IVISTA

China Intelligent Vehicle Index

Intelligent Cruise Index
Cruise Assist System Rating Protocol

(Version 2023)

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Cruise Assist System Rating Protocol

1   Scope

This document specifies the rating methods of IVISTA China Intelligent Vehicle Index - Intelligent Cruise Index - Cruise Assist System.

2   Normative References

The following normative documents contain provisions which, through reference in this text, constitute indispensable provisions of this document. For dated references, only the dated edition applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB 5768.2-2022 Road Traffic Signs and Markings - Part 2: Road Traffic Signs

GB 5768.3-2009 Road Traffic Signs and Markings - Part 3: Road Traffic Markings

GB 5768.5-2017 Road Traffic Signs and Markings - Part 5: Speed Limit

GB/T 23826-2009 Light-emitting Diode Changeable Speed Limit Signs of Expressway

GB/T 15089 Classification of Power-driven Vehicles and Trailers

GB/T 18385-2005 Electric Vehicles - Power Performance - Test Method

GB/T 20608-2006 Intelligent Transportation Systems - Adaptive Cruise Control Systems - Performance Requirements and Test Procedures

GB/T 39263-2020 Road Vehicles - Advanced Driver Assistance Systems - Terms and Definitions

GB/T 40429-2021 Taxonomy of Driving Automation for Vehicles

ISO 11270 Intelligent transport systems - Lane keeping assistance systems (LKAS) - Performance requirements and test procedures

ISO 15622 Intelligent transport systems - Adaptive cruise control systems - Performance requirements and test procedures

ISO NP 21717 Intelligent transport systems - Partially Automated In-Lane Driving Systems (PADS) -Performance requirements and test procedures

ISO 22179 Intelligent transport systems-Full speed range adaptive cruise control (FSRA) systems-Performance requirements and test procedures

3   Rating Methods

3.1   General

The total score of the cruise assist system test is 40 points, including 7 test scenarios: CCRs, CCRm, CCRb, TV cut-out, straight-to-curve, lane change assist and speed limit sign response, as well as rating of associated functions and review of user manual, as shown in Table 1.

Table 1 Overall Scoring of Cruise Assist

Items	Test Scenario		Rating Index	Score	Total Score
Test in scenarios	CCRs		Braking to stop and avoid collision, longitudinal deceleration and longitudinal deceleration change rate	8	37
	CCRm		Braking and following the forward vehicle, longitudinal deceleration and longitudinal deceleration change rate	10	
	CCRb		Braking and following the forward vehicle to stop, longitudinal deceleration and longitudinal deceleration change rate	3	
	TV cut-out	Stationary TV2	Braking to stop and avoid collision, triggering AEB function or not	4	
		Low-speed TV2	Braking and following the forward vehicle, triggering AEB function or not		
	Straight-to-curve	Without vehicles on the curve	Driving in the curve lane, lateral acceleration	3	
		With vehicles on the curve	Braking to stop and avoid collision, lateral acceleration, longitudinal deceleration and longitudinal deceleration change rate	4	
	Lane change assist	Without vehicles in blind spot	Correct lane change, lateral acceleration and lateral acceleration change rate	1	
		With vehicles in blind spot	Lane change prevention or lane change after avoidance of the TV, lateral acceleration and lateral acceleration change rate	2	
	Speed Limit Sign Response		Accurately identifying information on speed limit signs, giving an overspeed warning	2	
Rating of associated functions	Head-up display		Displaying the CA function-related information in the driver's field of view during normal driving, so that the driver can see such information without lowering his/her head	0.5	2
	V2X		Realizing communication between vehicles or communication between vehicle and infrastructure	0.5	
	Driver monitoring		Realize real-time monitoring of the driver status, and remind the driver in real time when he is in such statuses as fatigue driving, distracted driving and dangerous action	1	
Review of user manual			Clear, complete and unambiguous contents	1	1

3.2 Scoring of test scenarios

The specific scoring rules for the 7 scenarios of CCRs, CCRm, CCRb, TV cut-out, straight-to-curve, lane change assist and speed limit sign response are shown in Table 2.

