FOUR-WHEEL ALIGNMENT

20.1 FOUR-WHEEL ALIGNMENT

1 Warning and Precaution

1.1 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair.

(1) Be sure to perform wheel alignment procedures according to operating instructions of four-wheel alignment device.

(2) Periodic maintenance and service for four-wheel alignment device should be performed.

(3) After four-wheel alignment is completed, the center position calibration needs to be recalibrated.

(4) After four-wheel alignment is completed, it is necessary to perform SAM steering angle zero point calibration and motor position sensor calibration inside EPS module.

2 System Overview

2.1 System Description

As the installation among four wheels, steering mechanism and front and rear axles should have a certain relative position, which is the standard value formulated by manufacturer. Adjusting and restoring the installation in this position is wheel alignment.
In general, wheel alignment has the following 6 parameters:

(1) Check front wheel camber.

(2) Check front wheel toe-in.

(3) Check kingpin caster.

(4) Check kingpin inclination.

(5) Check rear wheel camber.

(6) Check rear wheel toe-in.

3 Parameter Operation Description

3.1 System Function Introduction

Front wheel alignment includes kingpin caster, kingpin inclination, front wheel camber and front wheel toe-in. Rear wheel alignment includes wheel camber and each rear wheel toe-in. In this way, front wheel alignment and rear wheel alignment are called wheel alignment, which is often called four-wheel alignment. The role of wheel alignment is to keep vehicle in stable straight line and light steering, and reduce wear of tires and steering gear parts during driving.

3.2 Kingpin Caster

When looking at wheel from side, steering kingpin (the center of rotation when the wheel turns) tilts backward, which is called kingpin caster. After setting kingpin caster, there is a distance (called kingpin caster distance, which is the same principle that the front wheel cross beam of bicycle tilts backward) between ground point of kingpin center line and ground projection point of wheel center. The ground point of wheel is located at rear end of extension line of steering kingpin, and wheel is pulled back by rolling resistance during driving, so that the direction of wheel is naturally toward driving direction. Setting a large kingpin caster can improve straight line driving performance, and kingpin caster distance is also increased. If kingpin caster distance is too large, steering wheel will be heavy and wheel bumps will be increased due to road interference.

3.3 Kingpin Inclination

When looking at the tire from front and rear direction of vehicle, kingpin is inclined toward the inside of vehicle body. This angle is called kingpin inclination. When wheel revolves around kingpin, the lowest point of wheel will sink below road surface, but in fact, the lower edge of wheel cannot sink below road surface. Instead, steering wheel and entire front of vehicle are lifted up to a corresponding height. The gravity of vehicle has effect of returning steering wheels to original middle position, so steering wheel is easy to reset.
In addition, kingpin inclination also reduces the distance between intersection of kingpin and road to intersection of wheel center plane and ground, thereby reducing driver's force on steering wheel during

steering, making steering easier and reducing the impact force transmitted from steering vehicle wheel to steering wheel. However, kingpin inclination should not be too large, otherwise it will accelerate tire wear.

3.4 Front Wheel Camber

When looking at wheel from front and rear direction, tires are not installed vertically, but slightly tilted to show an "八" shape, which is called negative camber, and when it is tilted in opposite direction, it is called positive camber. In heyday of using bias tires, camber was set to be relatively large because it made it easier to operate the steering wheel by tilting the tires to the ground. Vehicle generally sets camber to be very small, close to vertical. The use of flat radial tires for automobiles continues to grow in popularity. Due to characteristics of radial tires (large rigid tire tread pattern and wide outer tread), setting a large camber will cause tire to wear out and reduce tire friction. Also, due to continuous use of power steering mechanism, camber has been continuously reduced. Nevertheless, setting a small camber can apply appropriate lateral thrust to wheel bearings on axle.

3.5 Front Wheel Toe-in

Four-wheel alignment toe value
Toe-in, the so-called "pigeon toe", refers to the front left and front right wheels being pointed inward respectively. The purpose of adopting this structure is to correct outward rotation of wheel caused by front wheel camber. As mentioned above, due to camber, the steering wheel operation becomes more easy. On the other hand, due to the tilt of wheels, front left and front right wheels rotate to outside respectively. To correct this problem, the left and right wheels have an inward angle, thus left and right wheels can keep moving in a straight line and reducing tire wear.

4 Specifications (Parameters Standard for Four-wheel Alignment)

Items		Specified Value
Front Wheel	Front Wheel Camber	-30′ ± 30′
	Kingpin Caster	6°43′ ± 45′
	Kingpin Inclination	13°54′ ± 45′
	Front Wheel Toe-in	8′ ± 6′ (one side)
Rear Wheel	Rear Wheel Toe-in	10′ ±6′ (one side)
	Rear Wheel Camber	-1°11′ ± 30′

5 Diagnostic Information and Steps

5.1 Problem Symptoms Table

Hint:
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair or adjust faulty components, or replace as necessary.

