0
alpha=0.03
FLZCt=0.0000
FRZCt=0.0000
[Camera]
Param1bak=8,80,-7,1,80,128,0,1024,1024
Param2bak=8,80,-7,1,80,128,0,1024,1024

PC_ID: P508239
CAM:
      1.LS821632
      2.LS821633

Target-DISK:
      1.TD103452
      2.TD103453
      3.TD103454
      4.TD103455
```

Front Target is 6*6
Rear Target is 5*5

Confirm the type of targets and use the corresponding calibration program

Hardware preparation before calibration

Conditions of the calibration bar

The axiality tolerance should be ±0.05mm and the lubrication of the calibration kit is sufficient.

Confirm the height of the lift

The height of the lift should be the same with the normal alignment height.

Check the voltage, wind speed and vibration source

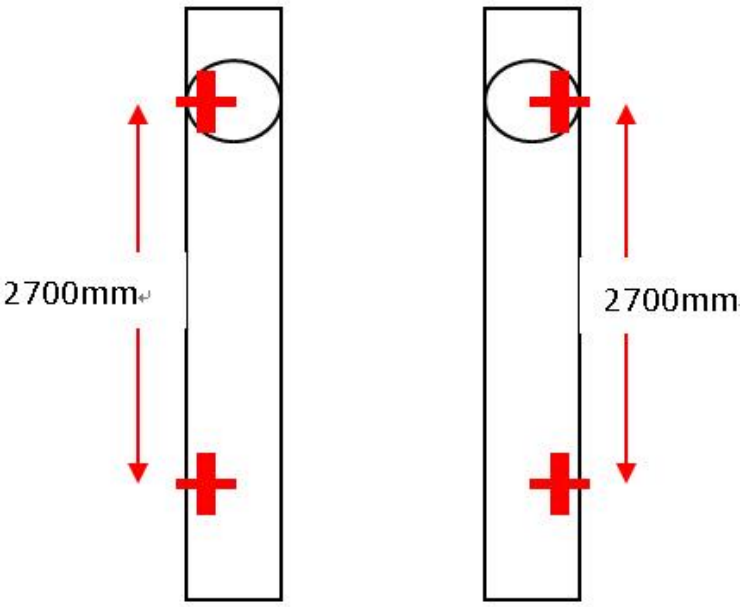
Ensure stable voltage, normal environment and remove the vibration source etc.

Calibration Operation

Mark the lines on the front and rear of the alignment platform.

Note:

- *a. The middle of the calibration bar should coincide with that of the two runways.*
- *b. The rear-wheel position should be 2700mm from the front-wheel turntable center.*
- *c. The calibration bar should always be vertical to the runways during calibration.*
- *d. Never grab the calibration bar on carrying.*



Generation of the calibration data

The name of the generated file is config.ini.
After calibration, send config.ini to supplier. The supplier will send back a new config.ini. Replace the new one with the old one in the folder.

Maintenance and transport of the calibration kit

a. Always handle the calibration kit gently.
b. Keep the calibration kit away from water and corrosion.

c. Spray WD-40 on the axles every three months.
d. Use the original packing boxes for transportation. Squeezing is forbidden.

Daily maintenance

Maintenance of the camera lens

a. Never demount the cameras or lens without permission.
b. Keep the cameras and lens away from vibration resources and moisture.
c. Blow the dust on the lens with a rubber blower. If unsuccessful, use the camera paper to gently clean away the dust or dirt on the surface.
d. Avoid electrostatics with earth line or an anti-static needle.

Maintenance of targets

a. Never demount the target without permission.
b. Keep the targets away from water and oil.
c. When there is oil or dust on the surface of the target, wipe it gently with a towel sprayed with neutral glass detergent.

Method to check the stability of the power pressure and the static (earth wire)

The unit should work under normal environment.

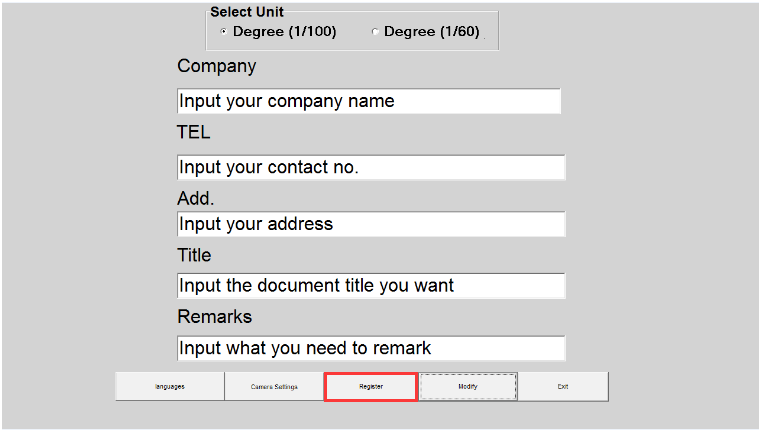
a. The normal working voltage for the unit is 210V~240V. A multimeter can be used for check.
b. A power polarity detector should be applied to check whether there exists the valid earth wire.