Table 2 Scoring Rules for Test Scenarios

Test Scenarios		SV Speed km/h	TV1 Speed km/h	TV2 Speed km/h	Rating Index		Score			Total Score of Scenario
					Safety indexes	Experience indexes	Safety	Experience	Total	
CCRs		60	0	/	Braking to stop and avoid collision	Longitudinal deceleration and longitudinal deceleration change rate	1	2	3	8
		80					1	2	3	
		100					1	1	2	
CCRm		90	30	/	Braking and following the forward vehicle	Longitudinal deceleration and longitudinal deceleration change rate	1	2	3	10
		100					1	2	3	
		110					1	1	2	
		120					1	1	2	
CCRb		120	70 (-3 m/s^2)	/	Braking and following the forward vehicle to stop	Longitudinal deceleration and longitudinal deceleration change rate	0.5	1	1.5	3
		120	70 (-4 m/s^2)	/			0.5	1	1.5	
TV cut-out	Stationary TV2	40	40	0	Braking to stop and avoid collision	Triggering AEB function or not	0.5	0.5	1	4
		60	60	0			0.5	0.5	1	
	Low-speed TV2	40	40	15	Braking and following the forward vehicle	Triggering AEB function or not	0.5	0.5	1	
		60	60	10			0.5	0.5	1	
Straight-to-curve	Without vehicles on the curve	100	/	/	Driving in curve lane	Lateral acceleration	0.5	0.5	1	7
		110	/	/			0.5	0.5	1	
		120	/	/			0.5	0.5	1	
	With vehicles on the curve	60	0	/	Braking to stop and avoid collision	Lateral acceleration, longitudinal deceleration and longitudinal deceleration change rate	0.5	1.5	2	
		80	0	/			0.5	1.5	2	
Lane change assist	Without vehicles in blind spot	90	/	/	Correctly performing lane change	Lateral acceleration and lateral acceleration change rate	0.5	0.5	1	3
	With vehicles in blind spot	90	90	/	Preventing lane change and giving an alarm	/	2	/	2	
					Lane change after avoidance of the TV	Lateral acceleration and lateral acceleration change rate	1	1	2	

Speed Limit Sign Response	90	/	/	Accurately identifying information on speed limit signs, giving an overspeed warning	/	2	/	2	2

3.2.1 Scoring of CCRs scenario

In the CCRs scenario, safety index and experience indexes are rated respectively, with a full score of 8 points. See Table 3 for specific scoring methods.

a) The safety index is whether the SV can identify the stationary TV and brake to stop and avoid collision. If the SV collides with the TV, 0 points will be given for the corresponding test condition;

b) The experience indexes are the longitudinal deceleration and the longitudinal deceleration change rate of the SV.

Table 3 Scoring of CCRs Scenario

Rating Index	Test Cycle / Score / Scoring Criteria	60km/h	80km/h	100km/h	Rating Index		Scoring Rate	Remarks
		3	3	2				
Safety indexes	Collision risk	1	1	1	The SV identifies the TV and brakes to stop and avoid collision, without triggering AEB		100%	-
					The SV identifies the TV and brakes to stop and avoid collision, triggering AEB		60%	0 points for experience indexes in such cases
					The SV identifies the TV and collides with the TV after deceleration and braking		0	
					When TTC=2.5 s, the SV has not decelerated and the driver actively departs from the lane		0	
Experience indexes	Longitudinal deceleration	1	1	0.5	Relation curve between longitudinal deceleration and speed of SV	No point exceeds the limit requirement for C1	100%	-
						Any point exceeds the limit requirement for C1	0	-
	Longitudinal deceleration change rate	1	1	0.5	Relation curve between longitudinal deceleration change rate and speed of SV	No point exceeds the limit requirement for C2	100%	-
						Any point exceeds the limit requirement for C2	0	-

Note 1: Triggering AEB means that the maximum deceleration exceeds 6 m/s^2;

Note 2: See Annex A for the definitions of C1 and C2.

3.2.2 Scoring of CCRm scenario

In the CCRm scenario, safety index and experience indexes are rated respectively, with a full score of 10 points. See Table 4 for specific scoring methods.

a) The safety index is whether the SV can identify the low-speed TV and brake and follow it. If the SV collides with the TV, 0 points will be given for the corresponding test condition;

b) The experience indexes are the longitudinal deceleration and the longitudinal deceleration change rate of the SV.

