

5D WHEEL ALIGNER

FCAR FD505

User manual



Installation, operation, adjustment and maintenance of the FCAR FD505 5D four-wheel alignment system.

FCAR FD505

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Statement

- This manual covers the use of the FCAR 5D four-wheel alignment system. No company or individual may copy or back up this manual in any form (electronic, mechanical, photocopying, recording or otherwise) without the prior written consent of FCAR Technology Co., Ltd.
- This manual is intended for professional vehicle repair technicians only.
- This manual describes how to operate FCAR products only. FCAR accepts no responsibility for the consequences of applying these operating methods to other equipment.
- FCAR accepts no responsibility for any costs or expenses arising from damage to or loss of the equipment caused by accidents involving the user or third parties, or by abuse, misuse, unauthorised modification or repair, or failure to follow the operating and maintenance requirements set out in this manual.
- This manual is based on the product's current configuration and functions. If new configurations or functions are added to the product, this manual will be updated without prior notice.
- In this manual, "Shenzhen FCAR Technology Co., Ltd." is referred to as "FCAR".

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Precautions for using the 5D four-wheel alignment system

- Operators must complete FCAR training and be qualified before using the system. They must have basic computer skills and a basic understanding of four-wheel alignment;
- The FCAR 5D four-wheel aligner is a precision instrument. A designated person should be responsible for its use to prevent knocks and falls;
- The computer of the 5D four-wheel aligner is dedicated to this equipment. Do not install any other software or hardware, and do not delete or change any of its applications. Only authorised maintenance staff may work on the computer;
- Regularly check that the alignment area floor is level to ensure correct measurements and personal safety. Keep the area around the vehicle clear of obstacles that could interfere with the work;
- Read the descriptions of the equipment structure and supporting tools in this manual carefully before installation and commissioning;
- Avoid switching the measuring unit on and off frequently;
- Do not dismantle the measuring unit or the supporting tools;
- The clamp must be securely fitted to the rim;
- Power supply requirements:
 - a. Check that the power cable is securely connected and undamaged. Use an earthed socket to supply the aligner's measuring unit. If the supply voltage is unstable, fit an AC voltage stabiliser;
 - b. Always use a three-pin earthed plug and socket to ensure personal safety and stable operation of the equipment;
 - c. When testing is finished, exit and close the 5D four-wheel alignment system, then switch off the power at the socket to prevent damage from mains voltage spikes;
 - d. Take particular care that all power supply equipment connected to the machine complies with the electrical standards of your country, e.g. no overloading and safe wiring. Failure to do so may damage the machine (for example by burning it out); such damage is not covered by the warranty;
 - e. Do not connect or disconnect the machine's cables without first switching off the power.

CHAPTER 1

Product description

The FCAR 5D four-wheel alignment system is a four-wheel alignment product and platform developed in-house by FCAR. It builds on feedback from 3D aligner users and addresses the shortcomings of 3D products (working area, precision, transport, installation, moving between bays, etc.). After more than five years of research, development and test validation, FCAR has launched a landmark four-wheel aligner that marks the leap from the 3D era to the 5D era.

1.1 When is wheel alignment needed?

A vehicle needs a wheel alignment in the following cases:

- A. As a general rule, every 15,000 km or every six months;
- B. On a new vehicle, after the first 3,000 km;
- C. The vehicle does not run straight, the steering wheel vibrates, shakes or feels too heavy, or it does not return to centre after a turn;
- D. The vehicle weaves or pulls to the left or right, or the body feels unstable;
- E. Abnormal tyre wear on the front or rear wheels;
- F. One-sided, irregular, block or feathered tyre wear;
- G. After fitting new tyres, after accident repairs, or after replacing suspension or steering components;

1.2 What is wheel alignment?

To ensure straight-line stability and light handling, and to reduce wear on the tyres and other parts, many factors must be taken into account when setting the angle between the wheels and the road. The steered wheels, the steering knuckles and the front axle must keep a defined position relative to the frame. This positional relationship is called steered-wheel alignment, also known as front-wheel alignment.

Wheel alignment used to mean front-wheel alignment only; today's vehicles also require rear-wheel alignment. Front and rear wheel alignment measures the angular relationships between the frame, the suspension components and the front and rear wheels along the X, Y and Z axes. Once the vehicle has been accurately measured with a dedicated instrument, the results are compared with the manufacturer's original specifications and adjusted to within the specified range, so that the vehicle delivers the intended driving performance.

1.3 Product configuration

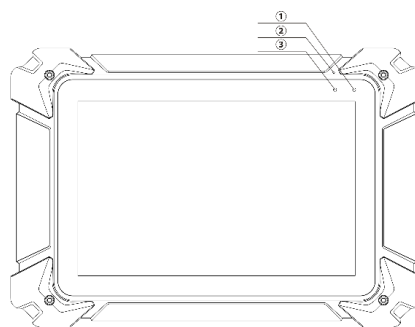
The standard configuration of the FCAR 5D four-wheel alignment system is shown in the figure below.



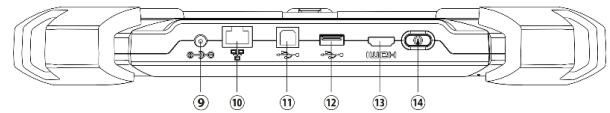
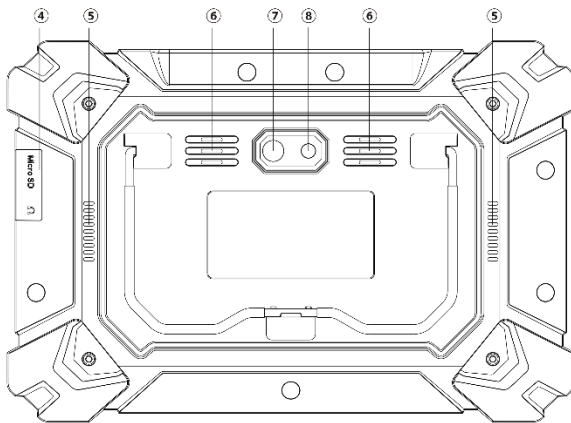
Technical specifications:

Measurement	Accuracy	Range
Camber	$\pm 0.01^\circ$	$\pm 8^\circ$
Caster	$\pm 0.03^\circ$	$\pm 19^\circ$
Kingpin inclination (KPI)	$\pm 0.02^\circ$	$\pm 19^\circ$
Toe	$\pm 0.01^\circ$	$\pm 2^\circ$
Rear thrust angle	$\pm 0.02^\circ$	$\pm 2^\circ$
Rear axle offset	$\pm 0.02^\circ$	$\pm 2^\circ$
Wheelbase difference	$\pm 0.02^\circ$	$\pm 2^\circ$
Front setback	$\pm 0.02^\circ$	$\pm 2^\circ$
Rear setback	$\pm 0.02^\circ$	$\pm 2^\circ$

Tablet layout



No.	Name	Description
1	Power indicator	Charging indicator
2	Microphone	Voice input
3	Light sensor	Senses ambient light intensity



No.	Name	Description
1		
2	TF card slot / 3.5 mm headphone jack	Holds the TF storage card / headphone connection
3		
4		
5	Ventilation holes	Cool the tablet and prevent overheating
6	Loudspeaker opening	Sound output
7	Camera	Takes photos and records video
8	Flash	Provides light in low-light conditions
9	DC power port	Charges or powers the tablet
10	RJ45 port	Network connection
11	USB port (Type B)	Device port: connects to a computer so the tablet can be used as a USB drive
12	USB port	Host port: connects the tablet to other devices or USB drives
13	HDMI port	Standard HDMI port: output to an HD TV
14	Power button	Switches the tablet on/off or locks the screen

1.4 Product functions and features

High precision

Five high-resolution 2-megapixel industrial cameras track changes in the wheel angles across the whole vehicle. Accuracy is higher because the compensation calculation is based on level changes monitored by the central camera. Two adjustment modes are supported — wheels on the ground and wheels raised — so both the front and the rear of the vehicle can be measured.

Wide field of view

The camera field of view can be adjusted freely, solving the problem of traditional 3D systems being unable to measure extra-long, extra-wide or extra-narrow vehicles.

Specialised hardware

The industrial-grade computer chip is faster and more accurate than a conventional computer at image recognition and angle calculation, and measurement data is synchronised in under 0.1 seconds. Position detection by rotating the targets fully overcomes the limitations of the measuring site.

Smart display

Supports synchronised display on multiple devices, such as Android tablets, Android TV and, in future, Android phones. Dynamic loading and a 3D view make the display more intuitive.

Practicality

Suitable for all types of lift (two-post, four-post, short scissor and long scissor), it removes the lift and site restrictions of traditional 3D aligners. The overseas version is supplied in a flight case with castors and can be moved by one person. It communicates directly with the tablet over Wi-Fi, so it can be demonstrated as soon as it is switched on, and it is quick and easy to install and operate.

CHAPTER 2

Selecting and using the supporting tools

The tools of the FCAR 5D four-wheel alignment system include high-precision clamps, targets and turntables, each of which is described below.

2.1 Using the turntables

The 5D four-wheel alignment system comes with two turntables, which are placed under the front wheels of the vehicle. Before driving the vehicle on, lock the turntables with the locking pins to stop them from rotating. Do not remove the locking pins when measuring toe and camber, as wheel slip during rolling compensation would cause measurement errors. To allow the wheels to turn freely during the caster measurement, the locking pins on both turntables must be removed.



Note: When driving the vehicle on, make sure each wheel is in the centre of its turntable.

