Annex B.1

China Intelligent-connected Car Assessment Programme

China Intelligent-connected Car Assessment Programme (C-ICAP)

(Version 1.1)

Detailed Rules for Assessment of Basic Parking Assistance

C-ICAP

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1 Assessment Method

1.1 Indicator System

The indicators for basic parking assistance are shown in Table 1-1.

Table 1- 1 Indicator System for Basic Parking Assistance

	level-1 indicator	level-2 indicator	Level-3 indicator
Basic parking assistance	Parking ability in front of parking space	Parallel parking space berthing-in ability	Parallel parking space-spatial parking space (standard size)
			Parallel parking space-spatial parking space (reduced size)
			Parallel parking space-parking space with lines
			Obstacle in parallel parking space
			Parallel parking space partially occupied
		Vertical parking space berthing-in ability	Vertical parking space-spatial parking space (standard size)
			Vertical parking space-spatial parking space (reduced size)
			Vertical parking space-parking space with lines
			Column obstacle on one side of vertical parking space
			Pedestrian interference during parking process
		Oblique parking space berthing-in ability	Oblique parking space-spatial parking space (standard size)
			Oblique parking space-spatial parking space (reduced size)
			Oblique parking space-parking space with lines
	Remote parking ability in front of parking space	Failure of remote controller	Loss of continuous remote-control function of remote parking assistance
		Incorrect use of remote-control function	Incorrect use of remote parking assistance function

1.2 Allocation of Weight to Indicators

1.2.1 Allocation of Weight to Level-1 Indicators

For the basic parking assistance, there are two level-1 indicators: berthing-in ability in front of parking space and remote parking ability in front of parking space. The weight of each level-1 indicator is shown in

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Table 1-2.

Table 1- 2 Weights of Level-1 Indicators for Basic Parking Assistance

No.	level-1 indicator	Weight
1	Parking ability in front of parking space	100%
2	Remote parking ability in front of parking space	+2%

1.2.2 Allocation of Weight to Level-Indicators

The weights of test scenarios of indicators at all levels for basic parking assistance are shown in Table 1-3.

Table 1- 3 Weights of Level-2 Indicators for Basic Parking Assistance

level-1 indicator	No.	level-2 indicator	Weight
Parking ability in front of parking space	1	Parallel parking space berthing-in ability	55%
	2	Vertical parking space berthing-in ability	40%
	3	Oblique parking space berthing-in ability	5%
Remote parking ability in front of parking space	1	Failure of remote controller	50%
	2	Incorrect use of remote-control function	50%

1.2.3 Allocation of Weight to Level-3 Indicators

The weights of test scenarios of indicators at all levels for basic parking assistance are shown in Table 1-4.

Table 1- 4 Weights of Level-3 Indicators for Basic Parking Assistance

	level-1 indicator	level-2 indicator	Level-3 indicator	Weight
Basic parking assistance	Parking ability in front of parking space	Parallel parking space berthing-in ability	Parallel parking space-spatial parking space (standard size)	30%
			Parallel parking space-spatial parking space (reduced size)	20%
			Parallel parking space-parking space with lines	20%
			Obstacle in parallel parking space	15%
			Parallel parking space partially occupied	15%
		Vertical parking space berthing-in ability	Vertical parking space-spatial parking space (standard size)	30%
			Vertical parking space-spatial parking space (reduced size)	20%
			Vertical parking space-parking space with lines	20%
			Column obstacle on one side of vertical	15%

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			parking space	
			Pedestrian interference during parking process	15%
		Oblique parking space berthing-in ability	Oblique parking space-spatial parking space (standard size)	35%
			Oblique parking space-spatial parking space (reduced size)	25%
			Oblique parking space-parking space with lines	40%
	Remote parking ability in front of parking space	Failure of remote controller	Loss of continuous remote-control function of remote parking assistance	50%
		Incorrect use of remote-control function	Incorrect use of remote parking assistance function	50%

1.3 Scoring Method

The total score of basic parking assistance shall be calculated on the basis of the score and weight of level-1 indicators, with two decimal places reserved. The calculation method is shown in Formula 1-1.

$$S = \sum_{i=1}^{4} S_i \times b_i \tag{1-1}$$

Where: S is the total score of basic parking assistance, and i is the serial number of level-1 indicator. S_i and b_i are the score and weight of level-1 indicator with the serial number of i.

1.3.1 Scoring Method for Level-1 Indicators

The score of each level-1 indicator shall be calculated on the basis of the scores and weights of level-2 indicators, with two decimal places reserved. The calculation method is as shown in Formula 1-2.

$$S_i = \sum_{j=1}^{n_i} S_{ij} \times b_{ij} \tag{1-2}$$

Where: Si is the score of level-1 indicator, i is the serial number of level-1 indicator, j is the serial number of level-2 indicator, and n_i is the number of level-2 indicators. $S_{ij}$and b_{ij} are the score of level-2 indicator and the weight of the corresponding level-2 indicator respectively.

1.3.2 Scoring Method for Level-2 Indicators

The score of each level-2 indicator shall be calculated on the basis of the scores and weights of level-3 indicators, with two decimal places reserved. The calculation method is as shown in Formula 1-3.

$$S_{ij} = \sum_{z=1}^{n_{ij}} s_{ijz} \times b_{ijz} \tag{1-3}$$

Where: S_{ij} is the score of level-2 indicator. i is the serial number of level-1 indicator, j is the serial number

of level-2 indicator, z is the serial number of level-3 indicator, and n_{ij} is the number of level-3 indicators. S_{ijz} and b_{ijz} are the score of level-3 indicator and the weight of the corresponding level-3 indicator respectively.

1.3.3 Scoring Method for Level-3Indicators

Each test item shall be repeated for 3 times, and the VUT shall be able to identify the parking space target and complete the parking operation in at least two times. The best one shall be taken as the final result. If the direction control of the VUT only includes transversal control, the longitudinal control assessment indicators in all the following scenarios will not be scored.

1.3.3.1 Explanation on Scoring for Parallel Parking Space

1.3.3.1.1 Explanation on Scoring for Parallel Parking Space-Spatial Parking Space

The test scenario and scoring rules of parallel parking space-spatial parking space are shown in Table 1-5.

Table 1- 5 Score of Test Scenario for Parallel Parking Space-Spatial Parking Space

level-3 indicator	Assessment Method			Score
Parking space search ability	The parking space target shall be identified at least twice in three tests.			10
Parking ability	Number of parking		Number of parking ≤4	20
			4 <number of parking≤6	15
			6 <number of parking≤9	10
			Number of parking >9	0
	Parking posture α (-3° to 3°)		-1°≤α≤1°	25
			1°＜|α|≤2°	20
			2°＜|α|≤3°	15
			|α|＞3°	0
	Accurate parking in target area	Transversal control assessment indicator	(0.30m≥ D_r、D_f ≥0.05m)	15
		Longitudinal control assessment indicator	Δl≥0.1 m	10
	The rolling on curbs and collision with static vehicle shall be avoided			20

1.3.3.1.2 Explanation on Scoring for Parallel Parking Space-Parking Space with Lines

The test scenario and scoring rules of parallel parking space-parking space with lines are shown in Table 1-6.

