INTERNATIONAL STANDARD

ISO 15622

Second edition
2010-04-15

Intelligent transport systems — Adaptive Cruise Control systems — Performance requirements and test procedures

Systèmes intelligents de transports — Systèmes stabilisateurs de vitesse adaptés — Exigences de performance et modes opératoires

Reference number
ISO 15622:2010(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15622 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 15622:2002), which has been technically revised.

Introduction

The main system function of Adaptive Cruise Control is to control vehicle speed adaptively to a forward vehicle by using information about: (1) ranging to forward vehicles, (2) the motion of the subject (ACC equipped) vehicle and (3) driver commands (see Figure 1). Based upon the information acquired, the controller (identified as “ACC control strategy” in Figure 1) sends commands to actuators for carrying out its longitudinal control strategy and it also sends status information to the driver.

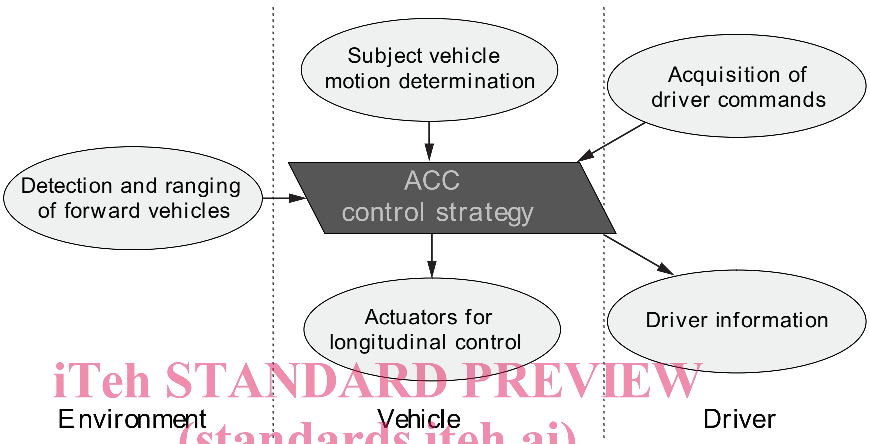


Figure 1 — Functional ACC elements

The goal of ACC is a partial automation of the longitudinal vehicle control and the reduction of the workload of the driver with the aim of supporting and relieving the driver in a convenient manner.

This International Standard can be used as a system level standard by other standards, which extend the ACC to a more detailed standard, e.g. for specific detection and ranging sensor concepts or higher level of functionality. Therefore, issues like specific requirements for the detection and ranging sensor function and performance or communication links for co-operative solutions will not be considered here.

Intelligent transport systems — Adaptive Cruise Control systems — Performance requirements and test procedures

1 Scope

This International Standard contains the basic control strategy, minimum functionality requirements, basic driver interface elements, minimum requirements for diagnostics and reaction to failure, and performance test procedures for Adaptive Cruise Control (ACC) systems. Adaptive cruise control is fundamentally intended to provide longitudinal control of equipped vehicles while travelling on highways (roads where non-motorized vehicles and pedestrians are prohibited) under free-flowing traffic conditions. ACC can be augmented with other capabilities, such as forward obstacle warning.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2575, *Road vehicles — Symbols for controls, indicators and tell-tales*

UN/ECE Regulation No. 13-H, *Uniform provisions concerning the approval of passenger cars with regard to braking*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
active brake control
function that causes application of the brake(s), not applied by the driver, in this case controlled by the ACC system

3.2
Adaptive Cruise Control
enhancement to conventional cruise control systems [see Conventional Cruise Control (3.5)], which allows the subject vehicle to follow a forward vehicle at an appropriate distance by controlling the engine and/or power train and potentially the brake

3.3
brake
part in which the forces opposing the movement of the vehicle develop

NOTE 1 It can be a friction brake (when the forces are generated by friction between two parts of the vehicle moving relatively to one another); an electrical brake (when the forces are generated by electro-magnetic action between two parts of the vehicle moving relatively but not in contact with one another); a fluid brake (when the forces are generated by the action of a fluid situated between two parts of the vehicle moving relatively to one another); an engine brake (when the forces are derived from an artificial increase in the braking action, transmitted to the wheels, of the engine).

NOTE 2 Adapted from UN ECE Regulation No. 13-H:1998, definition 2.6.

NOTE 3 For the purposes of this International Standard, transmission control devices are not considered as brakes.

