INTERNATIONAL STANDARD

ISO 20901

First edition
2020-04

Intelligent transport systems — Emergency electronic brake light systems (EEBL) — Performance requirements and test procedures

Systèmes de transport intelligents — Systèmes de diffusion de l'information d'un freinage d'urgence (EEBL) — Exigences de performance et procédures d'essai

Reference number
ISO 20901:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: 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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

Emergency Electronic Brake Light systems (EEBL) alert the driver against the danger caused by the emergency braking of a forward vehicle (FV) on the upcoming road. EEBL generates an emergency brake message based on vehicle emergency brake and transmit. The system periodically broadcasts the message to nearby vehicles through vehicle to vehicle (V2V) wireless communication. If the system equipped on an FV detects the emergency braking of its own vehicle, the system generates the emergency braking flag, and sends the message including emergency braking flag. When the system equipped on the subject vehicle (SV) receives the message containing the emergency braking flag, the system judges whether an alert needs to be issued. If the location of the FV is within the specified region of interest (ROI) of the SV, the system provides an alert to the driver to prompt appropriate deceleration for driver safety. The scope of EEBL does not include automated intervention features or means for controlling the vehicle to match a desired speed.

A significant benefit of cooperative safety systems such as EEBL is the significant reduction of the potential risk of collision when a driver cannot see the brake light of an FV that is braking hard. For example, when there is an interfering vehicle between the emergency braking vehicle (FV) and the SV, the driver in the SV can still be alerted through vehicle to vehicle (V2V) wireless communication while on-board sensor-based systems cannot even detect the existence of the FV.

Intelligent transport systems — Emergency electronic brake light systems (EEBL) — Performance requirements and test procedures

1 Scope

This document contains the basic alert strategy, minimum functionality requirements, basic driver interface elements, minimum requirements for diagnostics and reaction to failure, and performance test procedures for Emergency Electronic Brake Light systems (EEBL).

EEBL alerts the driver against danger caused by the emergency braking of an FV on the upcoming road, so that the driver may reduce the speed. The system does not include the means to control the vehicle to meet the desired speed. The responsibility for safe operation of the vehicle always remains with the driver.

The scope of this document does not include performance requirements and test procedures of the wireless communication device used for EEBL. The requirements of communication devices are defined in other standards, e.g. the IEEE series listed in the Bibliography[6][7][8]. The test procedure in this document is designed for third party testing of the product while the test procedure can also be used for other stakeholders such as manufacturers or consumer unions.

The document applies to light duty vehicles and heavy vehicles. These systems are not intended for off-road use.

2 Normative references

There are no normative references in this document.

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
Emergency Electronic Brake Light system
EEBL
system consisting of *EEBL-T* (3.1.1) and *EEBL-R* (3.1.2)

3.1.1
Emergency Electronic Brake Light – Transmitting system
EEBL-T
system capable of detecting the emergency braking of the vehicle where the system is equipped, and capable of transmitting a message including emergency brake flag and other information, e.g. location, speed, to nearby vehicles

3.1.2
Emergency Electronic Brake Light – Receiving system
EEBL-R
system capable of receiving a message including emergency brake flag from *forward vehicles (FVs)* (3.3), and capable of alerting the driver of emergency braking of an FV on the same road and traveling in the same direction as the *SV* (3.2)

3.2
subject vehicle
SV
receiving vehicle
vehicle equipped with the *EEBL-R* (3.1.2) system

Note 1 to entry: The subject vehicle is located behind and traveling in the same direction as the *forward vehicle (FV)* (3.3).

3.3
forward vehicle
FV
transmitting vehicle
vehicle equipped with the *EEBL-T* (3.1.1) system

Note 1 to entry: The *forward vehicle (FV)* (3.3) is located ahead of the *subject vehicle (SV)* (3.2) within the *region of interest (ROI)* (3.9) of the SV.

3.4
interfering vehicle
IV
vehicle which is located in between the *subject vehicle (SV)* (3.2) and *forward vehicle (FV)* (3.3) to interfere with the line-of-sight between the SV and FV

Note 1 to entry: During the test, the IV does not generate a message including emergency brake flag nor issue an emergency brake alert to the driver, so the IV will not influence the *EEBL* (3.1) operation of the *FV* (3.3) and SV.