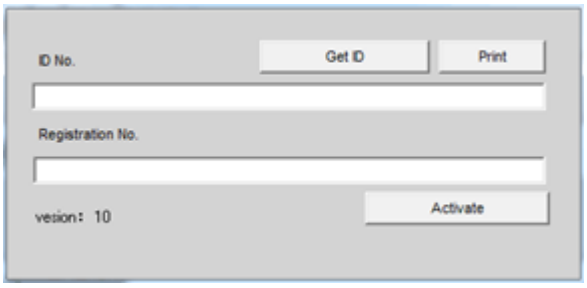
Checkup of the vibration resource

Always keep the installation place of the unit far away from the roads and air compressor which might cause obvious vibration.

FAQ

How to activate the program





Go to Setting. Click on Register.

The window for getting ID will show up.

Click Get ID. Copy the ID and send it to the dealer/manufacturer.

After getting the code from the dealer/manufacturer, copy it to the blank and click Activate.

How to change the PC

If the computer has to be changed, registration and installation of the program in the new computer will be necessary. Please contact the dealer/manufacturer for this service.

Note: The alignment program can work in the computer systems of windows xp, windows 7 and windows 8 computer systems. For windows 7 and 8, there will be extra setting required.

How to upgrade the vehicle specification

The vehicle specification is upgraded twice in one year. The manufacturer will send the data file together with the instruction to the customers for how to do the update.

How to add/ delete/ modify data

In home screen, click the button to enter.

Select the model to be added by pressing on the UP and DOWN buttons on the keyboard.

Input the data and click OK.

The newly added data can be deleted from the databank. Open the specification and click Delete.

How to add a new language

Open the software folder and then open LANG. Copy the folder named “English” and paste. Rename this file, for example Russian.

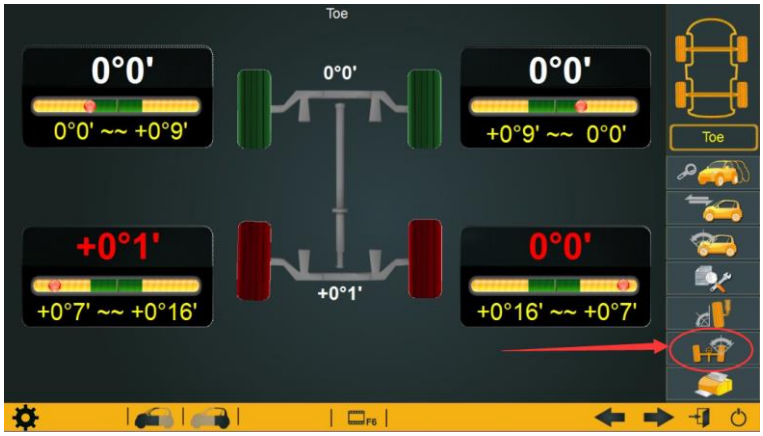
In the copied English folder, translate Frml.txt and msgl.txt and save.

Right click Vod.lan. Choose “Open the file in notepad”. Translate and save it.

Remark: If windows could not read the new language in voice, it’s suggested to keep Vod.lan in English.

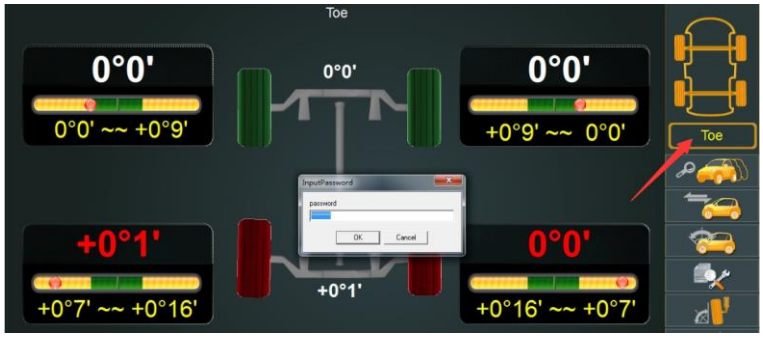
How to perform steering-wheel correction function

If over 70% of the car being aligned result at non-centered steering wheels which tile to the same side, please use the steering wheel correction function to correct the machine. Below are the procedures.



Find a car with a straight steering wheel. Drive it onto the pit.
Select the model and do push measurement.

Click button “Toe”



Press Shift + Click Toe at the same time

The system will ask for password. Input “Admin” and then click OK.

In this interface, click OK and then Save and Exit.

After that, in future, for any car being aligned, they’ll have a straight steering wheel.

Note: If you have a calibration kit, it’s better to do calibration first, and then straight steering wheel correction. This function is to compensate for the possible error due to improper calibration. If calibration can be done perfectly, this function is not necessary.