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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

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This third edition of ISO 15622 cancels and replaces ISO 15622:2010 and ISO 22179:2009, which have been technically revised.

The main changes compared to the previous editions are as follows:

— the third edition of ISO 15622 is extended with the performance requirements and test procedures for full speed range adaptive cruise control systems formerly described in ISO 22179:2009 (with minor changes);

— in-vehicle devices are allowed as a possible source for the acquisition of driver commands (set-speed-advise);

— curve classification and related dependencies have been removed;

— automatic start from hold is no longer prohibited.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The main system function of Adaptive Cruise Control (ACC) is to control vehicle speed adaptively to a forward vehicle by using information about: (1) distance 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. Optionally, the driver may choose to have the ACC use set speed advice from in-vehicle devices.

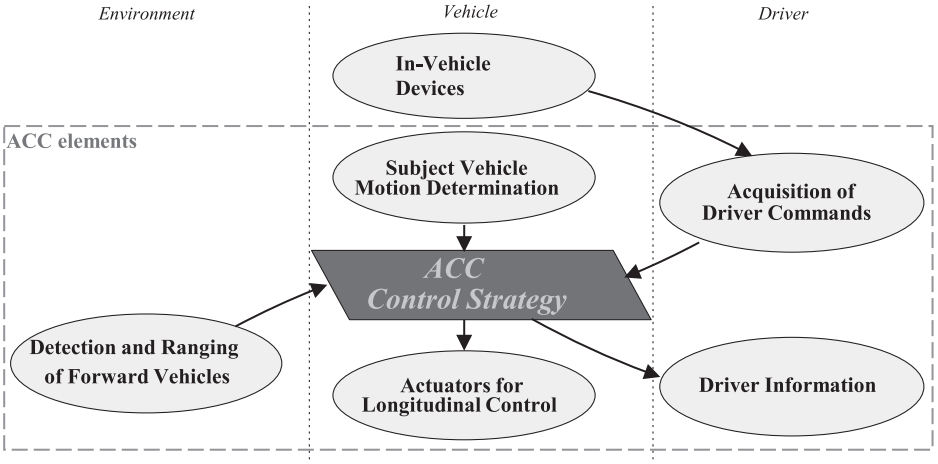


Figure 1 — Functional ACC elements

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. The generic ACC system comprehends two classes: Full Speed Range ACC (FSRA) and Limited Speed Range ACC (LSRA).

This document 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.

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Intelligent transport systems — Adaptive cruise control systems — Performance requirements and test procedures

1 Scope

This document 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.

ACC systems are realised as either Full Speed Range Adaptive Cruise Control (FSRA) systems or Limited Speed Range Adaptive Cruise Control (LSRA) systems. LSRA systems are further distinguished into two types, requiring manual or automatic clutch. 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 and for FSRA-type systems also for congested traffic conditions. ACC can be augmented with other capabilities, such as forward obstacle warning. For FSRA-type systems the system will attempt to stop behind an already tracked vehicle within its limited deceleration capabilities and will be able to start again after the driver has input a request to the system to resume the journey from standstill. The system is not required to react to stationary or slow moving objects

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

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
ACC
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

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

Note 1 to entry: 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 to entry: Definition according to ECE-R 13-H, except for the purposes of this document, transmission control devices are not considered as brakes.

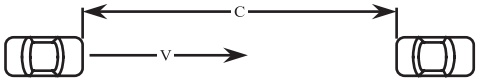
3.4
clearance
distance from the forward vehicle's trailing surface to the subject vehicle's leading surface

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
time gap calculated as clearance, *c, divided by* vehicle speed *v*



Key

c clearance

v vehicle speed

NOTE $\tau = c/v$.

Figure 2 — Time gap

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 1 to entry: 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.

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

3.12
system states
one of several stages or phases of system operation

Note 1 to entry: See Figure 3.

3.12.1
ACC off state
phase in which direct access for activation of "ACC active state" is disabled

3.12.2
ACC stand-by state
phase 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
phase in which the system controls the speed and/or clearance

3.12.4
ACC speed control state
phase in which the system controls the speed according to the set speed

3.12.5
ACC following control sub-state
phase in which the system controls the clearance to the target vehicle according to the selected time gap

3.12.6
FSRA hold state
phase in which the system is active during standstill

Note 1 to entry: Applied for FSRA-type systems only.

3.13
target vehicle
vehicle that the subject vehicle follows

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

3.15
slow moving object
object in front of the subject vehicle which is moving with less than MAX [1,0 m/s, 10 % of subject vehicle speed] in the direction of the centreline of the subject vehicle

3.16
Full Speed Range Adaptive Cruise Control
FSRA cruise control
class of *adaptive cruise control systems* (3.2), which allows the subject vehicle to follow a forward vehicle at an appropriate distance by controlling the engine and/or power train and the brake down to standstill

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3.17
Limited Speed Range Adaptive Cruise Control
LSRA cruise control
class of *adaptive cruise control systems* (3.2), which allows the subject vehicle to follow a forward vehicle at an appropriate distance by controlling the engine and/or power train and the brake above a certain minimum velocity

3.18
in-vehicle device
manufacturer-integrated device that provides the ACC set-speed value without active communication to external devices

4 Symbols and abbreviated terms

$a_{lateral_max}$	maximum allowed lateral acceleration in curves
$a_{stopping}$	longitudinal acceleration of the target vehicle at the automatic "stop" capability test
CTT	Coefficient for Test Target for infrared reflectors
c	clearance, inter vehicle distance
c_{min}	minimum clearance under steady state conditions for all speeds (including hold state)
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 purposes
d_{max}	maximum detection range on straight roads
R	circle radius, curve radius
R_{min}	minimum curve radius
RCS	RADAR Cross Section
v	the 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 operational speed
v_{set_max}	maximum selectable set speed
v_{set_min}	minimum selectable set speed
$v_{stopping}$	vehicle speed of the target vehicle at the automatic "stop" capability test
$v_{vehicle_end}$	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
τ	gap, time gap between vehicles

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