3.5
subject vehicle speed
longitudinal component of the *subject vehicle (SV)* (3.2) velocity

3.6
visibility
distance at which the illuminance of a non-diffusive beam of white light with the colour temperature of 2700K is decreased to 5 % of its original light source illuminance

3.7
host lane
lane in which the *subject vehicle (SV)* (3.2) is located

3.8
adjacent lane
lane of travel sharing one lane boundary with the host lane and having the same direction of travel as the host lane

3.9
region of interest
ROI
area in which a *subject vehicle (SV)* (3.2) receives the emergency brake flag from the *forward vehicle (FV)* (3.3)

4 Symbols and abbreviated terms

a_{d}	The deceleration of the FV
$a_{d\_Current}$	Absolute value of the deceleration of the FV
$a_{d\_Threshold}$	Threshold amount of deceleration of the FV to judge the emergency braking
EEBL	Emergency Electronic Brake Light system
EEBL-T	Emergency Electronic Brake Light -Transmitting system
EEBL-R	Emergency Electronic Brake Light - Receiving system
FSRA	Full Speed Range ACC
FV	Forward Vehicle
FVCWS	Forward Vehicle Collision Warning System
GNSS	Global Navigation Satellite System
HMI	Human Machine Interface
IV	Interfering Vehicle
PER	Packet Error Rate
ROI	Region of Interest
RSE	Road Side Equipment
SV	Subject Vehicle
V_1	A pre-set speed of vehicle for test
V2I	Vehicle to Infrastructure communication
V2V	Vehicle to Vehicle communication
V_{max}	Maximum operational speed value

5 Specifications and requirements

5.1 Basic functions

The purpose of the EEBL is to provide alerts that will assist drivers in avoiding or reducing the severity of rear end crashes caused by emergency braking of an FV.

EEBL has following functions.

— EEBL-T detects and judges the emergency braking of an FV, and broadcasts a message including the emergency braking flag. For better understanding, the vehicle that broadcasts the emergency braking flag is denoted as FV in this document.

— EEBL-R receives the message including the emergency braking flag, judges whether the alert shall be issued, and provides the alert to the driver. For better understanding, the vehicle whose driver is alerted is denoted as SV in this document.

— The EEBL requires both of these functions, EEBL-T and EEBL-R, on separate vehicles. The implementations can be different for different manufacturers on their respective vehicles.

The alert should be issued as soon as the SV receives the emergency braking message flag from an FV within its ROI and has evaluated it to be relevant. EEBL provides an alert only and does not perform vehicle control to mitigate the crash.

EEBL may suppress or delay the alert when the SV is applying an automatic braking or alert(s) commanded by another system in the vehicle, e.g. FVCWS or FSRA.

The basic components of EEBL can include radio communication transmitter/receiver and antenna, GNSS receiver and antenna, processing device and HMI device. The processing device can be a separate control unit or it can be combined with another control unit.

5.2 Necessary functions

Vehicles equipped with EEBL-T shall be equipped to fulfil the following functions:

— monitor vehicle deceleration, vehicle position, vehicle speed and vehicle heading direction;

— detect emergency braking in accordance with deceleration threshold value;

— broadcast the message including emergency braking flag to nearby vehicles.

Vehicles equipped with EEBL-R shall be equipped to fulfil the following functions:

— receive the message including emergency braking flag;

— judge the position and heading of the FV with respect to the SV;

— provide alerts to driver in accordance with the EEBL function and requirements.