Symptom	Suspected Area
Vehicle pulls	Front wheel alignment (incorrect)
	Rear wheel alignment (incorrect)
Wheel shimmy	Front wheel alignment (incorrect)
	Rear wheel alignment (incorrect)
Abnormal tire wear	Tire (worn or improperly inflated)
	Front wheel alignment (incorrect)
	Rear wheel alignment (incorrect)

6 On-vehicle Service

6.1 Inspection before Wheel Alignment

If following components have been removed, installed or replaced, check and perform wheel alignment procedures:

- Front control arm assembly
- Front control arm ball pin assembly
- Front steering knuckle
- Front shock absorber assembly
- Steering gear and steering tie rod
- Drive shaft
- Front sub frame welding assembly
- Rear torsion beam welding assembly

(1) Vehicle is in unloaded state.

(2) Use a lift to support and raise vehicle to a proper height.

(3) Check hub bearing for excessive clearance, and replace hub bearing as necessary.

(4) Check suspension components, steering tie rod and ball pin for wear, deformation or damage. Replace malfunctioning parts as necessary.

(5) Check shock absorber assembly for proper operation.

(6) Check if tire pressure is within specified range and adjust it to specified pressure as necessary.

Items	Front Wheel	Rear Wheel	Spare Tire
Tire Pressure (kPa) (Unloaded)	220 (Unloaded 17 inch) 230 (Unloaded 18/19 inch)	220 (Unloaded 17 inch) 230 (Unloaded 18/19 inch)	420

(7) Check rim and tire.
1)Visually check rim and tire for scratches, wear or damage.
2)Perform wheel dynamic balance procedures.

6.2 Front Wheel Camber

(1) Incorrect front wheel camber will cause abnormal tire wear. Check and adjust front wheel camber as necessary.
In normal conditions, it is not necessary to adjust camber after assembling independent suspension and wheel steering knuckle. If wheel camber is not within the tolerance due to other reasons, adjust through the coupling bolt between independent suspension and steering knuckle.
Specified Value for Front Wheel Camber:

Items	Parameter
Front Wheel Camber	-30′ ± 30′

■ **Inspection**

(1) Visually check driving system components for deformation and damage before adjustment. Replace deformed or damaged components as necessary.

(2) Install wheel alignment device onto front wheel, and perform inspection procedures according to operating instructions for wheel alignment device.

6.3 Front Wheel Toe-in

(1) Incorrect front wheel toe-in will cause wheel pull and abnormal tire wear. Check and adjust front wheel toe-in as necessary.
If front wheel toe-in is not within the tolerance due to other reasons, adjust the length of steering tie rod to return the toe-in to specified value.
Specified Value for Front Wheel Toe-in:

Items	Parameter
Front Wheel Toe-in	8′ ±6′ (one side)

■ **Inspection**

(1) Perform inspection with four-wheel alignment device (perform inspection procedures referring to operating instructions for four-wheel alignment device).

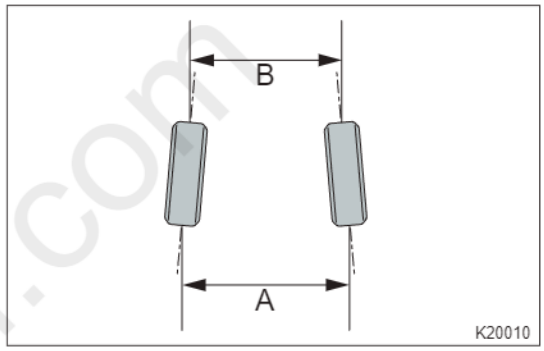
(2) Manual check:

1) Park vehicle on level ground, check if front tire pressure is within the specified range and adjust it to specified value as necessary.

2) Place marks on center position in front of front wheels, and measure distance A between marks with a tape measure.

3) Push vehicle to rotate wheels 180°, and measure distance B between marks with a tape measure when marks are turned to rear of wheels.

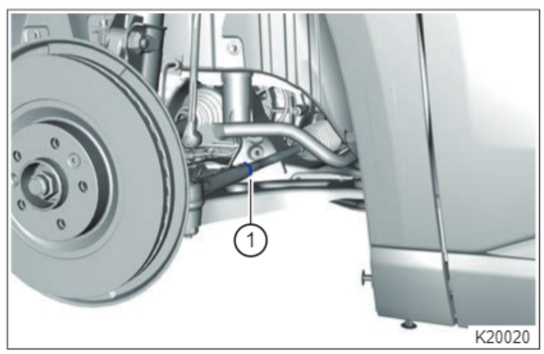
4) Calculation method: Front wheel toe-in = A - B ⩽ 1 mm.



■ **Adjustment**

(1) Make adjusting preparation for wheel alignment according to requirement of tester.

(2) Loosen the locking nut (1) of steering tie rod, and turn the tie rod to adjust the length as required until front wheel toe-in reaches the specified value.



(3) Tighten the steering tie rod locking nut (23# dual-purpose wrench) and reinstall the elastic jacket snap ring. Check if locking nut is tightened in place and if jacket position is correct.