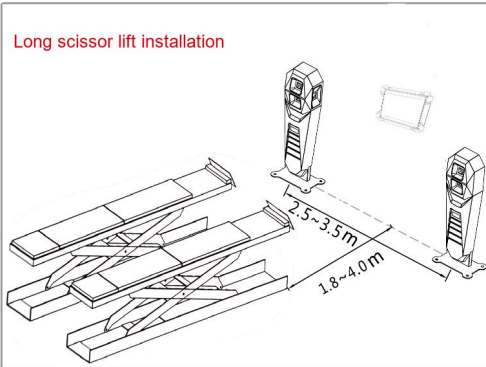
2.2 Clamps and targets

The clamp is a 4-point clamp designed specifically for the 5D four-wheel alignment system; it is attractive and versatile. The aligner comes with 4 targets (2 short and 2 long), which provide the target images for the cameras. Check the cameras before measuring to make sure all four targets are within their field of view.

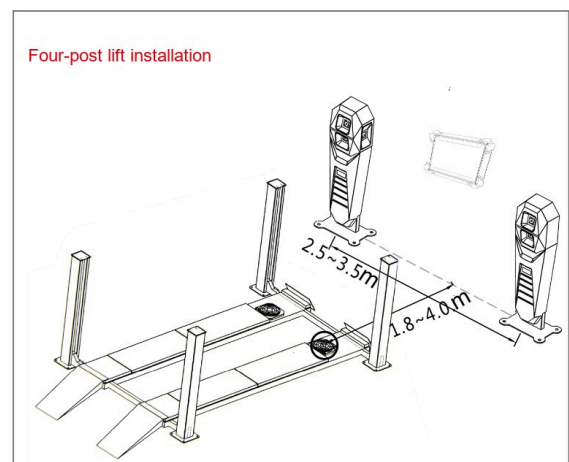
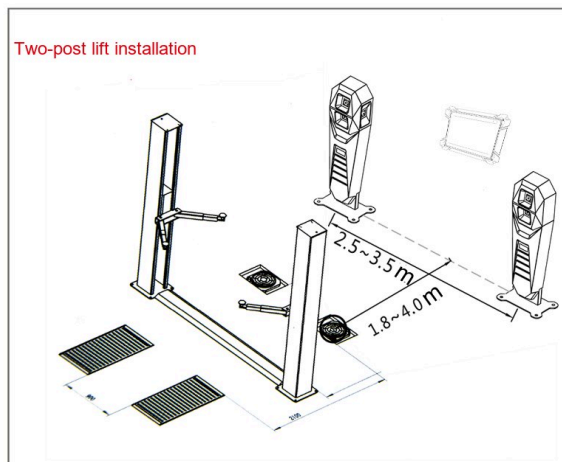


2.3 Installing the 5D four-wheel alignment system

The FCAR 5D four-wheel alignment system is not limited by the working area and is suitable for a wide range of lifts (two-post, four-post, short scissor and long scissor). The installation options are as follows:



Note: The short scissor lift installation is similar to the long scissor lift installation.



Target selection

Use the table below to select the target type for each type of lift:

Type	Photo	Installation
Long target		Long scissor / short scissor lift installation
Trapezoidal target		Two-post lift installation, four-post lift installation

Tip: once the target type has been chosen, it must be set in **System Settings**, as described in **Chapter 6**.

CHAPTER 3

Preparing for wheel alignment

3.1 Before starting

- 1) Position the turntables and lock them with the locking pins to stop them from rotating;
- 2) When driving the vehicle on, make sure the tyres are in the centre of the turntables. Once the vehicle is stopped, apply the handbrake so that the vehicle cannot move and personnel are safe;
- 3) Check the rim size, tyre pressures and tyre wear, and the condition of the steering and suspension components, such as track rod ends and shock absorbers. If any component is excessively worn or faulty, repair it before carrying out the wheel alignment;
- 4) Identify the vehicle's origin, manufacturer, model and year of manufacture.
- 5) During rolling compensation and adjustment, make sure the steering wheel is centred and secure it with the steering wheel lock, as shown in the figure. When measuring and adjusting caster, apply the handbrake and hold the brake pedal down.



Figure 3.1-1 Fitting the steering wheel lock

3.2 Fitting the clamps and targets

The FCAR 5D four-wheel alignment system comes with 4 clamps, 4 targets and 2 measuring units. The measuring units must be positioned in front of the vehicle, one on the left and one on the right (see the installation options for the 5D four-wheel alignment system). Fit the two short-arm targets to the front wheels and the two long-arm targets to the rear wheels.

How to fit the clamps and targets

The clamp is centred and locked at the factory, so no centring adjustment is needed. Fit the clamp as follows:

- 1) Turn the hand wheel to open the claws to the diameter of the rim. The fitting direction of the clamp is shown in figure 3.2-1;
- 2) With the clamp handle pointing upwards and perpendicular to the ground, the four claws should sit tightly against the edge of the rim;
- 3) Turn the hand wheel again to tighten and lock the clamp on the rim.

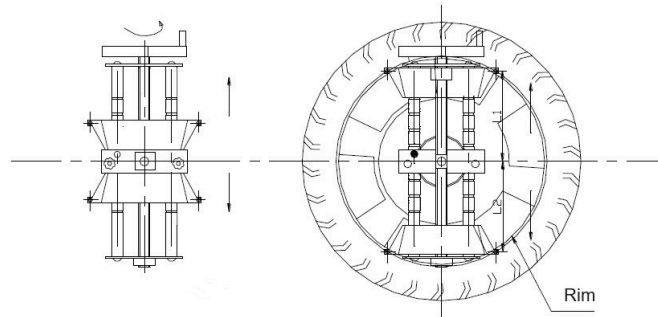


Figure 3.2-1 Fitting the clamp

Photo of the fitted clamp:



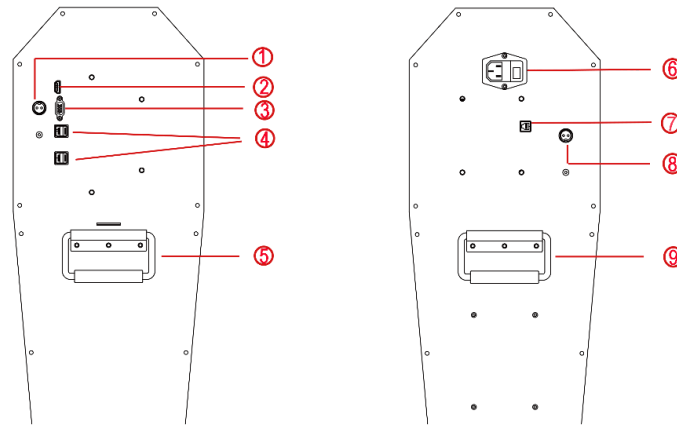
Note: When fitting the clamp, keep the claws away from any balance weights on the rim and make sure all four claws are in full contact with the rim.

The long and short targets fitted to the vehicle are shown below:



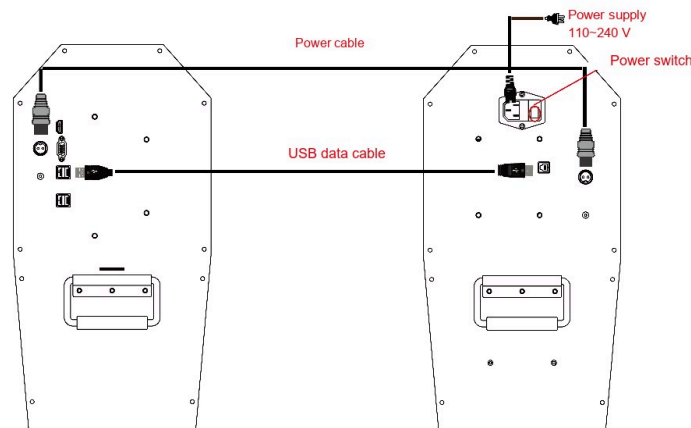
3.3 Connecting the equipment

The ports on the back of the measuring unit are shown below:



No.	Name	No.	Name
1	Power port	2	HDMI HD output
3	VGA port	4	USB port
5	Handle	6	Power port
7	USB port (Type B)	8	Power port
9	Handle		

Connect the two measuring units using the factory-supplied power cable and data cable, as shown below. Plug the power plug into a standard three-pin socket. The power supply must be 110~240V. Turn on the power switch to start both measuring units.



3.4 Switching on and the main menu

Once the measuring unit has started, switch on the tablet. The tablet is connected at the factory to the Wi-Fi of the router built into the measuring unit, so the program connects to the measuring unit automatically. If it does not, select the network manually using the Wi-Fi name shown on the back of the measuring unit. Run the program; the main menu is shown in figure 3.4-1:

Note: If the tablet cannot connect, check that the measuring unit has started, that the network connection is working and that the Wi-Fi name is correct.