Table 1 -6 Scenario and Score of Parallel parking Space-Parking Space with Lines

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level-3 indicator	Assessment Method			Score
Parking space search ability	The parking space target shall be identified at least twice in three tests.			10
Parking ability	Number of parking		Number of parking ≤4	20
			4 <number of parking≤6	15
			6 <number of parking≤9	10
			Number of parking >9	0
	Parking posture α1 (-3° to 3°)		-1°≤α1≤1°	25
			1°＜|α1|≤2°	20
			2°＜|α1|≤3°	15
			|α1|＞3°	0
	Accurate parking in target area	Transversal control assessment indicator	(0.30 m≥ D_r、D_f ≥0.05 m)	15
		Longitudinal control assessment indicator	Δl≥0.1 m	10
	The rolling on curbs shall be avoided			20

1.3.3.1.3 Explanation on Scoring for Obstacle in Parallel Parking Space

If the VUT identifies the parking space as unavailable, then 100 points will be obtained. If the VUT identifies the parking space as available and the collision can be avoided during parking, then 80 points will be obtained.

1.3.3.1.4 Explanation on Scoring for Parallel Parking Space Partially Occupied

If the VUT identifies the parking space occupied as unavailable, then 100 points will be obtained. If the VUT identifies the parking space as available and the collision can be avoided during parking, then 80 points will be obtained.

1.3.3.2 Explanation on Scoring for Vertical Parking Space

1.3.3.2.1 Explanation on Scoring for Vertical Parking Space-Spatial Parking Space

The test scenario and scoring rules of vertical parking space-spatial parking space are shown in Table 1-7.

Table 1 -7 Score of Test Scenario for Vertical Parking Space-Spatial Parking Space

level-3 indicator	Assessment Method		Score
Parking space search ability	The parking space target shall be identified at least twice in three tests.		10
Parking ability	Number of parking	Number of parking ≤4	20

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			4 <number of parking≤6	15
			6 <number of parking≤9	10
			Number of parking >9	0
	Parking posture β (-3° to 3°)		-1°≤β≤1°	25
			1°＜|β|≤2°	20
			2°＜|β|≤3°	15
			|β|＞3°	0
	Accurate parking in target area	Transversal control assessment indicator	Δd≥0.2 m	15
		Longitudinal control assessment indicator	Δx≤0.4 m	10
	The collision with static vehicle shall be avoided			20

1.3.3.2.2 Explanation on Scoring for Vertical Parking Space-Parking Space with Lines

The test scenario and scoring rules of vertical parking space-parking space with lines are shown in Table 1-8.

Table 1- 8 Score of Test Scenario for Vertical Parking Space-Parking Space with Lines

level-3 indicator	**Assessment Method**			**Score**
Parking space search ability	The parking space target shall be identified at least twice in three tests.			10
Parking ability	Number of parking		Number of parking ≤4	20
			4 <number of parking≤6	15
			6 <number of parking≤9	10
			Number of parking >9	0
	Parking posture β1 (-3° to 3°)		-1°≤β1≤1°	20
			1°＜|β1|≤2°	15
			2°＜|β1|≤3°	10
			|β1|＞3°	0
	Accurate parking in target area	Transversal control assessment indicator	Δd≥0.1 m	10

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level-3 indicator	Assessment Method			Score
		Longitudinal control assessment indicator	Δl≥0.1 m	10
	An alternative parking space shall be provided for the driver to choose, and the vehicle shall park in the parking space target accurately			10
	The rolling on curbs and collision with static vehicle shall be avoided			20

1.3.3.2.3 Explanation on Scoring for Column Obstacle on One Side of Vertical Parking Space

The test scenario and scoring rules of column obstacle on one side of vertical parking space are shown in Table 1-9.

Table 1- 9 Score of Test Scenario for Column Obstacle on One Side of Vertical Parking Space

level-3 indicator	Assessment Method			Score
Parking space search ability	The parking space target shall be identified at least twice in three tests.			10
Parking ability	Number of parking		Number of parking ≤4	20
			4 <number of parking≤6	15
			6 <number of parking≤9	10
			Number of parking >9	0
	Parking posture β1 (-3° to 3°)		-1°≤β1≤1°	20
			1°＜|β1|≤2°	15
			2°＜|β1|≤3°	10
			|β1|＞3°	0
	Accurate parking in target area	Transversal control assessment indicator	Δd≥0.1 m	10
		Longitudinal control assessment indicator	Δl≥0.1 m	10
	An alternative parking space shall be provided for the driver to choose, and the vehicle shall park in the parking space target accurately			10
	The collision with column and static vehicle shall be avoided			20

1.3.3.2.4 Explanation on Scoring for Pedestrian Interference during Parking Process

If the VUT identifies the parking space as unavailable, then 100 points will be obtained. If the VUT identifies the parking space as available and the collision can be avoided during parking, then 80 points will

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be obtained.

1.3.3.3 Explanation on Scoring for Oblique Parking Space

1.3.3.3.1 Explanation on Scoring for Oblique Parking Space-Spatial Parking Space

The test scenario and scoring rules of oblique parking space-spatial parking space are shown in Table 1-10.

Table 1 - 10 Score of Test Scenario for Oblique Parking Space-Spatial Parking Space

level-3 indicator	Assessment Method			Score
Parking space search ability	The parking space target shall be identified at least twice in three tests.			10
Parking ability	Number of parking		Number of parking ≤2	20
			2 <number of parking≤4	15
			4 <number of parking≤7	10
			Number of parking >7	0
	Parking posture β2 (-3° to 3°)		-1°≤β2≤1°	25
			1°＜|β2|≤2°	20
			2°＜|β2|≤3°	15
			|β2|＞3°	0
	Accurate parking in target area	Transversal control assessment indicator	Δd≥0.1 m	15
		Longitudinal control assessment indicator	Δx≤0.4 m	10
	The collision with static vehicle shall be avoided			20

1.3.3.3.2 Explanation on Scoring for Oblique Parking Space-Parking Space with Lines

The test scenario and scoring rules of oblique parking space-parking space with lines are shown in Table 1-11.

Table 1- 11 Score of Test Scenario for Oblique Parking Space-Parking Space with Lines

level-3 indicator	Assessment Method		Score
Parking space search ability	The parking space target shall be identified at least twice in three tests.		10
Parking ability	Number of parking	Number of parking ≤2	20
		2 <number of parking≤4	15
		4 <number of parking≤7	10

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level-3 indicator	Assessment Method			Score
			Number of parking >7	0
	Parking posture β3 (-3° to 3°)		-1°≤β3≤1°	20
			1°＜|β3|≤2°	15
			2°＜|β3|≤3°	10
			|β3|＞3°	0
	Parking in target area	Transversal control assessment indicator	Δd≥0.1 m	10
		Longitudinal control assessment indicator	Δl≥0.1 m	10
	An alternative parking space shall be provided for the driver to choose, and the vehicle shall park in the parking space target accurately			10
	The rolling on curbs shall be avoided			20

1.3.3.4 Explanation on Scoring for Failure of Remote Controller

1.3.3.4.1 Explanation on Scoring for Loss of Continuous Remote-Control Function of Remote Parking Assistance

(1) If under the circumstance that there is no remote-control failure, the remote parking function can be started normally; under the circumstance that the remote-control function is lost, the VUT exits/suspends the parking assistance state and stops, the system gives an alarm, and the braking distance is not greater than 0.7m, then 100 points will be obtained;

(2) If under the circumstance that there is no remote-control failure, the remote parking function can be started normally; under the circumstance that the remote-control function is lost, the VUT exits/suspends the parking assistance state and stops, then 80 points will be obtained;

1.3.3.5 Explanation on Scoring for Incorrect Use of Remote-Control Function

1.3.3.5.1 Explanation on Scoring for Incorrect Use of Remote-Control Function of Remote Parking Assistance

If the remote parking function can be normally started within the remote-control distance of 6m, and the remote parking function is not started in the three tests carried out in accordance with the test method (2) in 2.6.2.2, then 100 points will be obtained

2 Test Method

2.1 Scope of Application

This Specification is applicable to M_1 passenger vehicles.