Table 4 Scoring of CCRm Scenario

Rating Index	Test Cycle / Score / Scoring Criteria	90km/h 3	100km/h 3	110km/h 2	120km/h 2	Rating Index	Scoring Rate	Remarks
Safety indexes	Collision risk	1	1	1	1	The SV identifies the TV, brakes and follows it, without triggering AEB	100%	-
						The SV identifies the TV, brakes and follows it, triggering AEB	60%	0 points for experience indexes in such cases
						The SV identifies the TV and collides with the TV after deceleration and braking	0	
						When TTC=2.5 s, the SV has not decelerated and the driver actively departs from the lane	0	
Experience indexes	Longitudinal deceleration	1	1	0.5	0.5	Relation curve between longitudinal deceleration and speed of SV	No point exceeds the limit requirement for C1 — 100%	-
							Any point exceeds the limit requirement for C1 — 0	-
	Longitudinal deceleration change rate	1	1	0.5	0.5	Relation curve between longitudinal deceleration change rate and speed of SV	No point exceeds the limit requirement for C2 — 100%	-
							Any point exceeds the limit requirement for C2 — 0	-

Note 1: Triggering AEB means that the maximum deceleration exceeds 6 m/s^2;

Note 2: See Annex A for the definitions of C1 and C2.

3.2.3 Scoring of CCRb scenario

In the CCRb scenario, safety index and experience indexes are rated respectively, with a full

score of 3 points. See Table 5 for the score of the CCRb scenario.

a) The safety index is whether the SV can identify the decelerating TV and brake and follow it to stop. If the SV collides with the TV, 0 points will be given for the corresponding test condition;

b) The experience indexes are the longitudinal deceleration and the longitudinal deceleration change rate of the SV.

Table 5 Scoring of CCRb Scenario

Rating Index	Test Cycle / Score / Scoring Criteria	$-3m/s^2$ 1.5	$-4m/s^2$ 1.5	Rating Index		Scoring Rate	Remarks
Safety indexes	Collision risk	0.5	0.5	The SV identifies the TV, brakes and follows it to stop, without triggering AEB		100%	-
				The SV identifies the TV, brakes and follows it to stop, triggering AEB		60%	0 points for experience indexes in such cases
				The SV identifies the TV and collides with the TV after deceleration and braking		0	
				When TTC=2.5 s, the SV has not decelerated and the driver actively departs from the lane		0	
Experience indexes	Longitudinal deceleration	0.5	0.5	Relation curve between longitudinal deceleration and speed of SV	No point exceeds the limit requirement for C1	100%	-
					Any point exceeds the limit requirement for C1	0	-
	Longitudinal deceleration change rate	0.5	0.5	Relation curve between longitudinal deceleration change rate and speed of SV	No point exceeds the limit requirement for C2	100%	-
					Any point exceeds the limit requirement for C2	0	-

Note 1: Triggering AEB means that the maximum deceleration exceeds 6 m/s2;

Note 2: See Annex A for the definitions of C1 and C2.

3.2.4   Scoring of TV cut-out scenario

The TV cut-out scenario includes the stationary TV2 scenario and the low-speed TV2 scenario. The safety index and experience index are rated respectively, with a full score of 4 points. See Table 6 and Table 7 for the score of the TV cut-out scenario.

a) The safety index is whether the SV can identify the TV2, and brake to stop and avoid collision or brake and follow it. If the SV collides with the TV, 0 points will be given for the corresponding test condition;

b) The experience index is whether the SV triggers the AEB function.

Table 6 Scoring of TV Cut-out Scenario (Stationary TV2)

Rating Index	Test Cycle / Score / Scoring Criteria	40km/h	60km/h	Rating Index	Scoring Rate	Remarks
		1	1			
Safety indexes	Collision risk	0.5	0.5	The SV identifies the stationary TV2, and brakes to stop and avoid collision	100%	-
				The SV collides with the stationary TV2	0	0 points for experience indexes in such cases
Experience indexes	AEB operation	0.5	0.5	The SV does not trigger the AEB function during braking	100%	-
				The SV triggers the AEB function during braking	0	-

Note: Triggering AEB means that the maximum deceleration exceeds 6 m/s^2.

