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Intelligent transport systems — Acceleration control for pedal error (ACPE) — Performance requirements and test procedures

Systèmes de transport intelligents — Contrôle de l'accélération en cas d'erreur de pédale (ACPE) — Exigences de performance et procédures d'essai

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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 document 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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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.

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Introduction

In recent years, accidents caused by operating errors have become an increasing problem. “Pedal errors” are one of the causes that often lead to major accidents. A typical "pedal error" case is when a driver accidentally presses the accelerator pedal as hard and deeply as a brake pedal when braking hard, even though the driver's true intention was to press the brake to slow down or stop.

If the driver was not aware of this mistake, the vehicle will accelerate unintentionally, potentially resulting in an accident.

In various countries, for example Japan, there is concern that societal changes such as an aging population could potentially lead to an increase in such accidents. Dealing with this circumstance has become an urgent issue for automobile manufacturers, and they are expected to take action as soon as possible.

NOTE 1 The relationship between age and frequency of pedal error accidents is explored in Annex A.

This document specifies the functional requirements for an acceleration control for pedal error (ACPE) system, which helps to prevent collisions caused by pedal errors and thereby reduces damage.

Such a system notifies the driver at an early stage of the manoeuvre, and suppresses vehicle acceleration. This is very effective because it encourages the driver to operate correctly and also mitigates the damage in the event of an accident by delaying the time to collision, and reducing the impact load at a collision.

However, with current technology, it is impossible to determine the driver's true intentions. This is because it is not possible to directly determine whether the driver is pressing the accelerator correctly or incorrectly.

Therefore, this document describes a system that suppresses acceleration when an obstacle is detected in the immediate direction of the vehicle's travel and the driver presses the accelerator pedal faster and deeper than usual. Such a situation suggests that the driver is likely to have pressed the accelerator pedal by mistake.

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An automatic emergency braking system (AEB) that aims to avoid and mitigate collisions is already available in the market, with the relevant system requirements specified in ISO 22839. However, because driver operation is given the top priority in such a system, acceleration suppression cannot be activated when the driver presses the accelerator pedal, even if pressed in error. In addition, the sensors used for AEB are specialized for detecting objects at a relatively greater distance it is difficult to detect nearby building walls and windows, which are the main targets of ACPE. Therefore, AEB is unlikely to function in the crash cases targeted by ACPE systems.

This document does not preclude acceleration suppression for distant obstacles. It is desirable to simultaneously reduce unnecessary system activations that impede the driver's true intention to accelerate, and be able to activate the system even for obstacles at a greater distance, depending on the circumstances in every country.

NOTE 2 The inclusion of vulnerable road users (VRUs) as target obstacles and the extension of target distance are potential points for development in future revisions of this document.

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Intelligent transport systems — Acceleration control for pedal error (ACPE) — Performance requirements and test procedures

1 Scope

This document specifies the functional requirements and test procedures for an acceleration control for pedal error (ACPE) system. This document applies to the systems installed in light vehicles (category M1 and N1)[2] and it does not apply to those installed in large vehicles or motorcycles.

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 19206-1, *Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions — Part 1: Requirements for passenger vehicle rear-end targets*

ISO 19206-3, *Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions — Part 3: Requirements for passenger vehicle 3D targets*

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3 Terms and definitions

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

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

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

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

3.1
obstacle
object such as a vehicle or wall, which is present in the travelling direction of the subject vehicle and becomes a potential object to be collided with

3.2
full stroke
position of the accelerating pedal pressed 90 % or more

4 Requirements

4.1 Basic requirements

The APCE system shall have the following basic functions:

— detection of the presence of an obstacle;

— detection of driver's sudden acceleration command;

— ability to control output torque (acceleration);

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— notification of system operation to the driver.

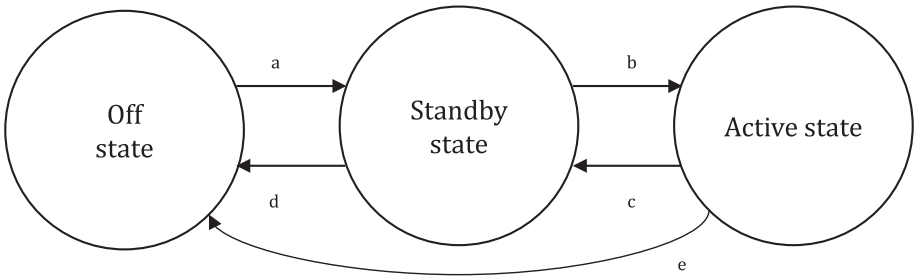
The system may have the following functions;

— braking control;

— system On/Off function by the driver.

4.2 State transition

Figure 1 below shows system states and state transition conditions for this system.



a From Off state to Standby state.
b From Standby state to Active state.
c From Active state to Standby state.
d From Standby state to Off state.
e From Active state to Off state.

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Figure 1 — State transition

4.2.1 Definitions of states

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4.2.1.1 Off state

State in which the power of the system is off, or the user switch is off if there is an on/Off switch for the ACPE system.

4.2.1.2 Standby state

State in which the system power is on, monitoring surroundings, and ready for activation.

4.2.1.3 Active state

State in which the system is activated and acceleration is suppressed.

4.2.2 Transition conditions

Transitions from a) through e) in Figure 1 shall satisfy the following conditions.

a) Transition from Off state to Standby state shall satisfy all of the following conditions:

— power-on;

— no system failure;

— driver switch is On, if the system is equipped with an On/Off switch;

— gear position is engaged in forward or reverse motion, i.e. D (Drive) or R (Reverse).