2.2 Normative References

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The terms and conditions in the following documents constitute the terms and conditions of this Specification through reference in this Specification. For dated references, all subsequent amendments (excluding corrections) or revisions are not applicable to this Specification. For undated references, the latest edition is applicable to this Specification.

GB 5768.3 Road Traffic Signs and Markings - Part 3: Road Traffic Markings

ISO 16787 《Intelligent transport systems - Assisted parking systems (APS) - Performance requirements and test procedures》

JGJ 100 Code for Design of Parking Garage Building

05MR404(GJBT-855) Urban Road - Curb

2.3 Definitions

Vehicle Under Test (VUT)

The vehicle that can continuously control both transversal and longitudinal movements and will be tested in accordance with these Rules.

Number of parking

During the parking process, one parking will be counted when the shift to gear R is carried out and the vehicle moves. During the parking process, one parking will be counted when the shift from gear R to gear D or from gear D to gear R is carried out.

2.4 General Provisions

The test of each scenario is divided into two parts: parking search ability test and parking ability test.

The test may be carried out for up to three times for each test scenario. If the parking space is identified and the parking is completed in two tests of such three tests, then the scenario shall be deemed as passed, and the one with better results in the 2 tests shall be scored; if the parking space can be identified and the parking can be completed in the first two tests, then the third test will not be conducted. If the vehicle fails to identify the parking space or fails to complete the parking in 2 or more tests, then the scenario shall be deemed as failed.

For the following scenario tests, unless otherwise specified, the following validity requirements shall be met:

1) The length of the VUT is recorded as X, and the width is recorded as Y;
2) The transversal spacings d1 and d2 of the VUT shall be 1.2 ± 0.2m;
3) During the parking ability test, the driving track shall avoid collision with any object detected by the VUT.

2.5 Test Conditions

2.5.1 Site Conditions

1) The test road surface shall be dry, flat and solid, without visible moisture, and the peak braking force coefficient shall be greater than 0.9;
2) The test road surface shall be compacted and free of irregularities (such as large inclination, cracks, well covers or reflective bolts) that may cause abnormal operation of the sensor;

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3) The curb shall be TF-type curb as defined in 05MR404 (GJBT-855). The height h from the ground shall be 10-20cm, the width b shall be 10-15cm, and the chamfer c shall be 45-90°. Refer to Figure 2-1 “Schematic Diagram of Cross Section” below.

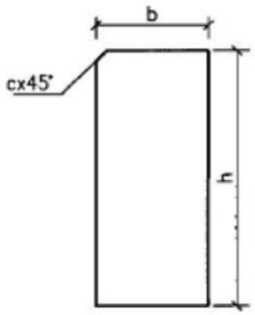

Figure 2-1 Schematic Diagram of Cross Section

4) The color of parking lot markings shall be white, and the parking lot lines shall be clear and visible without damage.

2.5.2 Weather Conditions

1) The weather shall be dry without precipitation and snowfall;
2) The visibility in the horizontal direction shall not be less than 1km;
3) The wind speed shall not be greater than 10m/s;
4) For the test conducted under natural light conditions, the lighting conditions in the whole test area shall be consistent, and the light intensity shall not be less than 2000Lux.

2.5.3 Equipment Requirements

2.5.3.3.1 Requirements on Child Dummy Target

As shown in Figure 2-2, the child dummy target shall be used to replace the child target (including visual, radar, lidar and PMD attributes). For the requirements on specifications of child dummy, please refer to ISO 19206.

Figure 2-2 Appearance Diagram of Child Dummy Target

2.5.3.3.2 Requirements on Obstacle Vehicle

The obstacle vehicle located in the parking space shall be a mass-produced M_1 vehicle with a length of 4100-5000m, a width of 1700-1950mm and a height of 1300-1800mm.

2.5.4 Test Procedures

2.5.4.1 Preparation of VUT

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2.5.4.1.1 Confirmation on Tyre Conditions

The test shall be conducted with the brand new and genuine tyres consistent with the tyre configuration (supplier, model, size, speed and load class) specified by the manufacturer. To the extent that the tyre configuration (supplier, model, size, speed and load grade) is consistent with that specified by the manufacturer, the replacement tyre provided by the manufacturer or the agent designated by the manufacturer may be used. The tyres shall be inflated to the standard cold air pressure recommended by the manufacturer, which shall be at least suitable for normal load conditions.

2.5.4.1.2 Confirmation on Vehicle Conditions

2.5.4.1.2.1 It shall be ensured that the spare wheel (if equipped) and on-board tools are loaded on the VUT. There shall be no other objects on the VUT.

2.5.4.1.2.2 It shall be ensured that all tyres are inflated to the manufacturer's recommended tyre pressures for the current load state.

2.5.4.2 Preparation for Test

2.5.4.2.1 Active hood system

If the failure of the vehicle's active hood system will not affect the normal operation of the system, the system shall be disabled before the test.

2.5.4.2.2 Airbag system

If the failure of the vehicle's airbag system will not affect the normal operation of the system, the system shall be disabled before the test.

2.6 Test Items

2.6.1 Parking ability in front of parking space

2.6.1.1 Parallel parking space berthing-in ability

2.6.1.1.1 Parallel parking space-spatial parking space

(1) Test Scenarios

The parking space shall be composed of two static vehicles and curbs. The static vehicles shall be aligned in the same direction and parallel to each other. The difference between the width of the vehicles on both sides and the width of the VUT shall be less than 15cm, as shown in Figure 2-3.

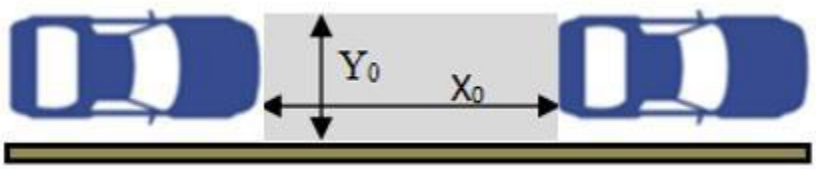

Figure 2-3 Schematic Diagram of Scenario Parallel Parking Space-Spatial Parking Space

The parking spaces under this scenario are divided into standard size and reduced size. On the basis of the length of parking space, the test shall be conducted according to the scenarios listed in Table 2-1.

Table 2 -1 Test Scenario for Parking Ability for Parallel Parking Space-Spatial Parking Space

Name of parking space	Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2

Standard size	X_0=X+1.0，X≤4 m; X_0=1.25X，4 m<X<6 m; X_0=X+1.5，X≥6 m;	Y+0.2 m	1.2±0.2 m
Reduced size	X_0=X+max(0.7m，0.15X)	Y+0.2 m	1.2±0.2 m

(2) Test Method

1) Start the vehicle, start the parking assistance function, drive the VUT to the starting point, and ensure that the transverse distances d1 and d2 between the VUT and the parking space meet the requirements of Table 2-1 before the test. The test scenario is shown in Figure 2-4. Select the parking space target on the right side for test.

2) After the test is completed, record the number of parking, measure the distances D_f and D_r between the outer grounding points of the front/rear wheels of the VUT and the curb of the parking space target, and calculate the parking posture α. The minimum distance between the front/rear end of the VUT and the vehicles on both sides is △l, as shown in Figure 2-5.