Table 7 Scoring of TV Cut-out Scenario (Low-speed TV2)

Rating Index	Test Cycle / Score / Scoring Criteria	40km/h	60km/h	Rating Index	Scoring Rate	Remarks
		1	1			
Safety indexes	Collision risk	0.5	0.5	The SV identifies the low-speed express tricycle TV2, brakes and follows it	100%	-
				The SV collides with the low-speed express tricycle TV2	0	0 points for experience indexes in such cases
Experience indexes	AEB operation	0.5	0.5	The SV does not trigger the AEB function during braking	100%	-
				The SV triggers the AEB function during braking	0	-

Note: Triggering AEB means that the maximum deceleration exceeds 6 m/s^2.

3.2.5 Scoring of straight-to-curve scenario

The straight-to-curve scenario includes the scenario without vehicles on the curve and the scenario with vehicles on the curve. Safety indexes and experience indexes are rated respectively, with a full score of 7 points.

a) The safety indexes of the straight-to-curve scenario (without vehicles on the curve) are whether the SV runs on the curve; the safety indexes of the straight-to-curve scenario (with vehicles on the curve) are whether the SV can identify the stationary TV on the curve, and brakes to stop and avoid collision with it, as shown in Table 8. If the SV runs out of the curve or collides with the TV, 0 points will be given for the corresponding test condition.

b) The experience indexes of straight-to-curve scenario (without vehicles on the curve) are whether the lateral acceleration exceeds the limit; the experience indexes of straight-to-curve

scenario (with vehicles on the curve) are whether the lateral acceleration, longitudinal deceleration and longitudinal deceleration change rate exceed the limit, as shown in Table 9.

Table 8 Safety Indexes of Straight-to-curve Scenario

Rating Index		Score	Experience indexes
Straight-to-curve (without vehicles on the curve)	The SV runs on a curve and keeps running in the lane for at least 5 s.	0.5	Rate according to Table 9
	When the SV cannot keep running in the lane and deviates from the curve, it sends a takeover request or the LDW gives a departure warning. The takeover request/warning contains the form of either sound or vibration.	0.3	
	When the SV cannot keep running in the lane and deviates from the curve, it does not send a takeover request and the LDW does not give a departure warning, or the takeover request/warning does not contain the form of sound and vibration.	0	
Straight-to-curve (with vehicles on the curve)	The SV identifies the stationary TV on the curve and brakes to stop and avoid collision.	0.5	Rate according to Table 9
	The SV identifies the stationary TV on the curve, collides with the TV after deceleration and braking, or the SV does not identify the stationary TV on the curve.	0	

Note: The SV deviating from the curve means that any running wheel of the SV crosses the lane line of the current running curve on either side.

Table 9 Experience Indexes of Straight-to-curve Scenario

Scenarios	SV Speed (km/h)	Rating Index		Score
Straight-to-curve (without vehicles on the curve)	100	The lateral acceleration of driving on the curve does not exceed 2.3 m/s^2		0.5
		The lateral acceleration of driving on the curve exceeds 2.3 m/s^2 at any point		0
	110 120	The lateral acceleration of driving on the curve does not exceed 2.0 m/s^2		0.5
		The lateral acceleration of driving on the curve exceeds 2.0 m/s^2 at any point		0
Straight-to-curve (with vehicles on the curve)	60 80	The lateral acceleration of driving on the curve does not exceed 2.3 m/s^2		0.5
		The lateral acceleration of driving on the curve exceeds 2.3 m/s^2 at any point		0
		Relation curve between longitudinal deceleration and speed of SV	No point exceeds the limit requirement for C1	0.5
			Any point exceeds the limit requirement for C1	0
		Relation curve between longitudinal deceleration change rate and speed of SV	No point exceeds the limit requirement for C2	0.5
			Any point exceeds the limit requirement for C2	0

Note: See Annex A for the definitions of C1 and C2.