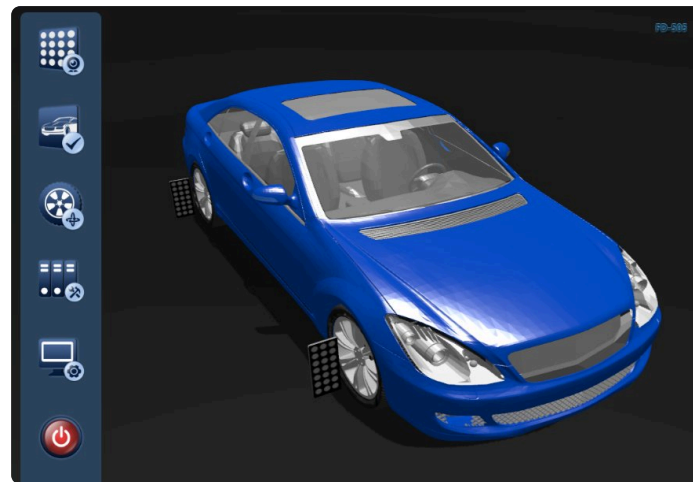


Figure 3.4-1 System main screen

The function of each icon is shown in the table below:

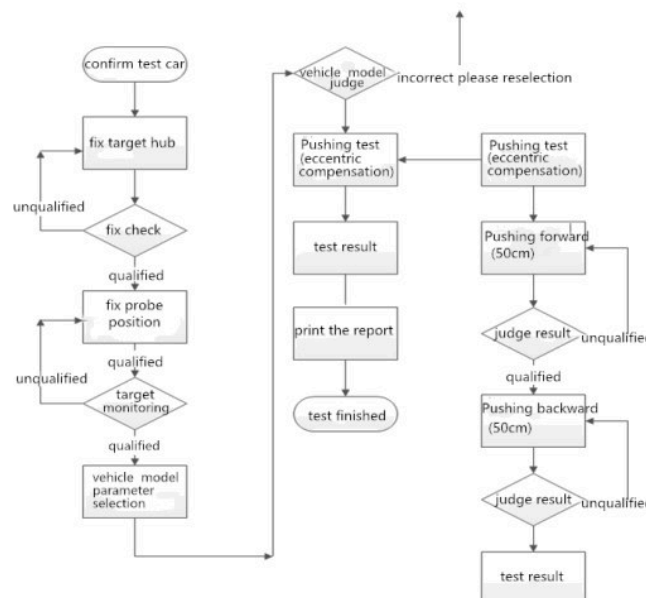
Icon	Icon name	Function
	Target monitoring	Before wheel alignment, use camera monitoring to make sure all targets are clearly within the camera's field of view
	Select model	Selects the vehicle for wheel alignment, in one of two modes: Direct Access mode or Guided mode.
	Fast positioning	Lets the technician quickly check whether the relative position of the cameras and targets is correct, or measure without vehicle data
	Maintenance information	View, edit and print service records
	System settings	Device-specific settings, global system settings, workshop information settings, etc.
	Exit	Closes the 5D four-wheel alignment system normally and returns to the Android home screen

CHAPTER 4

Operating the 5D four-wheel alignment system

Before measuring the wheels, monitor the targets to make sure they are fully and clearly within the camera's field of view. Once target monitoring is complete, carry out rolling compensation and the caster measurement. If the results do not meet the values in the standard database, make the necessary adjustments. After adjusting, carry out a test drive to check that the vehicle's fault has been eliminated. If the specification is still not met, measure and adjust again. The functions and operation of the FCAR 5D four-wheel alignment system are described in detail below.

The procedure is shown in the flow chart below:



The FCAR 5D four-wheel aligner has two measuring modes, ground mode and lift mode, to suit different measuring platforms and site constraints. Each mode is described separately below.

4.1 Target monitoring

Before carrying out a four-wheel alignment, target monitoring is required whichever measuring mode is used. Select Target monitoring  on the system main screen, as shown in figures 4.1-1 and 4.1-2, and make sure all four targets are clearly within the camera's field of view.

IT IS VERY IMPORTANT THAT THE TARGETS ALWAYS REMAIN WITHIN THE DOTTED LINES.

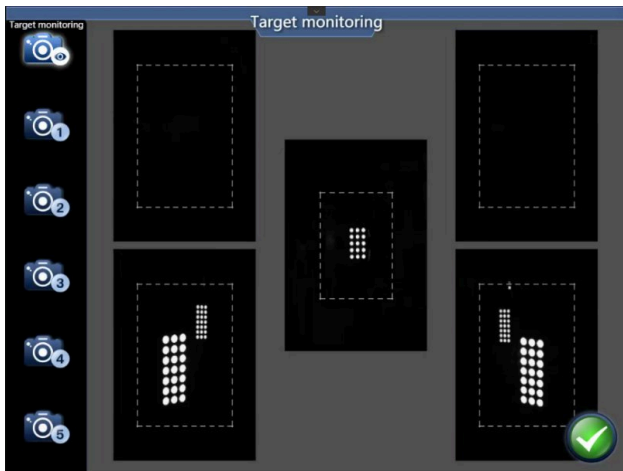


Figure 4.1-1 Camera monitoring

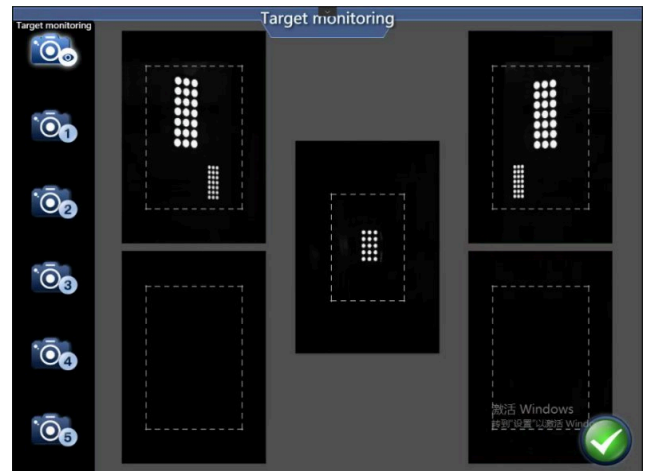


Figure 4.1-2 Target monitoring in lift mode

Note:

1. During measurement, remove any objects or people between the cameras and the targets so that the targets are not obstructed, and make sure the floor does not reflect light, which would affect the results.
2. If a target is obstructed, adjust the left and right targets as needed. The targets must be clearly visible.
3. Before starting target monitoring, make sure the target type and vehicle front position are set correctly. For details, see **Chapter 6 System Settings**.

4.2 Ground mode

Standard measuring procedure in ground mode: Vehicle selection → Rolling compensation → Adjustment → Caster measurement → Adjustment → Test drive → Save measurement data → View/print results. The procedure and method are described below.

Vehicle selection

Select  on the system main screen; the system opens the vehicle selection screen. There are two options: Guided Mode and Direct Access Mode.



Guided Mode offers two options: a tyre condition check and a tyre tread depth check using the Tread Detector. These pre-alignment checks are included in the final report if the report is saved.

Tread Detector

A tyre tread depth gauge is required. It connects to the tablet via Bluetooth.

Alignment Check

The condition of the suspension and steering components can be recorded.

Once either of these checks has been completed, the user can go on to the vehicle selection screen shown in figure 4.2.1-1:

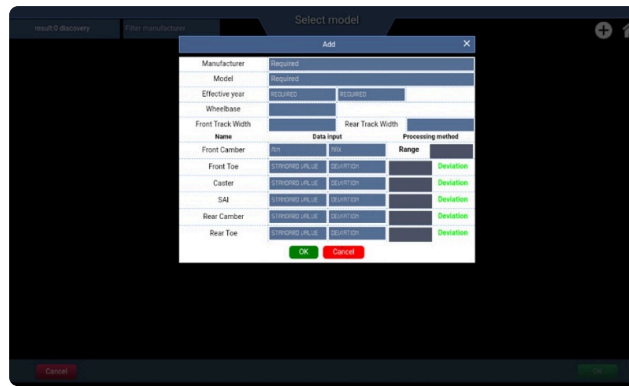
Figure 4.2.1-1 Vehicle selection

Figure 4.2.1-2 Standard data

You can add your own vehicle data using:

CustomModels

To add a custom model, select **Custommodels**, then tap the “+” button in the top right-hand corner.



Selecting the **Custommodels** menu displays your list of custom models.

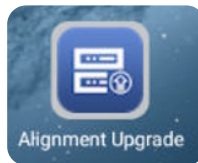
Note:

- Always enter model data according to the manufacturer's specifications; never enter arbitrary values.
- System models cannot be deleted.

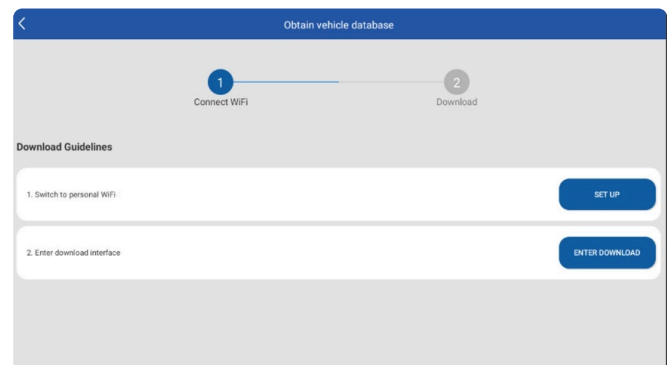
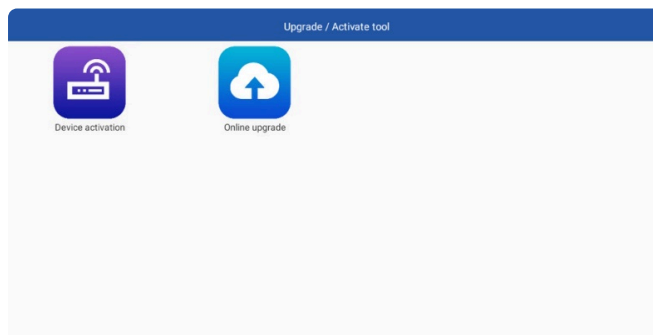
UpdateDatabase/Software

Proceed as follows:

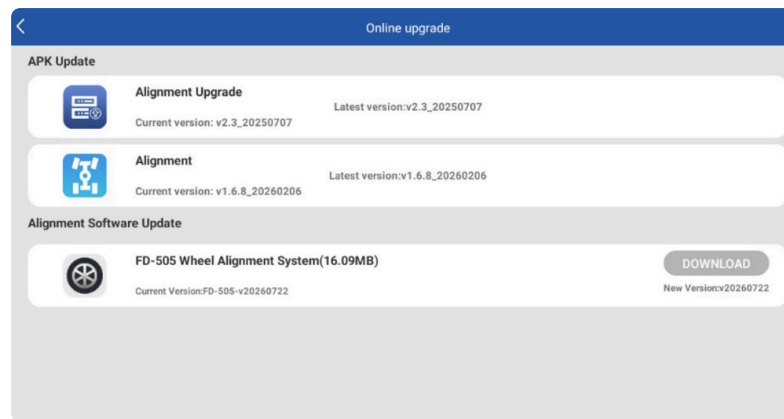
- a) Tap the “Alignment Upgrade” app icon on the tablet’s home screen.