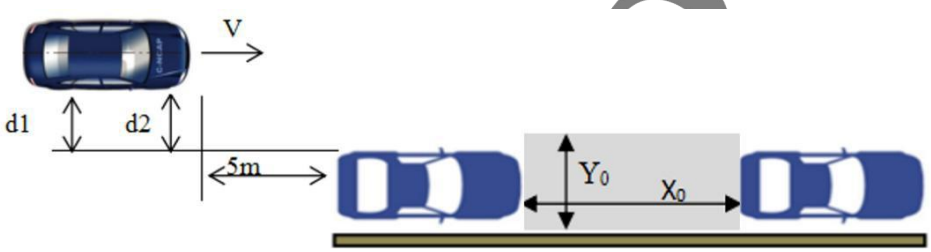

Figure 2-4 Schematic Diagram of Test for Parallel Parking Space-Spatial Parking Space

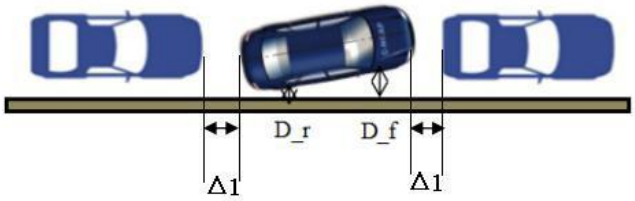

Figure 2-5-1 Schematic Diagram of D_r, D_f and △l

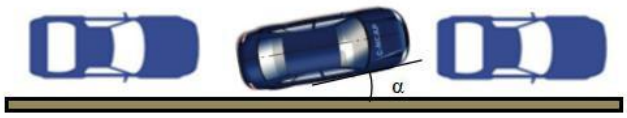

Figure 2-5-2 Schematic Diagram of α

(3) Exit Conditions

1) The system reminds that the function fails;

2) The VUT collides with any of the static vehicles on both sides during the parking process;

3) The VUT cannot complete the parking action.

2.6.1.1.2 Parallel parking space-parking space with lines

(1) Test Scenarios

The parking space shall be composed of white lines and curbs, with the line width of 15cm, as shown in

Figure 2-6. The length X_0 of the parking space shall be 5.9m. For the vehicle with the vehicle length of more than 5.3m, the length of parking space may be set according to the length of the VUT plus 0.6m. The width Y_0 of the parking space shall be 2.4m. For the vehicle with the vehicle width of more than 2m, the width of parking space shall be set according to the width of the VUT plus 0.4m. The dimensions in the following scenarios shall be determined according to this standard. The length and width of parking space are the distance within the parking space lines. There shall be no lines or other obstacles within the parking space.

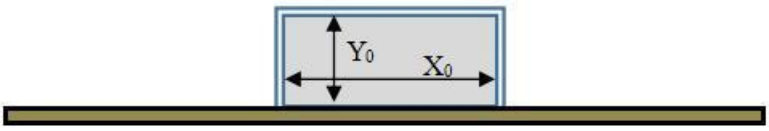

Figure 2-6 Schematic Diagram of Scenario for Parallel Parking Space-Parking Space with Lines

The test shall be conducted according to the scenario shown in Table 2-2.

Table 2 -2 Test Scenario for Parallel Parking Space-Parking Space with Lines

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
5.9 m	2.4 m	1.2±0.2 m

(2) Test Method

1) The test method is as same as the test method for parking ability for parallel parking space-spatial parking space. The test scenario is shown in Figure 2-7. The right parking space target shall be selected for test.

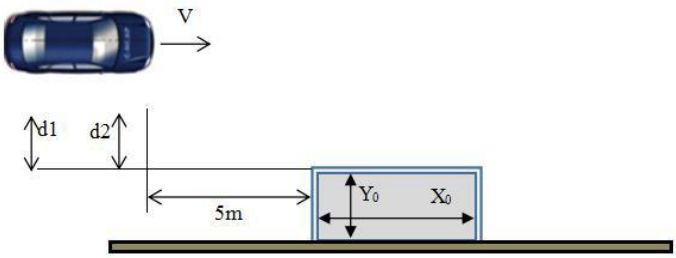

Figure 2-7 Schematic Diagram of Test for Parallel Parking Space-Parking Space with Lines

2) After the test is completed, record the number of parking, and measure the minimum distances D_r1 and D_f1 between the outside grounding points of the front/rear wheels of the VUT and the inner side of the parking space boundary line, and calculate the parking posture α1. The minimum distance between the front/rear end of the VUT and the inner edge of the parking space boundary line is △l, as shown in Figure 2-8.

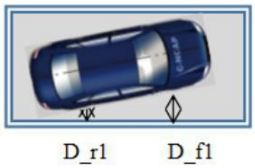

Figure 2-8-1 Schematic Diagram of

Figure 2-8-2 Schematic Diagram of α1

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D_r1 and D_f1 and Target Area △l

(3) Exit Conditions

1) The system reminds that the function fails;

2) The VUT cannot complete the parking action.

2.6.1.1.3 Obstacle in parallel parking space

(1) Test Scenarios

The parking space shall be limited by two boundary vehicles and curbs. The boundary vehicles shall be aligned in the same direction and parallel to each other, as shown in Figure 2-9. There shall be a cone barrel (recommended size: 50cm * 35cm) within the parking space, and the cone barrel shall be placed at the center of the parking space.

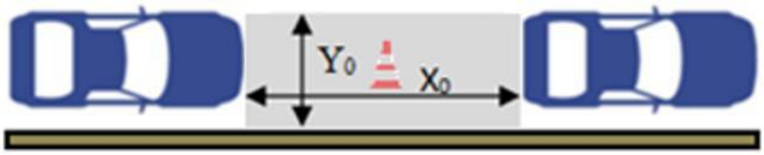

Figure 2-9 Schematic Diagram of Scenario for Obstacle in Parallel Parking Space

The test shall be conducted according to the scenario shown in Table 2-3.

Table 2 -3 Test Scenario for Obstacle in Parallel Parking Space

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
X_0=X+1.0，X≤4 m; X_0=1.25X，4m<X<6m; X_0=X+1.5，X≥6 m;	Y+0.2 m	1.2±0.2 m

(2) Test Method

The test method is as same as the test method for parking ability for parallel parking space-spatial parking space. The test scenario is shown in Figure 2-10. The left or right parking space target shall be randomly selected for test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

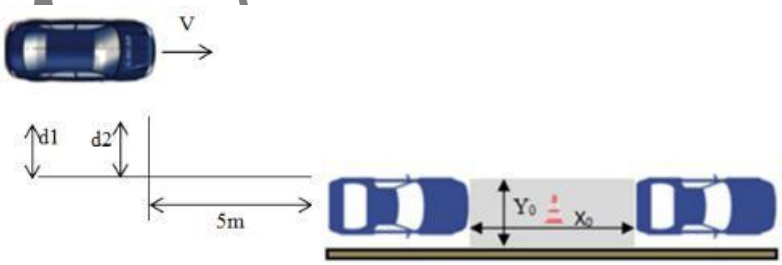

Figure 2-10 Schematic Diagram of Test for Obstacle in Parallel Parking Space

(3) Exit Conditions

1) The system reminds that the function fails;

2) During the parking process, the VUT fails to detect the conical barrel obstacle, and thus collision occurs.

2.6.1.1.4 Parallel parking space partially occupied

(1) Test Scenarios

The parking space shall be composed of white lines and curbs, with the line width of 15cm, as shown in Figure 2-11. The length X0 of the parking space shall be 5.9m. The width Y0 of the parking space shall be 2.4m. The length and width of parking space are the distance within the parking space lines. One obstacle vehicle shall be placed in the center between two adjacent parking spaces, and the obstacle vehicle shall be a category-M1 vehicle.

Figure 2-11 Schematic Diagram of Scenario for Parallel Parking Space Partially Occupied

The test shall be conducted according to the scenario shown in Table 2-4.