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b) Transition from Standby state to Active state shall satisfy all of the following conditions:

— an obstacle is detected in the subject vehicle (SV) travel direction [see 4.3.2 a) for obstacle detection];

— sudden acceleration is detected [See 4.3.2 b) for the degree of acceleration];

— within operational vehicle speed range [See 4.3.2 c) for the operational vehicle speed].

c) Transition from Active state to Standby state shall occur if any one of the following conditions is satisfied:

— acceleration pedal is Off;

— driver has disengaged the system;

— gear position is engaged in no available motion, i.e. P (Parking);

— other condition defined by manufacturer.

EXAMPLE Obstacle no longer detected, time in the “active state” exceeded the limit which is designed by manufacturer (e.g. 3 s to 5 s).

d) Transition from Standby state to Off state shall occur if any one of the following conditions is satisfied:

— power-Off;

— system failure;

— driver switch is Off, if the system is equipped with an On/Off switch.

e) Transition from Active state to Off state occur if any one of the following conditions is satisfied:

— power-Off;

— system failure;

— driver switch is Off, if the system is equipped with an On/Off switch.

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4.3 Activation requirements

4.3.1 General

The system countermeasure is activated upon detection of the driver’s sudden acceleration operation, when the subject vehicle is at stand still or moving forward or backward, and with the presence of an obstacle, e.g. vehicle or building structure, in its direction of motion.

4.3.2 Activating conditions

The function shall be activated when four criteria, a) to d), are all satisfied.

a) An obstacle is detected immediately in front of the subject vehicle when moving forward, or immediately behind the vehicle when moving backward. The distance to the obstacle concerned should be approximately 0,8 m to 1,5 m.

b) The driver commands the accelerator pedal to full stroke at the speed of 400 %/s or higher (see Figure 2).

c) The vehicle is standing still or the vehicle is already in motion, i.e. 30 km/h or slower.

d) No unnecessary system activation condition (see 4.3.3) is met.

NOTE 1 Lowering the pedal speed criteria down to 100 %/s is recommended to broaden the activating cases if the system has the capability to reduce the unnecessary system activation which is described in 4.3.3 (see Figure 2).

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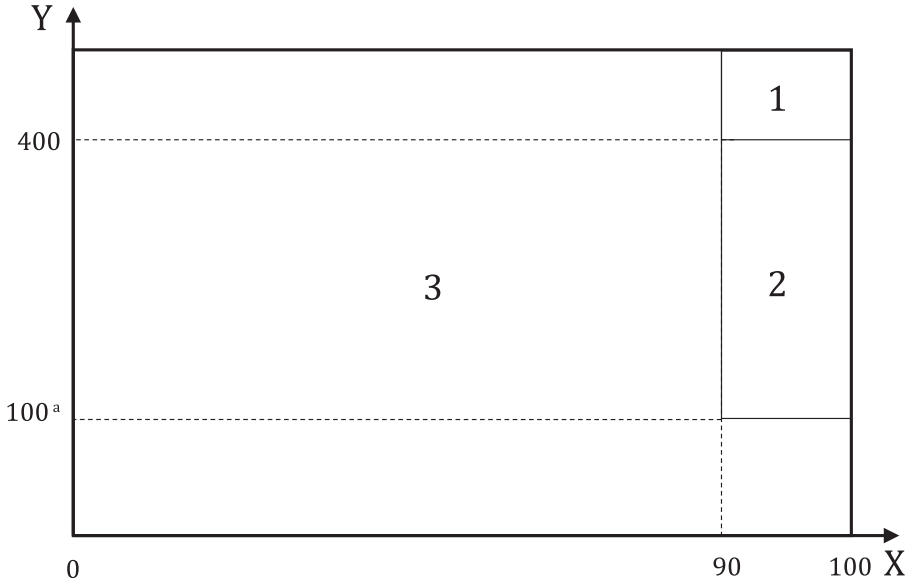
NOTE 2 Annex B provides information on the manner in which the accelerator is pressed.



Key

X accelerator pedal stroke (%)
Y accelerator pedal speed (%/s)
1 activation required
2 activation recommended
3 design-dependent
a Recommended pedal speed.

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Figure 2 — ACPE activation criteria

4.3.3 Reducing unnecessary system activation

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The system should have means to determine the conditions for reducing unnecessary acceleration suppression. Some practical examples of such conditions are as follows.

a) The driver presses the accelerator pedal while the turn signal switch is on or within 2 s after it switches off.

   This condition represents a situation where the driver is trying to turn into a street and is crossing the oncoming lane from a standstill, in which case the system will allow acceleration.

b) The driver slightly releases the accelerator pedal (less than 30 % and with a still pressed pedal) and then presses the accelerator pedal immediately after.

c) The driver continues to press the accelerator pedal for a certain period of time (3 s to 5 s).

d) The driver presses the accelerator pedal while the SV is on a 4° to 5° uphill slope.

e) Maximum velocity of the car should be less than 30 km/h, so the system does not activate during an overtaking session.

4.4 Functional requirements

4.4.1 Suppression function

The system shall have the function to suppress sudden acceleration. When the system is activated and this function is tested according to the procedures defined in Clause 5, the collision speed shall be less than 70 % of what it would be if the system had not been activated.

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