5.3 Basic operation principle

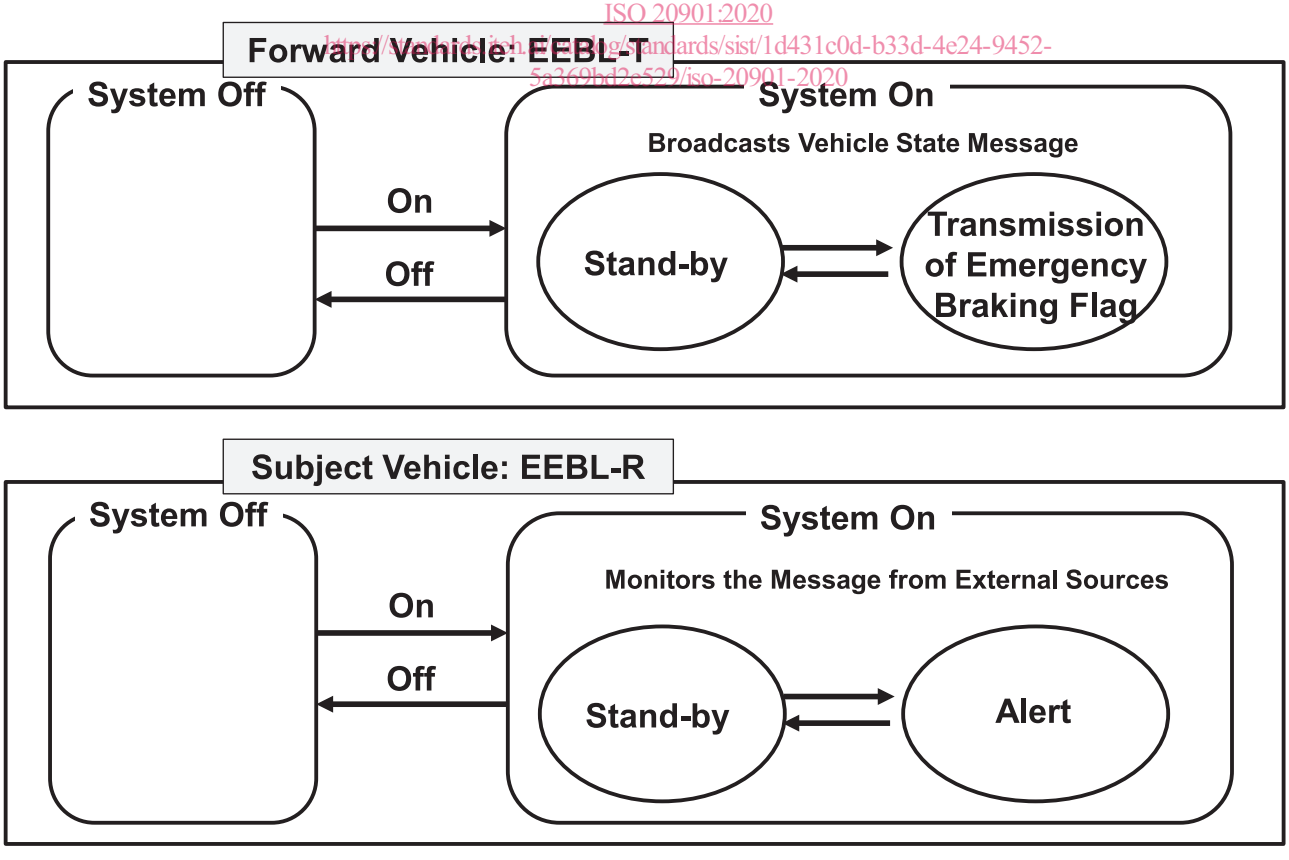

Figure 1 — EEBL states and transitions

5.3.1 State functional descriptions

5.3.1.1 State transition conditions

Conditions for EEBL transitions from system Off state to system On state:

a) For EEBL vehicles equipped with on/off control, both the vehicle ignition and the on/off control are on.

b) For EEBL vehicles not equipped with on/off control, the vehicle ignition is on.

c) The transition from EEBL Off to EEBL On may be performed by the driver or automatically.

d) The transition from EEBL Off to EEBL On shall only occur if no EEBL system failures have been detected.

Conditions for EEBL transitions from system On state to system Off state:

a) For EEBL vehicles equipped with on/off control, either the vehicle ignition or the on/off control are off.

b) For EEBL vehicles not equipped with on/off control, the vehicle ignition is off.

c) If the system is in on state, and a system failure occurs.

The system may be fitted with an on/off control that can be operated by the driver at all times.

EEBL shall as a minimum, provide the following operations and state transitions. The following constitutes the fundamental behaviour of EEBL. The alert criteria are described in 5.4.

— The EEBL-T system of an FV generates the message including the emergency braking flag as long as the vehicle braking exceeds the threshold value ($a_{\text{d\_Threshold}}$), and returns back to the stand-by state after the vehicle braking no longer exceeds the threshold value. The system broadcasts the message including the emergency braking flag to nearby vehicles through V2V wireless communication within 100 ms of detecting the emergency brake.

— When the EEBL-R system of an SV is in the stand-by state, the system monitors messages from external wireless communication sources. If a message including the emergency braking flag is received, the system judges the alert criteria to determine whether the alert should be issued. If the system judges to alert, the system transitions to the alert state, and the EEBL-R starts alert(s) immediately.

— When the EEBL-R system of an SV is in the alert state, the system provides alert(s) to the driver for a minimum 2 s, and maximum of the duration that the FV emergency braking flag is received, and then returns back to the stand-by state.

One of several stages or phases of system operation.

— EEBL off state: The state that EEBL is off. This state has one of the following three causes: the driver has selected the off condition, the ignition is off, or the EEBL is in failure. The failure of EEBL means that the system cannot function as it is described in the user manual due to the failure of the system or the failure of the sub-component of the EEBL. The cause of failure can be, e.g. system malfunction, communication fail, failure during self- diagnosis process.

— EEBL system on state: For EEBL-T equipped on a FV, this state is either stand-by or broadcast state. For EEBL-R equipped on an SV, this state is either stand-by or alert state. Vehicles equipped with EEBL-T periodically broadcast and the vehicles equipped with the EEBL-R receive status messages.

— EEBL system stand-by state: For EEBL-T equipped on a FV, the system monitors the vehicle deceleration. For EEBL-R equipped on an SV, the system is ready to receive the message including the emergency braking flag.