Table 2 -4 Test Scenario for Parallel Parking Space Partially Occupied

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
5.9 m	2.4 m	1.2±0.2 m

(2) Test Method

The test method is as same as the test method for parking ability for parallel parking space-spatial parking space. The test scenario is shown in Figure 2-12. The left or right parking space target shall be randomly selected for test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

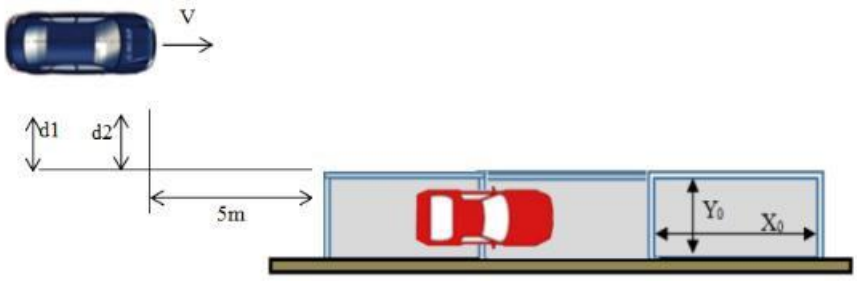

Figure 2-12 Schematic Diagram of Test for Parallel Parking Space Partially Occupied

(3) Exit Conditions

1) The system reminds that the function fails;

2) During the parking process, the VUT fails to detect the occupying vehicle and thus collision occurs;

2.6.1.2 Vertical parking space berthing-in ability

2.6.1.2.1 Vertical parking space-spatial parking space

(1) Test Scenarios

The parking space shall be composed of static vehicles on both sides. The difference between the length of the vehicles on both sides and the length of the VUT shall be less than 30cm. The vehicles on both sides shall be placed with their front ends aligned. One or more obstacle vehicles shall be placed at 5.5m in front of the parking space, so as to limit the front berthing space for vertical parking. The length X_0 of the parking space shall be X, and the width Y_0 of the parking space shall be Y+1.0m, as shown in Figure 2-13.

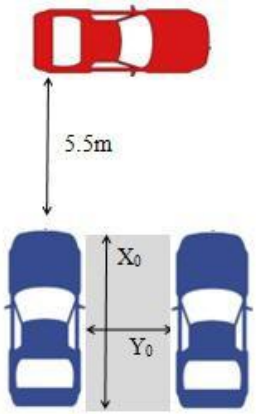

Figure 2-13 Schematic Diagram of Scenario for Vertical Parking Space - Spatial Parking Space

The parking spaces under this scenario are divided into standard size and reduced size. The test shall be conducted according to the scenarios listed in Table 2-5.

Table 2 -5 Test Scenario for Vertical Parking Space - Spatial Parking Space

Name of parking space	Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
Standard size	X	Y+1.0m	1.2±0.2m
Reduced size	X	Y+0.8m	1.2±0.2m

(2) Test Method

1) Start the vehicle, start the parking assistance function, drive the VUT to the starting point, and ensure that the transverse distances d1 and d2 between the VUT and the parking space meet the requirements of Table 2-5 before the test. The test scenario is shown in Figure 2-14. The left or right parking space target shall be randomly selected for the test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

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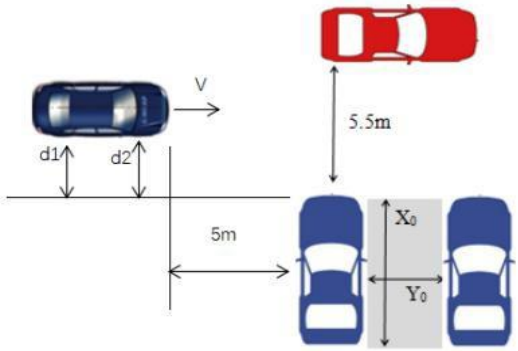

Figure 2-14 Schematic Diagram of Test for Vertical Parking Space - Spatial Parking Space

2) After the test is completed, record the number of parking, and measure the minimum distance Δd between the outer grounding point of the front/rear tyres of the VUT and the outer edge of the static vehicle, and calculate the parking posture β on the basis of Δd. The distance from the front end of the VUT to the front end reference line of vehicles on both sides is Δx. The rectangular area shown in Figure 2-15 is called the target area.

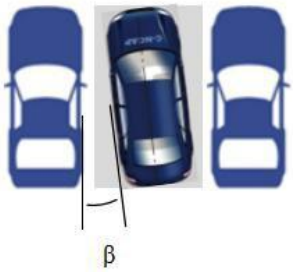

Figure 2-15-1 Schematic Diagram of β

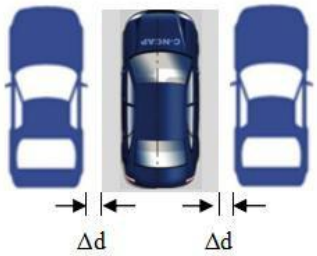

Figure 2-15-2 Schematic Diagram of Target Area Δd

Figure 2-15-3 Schematic Diagram of Target Area Δx

(3) Exit Conditions

1) The system reminds that the function fails;

2) The VUT collides with the static vehicle and obstacle vehicle during the parking process;

3) The VUT cannot complete the parking action.

2.6.1.2.2 Vertical parking space-parking space with lines

(1) Test Scenarios

Three consecutive vertical parking spaces with continuous lines shall be used for the test. The test will

examine whether the VUT can accurately identify the parking spaces, whether it can provide the alternative parking spaces for the driver, and whether it can park accurately after the driver selects the parking space. The parking space shall be composed of white lines, with the line width of 15cm. As shown in Figure 2-16, the length X_0 of parking space shall be 5.9m, the width Y_0 shall be 2.4 m, and the length and width of parking space are the inner distance of parking space lines. An obstacle vehicle shall be placed at 5.5m in front of the parking space, so as to limit the front parking space for vertical parking operation.

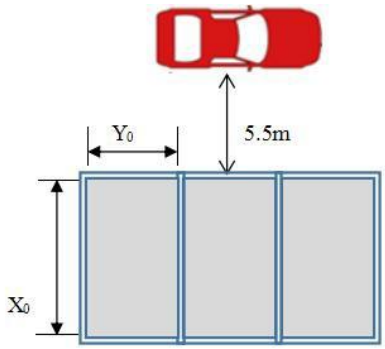

Figure 2-16 Schematic Diagram of Scenario for Vertical Parking Space-Parking Space with Lines

The test shall be conducted according to the scenario shown in Table 2-6.

Table 2-6 Test Scenario for Vertical Parking Space-Parking Space with Lines

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
5.9m	2.4 m	1.2±0.2 m

(2) Test Method

1) The test method shall be as same as the test method for vertical parking space-spatial parking space, and the test scenario is shown in Figure 2-17. The left or right parking space target shall be randomly selected for test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

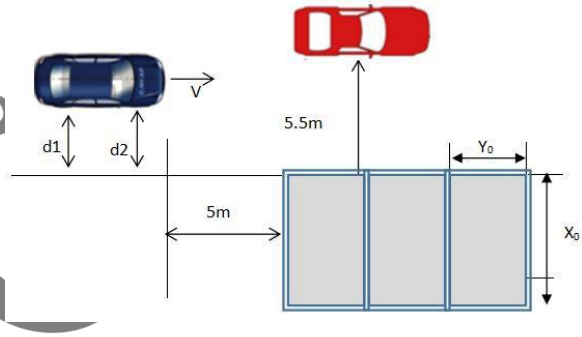

Figure 2-17 Schematic Diagram of Test for Vertical Parking Space - parking Space with Lines

2) After the test is completed, record the number of parking, and measure the minimum distance Δd between the outer grounding point of the front/rear tyres of the VUT and the inner side of the parking space boundary line, and calculate the parking posture β1 on the basis of Δd. The distance between the front/rear end of the vehicle and the inner side of the parking space line is △l, as shown in Figure 2-18.