3.2.6   Scoring of lane change assist scenario

The lane change assist scenario includes the scenario without vehicles in blind spot and the scenario with vehicles in blind spot. Safety indexes and experience indexes are rated respectively,

with a full score of 3 points.

a) The safety index of the scenario without vehicles in blind spot is whether the SV can correctly perform lane change. The safety indexes of the scenario with vehicles in blind spot are whether the SV can identify the TV on an adjacent lane, prevent lane change and give an alarm, or whether the SV can accelerate/decelerate to avoid the TV before successfully performing lane change, as shown in Table 10. If the SV cannot perform lane change correctly in the scenario without vehicles in blind spot or cannot prevent lane change and does not give an alarm in the scenario with vehicles in blind spot, 0 points will be given for the corresponding test condition.

b) The experience indexes of the scenario without vehicles in blind spot are whether the lateral acceleration and the lateral acceleration change rate exceed the limit when the SV performs lane change on a straight lane. The experience indexes of the scenario with vehicles in blind spot are whether the lateral acceleration and the lateral acceleration change rate exceed the limit when the SV performs lane change on a straight lane, provided that the SV can successfully perform lane change after avoiding the TV by acceleration/deceleration. as shown in Table 10.

Table 10   Scoring of Lane Change Assist Scenario

Test Scenario	SV Speed km/h	TV Speed km/h	Rating Index	Score	Total Score
Scenario without vehicles in blind spot	90	-	The SV performs lane change correctly	0.5	3.0
			In the lane change manoeuvre phase, the lateral acceleration of the SV is not more than $1m/s^2$	0.25	
			In the lane change manoeuvre phase, the average lateral acceleration change rate of the SV is not more than $5m/s^3$ within any 0.5 s	0.25	
Scenario with vehicles in blind spot	90	90	The SV prevents lane change and gives an alarm	2.0	
			The SV does not prevent lane change, but gives an alarm (at least one of auditory and tactile alarms)	1.2	
			The SV can successfully perform lane change after avoiding the TV by acceleration/deceleration	1.0	
			In the lane change manoeuvre phase, the lateral acceleration of the SV is not more than $1m/s^2$	0.5	
			In the lane change manoeuvre phase, the average lateral acceleration change rate of the SV is not more than $5m/s^3$ within any 0.5 s	0.5	

Note: "Successfully perform lane change" means that all driving wheels of the SV enter the adjacent lane.

3.2.7   Scoring of speed limit sign response scenario

In the speed limit sign response scenario, safety indexes are rated, with a full score of 2 points, as shown in Table 11.

a)   The safety indexes are whether the SV can accurately identify the information on speed limit signs and give an overspeed warning in time.

Table 11   Safety Indexes of Speed Limit Sign Response

Rating Index		Score	Total Score
Accurately identifying information on speed limit signs	The SV accurately identifies the 80 km/h ordinary speed limit sign. The system shall display the current road speed limit information no later than 2 s before the plane where the SV's head is located passes the plane where the speed limit sign is located (including before passing the speed limit sign).	0.6	2.0
	The SV accurately identifies the 100 km/h LED electronic speed limit sign. The system shall display the current road speed limit information no later than 2 s before the plane where the SV's head is located passes the plane where the speed limit sign is located (including before passing the speed limit sign).	0.4	
Giving an overspeed warning	When the SV passes the 80 km/h speed limit sign, the warning shall be sent to the driver 1.5 s before the plane where the SV's head is located passes the plane where the speed limit sign is located (including before passing the speed limit sign). The warning signal shall be in two forms of acoustic, tactile or optical signals.	1.0	
	When the SV passes the 80 km/h speed limit sign, the warning shall be sent to the driver 1.5 s before the plane where the SV's head is located passes the plane where the speed limit sign is located (including before passing the speed limit sign). The warning signal shall be in one form of acoustic, tactile or optical signals.	0.5	
	No warning message is sent when the SV passes the 80 km/h speed limit sign.	0	

3.3 Scoring of associated functions

The rating of associated functions includes 3 items: head-up display, C-V2X function and driver monitoring. The scoring rules are shown in Table 12.

Table 12   Scoring of Associated Functions

Rating Index		Score	Total Score
Head-up display	Displaying the ICA-related information in the driver's field of view during normal driving, so that the driver can see such information without lowering his/her head.	0.5	2.0
C-V2X function	Realizing communication between vehicles or communication between vehicle and infrastructure.	0.5	
Driver monitoring	Realizing real-time monitoring of the driver's status, and reminding the driver in real time when he/she is in such statuses as fatigue driving, distracted driving and dangerous action.	1.0	

3.4 Scoring of review of user manual

The scoring rules for review of user manual are shown in Table 13.