Tightening torque: 50 ± 5 N·m

⚠ Caution
• **If elasticity of elastic jacket snap ring is not enough, replace it.**

(4) After adjusting front wheel toe-in, check steering wheel for eccentricity. If necessary, loosen the steering wheel locking nut and adjust the steering wheel to horizontal position, and then tighten the steering wheel locking nut (22# socket wrench) to specified torque.

Tightening torque: 48 ± 4 N·m

6.4 Kingpin Caster & Kingpin Inclination

(1) Kingpin caster and kingpin inclination can only be checked by using four-wheel alignment device.

Kingpin caster and kingpin inclination are assured by design structure and cannot be adjusted.

If measured value is not within the specified range, check if other components that connect to steering knuckle are deformed or damaged. In addition, check the connecting part of steering knuckle for deformed or damaged.

If so, replace corresponding components.

Specified Value for Kingpin Caster & Kingpin Inclination:

Items	Parameter
Kingpin Caster	6°43′ ± 45′
Kingpin Inclination	13°54′ ± 45′

6.5 Rear Wheel Camber

(1) Incorrect rear wheel camber will cause wheel pull and abnormal tire wear. Check and adjust rear wheel camber as necessary.

If rear wheel camber is not within the tolerance due to other reasons, adjust eccentric adjusting bolt and eccentric adjusting shim between rear lower control arm assembly and rear sub frame welding assembly to return the camber to specified value.

If rear wheel camber is not as specified, check rear suspension and wheels for damage or deformation. Replace damaged or deformed components as necessary.

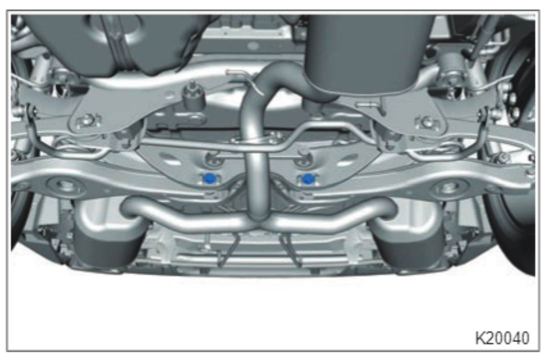
Specified Value for Rear Wheel Camber:

Items	Parameter
Rear Wheel Camber	-1°11′ ± 30′

■ **Adjustment**

(1) Make adjusting preparation for wheel alignment according to requirement of tester.

(2) Loosen the coupling bolts (18# socket wrench) between rear lower control arm assembly and rear sub frame welding assembly, be careful that eccentric adjusting shim does not detach from groove.



(3) Rotate the eccentric adjusting shim and eccentric adjusting bolt to adjust rear wheel camber to specified value.

(4) Tighten the coupling bolts (18# socket wrench) between rear lower control arm assembly and rear sub frame welding assembly to specified torque after adjustment (adjusting method of left and right wheels is the same).

Tightening torque: 100 ± 7.5 N·m

6.6 Rear Wheel Toe-in

(1) Incorrect rear wheel toe-in will cause wheel pull and abnormal tire wear. Check and adjust rear wheel toe-in as necessary.

If rear wheel toe-in is not within the tolerance due to other reasons, adjust eccentric adjusting bolt and eccentric adjusting shim between tie rod assembly and rear sub frame welding assembly to return the toe-in to specified value.

If rear wheel toe-in is not as specified, check rear suspension and wheels for damage or deformation. Replace damaged or deformed components as necessary.

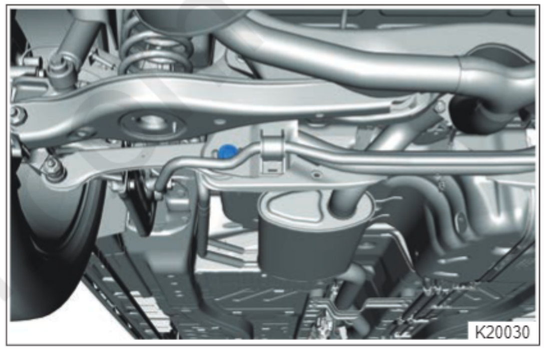
Specified Value for Rear Wheel Toe-in:

Items	Parameter
Rear Wheel Toe-in	10′ ±6′ (one side)

■ Adjustment

(1) Make adjusting preparation for wheel alignment according to requirement of tester.

(2) Loosen the coupling bolts (21# socket wrench) between tie rod assembly and rear sub frame welding assembly, be careful that eccentric adjusting shim does not detach from groove.



(3) Rotate the eccentric adjusting bolt and eccentric adjusting sleeve to adjust rear wheel toe-in to specified value.

(4) Tighten the coupling bolts (21# socket wrench) between tie rod assembly and rear sub frame welding assembly to specified torque after adjustment (adjusting method of left and right wheels is the same).

Tightening torque: 130 ± 10 N·m