- b) Tap **Online Upgrade**.



- c) In SETUP, select your own Wi-Fi network with internet access.
- d) A screen shows the updates available for download alongside the versions currently installed on the equipment. Tap “Download” to start downloading the update files. When the download is complete, reconnect to the wheel aligner’s own Wi-Fi network; the network name (SSID) is shown on the label on the wheel aligner. On-screen instructions then explain how to transfer the update files from the tablet to the wheel aligner.



Rolling compensation

Once you have found the model to be measured, tap **OK** to open the rolling compensation screen. If a target is not positioned correctly, an adjustment prompt is shown (figure 4.2.2-1) or another message appears. Adjust each target until the prompt disappears.

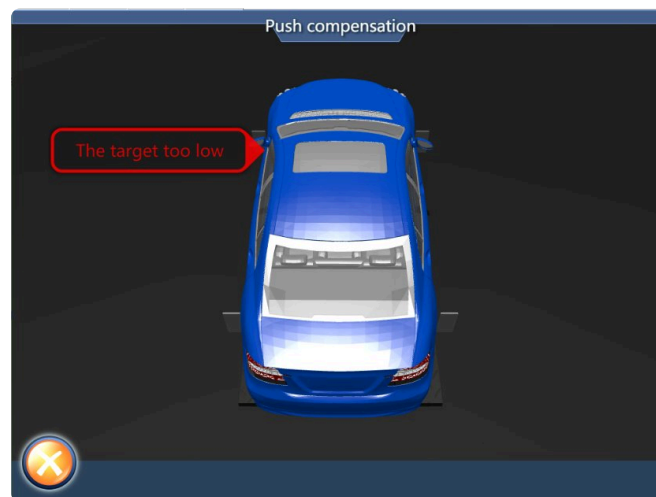


Figure 4.2.2-1 Target adjustment prompt

When the adjustment is complete, the program automatically switches to the rolling screen, as shown in figure 4.2.2-2.

How to carry out rolling compensation

- 1) Following the on-screen prompt, roll the vehicle slowly and steadily backwards by about 15 cm (with the steering wheel centred);

Note: Before rolling the vehicle, make sure the steering wheel is centred and secure it with the steering wheel lock.

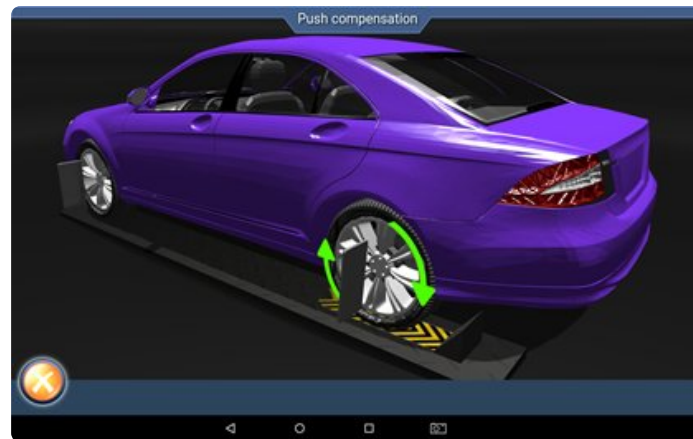


Figure 4.2.2-2 Rolling backwards

- 2) When the screen below appears, stop rolling backwards; a rubber chock can be used to hold the wheel;

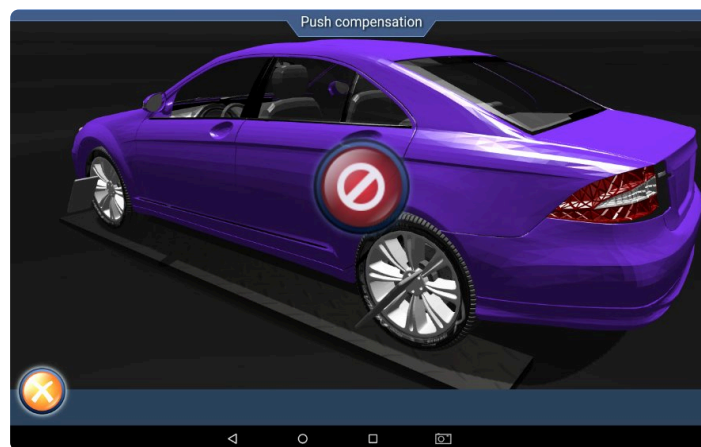


Figure 4.2.2-3 Stop rolling

- 3) When the screen below appears, roll the vehicle slowly and steadily forwards as prompted;

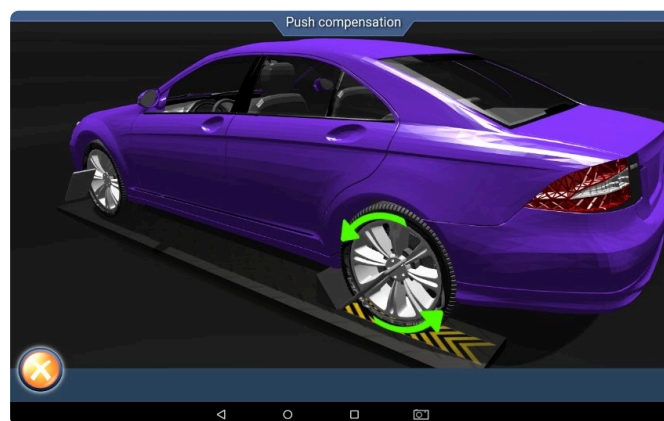


Figure 4.2.2-4 Rolling forwards

- 4) When the screen below appears, stop rolling forwards. The system may take a few seconds to calculate; please wait;

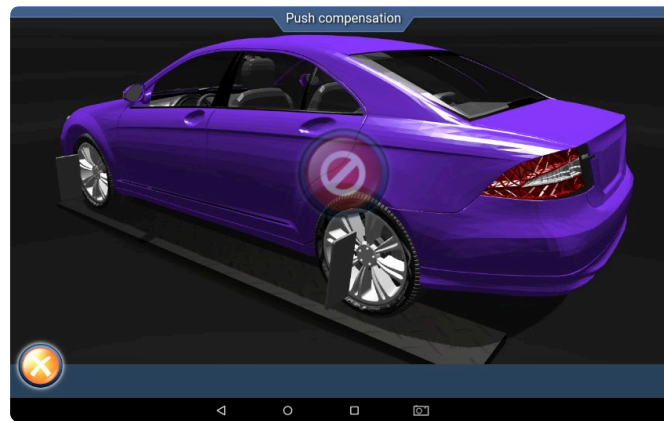


Figure 4.2.2-5 Stop rolling

- 5) If the measurement is successful, the system automatically switches to the results screen, as shown in figure 4.2.2-6 (the data in the figure is for illustration only and has no reference value).

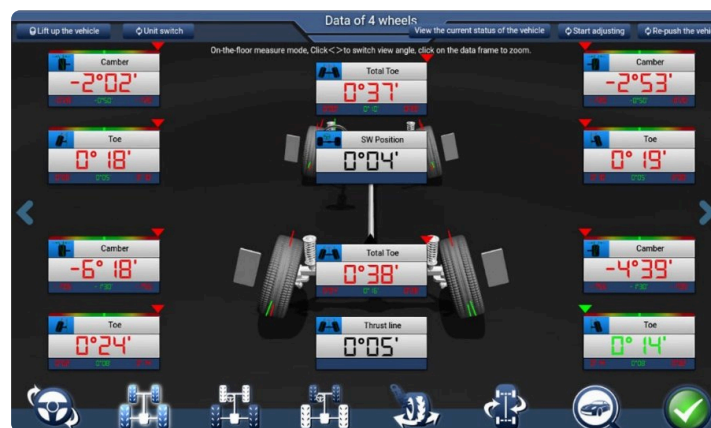


Figure 4.2.2-6 Measurement results

To show the condition of the vehicle at a glance, the results screen uses colour-coded values to indicate whether each measured value is within specification:

- Red: measured value outside the specified range
- Green: measured value within the specified range

Precautions:

1. During measurement, remove any objects or people between the cameras and the targets so that the targets are not obstructed, which would affect the results.
2. Before measuring, make sure the steering wheel is centred and secured so that it cannot turn during rolling, which would affect the results.

Caster measurement

When measuring caster, the handbrake must be applied and the turntables must be centred under the front wheels. To allow the wheels to turn freely, the locking pins on both turntables must be removed.

On the rolling compensation results screen, select caster measurement  in the bottom left-hand corner. The caster measurement screen is shown in figure 4.2.3-1:



Figure 4.2.3-1 Caster measurement screen

The caster measurement applies to the front wheels and covers kingpin inclination and caster. Kingpin inclination spreads the vehicle's weight evenly over the bearings, protecting them from damage, and keeps steering effort even and light. Caster places the point where the steering axis meets the road ahead of the tyre contact point, so that the road's resistance on the tyre helps keep the vehicle running straight.

