INTERNATIONAL STANDARD

ISO
21717

First edition
2018-09

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Reference number
ISO 21717:2018(E)

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ISO 21717:2018
https://standards.iteh.ai/catalog/standards/sist/def2be10-0b61-4f98-9071-
9c15b882d03b/iso-21717-2018

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Contents

Foreword

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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 of 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 www.iso .org/iso/foreword.html.

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

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.

Introduction

PADS is fundamentally intended to provide partially automated driving by longitudinal and lateral control of equipped vehicles while travelling on roads where non-motorized vehicles and pedestrians are prohibited. Free-flowing as well as congested traffic conditions could be addressed by PADS. The functionality of the longitudinal control is standardized in accordance with ISO 15622. The intention of the lateral control is to keep the vehicle in the lane and not to perform lane changes.

The main system function of a Partially Automated In-Lane Driving System (PADS) is to support the driver in keeping the vehicle within the current lane and to keep the vehicle speed below a set maximum or to control vehicle speed adaptively to a forward vehicle by using information about:

a)   distance to forward vehicles,

b)   the motion of the subject (PADS equipped) vehicle,

c)   the position of the subject vehicle within the lane, and

d)   driver commands (see Figure 1).

Based upon the information acquired, PADS sends commands to actuators that carry out its longitudinal and lateral control strategy, and sends status information to the driver.

The goal of PADS is partial automation of longitudinal and lateral vehicle control to reduce drivers' workload.

This document may be used as a system level standard by other standards, which extend the PADS standard to a more detailed standard, e.g. for specific detection and ranging sensor concepts or higher levels of functionality. Specific requirements for the detection and ranging sensor function and performance or communication links for co-operative solutions are not considered in this document.

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9c15b882d03b/iso-21717-2018

Intelligent transport systems — Partially Automated In-Lane Driving Systems (PADS) — 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 Partially Automated In-Lane Driving Systems (PADS).

This document is applicable to passenger cars, commercial vehicles and buses. It is not applicable to automated driving systems of level 3 or higher (as defined in SAE J3016:2016).

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 15622, *Intelligent transport systems — Adaptive cruise control systems — Performance requirements and test procedures*

3 Terms and definitions

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

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

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

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

3.1
subject vehicle
vehicle equipped with PADS

3.2
forward vehicle
vehicle in front of and moving in the same direction and travelling on the same roadway as the subject vehicle

3.3
system states
one of several stages or phases of system operation

Note 1 to entry: See Figure 1.

3.3.1
PADS off state
state in which the system is switched off

3.3.2
PADS stand-by state
state in which the system is ready for activation by the driver

3.3.3
PADS active state
state in which the system is activated

3.3.4
PADS longit state
state in which the system controls speed and distance to a forward vehicle

3.3.5
PADS longit-lat state
state in which the system controls speed and distance to a forward vehicle and performs steering actions

3.4
lane
area of roadway that a vehicle would be expected to travel along in the absence of any obstruction without the driver's desire to change the path of travel

3.5
visible lane marking
delineators intentionally placed on the borderline of the lane that are directly visible by the driver while driving, e.g. not covered by snow

3.6
incidental visible road feature
visible patterns on the road surface that were not explicitly intended to delineate the boundaries of the lane but which are indicative of the position of the lane

Note 1 to entry: These may include such features as pavement seams or edges, curbs.

3.7
lane boundary
borderline of the lane that is determined by a visible lane marking and, in the absence of a visible lane marking, by incidental visible road features or other means such as GPS, magnetic nails

Note 1 to entry: In the case of a visible lane marking, the boundary shall be at the centre thereof.

3.8
suppression request
driver request or a system feature intended to prevent PADS action if an intentional lane departure is detected

3.9
steering action
steering manoeuvre which the system performs to influence the lateral movement of the subject vehicle with the intention of keeping the vehicle within the lane

3.10
visibility
distance at which the illuminance of a non-diffusive beam of white light with a colour temperature of 2 700 K is decreased to 5 % of its original light source illuminance

3.11
failure
mechanical or electronic malfunction which causes a persistent loss of performance or function

Note 1 to entry: Temporary performance reductions, e.g. due to bad weather conditions, bad lane markings or temporarily occurring sensor blindness are not a failure.

3.12
straight
segment of road on which curvature is less than 1/5 000 m

4 Symbols

Table 1 — Symbols and definitions

Symbol	Definition
PADS_curvature_rate_max	maximum rate of change of curvature which is allowed for the curve test track
PADS_Lat_Acel_max	maximum lateral acceleration which is allowed to be induced by a steering action
PADS_Lat_Jerk_max	maximum lateral jerk which is allowed to be induced by a steering action
Vmax	maximum speed at which PADS is designed to function
Vmin	minimum speed at which PADS is designed to function
PADS_lat_test_speed	speed, at which the function is tested

5 Requirements for longitudinal control

Depending on the minimum speed, *Vmin*, PADS shall fulfil the following requirements of specific ACC types:

— PADS with *Vmin* less than 5 m/s shall fulfil the requirements of ACC type FSRA according to ISO 15622.

— PADS with *Vmin* of at least 5 m/s shall fulfil the requirements of ACC type FSRA or LSRA2 according to ISO 15622.

6 Requirements

6.1 Functionality

The responsibility for safe operation of the vehicle always remains with the driver. The driver shall have means to override the PADS at any time.

Within its system limitations, PADS provide the following subfunctions:

— Keeps the speed below a selected maximum speed.

— Keeps a safe distance to forward vehicles in the same lane as specified within the ACC standard.

— Allows the vehicle to follow the current subject vehicle's lane if the lane is defined with lane boundaries.

— Allows the vehicle to follow an estimated lane for the current subject vehicle. The position of the lane may be estimated using the locations of the forward vehicles which are not necessarily driving in the same lane as the subject vehicle.
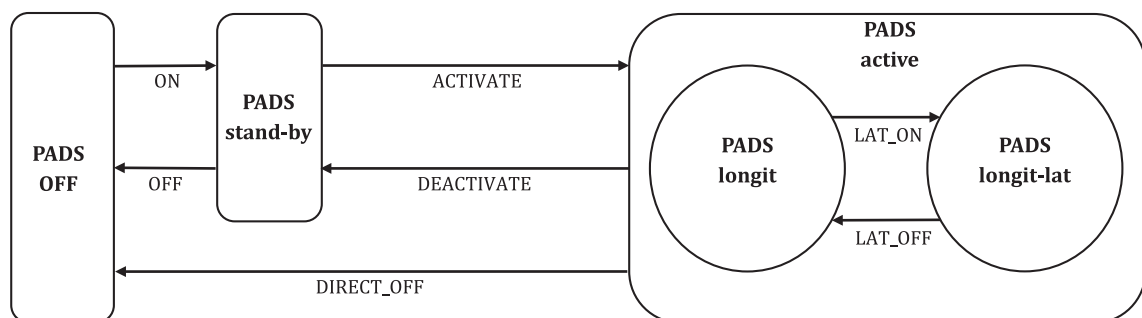

Figure 1 — PADS states and transitions