Figure 2-18-1 Schematic Diagram of β1

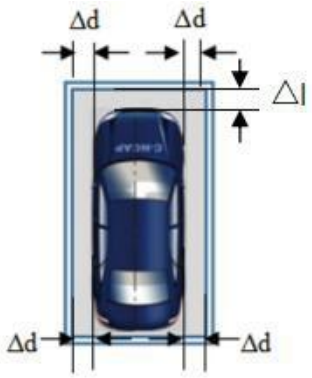

Figure 2-18-2 Schematic Diagram of Target Area Δd

(3) Exit Conditions

1) The system reminds that the function fails.

2) The VUT collides with the obstacle vehicle during the parking process.

3) The VUT cannot complete the parking action.

2.6.1.2.3 Column obstacle on one side of vertical parking space

(1) Test Scenarios

The parking space shall be composed of white lines with the line width of 15cm. A static M_1 vehicle shall be placed at the center of the parking space adjacent to the parking space target. The parking space target shall be placed adjacent to the column which is 0.7m long, 0.75m wide and 1.9m high. The column shall be placed adjacent to the two parking spaces and flush with the outer edge of the parking space lines. As shown in Figure 2-19, the length X_0 of parking space is 5.9m and the width Y_0 is 2.4m. An obstacle vehicle shall be placed at 5.5m in the front of the parking space, so as to limit the front parking space for vertical parking operation. In this scenario, one of two parking spaces may be randomly selected for parking test, as shown in Figure 2-19.

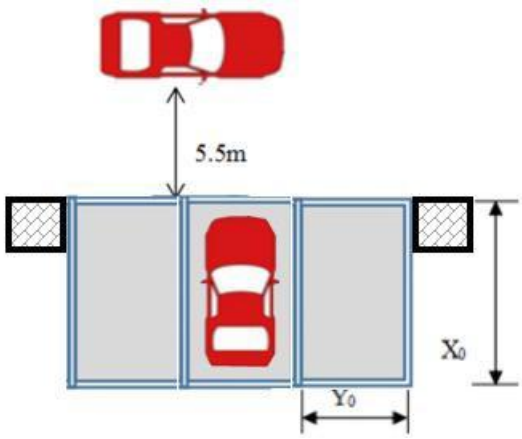

Figure 2-19 Schematic Diagram of Scenario for Column Obstacle on One Side of Vertical Parking Space

The test shall be conducted according to the scenario shown in Table 2-7.

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Table 2-7 Test Scenario for Vertical Parking Space-Parking Space with Lines

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
5.9m	2.4 m	1.2±0.2 m

(2) Test Method

1) The test method shall be as same as the test method for vertical parking space-spatial parking space, and the test scenario is shown in Figure 2-20. The left or right parking space target shall be randomly selected for test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

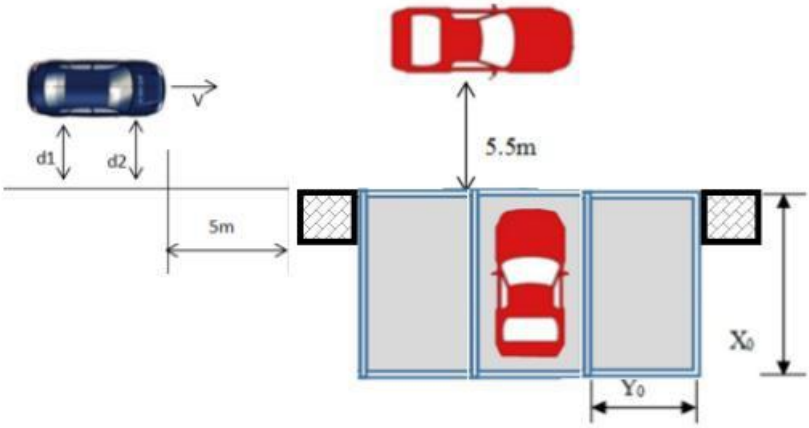

Figure 2-20 Schematic Diagram of Test for Column Obstacle on One Side of Vertical Parking Space

2) After the test is completed, record the number of parking, and measure the minimum distance Δd between the outer grounding point of the front/rear tyres of the VUT and the inner side of the parking space boundary line, and calculate the parking posture β2 on the basis of Δd. The distance between the front/rear end of the vehicle and the inner side of the parking space line is △l, as shown in Figure 2-21.

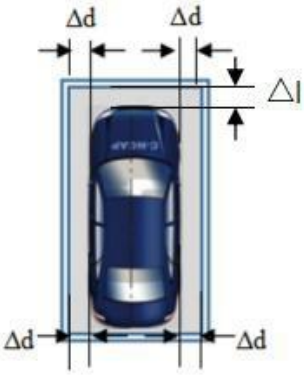

Figure 2-21-1 Schematic Diagram of β2

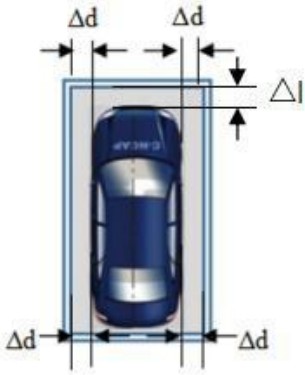

Figure 2-21-2 Schematic Diagram of Target Area Δd

(3) Exit Conditions

1) The system reminds that the function fails.

2) During the parking process, the VUT collides with the obstacle vehicle or the column obstacle.

3) The VUT cannot complete the parking action.

2.6.1.2.4 Pedestrian interference during parking process

(1) Test Scenarios

A vertical parking space shall be used for the test, and a child dummy shall be placed at the center of the parking space. The parking space shall be composed of white lines with the line width of 15cm. As shown in Figure 2-22, the length X_0 of parking space is 5.9m and the width Y_0 is 2.4m. An obstacle vehicle shall be placed at 5.5m in front of the parking space, so as to limit the front parking space for vertical parking operation.

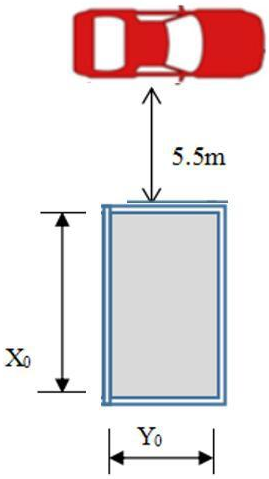

Figure 2-22 Diagram of Scenario Vertical Parking Space Schematic

The test shall be conducted according to the scenario shown in Table 2-8.

Table 2 -8 Test Scenario for Pedestrian Interference during Parking Process

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
5.9 m	2.4 m	1.2±0.2 m

(2) Test Method

The test scenario is shown in Figure 2-23. The left or right parking space target shall be randomly selected for the test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

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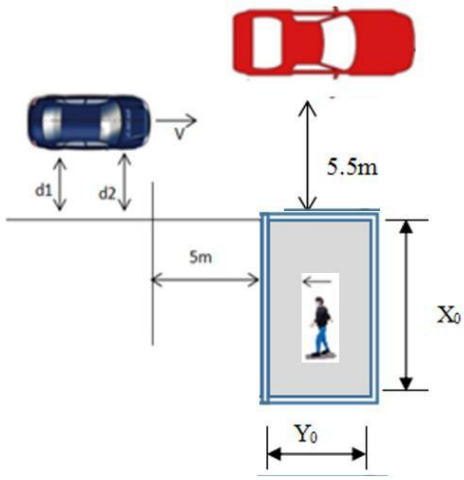

Figure 2-23 Schematic Diagram of Scenario for Pedestrian Interference during Parking Process

(3) Exit Conditions

1) The system reminds that the function fails;

2) During the parking process, the VUT fails to detect the pedestrian, and thus collision occurs.