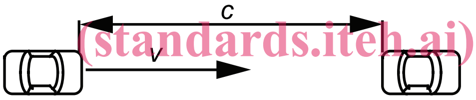
3.4
clearance
distance from the forward vehicle's trailing surface to the subject vehicle's leading surface

3.5
Conventional Cruise Control
system capable of controlling the speed of a vehicle as set by the driver

3.6
forward vehicle
vehicle in front of and moving in the same direction and travelling on the same roadway as the subject vehicle (3.11)

3.7
free-flowing traffic
smooth-flowing and heavy traffic excluding stop and go and emergency braking situations

3.8
time gap
τ
value calculated from vehicle speed v and clearance c by: $\tau = c/v$



3.9
set speed
desired travel speed, set either by the driver or by some control system that is external to the ACC system

NOTE The set speed is the maximum desired speed of the vehicle while under ACC control.

3.10
steady state
condition whereby the value of the described parameter does not change with respect to time, distance, etc.

3.11
subject vehicle
vehicle equipped with the system in question and related to the topic of discussion

3.12
ACC system states
For the purposes of this International Standard, three system states are distinguished (see Figure 2)

3.12.1
ACC off state
state in which direct access for activation of “ACC active state” is disabled

3.12.2
ACC stand-by state
state in which there is no longitudinal control by ACC system and the system is ready for activation by the driver

3.12.3
ACC active state
state in which the system controls speed and/or clearance

3.12.3.1
ACC speed control sub-state
state in which the system controls the speed according to the set speed

3.12.3.2
ACC following control sub-state
state in which the system controls the clearance to the target vehicle according to the selected time gap

3.13
target vehicle
vehicle that the subject vehicle follows

3.14
stationary object
object in front of the subject vehicle which is stationary

4 Symbols and abbreviated terms

4.1 Symbols

See Table 1.

Table 1 — Symbols and meanings

Symbol	Meaning
A	Utilized area, general for area
A_t	Illuminated surface
$a_{lateral\_max}$	Maximum allowed lateral acceleration in curves
a_{min}	Minimum allowed longitudinal acceleration = maximum allowed longitudinal deceleration
a_{max}	Maximum allowed longitudinal acceleration
a_{test}	Maximum allowed acceleration during curve test
$a_{vehicle\_max}$	Maximum possible deceleration capability during manual driving
c	Clearance, inter-vehicle distance
d	Distance between object and sensor, general for distance
d_0	Distance below which detection of a target vehicle is not required
d_1	Distance below which neither distance measurement nor determination of relative speed is required
d_2	Distance for measurement purpose
d_A	Distance between source and projected plane A
d_{max}	Maximum detection range on straight roads
d_{max_curve}	Maximum detection range on curves
E_t	Intensity of irradiation out of transmitter
I_0	Radiated intensity
I_{ref}	Radiated intensity in a given direction
L	Length of a side of a radar test reflector

Table 1 (*continued*)

Symbol	Meaning
R	Circle radius, curve radius
R_{circle}	Actual radius of curve
R_{min}	Minimum curve radius
$T_{brake\ max}$	Minimum time to achieve maximum deceleration
t_0	Time, start test
t_1	Time, start manoeuvre
t_2	Time, end manoeuvre
t_3	Time, end test
v	True subject vehicle speed over ground
v_{circle}	Maximum speed on a curve for a given lateral acceleration $a_{lateral\_max}$
v_{circle_start}	Vehicle speed as it enters a curve of radius R
v_{low}	Minimum speed at which automatic acceleration is allowed
v_{set}	Vehicle set speed
v_{set_max}	Maximum selectable set speed
v_{set_min}	Minimum selectable set speed
$v_{vehicle\_end}$	Vehicle speed at the end of a test
$v_{vehicle\_max}$	Maximum vehicle speed
$v_{vehicle\_start}$	Vehicle speed at the start of a test
y_{max}	Width of FOV measured from the centreline at d_{max_curve}
α	Half angle of field of view
λ	Wavelength of radar wave
τ	Time gap between vehicles
$\tau_{max}(v)$	Maximum possible steady-state time gap at a given speed v
τ_{max}	Maximum selectable time gap
$\tau_{min}(v)$	Minimum steady-state time gap at speed v
τ_{min}	Minimum selectable time gap
Φ	Radiated power
Ω	Solid angle
Ω_0	Solid angle (of the source)
Ω_1	Illuminated solid angle

4.2 Abbreviated terms

— CTT coefficient for test target for infrared reflectors

— FOV field of view

— HDA horizontal detection area

— RCS radar cross-section

5 Classification

5.1 Type of ACC systems

Different configurations of actuators for longitudinal control result in very different system behaviour. Therefore four types of ACC systems are addressed in this International Standard. See Table 2.