Screen elements:

- a. Scroll bar: the red square slides left and right as the steering wheel is turned;
- b. Steering direction prompt: tells the operator which way to turn the steering wheel;
- c. Target status: if there is an error acquiring target data, a target position adjustment prompt appears.

Note: Apply the handbrake and hold the brake pedal down before measuring caster and turning the steering wheel.

How to carry out the caster measurement

- 1) Following the on-screen prompt, first turn the steering wheel to the right (to approx. 8°). When the scroll bar nears the edge, stop turning.



Figure 4.2.3-2 Turning the steering wheel right

- 2) Following the on-screen prompt, turn the steering wheel to the left (to approx. -8°). When the scroll bar nears the edge, stop turning.



Figure 4.2.3-3 Turning the steering wheel left

- 3) Then, as prompted, slowly turn the steering wheel back to the right to the centre (approx. 0°);



Figure 4.2.3-4 Returning the steering wheel to centre

- 4) If the measurement is successful, the system automatically displays the results, as shown in the figure:



Figure 4.2.3-5 Caster measurement results

To show the condition of the vehicle at a glance, the results screen uses colour-coded values to indicate whether each measured value is within specification:

- Red: measured value outside the specified range

- Green: measured value within the specified range
- Black: measured value with no reference range

4.3 Lift mode

Standard measuring procedure in lift mode: Vehicle selection → Raise the vehicle/ rolling compensation → Adjustment → Caster measurement → Adjustment → Test drive → Save measurement data → View/print results. The procedure and method for lift mode are described below.

Note: Before rolling compensation, the steering wheel must be centred and secured with a steering wheel lock.

- 1) On the four-wheel data screen, tap **Lift up the vehicle** in the top left-hand corner. The software automatically switches to lift mode, and target monitoring switches mode accordingly.



Figure 4.3-1 Four-wheel data screen

- 2) When the software displays the prompt below, operate the lift and raise the vehicle slowly;

IT IS VERY IMPORTANT THAT THE TARGETS ALWAYS REMAIN WITHIN THE DOTTED LINES.

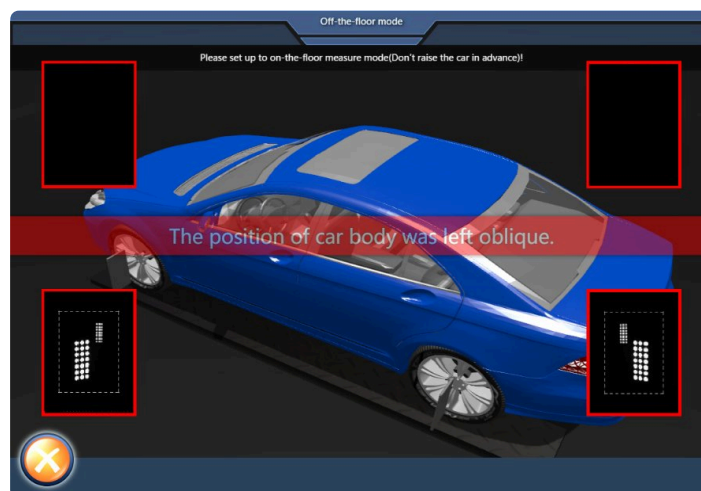


Figure 4.3-2 Raised vehicle screen 1

- 3) If the target frames are red, the targets are not in the correct position: raise the vehicle further or adjust the tilt angle of the targets. When the frames turn green, stop raising the vehicle and tap  to complete the lift mode setup;

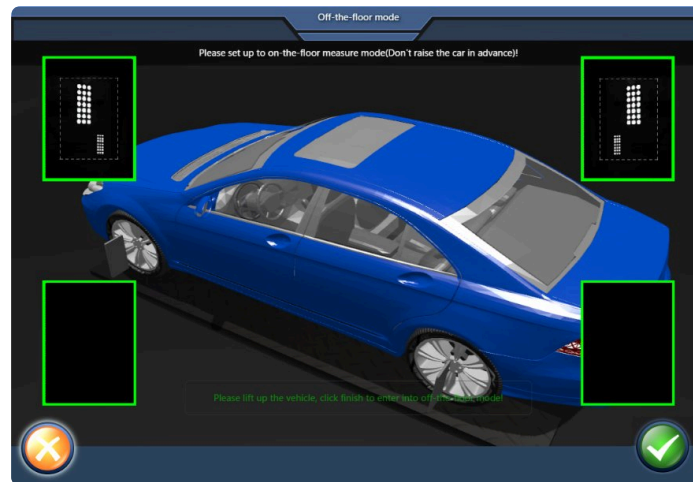


Figure 4.3-3 Raised vehicle screen 2

- 4) Once lift mode has been set up, the software automatically returns to the four-wheel data screen in lift mode. As shown in the figure below, tap **Re-push the vehicle** in the top right-hand corner to start rolling compensation;



Figure 4.3-4 Four-wheel data screen in lift mode

- 5) The rolling compensation screen is shown in figure 4.3-5. First, as prompted, slowly turn the left rear wheel backwards until the yellow reference line reaches the green dot, as shown in figure 4.3-6, then stop turning;

Note: Do not touch the target while turning the wheel!



Figure 4.3-5 Rolling compensation screen 1



Figure 4.3-6 Rolling compensation screen 2

- 6) Repeat this method, turning each wheel backwards in turn: left rear wheel, right rear wheel, right front wheel, left front wheel;

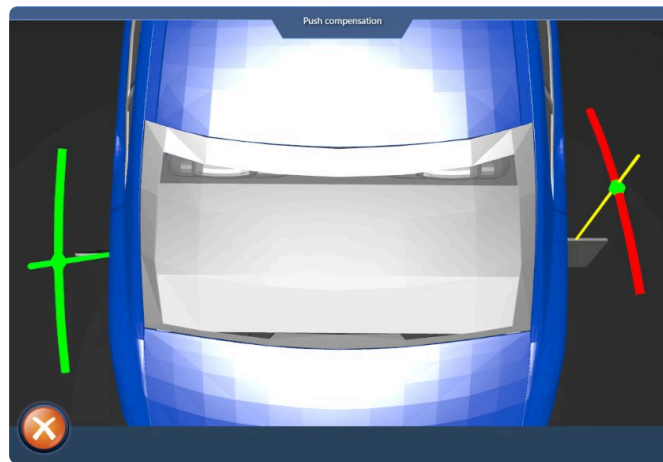


Figure 4.3-7 Rolling compensation screen 3

- 7) The measurement is complete and the results are shown below (the data in the figure is for illustration only and has no reference value).



Figure 4.3-8 Four-wheel data screen

To show the condition of the vehicle at a glance, the results screen uses colour-coded values to indicate whether each measured value is within specification:

- Red: measured value outside the specified range
- Green: measured value within the specified range

Precautions:

1. During measurement, remove any objects or people between the cameras and the targets so that the targets are not obstructed, which would affect the results.
2. Before measuring, make sure the steering wheel is centred and secured so that it cannot turn during rolling compensation, which would affect the results.

4.4 Vehicle adjustment

On the results screen, select **Adjust the rear wheel**, **Adjust the front wheel** or **Adjust the caster** to open the adjustment screen, as shown below:

General adjustment sequence: rear wheels first, then front wheels.

Rear wheel adjustment sequence: camber → toe

Front wheel adjustment sequence: caster → kingpin inclination → camber → wheelbase → toe

Note: For a general overview of wheel alignment and how to analyse the measurement data, see the appendix.



Figure 4.4 Adjustment screen

Caution!

On a new vehicle or one in good condition, adjusting to within the specified range will eliminate the fault; on an older or worn vehicle, the specifications should be used for reference only.

4.5 Saving data

When you tap the  button after completing the vehicle adjustment, the system displays the prompt below. Select **Save Data**, enter the vehicle details on the service record screen and tap **OK** to save. All test records can be viewed or edited on the data maintenance screen.

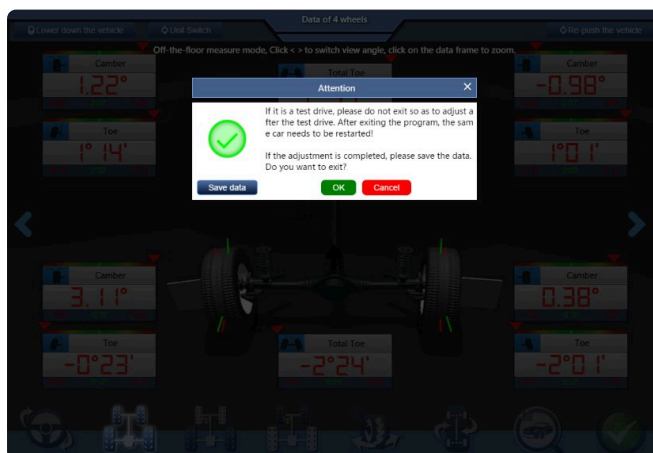


Figure 4.2.6-1 Save data prompt

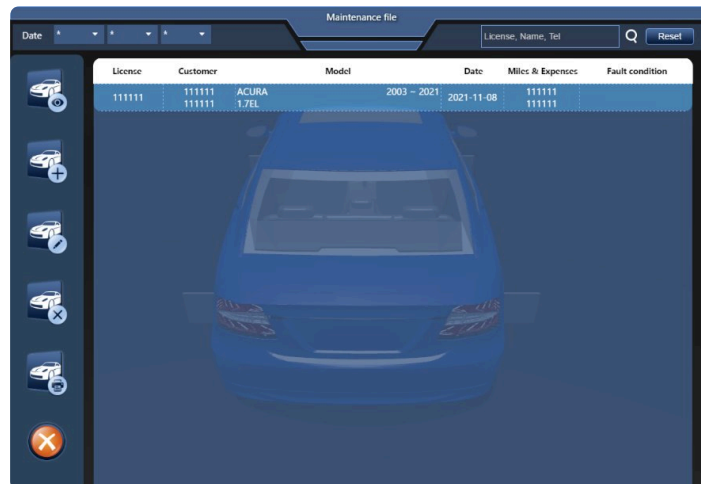


Figure 4.2.6-2 Saving measurement data

CHAPTER 5

Maintenance information

Select the maintenance information icon  on the main screen to view, edit, delete, create and print service records.