2.6.1.3 Oblique parking space berthing-in ability

2.6.1.3.1 Oblique parking space-spatial parking space

(1) Test Scenario

The parking space shall be composed of the parallel static vehicles on both sides. The difference between the vehicle length on both sides and the length of the VUT shall be less than 10cm. The front ends of the vehicles shall be aligned. The angle of inclination of the static vehicles shall be 45°. The test scenario is shown in Figure 2-24.

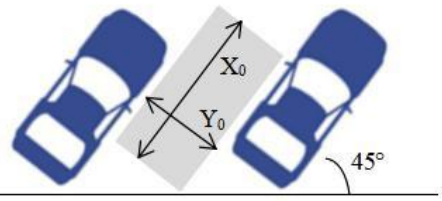

Figure 2-24 Schematic Diagram of Scenario for Oblique Parking Space - Spatial Parking Space

The parking spaces under this scenario are divided into standard size and reduced size. The test shall be conducted according to the scenarios listed in Table 2-9.

Table 2 -9 Test Scenario for Oblique Parking Space-Spatial Parking Space

Name of parking space	Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
Standard size	X	Y+1.0m	1.2±0.2 m
Reduced size	X	Y+0.8m	1.2±0.2 m

(2) Test Method

1) Start the vehicle, start the parking assistance function, drive the VUT to the starting point, and ensure that the transverse distances d1 and d2 between the VUT and the parking space meet the requirements of Table 2-9 before the test. The test scenario is shown in Figure 2-25. The right parking space target shall be selected for test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

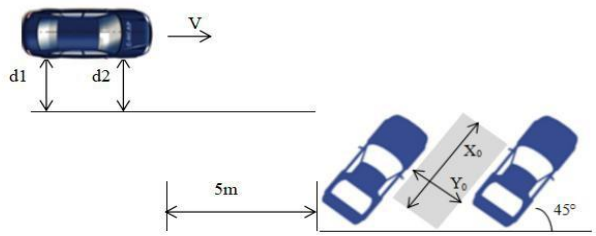

Figure 2-25 Schematic Diagram of Test for Oblique Parking Space - Parking Space with Lines

2) After the test is completed, record the number of parking, and measure the distance between the outer grounding point of the front/rear tyres of the VUT and the inner side of the parking space boundary line Δd, and calculate the parking posture β2 on the basis of Δd. The projection distance between the front end of vehicle and the front end reference line of vehicles on both sides is △x, as shown in Figure 2-26.

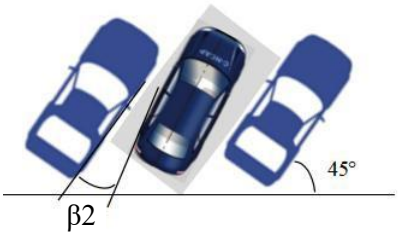

Figure 2-26-1 Schematic Diagram of β2

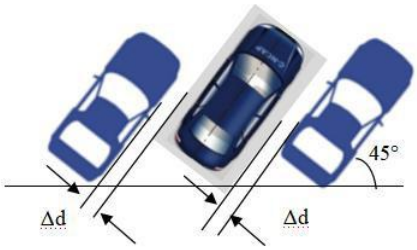

Figure 2-26-2 Schematic Diagram of Target Area Δd

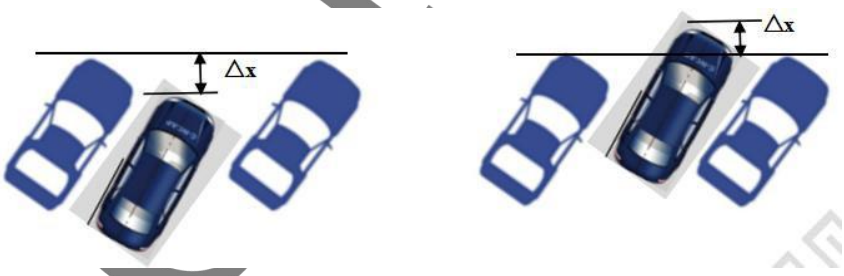

Figure 2-26-3 Schematic Diagram of Target Area Δx

(3) Exit Conditions

1) The system reminds that the function fails.

2) The VUT collides with any of the static vehicles on both sides during the parking process.

3) The VUT cannot complete the parking action.

2.6.1.3.2 Oblique parking space-parking space with lines

(1) Test Scenario

As shown in Figure 2-27, three oblique parking spaces with continuous lines shall be used for the test. The test shall examine whether the VUT can accurately identify the parking spaces and provide the alternative parking spaces for the driver, and whether it can park accurately after the driver selects the parking space. There shall be no other obstacles on both sides of the parking space. The parking space shall be composed of white lines with the line width of 15cm. As shown in Figure 2-27, the length X_0 of parking space shall be 7m, the width Y_0 shall be 2.4m, and the length and width of parking space are the inner distance of parking space lines.

Figure 2-27 Schematic Diagram of Scenario for Oblique Parking Space - Parking Space with Lines

The test shall be conducted according to the scenario listed in Table 2-10.

Table 2-10 Test Scenario for Oblique Parking Space - Parking Space with Lines

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2
7.0 m	2.4 m	1.2±0.2 m

(2) Test Method

1) Start the vehicle, start the parking assistance function, drive the VUT to the starting point, and ensure that the transverse distances d1 and d2 between the VUT and the parking space meet the requirements of Table 2-10 before the test. The test scenario is shown in Figure 2-28. The left or right parking space target shall be randomly selected for the test, and the direction of the parking space target relative to the VUT shall not be changed during the test.

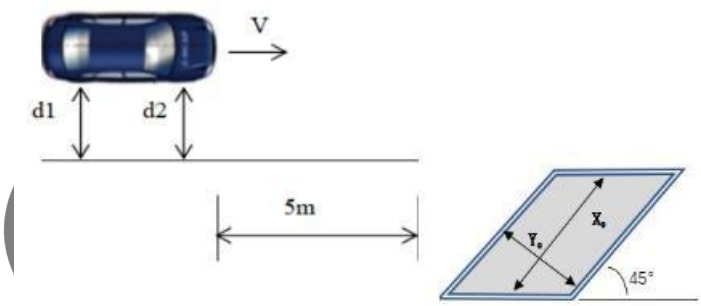

Figure 2-28 Schematic Diagram of Test for Oblique Parking Space - Parking Space with Lines

2) After the test is completed, record the number of parking, and measure the distance between the outer grounding point of the front/rear tyres of the VUT and the inner side of the parking space boundary line Δd, and calculate the parking posture β3 on the basis of Δd. The distance between the front/rear end of the vehicle and the inner side of the parking space line is △l, as shown in Figure 2-29.

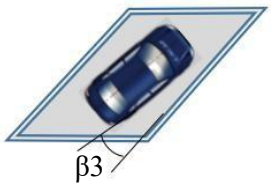

Figure 2-29-1 Schematic Diagram of β3

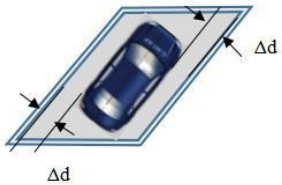

Figure 2-29-2 Schematic Diagram of Target Area Δd

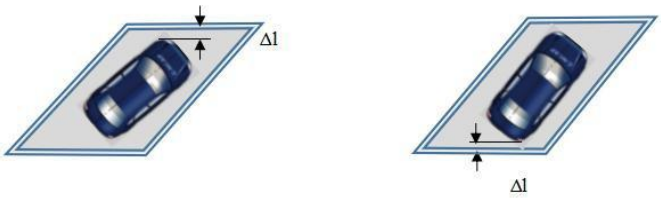

Figure 2-29-3 Schematic Diagram of Target Area △l

(3) Exit Conditions

1) The system reminds that the function fails.