Table 13   Scoring of Review of User Manual

Review Contents	Rating Index	Score	Total Score
Definition of ICA system	Definition clear or not	0.25	1.0
Description of driver's responsibility	Description clear or not	0.25	
Description of service conditions of L2 ICA function	Clear or not	0.25	
Description of limitation of L2 ICA function (warning information)	Clear or not	0.25	

Annex A

Requirements for Deceleration and Deceleration Change Rate of SV

A.1 Limit requirement for deceleration C1 of SV

When the speed of SV is greater than 72 km/h, its deceleration shall not exceed 3.5 m/s2; when the speed of SV is less than 18 km/h, its deceleration shall not exceed 5 m/s2; when the speed of SV is between 18 km/h and 72 km/h, its deceleration shall change linearly, as shown in Fig. A.1.
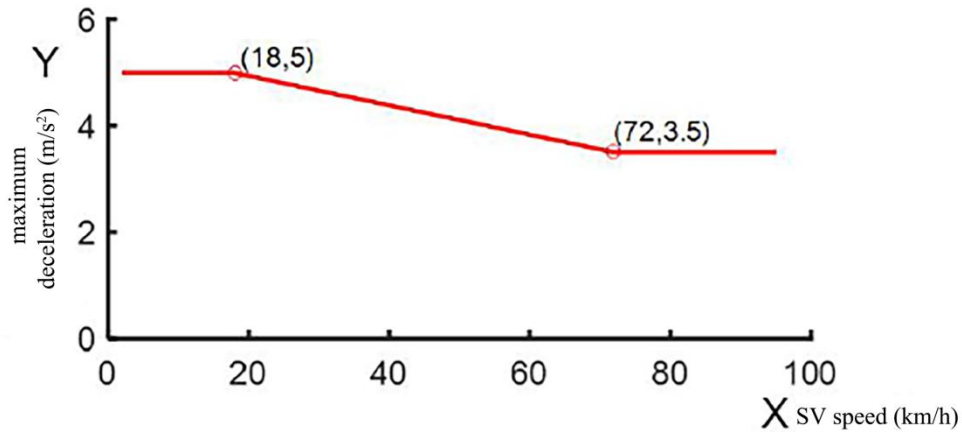

Fig. A.1 Limit Requirement for Deceleration of SV

A.2 Limit requirement for deceleration change rate C2 of SV

When the speed of SV is greater than 72 km/h, its deceleration change rate shall not exceed 2.5 m/s3; when the speed of SV is less than 18 km/h, its deceleration change rate shall not exceed 5 m/s3; when the speed of SV is between 18 km/h and 72 km/h, its deceleration change rate shall change linearly, as shown in Fig. A.2.
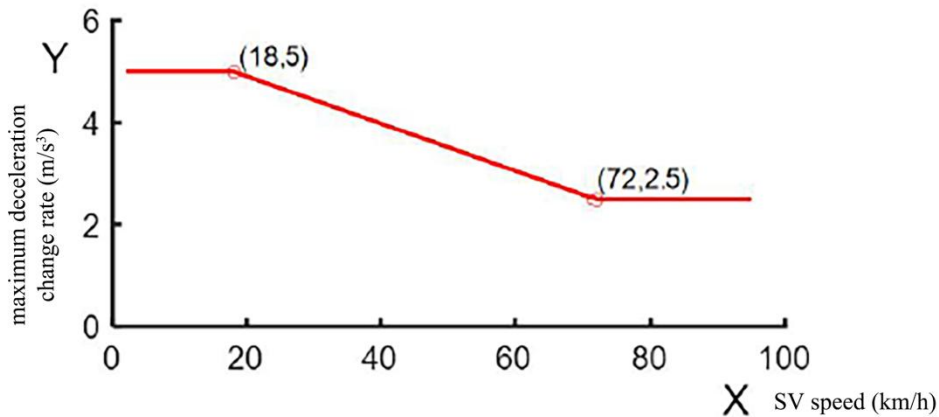

Fig. A.2 Limit Requirement for Deceleration Change Rate of SV