To print a four-wheel alignment report, connect a printer, keyboard, mouse and monitor to the measuring unit via the USB port or the relevant port, and install the printer driver on the measuring unit.

CHAPTER 6

System settings

Select the system settings icon  on the main screen to view workshop information, language settings, synchronisation settings, model display settings, print settings and more.



Figure 6-1 System settings

6.1 Print information settings

You can set the title, workshop name, address, etc. that appear on the test report.

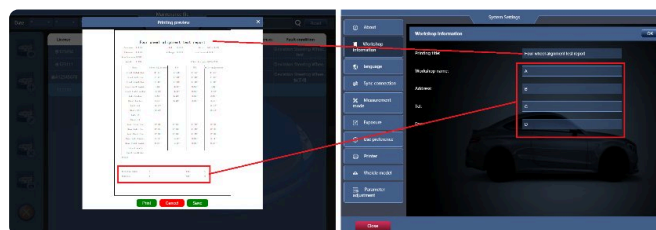


Figure 6.1-1 Print information settings

6.2 Target type setting

Select the target type that matches the installation option, as shown in Table 1.

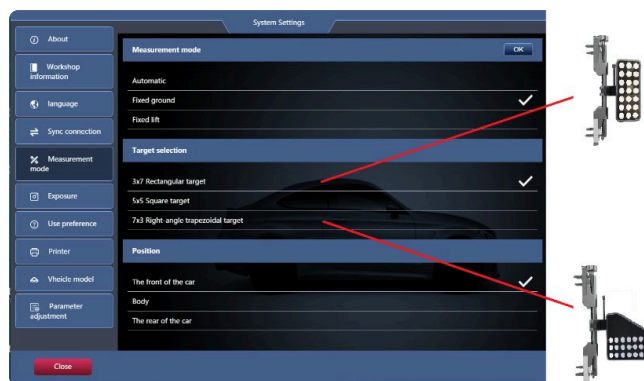


Figure 6.2-1 Target type setting

Table 1:

Target type	Photo	Applicable lift
Short scissor target		Short scissor lift installation, long scissor lift installation
Two-post target		Two-post lift installation, four-post lift installation
Large target 5*5	Not applicable	Not applicable
Small target 5*5	Not applicable	Not applicable

Tip: For the installation option for each lift, see section 2.3, “Installing the 5D four-wheel alignment system”, of this manual.

6.3 Unit settings

This setting defines the units displayed on the test report.

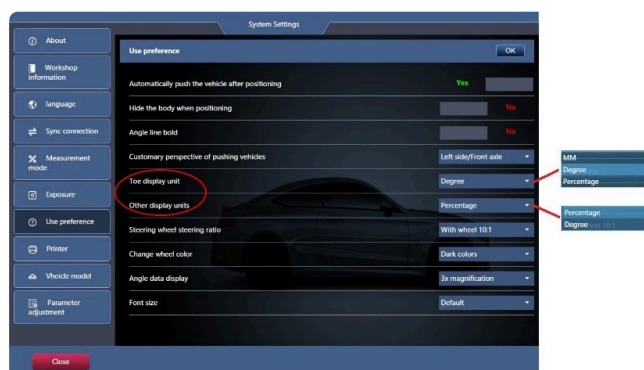


Figure 6.3-1 Unit settings

6.4 Vehicle front position setting

Set the vehicle front position to suit your measuring environment and working practice. Once it has been set, do not change it unnecessarily.

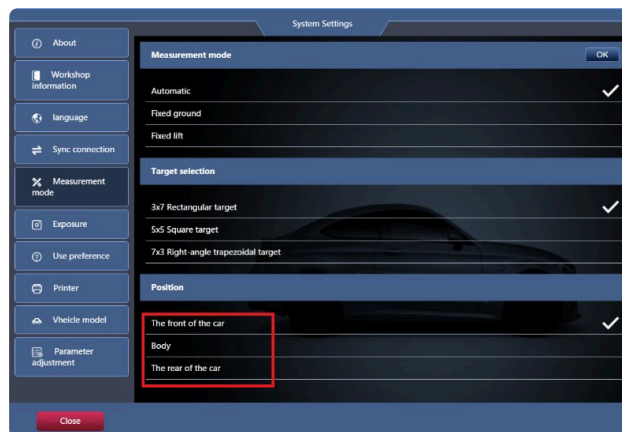


Figure 6.4-1 Vehicle front position setting

Position mode	Description
Front of vehicle	Ground mode: the front of the vehicle faces the four-wheel alignment measuring unit.
Body	Lift mode: the front of the vehicle faces the four-wheel alignment measuring unit.
Rear of vehicle	Ground mode: the rear of the vehicle faces the four-wheel alignment measuring unit.



6.5 Camera settings

If the measuring environment is too dark or too bright for the targets to return a good image, the camera exposure can be adjusted. In general, increase the exposure value if the target image is too dark and reduce it if the image is too bright.

The fields of view of the five cameras are shown in figures 6.5-1 and 6.5-2. Adjust the exposure of each camera according to its position.

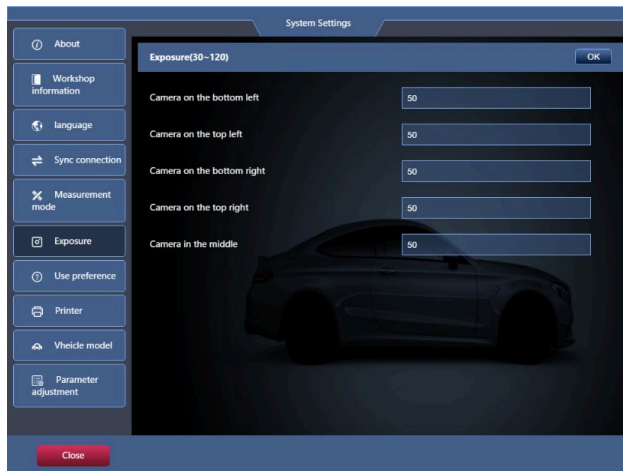


Figure 6.5-1 Camera exposure setting

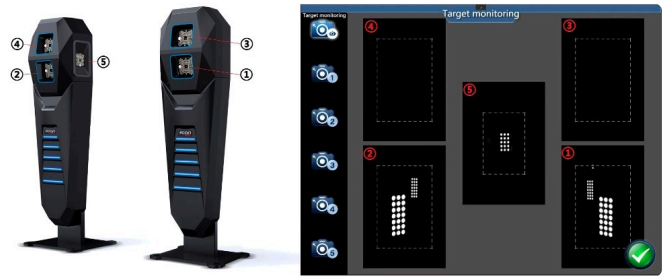


Figure 6.5-2 Camera positions

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Maintenance and storage environment

Environmental requirements:

- a. The machine is designed to operate between 0°C and 40°C. At ambient temperatures above or below this range, the machine may not work properly; take steps to keep the working temperature within range;
- b. Place the measuring unit and display on a flat workbench. Do not place the equipment near a heat source or in direct sunlight;
- c. Allow for heat dissipation while the equipment is in use and keep the area around it well ventilated. Protect the aligner's working area from moisture and corrosion; operating in a humid environment will harm the equipment;
- d. Some parts of the aligner, such as the monitor, are sensitive to magnets. Do not place the equipment near magnets.

Precautions for using the targets:

- 1) Protect the targets from glare and direct sunlight during use; otherwise they will not work properly;
- 2) Store them in a dry, ventilated place after use;
- 3) Clean the target surfaces regularly with a soft cloth;
- 4) Do not shake, knock or drop the targets, to avoid damaging the sensing element;
- 5) Do not open or modify the original structural parts.

Equipment maintenance

- a. Static electricity causes the screen surface to attract dust. A dedicated LCD screen wipe is recommended for cleaning the measuring unit's screen.
- b. Do not wipe off dust with your fingers, to avoid leaving fingerprints. Do not use chemical cleaners on the screen.
- c. Do not use solvents such as banana oil, engine cleaner or petrol to clean the measuring unit;

- d. If the equipment is dirty, first disconnect the power, then wipe its surface with a non-woven cloth or a mild neutral cleaner;
- e. If water or other liquid is splashed on the equipment during use, disconnect the power immediately.
- f. Protect the equipment from dust and keep it clean to extend its service life.

APPENDIX 1

Standard wheel alignment procedure

Step 1: Symptom enquiry and test drive

Listen carefully to the driver's description of the vehicle's symptoms and note them down. Some symptoms caused by incorrect alignment angles, such as tyre wear, can be seen visually; others cannot. If necessary, take the vehicle for a test drive to form an initial view of the likely causes of the fault.