2) The VUT cannot complete the parking action.

2.6.2 Remote parking ability in front of parking space

2.6.2.1 Failure of remote controller

2.6.2.1.1 Loss of continuous remote-control function of remote parking assistance

(1) Test Scenarios

The parking space shall be composed of static, parallel and vertically-placed vehicles on both sides, and the front end of vehicles on both sides shall be aligned. The length X_0 of parking space shall be X, and the width Y_0 shall be Y+1.0m, as shown in Figure 2-30.

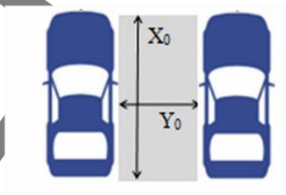

Figure 2-30 Schematic Diagram of Parking Space for Loss of Continuous Remote-Control Function

The test shall be conducted according to the scenario parameters listed in Table 2-11.

Table 2 -11 Parameters of Test Scenario for Loss of Continuous Remote-Control Function

Length X_0 of parking space	Width Y_0 of parking space	Transversal distances d1 and d2	Remote control distance d3
X	Y+1.0m	1.2±0.2 m	<6m

(2) Test Method

1) The test scenario is shown in Figure 2-31. After the test starts, the parking space shall be searched according to the horizontal spacing required in Table 2-11. When the VUT

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successfully finds the parking space and stops, the test personnel shall use the remote-control device to start the parking function within the effective remote-control distance (The starting mode shall be subject to the design requirements of the system, such as one-button parking, or long-press parking), and observe whether the VUT can normally start the remote parking function.

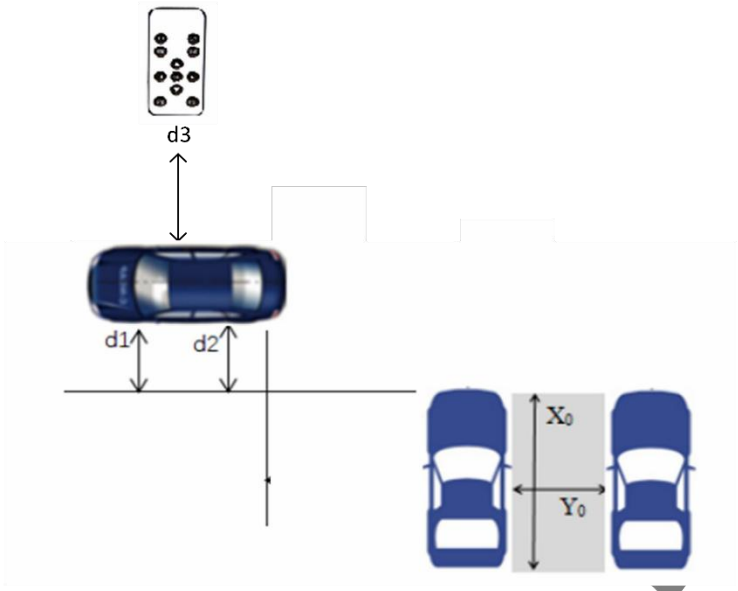

Figure 2-31 Schematic Diagram of Test Scenario for Loss of Continuous Remote-Control Function

2) If the VUT can normally realize the remote parking function according to the requirements of step 1), the parking space shall be searched again. After the VUT successfully finds the parking space and stops, the test personnel shall use the remote-control device to start the parking function within the effective remote-control distance (the starting mode shall be subject to the design requirements of the system, such as one-button parking, or long-press parking). After the remote parking function is activated, the remote-control failure shall be injected. The failure mode is shown in Table 2-12.

Table 2 -12 Table of Remote Parking Assistance Failure Types

Failure type	Fault injection form
Loss of remote-control signal	In case of mobile-phone remote control, set the mobile phone to flight mode directly during remote parking process; In case of remote controller, then: 1) In case of one-button parking, press the parking button and put the remote controller into a signal shielding box; 2) In case of long-press button or other modes that require continuous operation of remote controller, put the fixture (simulating the continuous manual operation for remote parking) and remote controller into the signal shielding box together.

(3) Exit Conditions

The test shall exit when any of the following conditions is met:

1) For a single test, the remote parking function cannot be realized when there is no remote-control failure;

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2) For a single test, after the remote-control failure is injected, the function exits/pauses, the vehicle stops, and the system gives alarm;

3) For a single test, after the remote-control failure is injected, the VUT continues to run without stopping for parking.

2.6.2.2 Incorrect use of remote-control function

2.6.2.2.1 Incorrect use of remote parking assistance function

(1) Test Scenarios

The parking space shall be composed of static, parallel and vertically-placed vehicles on both sides, and the front end of vehicles on both sides shall be aligned. The length X_0 of parking space shall be X, and the width Y_0 shall be Y+1.0m, as shown in Figure 2-32.

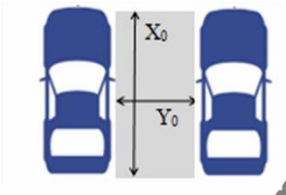

Figure 2-32 Schematic Diagram of Parking Space for Incorrect Use of Remote-Control Function

The test shall be conducted according to the scenario parameters listed in Table 2-13.

Table 2 -13 Parameters of Test Scenario for Incorrect Use of Remote-Control Function

Length X_0 of parking space	Width Y_0 of parking space	Search speed V	Transversal distances d1 and d2	Remote control distance d3
X	Y+1.0m	10±2km/h	1.2±0.2 m	6.5m

(2) Test Method

1) The test scenario shall be as shown in Figure 2-33. After the test starts, the parking space shall be searched according to the horizontal spacing required in Table 2-13. When the VUT successfully finds the parking space and stops, the test personnel shall use the remote-control device to start the parking function at the remote-control distance of no more than 6m, and observe whether the VUT can normally start the remote parking function.

2) If the VUT can normally realize the remote parking function according to the requirements of step 1), the parking space shall be searched again. After the VUT successfully finds the parking space and stops, the test personnel shall use the remote -control device to start the remote parking function at the place which is 6.5m vertically away from point A, point B and point C. The length of the VUT is L, and point B is the midpoint of the outer edge of the VUT.

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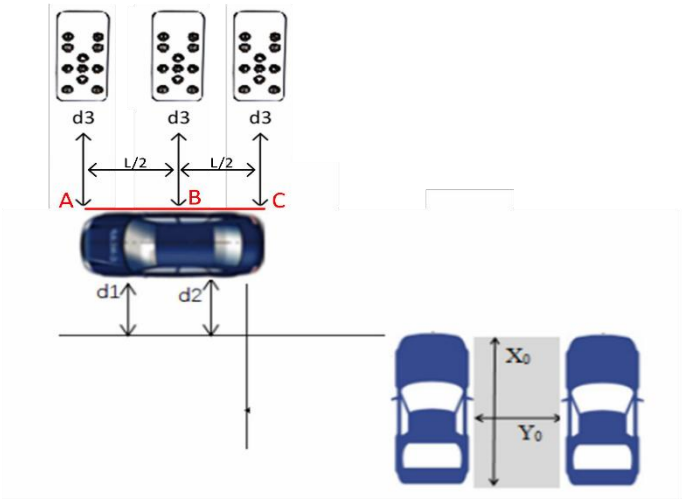

Figure 2-33 Schematic Diagram of Test Scenario for Incorrect Use of Remote-Control Function

(3) Exit Conditions

The test shall exit when any of the following conditions is met:

1) The remote parking function cannot be started normally within the remote-control distance of 6m;

2) In any test at point A, B or C, the remote parking function is started;

3) In the three tests at points A, B and C, the remote parking function cannot be started.

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