Table 2 — Classification of ACC system types

Type	Manual clutch operation required	Active brake control
1a	yes	no
1b	no	no
2a	yes	yes
2b	no	yes

The deceleration capability of the ACC system shall be clearly stated in the vehicle owner's manual. In case of active brake intervention in vehicles with a clutch pedal (type 2a) the driver shall be informed clearly and early about a potential conflict between brake and engine idle control, if the clutch cannot be disengaged automatically. A practicable and unambiguous handing-over procedure shall be provided for the driver. See 6.3.1.

5.2 Classification of curve capabilities

This International Standard is applicable to ACC systems of different curve capabilities as specified in Table 3.

Table 3 — ACC performance classifications

Dimensions in metres

Performance class	Curve radius capability
I	no performance capability claimed
II	⩾ 500
III	⩾ 250
IV	⩾ 125

6 Requirements

6.1 Basic control strategy

NOTE Manual transition describes a switch to enable/disable ACC function. Automatic switch-off can be forced by failure reaction.

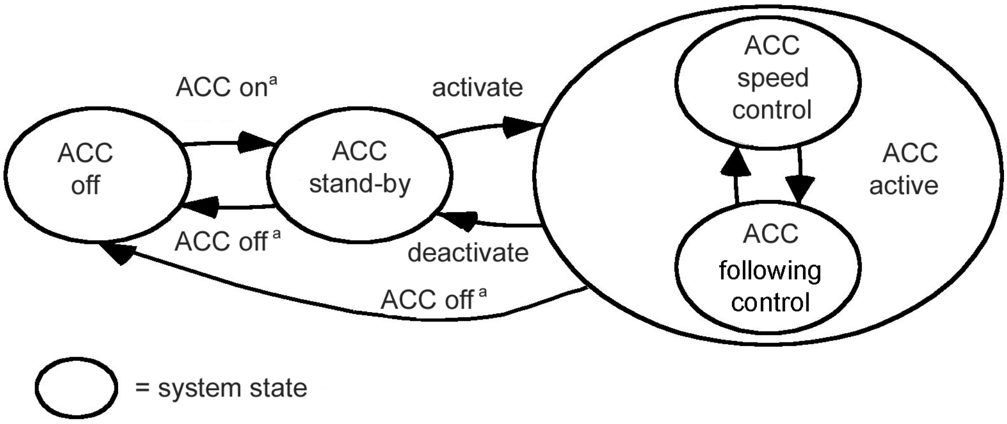
ACC systems shall, as a minimum, provide the following control strategy and state transitions. The following constitutes the fundamental behaviour of ACC systems.

— When the ACC is active, the vehicle speed shall be controlled automatically either to maintain a clearance to a forward vehicle, or to maintain the set speed, whichever speed is lower. The change between these two control modes is made automatically by the ACC system.

— The steady-state clearance may be either self-adjusting by the system or adjustable by the driver (see 6.3.1).

— The transition from “ACC stand-by” to “ACC active” shall be inhibited if the subject vehicle's speed is below a minimum operational speed, v_{low}. Additionally, if the vehicle's speed drops below v_{low} while the system is in the “ACC active” state, automatic acceleration shall be inhibited. Optionally, the ACC system may drop from “ACC active” to “ACC stand-by” (see 6.3.2 and 6.4).

— If there is more than one forward vehicle, the one to be followed shall be selected automatically (see 6.2.4.2).



Key

[a] Manual and/or automatically after self-test.

Figure 2 — ACC states and transitions

6.2 Functionality

6.2.1 Control modes

The transition between the control modes (following controlled or speed controlled) shall be made automatically.

6.2.2 Speed of subject vehicle

The ACC system shall be able to determine the speed of the subject vehicle.

6.2.3 Stationary targets

It is not a requirement that an ACC system be designed to respond to the presence of stationary targets. If the system is designed not to respond to stationary targets the driver shall be informed at least by a statement in the vehicle owner's manual.

6.2.4 Following capability

6.2.4.1 General

τ_{min} shall be the minimum selectable time gap for following control mode under steady-state conditions for all speeds v. τ_{min} shall be $\geqslant$ 0,8 s.