Step 2: Inspection and repair of the steering and suspension systems

After the enquiry or test drive, the next step is to inspect all steering and suspension components. Technicians should be aware that wheel alignment alone is not enough to eliminate steering faults, tyre wear problems and other contributing factors. All steering and suspension components should be inspected before wheel alignment.

Step 3: Preliminary checks for a pulling vehicle

If the driver reports that the vehicle pulls to one side, first establish, before alignment, whether the pull is caused by tyre side slip. Proceed as follows:

- (1) With tubeless (radial) tyres, swap the left and right front wheels and then test drive the vehicle.
- (2) If, after swapping the left and right wheels, the vehicle pulls in the opposite direction to before, front tyre side slip is one of the contributing factors (often the main one). There are two solutions: **1** swap the four wheels around until a combination that eliminates the pull is found; **2** remove the tyre from either front wheel, turn it round (180°) and refit it. In most cases, turning the tyre round greatly reduces the pull caused by side slip. If there is no noticeable improvement, advise the driver to fit a new tyre.
- (3) If the pull is in the same direction after swapping the left and right front wheels, repeat the same procedure with the left and right rear wheels.
- (4) If the pull is still in the same direction after swapping the rear wheels, it is not caused by side slip. A four-wheel alignment measurement must be carried out to identify the cause.

Step 4: Four-wheel alignment measurement and analysis of the results

Measuring methods and operating steps vary between aligner manufacturers and there is no single standard, but the basic procedure is essentially the same:

- (1) Select the correct vehicle model.
- (2) Rim run-out compensation (ROC). In practice, many four-wheel alignment providers skip this step to save time. Great care should be taken if it is skipped: first, the rim must be in good condition; second, the sensor clamp must be carefully checked to make sure it is fully seated. Otherwise, skipping wheel compensation can cause an error of 0.1° to 0.2°, which in some cases is significant.
- (3) Measurement: read the data.
- (4) Vehicle adjustment. The adjustment sequence is: rear wheels first, then front wheels; camber before toe; on the front wheels, caster first, then camber and finally toe.

(5) Print the results.

Here we focus on analysing the measurement results.

Some of the effects of incorrect angles on vehicle behaviour were introduced in “Basic concepts of alignment angles” above. The symptoms are summarised below:

1) Pulling to one side

Causes of pulling:

- 1 Front caster differs between left and right by more than 0.5°. The vehicle pulls towards the side with less caster.
- 2 Front camber differs between left and right by more than 0.5°. The vehicle pulls towards the side with more front camber.
- 3 Rear camber differs between left and right by more than 0.5°. The vehicle pulls towards the side with less rear camber.
- 4 Changes in the vehicle's wheelbase can be seen from the front and rear axle setback. When the sum of front and rear setback exceeds 0.2°, a noticeable pull occurs towards the side with the shorter wheelbase.

Causes of pulling that the four-wheel aligner cannot detect:

- 5 Side slip, mostly caused by the tyres.
- 6 Uneven tyre pressures.
- 7 Unbalanced or dragging brakes.
- 8 Unbalanced power steering assistance.
- 9 Worn or maladjusted suspension parts.

Because the four-wheel aligner cannot detect every cause of pulling, the aligner may show everything to be correct while the vehicle still pulls. In this case, check each item in turn.

Note:

In everyday four-wheel alignment work, it is common for a vehicle that did not pull, or pulled only slightly, to start pulling or pull more after the front toe has been adjusted. It is tempting to blame the toe adjustment, but this is not actually the cause. When a vehicle runs straight, the left and right toe are always equal, so front toe on its own does not cause a pull. However, if the front toe is incorrect, the friction between the tyres and the road increases, and this masks the pull. In fact, the vehicle already has a tendency to pull for other reasons, but it is masked. When a pull is masked in this way, it usually shows up as severe tyre wear. If you then adjust the toe without analysing all the factors that cause pulling, a fault that was not serious before will become apparent. The problem must therefore always be analysed and dealt with as a whole.

2) Tyre wear

Causes of tyre wear:

1. Both front tyres worn on the outer or inner edge: incorrect front toe.
2. One front tyre worn: incorrect camber.
3. Rear tyres worn: incorrect camber or toe.

In addition, a cause of tyre wear that the four-wheel aligner cannot detect is poor driving habits.

1. Tyre pressure too high: wear along the centre of the tread.
2. Tyre pressure too low: wear on both shoulders at the same time.
3. Chassis component problems

3) Vehicle floats

Caster close to zero or negative.

(1) Heavy steering

1. Excessive caster
2. Incorrect camber
3. Suspension parts slightly bent or seized after severe impacts.

(2) Poor steering wheel return

1. Insufficient caster
2. Steering gear problem
3. Other binding caused by incorrect angles.
4. Tyre problem

4) The rear of the vehicle steps out over slight bumps or under acceleration, mainly caused by incorrect rear toe.

Step 5: Adjustment

Once the analysis and diagnosis are complete, the alignment angles can be adjusted. The technician should have a clear idea of what the adjustment is expected to achieve. Adjust in the following order:

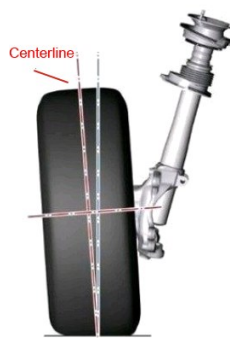
1. Rear axle wheels first: rear camber → rear toe
2. Then the front axle wheels: if toe-out on turns is incorrect, replace the steering arm → caster (on vehicles with adjustable engine mounts, always adjust the engine mounts first) → camber → toe (with the steering wheel centred and locked).

APPENDIX 2

Basic wheel alignment concepts

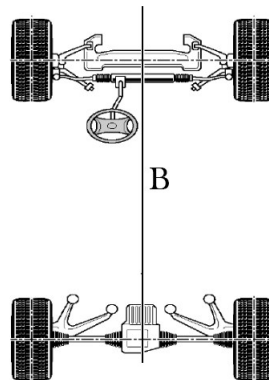
2.1 Wheel centreline

The straight line formed where the tyre contacts the ground; the line perpendicular to this line is called the wheel centreline.



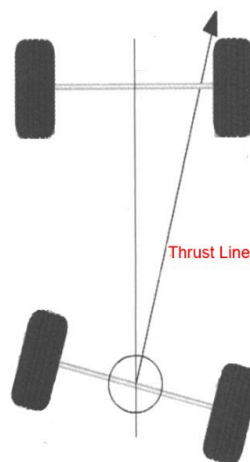
2.2 Vehicle centreline

The line that bisects the front and rear axles of the vehicle. B: vehicle centreline, also called the geometric centreline.



2.3 Thrust line

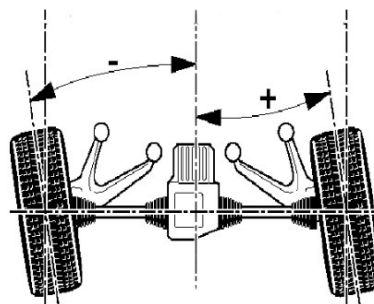
The line that bisects the toe angle of the rear wheels is called the thrust line, and the angle between the thrust line and the vehicle centreline is called the thrust angle.



2.4 Toe

Front toe is the angle between the vehicle's thrust line and the wheel centreline. Rear toe is the angle between the vehicle centreline and the wheel centreline.

Viewed from the front of the vehicle, if the wheel centreline points away from the thrust line or the vehicle centreline, toe is negative (toe-out); otherwise it is positive (toe-in).



2.4.1 Function

Reduces tyre wear and rolling friction.

2.4.2 Symptoms

1) Excessive toe-in causes

a. Rapid wear on the outer edge

- On radial tyres, a wear pattern similar to that caused by excessive positive camber.
- Saw-tooth or block wear.
- Running a hand across the tread from the inside to the outside, the inner edge of the tread feels sharp.

b. Unstable steering

- Poor straight-line stability
- Wheel shimmy

2) Excessive toe-out causes

a. Rapid wear on the inner edge

- On radial tyres, a wear pattern similar to that caused by excessive negative camber.
- Saw-tooth or block wear.
- Running a hand across the tread from the outside to the inside, the inner edge of the tread feels sharp.

b. Unstable steering

- Poor straight-line stability
- Wheel shimmy

2.4.3 Front toe adjustment method

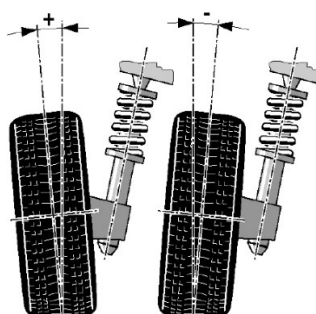
Adjust the track rods

2.4.4 Rear toe adjustment method

Original adjusters, eccentric cams, eccentric bolts, eccentric bushes and slotted shims.

2.5 Camber

Camber is the angle between the wheel centreline and the vertical plane of the vehicle. It is positive when the top of the wheel tilts outwards and negative when it tilts inwards. The main purpose of camber is to distribute the dynamic load between the wheel and the road correctly, extending the life of mechanical parts and reducing tyre wear. If camber is incorrect, the tyres wear abnormally and the vehicle pulls to one side when driven.



2.5.1 Function

Ensures the vehicle load acts on the centre of the tyre, eliminating pull and reducing tyre wear.

2.5.2 Symptoms

- 1) Excessive positive camber
 - a. One-sided wear on the outer edge of the tyre
 - b. Accelerated wear of suspension components;
 - c. The vehicle pulls towards the side with more camber.
- 2) Excessive negative camber
 - a. One-sided wear on the inner edge of the tyre;
 - b. Accelerated wear of suspension components;
 - c. The vehicle pulls towards the side with less camber.

