



BSI Standards Publication

Road vehicles — Pre-crash classification systems

National foreword

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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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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 36, *Safety and impact testing*.

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

This document describes currently available pre-crash classifications that specify the conflict situation between road traffic actors that lead to a crash. The document describes classifications that are based on different real-world crash data types and collection origins. The focus is on the description of attributes and characteristics of different approaches and their applicability to data-driven traffic safety research. This document gives examples for research questions which can be addressed with a respective classification system and the intended use of these classification systems.

The types of the traffic accidents vary in different countries and regions because of different administration modes, infrastructures, road users, road conditions and vehicle safety levels. Different stakeholders focus on different aspects of traffic accidents. For example, traffic administrations focus on typical accident modes. Manufactures focus on technology applications under different working conditions. Testing facilities focus on technical details like velocity and impact angle. Suppliers focus on the practical performance of specific parts or systems. At the same time, different accident reasons provide foundations for administrations to formulate regulations and for manufactures to update relative functions and configurations.

Therefore, traffic-accident research can promote the development of vehicle-safety technology, traffic administration and infrastructure, vehicle testing and certification, standards and regulations. Classifications based on traffic accidents can support the systematic and comprehensive description of the accident situation, which is an important foundation for the subsequent safety technology research and development. Research on the formulation of different accident classification systems analyses their difference and contributes to the harmonization of classification levels, accident types, accident reasons and participants.

The country or region mentioned within brackets on the heading of each method compiled indicates that the information has been provided by experts from that country or region. It does not indicate that the method referred to has an official status in that country or region.

Road vehicles — Pre-crash classification systems

1 Scope

This document describes pre-crash classification systems that specify the conflict situations between road traffic actors that lead to real-world crashes.

Classification systems are useful tools in defining and understanding the role and actions of traffic actors and therefore, can be applied to the development of vehicle active safety technology, vehicle-safety assessment and traffic-safety research in general.

This document addresses pre-crash classification systems that are based on characteristics of conflict situations which can lead to a crash.

This document does not address test scenarios that describe the operation domain of assisted or automated driving systems.

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 12353-1, *Road vehicles — Traffic accident analysis — Part 1: Vocabulary*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 12353-1 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Terms and definitions

3.1.1

accident

crash

event in road traffic that leads to property damage or personal injury or both

Note 1 to entry: In order to respect the terminology 'accident' or 'crash' used in different data sources, the terms are taken as interchangeable for the purpose of this document.

3.1.2

pre-crash

time before an *accident* or *crash* ([3.1.1](#)) where the accident or crash is unavoidable

3.1.3

near-crash

event in road traffic where traffic participants are not damaged or injured (no property damage or personal injury), but the event was critical

3.1.4

6-layer model

model for a systematic description of scenarios with six independent layers

Note 1 to entry: The six independent layers are comprehensively described in Reference [27].

3.2 Abbreviated terms

AEB	autonomous emergency braking
ASEG	accident study expert group
CATS	Cyclist-AEB Testing System
CEDATU	Central Database for In-Depth Accident Study
CIDAS	China In-Depth Accident Study Database
CISS	Crash Investigation Sampling System
CNCAP	China New Car Assessment Program
CRSS	Crash Report Sampling System
EuroFOT	European Field Operational Test (EU project)
EVADE	EU project
FARS	Fatality Analysis Reporting System
GES	General Estimates System
GIDAS	German In-Depth Accident Study
IGLAD	Initiative for the Global Harmonization of (in-depth) Accident Data
ITARDA	Institute for Traffic Accident Research and Data Analysis
LAB	Laboratory of Accidentology, Biomechanics and Human Behaviour (Nanterre, France)
L3Pilot	Level 3 Pilot (EU project)
NASS	National Automotive Sampling System
NCAP	New Car Assessment Program
OEM	original equipment manufacturer
PC	passenger car
PCS	pre-crash scenario
SHRP2	Strategic Highway Research Program 2
STRADA	Swedish Traffic Accident Data Acquisition
UDV	German Insurers Accident Research (Unfallforschung der Versicherer)
UTYP	Unfalltyp (German for accident type)
VOIESUR	Vehicle Occupant Infrastructure Road User Safety Study (Vehicule Occupant Infrastructure Etudes de la Sécurité des Usagers de la Route)
VRU	vulnerable road user
V_CAD	Volvo Cars Car Accident Database
VCTAD	Volvo Cars Traffic Accident Database
V_PAD	Volvo Cars Pedestrian Accident Database

4 Pre-crash scenarios

4.1 Focus of the system

The focus of the classification system called pre-crash scenarios (PCSs) is on the description of the conflict situation that leads to a critical event or accident. The goal is to identify the first two conflicting participants and describe their interaction. All possible combinations and degrees of freedom of the participants are

considered. This includes the relative orientation such as same lane or crossing, the directions of travel such as co-moving or oncoming, and the intention of each participant such as lane change, turning or reversing. Thus, all possible, however relevant, combinations of actions and goals of the actors in the conflict situation can be described.

The classification system does not focus on the accident causation such as human behaviour, system failure or environment conditions, that are the root cause of a conflict. Neither does the system describe the actual collision combinations such as crash direction or impact position of the involved participants.

The defined set of pre-crash situations is independent of the kind of participation. It can be applied to motor-vehicles like cars and trucks, and to vulnerable road users like motorcycles, bicycles or pedestrians. Due to the nature of the road layouts and traffic rules, not all possible combinations are applicable to all traffic participations. For example, in a right-hand traffic environment, a right-turning car can run into oncoming bicyclists or pedestrians; however, it cannot encounter an oncoming car.

The classification system allows to view the different conflict situations from the perspective of a motor-vehicle. Equally, each situation can also be seen through eyes of a vulnerable road user. This allows for a holistic analysis of relevant accidents from the point-of-view of each participant type.

A catalogue is used to list the available situations with their names and descriptions and including graphic pictograms.

The classification system was originally developed by Continental AG, based on the Cyclist-AEB Testing System (CATS, see [Clause 12](#)). To include all possible participants, the CATS was extended to also include other participant types.

4.2 Data basis

The classification system is not limited to a specific accident or driving database. Rather it can utilize a variety of different data sources. A prerequisite is that the data used contains relevant information on the combination of the dynamic objects in the conflict situation that might lead to an accident. The information needed includes the relative positions, the direction of travel, the intention of movement of the involved traffic participants. This includes at least the two participants in the conflict situation that leads to the critical event or accident but can also include further participants involved. All relevant vehicle types and different vulnerable road users are considered as possible conflicting participants.

4.3 Creation method

For generating the classifications, the available pre-crash descriptions, in each data set, are used. Equivalent descriptions are clustered to generate classifications that are equivalent to a vehicle-safety system, that can address the pre-crash situation and avoid or mitigate a collision.

Each critical event or accident is considered from the perspective of the first two involved participants. From each perspective the same accident represents a different situation. The same accident reflects two different situations that can be addressed by both participants using different safety systems. For example, in a crossing accident, one participant will observe a crossing-from-right and the other a crossing-from-left situation. See [Figures 1](#) and [2](#).