2.5.3 Example

Left front camber is set to 1.0° and right front camber to 0.5°; the vehicle pulls to the left (a left/right camber difference of 0.5° causes a pull).

2.5.4 Camber adjustment methods

Shims, eccentric cams, slotted holes, ball joint rotation, strut rotation, wedge shims, adjustable bearing housings, eccentric bolts, eccentric bushes and offset ball joints.

2.6 Setback

Setback is the angle between the line through the centres of the two front wheels (or the two rear wheels) and the line perpendicular to the thrust line. It is positive if the right wheel is ahead of the left wheel, and negative if it is behind. If the wheelbase is known, setback can be expressed in mm.

2.6.1 Causes of setback

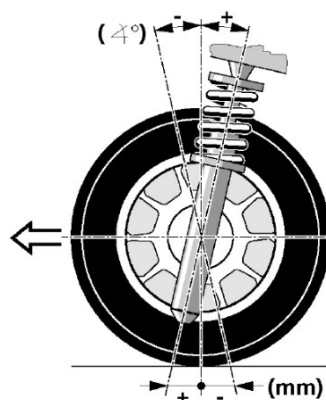
- Manufacturer design (specifically intended to offset the effect of road camber);
- Collision

2.6.2 Symptoms

Setback actually reflects a change in the vehicle's wheelbase. When setback reaches a certain level, the vehicle pulls towards the side with the shorter wheelbase.

2.7 Caster

Viewed from the side of the vehicle, caster is the angle between the vertical and the line joining the upper ball joint (or top of the strut) to the lower ball joint — the kingpin, about which the wheel turns when the vehicle steers. It is positive when the upper ball joint is behind the vertical, and negative when it is in front.



2.7.1 Function

Affects steering stability and the steering wheel's self-centring ability.

2.7.2 Symptoms

- Insufficient caster causes instability: the steering wheel lacks self-centring after a turn, and the vehicle floats at high speed (pay particular attention to this when driving on motorways).
- Unequal caster causes pulling: when left and right caster differ by more than 30' (0.5°), the vehicle pulls towards the side with less caster.

2.7.3 Example

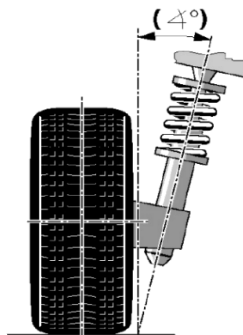
Left front caster is set to +0.5° and right front caster to +1.5°; the vehicle pulls to the left.

2.7.4 Caster adjustment methods

Shims, eccentric cams, slotted holes, strut rods, strut rotation, engine mount repositioning and eccentric ball joints.

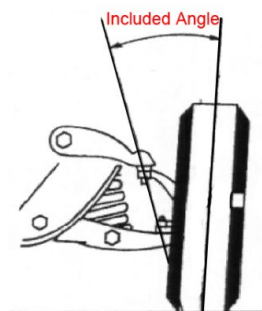
2.8 Kingpin inclination (steering axis inclination)

Viewed from the front of the vehicle, kingpin inclination is the angle between the vertical and the line joining the upper ball joint (or top of the strut) to the lower ball joint. It is positive when the top leans inwards and negative when it leans outwards. A suitable kingpin inclination makes the vehicle easy to steer, reduces road shocks transmitted through the steering to the steering wheel and provides a degree of self-centring. Kingpin inclination is the slight inward tilt of the kingpin on the front axle, and its purpose is to self-centre the front wheels. The greater the angle, the stronger the self-centring of the front wheels, but the heavier the steering and the greater the tyre wear; conversely, the smaller the angle, the weaker the self-centring effect.



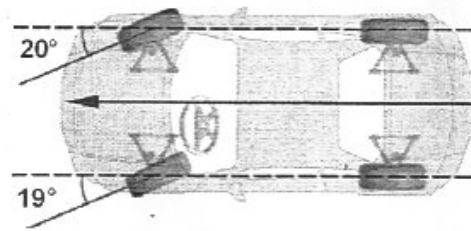
2.9 Included angle

The included angle is the angle between the wheel centreline and the steering axis; that is, the included angle equals the geometric sum of camber and kingpin inclination.



2.10 Toe-out on turns

The 20° toe-out on turns is the difference between the steering angles of the inner and outer wheels when the vehicle turns.



2.11 Thrust angle

The thrust angle is the angle between the vehicle centreline and the thrust line. It is positive when the thrust line lies to the left of the vehicle centreline, and negative otherwise.

A thrust angle pushes the rear of the vehicle to one side. To keep the vehicle running straight, the front wheels have to steer in the direction of the thrust line. If the front toe does not compensate for the thrust angle, the steering wheel will be off-centre when the vehicle runs straight. If the rear toe is adjustable, the thrust angle should be brought as close to zero as possible.

The thrust line is the direction in which the vehicle actually travels and is determined by the rear toe. When the thrust line does not coincide with the geometric centreline of the vehicle, the steering wheel must be turned to keep the vehicle straight, leaving it off-centre. At the same time, the rear wheels do not follow the same path as the front wheels; this is known as “dog tracking”. When the thrust line does not point straight ahead, the steering wheel must be turned to one side to keep the vehicle straight, which leaves the steering wheel off-centre.

If the thrust line is ignored, alignment accuracy cannot be guaranteed; this is the main cause of an off-centre steering wheel.

Using the thrust line as the measurement reference makes it possible to:

- ☆ After adjusting the rear toe to the specified (factory) value, the thrust line coincides with the vehicle centreline. On vehicles with adjustable rear suspension, adjust the rear toe so that the thrust angle is as close to zero as possible.
- ☆ The steering wheel can be centred using the thrust line as reference, whether or not the thrust angle is zero.

When the rear toe is not adjustable, adjust the front toe so that the front and rear toe angles match, setting it so that the steering wheel is centred and aligned with the direction of the rear wheels (thrust line). This ensures a centred steering wheel.

2.11.1 Causes of thrust angle

- It arises together with setback.
- Unequal rear toe.

2.11.2 Effects of thrust angle

- Tyre wear
- Off-centre steering wheel
- Pulling to one side
- The vehicle body runs crabwise when driving straight
- Steering wheel not straight

2.11.3 Correcting thrust angle

- Original manufacturer's adjuster
- Fit a wedge shim between the axle and the wheel
- Fit an adjuster behind the cam or similar

FCAR FD505

Common problems and solutions

1. The tablet does not synchronise with the computer program.

Check whether the tablet is connected to another network instead of the aligner's network (the tablet must be connected to the measuring unit's network to synchronise correctly).

2. Some wheels report that the target shows fewer circles than required

- 1) The target surface is dirty
- 2) The target is fitted at the wrong angle
- 3) The target is obstructed
- 4) The target is outside the camera monitoring screen or close to its edge
- 5) The target appears too bright or too dark on the camera monitoring screen

3. The tablet shows a login failure

- 1) Check that the measuring unit's Wi-Fi signal is present
- 2) Check that the tablet is connected to the measuring unit's wireless router
- 3) Switch off the measuring unit and switch it back on to restart the computer.

4. The equipment does not start or the tablet shows nothing

- 1) Check that the cables are in good order and the battery is charged; charge the measuring unit or tablet.
- 2) Check that the HDMI cable between the TV and the measuring unit is properly connected.

5. Routine care

Clean the targets, the filter (use a soft cloth; never wipe the filter surface with a rough cloth) and the lamp board regularly, as dust impairs reception.

FCAR FD505

Warranty

Dear FCAR customer,

Thank you for choosing FCAR. To get the best from the product, please look after it and follow the instructions in the user manual every time you use it. If you do so, your product will give you long-lasting, high-quality service.

1. This product is installed on site by FCAR technicians or authorised technicians, and the installation is checked on site.
2. The technicians provide on-site training on the use of the equipment and hand it over once you are proficient.
3. The product must be purchased from a distributor authorised by FCAR Technology. If the product was purchased through unofficial channels, the purchaser must pay for any repair service.
4. The following items are not covered by the warranty: tablet PC (display, touch screen), product manual, inner and outer packaging, targets, glass targets, dongle, promotional gifts and other consumables.
5. From the date of purchase (as shown by a valid proof of purchase and valid warranty card for this product), the complete machine is guaranteed for three years against performance faults not caused by human damage. Repairs are free of charge in the first year and chargeable in the second and third years.
6. Your product is not covered by the free warranty in any of the following cases:
 - 1) Faults or defects not caused by the quality of the FCAR product, including failure to use the product in accordance with the product manual and improper handling such as knocks, drops or unauthorised assembly and disassembly, resulting in pressure loss, or corrosion and rust caused by ingress of liquids or food;
 - 2) Normal wear and tear of the product, including but not limited to the housing, mouse, keyboard, column, clamps, etc.
 - 3) Disassembly, repair or modification without the approval of FCAR Technology.
7. If quality problems or faults occur during the warranty period, you can take the following steps:
 - 1) Contact the local distributor from whom you purchased the product or FCAR Europe customer service at **serviciotecnico@efitaller.com** for the correct service information.
 - 2) Once you have received a valid reply from the distributor or the company, send the product to the address designated by the company's factory for repair and maintenance, so that it can be repaired promptly and further loss prevented.
8. During warranty service, you will bear the costs of shipping the product and related costs, including packaging, transport and insurance.
9. The free warranty service provided under this warranty is the sole remedy for loss caused by product defects during the warranty period. FCAR Technology is not liable for any direct or indirect losses you may incur.
10. All warranty information, product features and specifications will be published in FCAR Technology's latest promotional materials and on its website without prior notice.

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flawless diagnostics.**

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