International Standard

ISO 34504

First edition
2024-02

Road vehicles — Test scenarios for automated driving systems — Scenario categorization

Véhicules routiers — Scénarios d'essai pour les systèmes de conduite automatisée — Catégorisation des scénarios

Reference number
ISO 34504:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
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 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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 *22*, *Road vehicles*, Subcommittee SC 33, *Vehicle dynamics, chassis components and driving automation systems 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

Test and verification of automated driving systems (ADS) is one of the main challenges for the introduction of ADS into the market. Scenario-based testing is an approach for prospective verification of ADS that is broadly supported in the automotive field. It is expected that many test scenarios will be used to conduct the validation and verification of ADS, e.g. see ISO 34502. It is common practice to use some form of categorization of the scenarios.

The goal of this document is to propose a way to categorize scenarios. Scenario databases, such as the German In-Depth Accident Study (GIDAS)[2], the Community database on Accidents on the Roads in Europe (CARE)[3], the Initiative for the GLobal harmonization of Accident Data (IGLAD)[4], road safety from the government of the United Kingdom[5], and the National Automotive Sampling System (NASS) General Estimates System (GES) from the United States[6], already contain categories, but these categories are generally not shared among different databases. This document provides a method to harmonize the way scenarios are categorized. To enable the scenario categorization, "tags" are defined as meta-attributes that provide an additional source of information for each of the scenarios. A scenario category is defined using tags, such that all scenarios that share the same tags are considered to belong to that scenario category.

NOTE This document does not provide a hierarchical structure for the scenarios. There are many ways to provide a hierarchical structure and there is no best way to do this. For example, scenarios can be structured based on the road layout or based on the driving behaviour of a vehicle. The most suitable way to structure the scenarios depends on the application.

Road vehicles — Test scenarios for automated driving systems — Scenario categorization

1 Scope

This document defines an approach for the categorization of scenarios by providing tags that carry information about the scenarios.

This document is applicable to SAE level 3 to SAE level 5 Automated Driving System (ADS)[19].

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 34501, *Road vehicles — Test scenarios for automated driving systems — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 34501 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/

4 Categorization

4.1 Objectives

The objective of this clause is to provide a way to categorize scenarios.

4.2 General

A scenario category refers to a set of scenarios that share one or more characteristics. Tags are attached to a scenario for the purpose of categorizing the scenarios. A given scenario is part of a scenario category if all tags of the scenario category are also part of the tags that are applicable to the given scenario. Scenario categories do not need to be mutually exclusive. A standardized set of tags for defining scenario categories makes sharing and transferring scenario (categories) between different entities easier.

Scenario categorization can be used to structure the test cases for ADS. Another application of scenario categorization is the scenario assignment for the assessment of ADS within a given Operational Design Domain (ODD) because it might be easier to relate an ODD to scenario categories instead of relating an ODD to all possible scenarios. Scenario categorization can also be used to select scenarios from a scenario database or scenario library by using tags or a combination of tags.

In some cases, there is a need of having generic scenario categories – and thus a wide variety among the scenarios belonging to the scenario category – and, in other cases, there is a need of having specific scenario categories without much variety among the scenarios in the scenario category. For some systems, one may be interested in a very specific set of scenarios, while for another system one might be interested in a set

of scenarios with a high variety. To accommodate this, tags can be structured in hierarchical trees. The different layers in a tree can be regarded as different abstraction levels.

If the provided tags do not adequately represent a specific characteristic of a scenario, stakeholders may extend the provided tags. This applies to tags that provide a more specific description of a characteristic described by one of the tags of this clause. It may also apply to tags that describe a characteristic of a scenario that is not addressed in this document.

The actual implementation of the tags into a specification is out of scope of this document. Stakeholders may choose to support, for example, scenario hierarchy whereby a specific scenario (category) inherits tags from another scenario (category). It is also possible to combine tags of the same level to create a new scenario category, e.g. a definition of a scenario category that includes the wind tag “light breeze”, “gentle breeze”, “moderate breeze”, or “fresh breeze”.

4.3 Inputs to this clause

4.3.1 Informative references

a) ISO 34502[1]

b) ISO 34503 [7]

c) ASAM OpenLABEL[8]

d) Scenario Categories for the Assessment of Automated Vehicles[9]

e) Proposal for a second iteration of the New Assessment/Test Method for Automated Driving – Master Document, ECE/TRANS/WP.29/GRVA/2022/2[10]

f) HEADSTART deliverable on the integration of simulation and physical testing[11]

4.4 Requirements and recommendations

4.4.1 General

A scenario category shall be defined by a collection of tags, where this collection contains one or multiple tags. A scenario category shall comprise scenarios for which these tags are applicable. A scenario category Y shall include a scenario category X if this scenario category X contains the same (structure of) tags as this scenario category Y.

NOTE 1 This implies that if scenario category X includes scenario category Y, then scenario category X comprises all scenarios that scenario category Y comprises.

EXAMPLE Figure 1 illustrates this, where three scenario categories are shown:

a) the red circle denotes the scenario category with the tag “daytime”;

b) the green circle denotes the scenario category with the tag “heavy rain”;

c) the overlap of the red and green circles denotes the scenario category with the tags “daytime” and “heavy rain”.

In this example, let X be the scenario category with tags “daytime” and “heavy rain” and let Y be the scenario category with the tag “daytime”. Since X contains the same tag as Y, Y includes X. Figure 1 illustrates this, as Y (the circle with tag “daytime”) fully overlaps the area that represents X (the intersection area of both circles). As a result, both the X and Y comprise the scenario occurring at daytime with heavy rain, i.e. Y comprises all scenarios of X.

NOTE 2 Figure 1 is simplified in the sense that there are typically many other characteristics considered for categorizing scenarios.

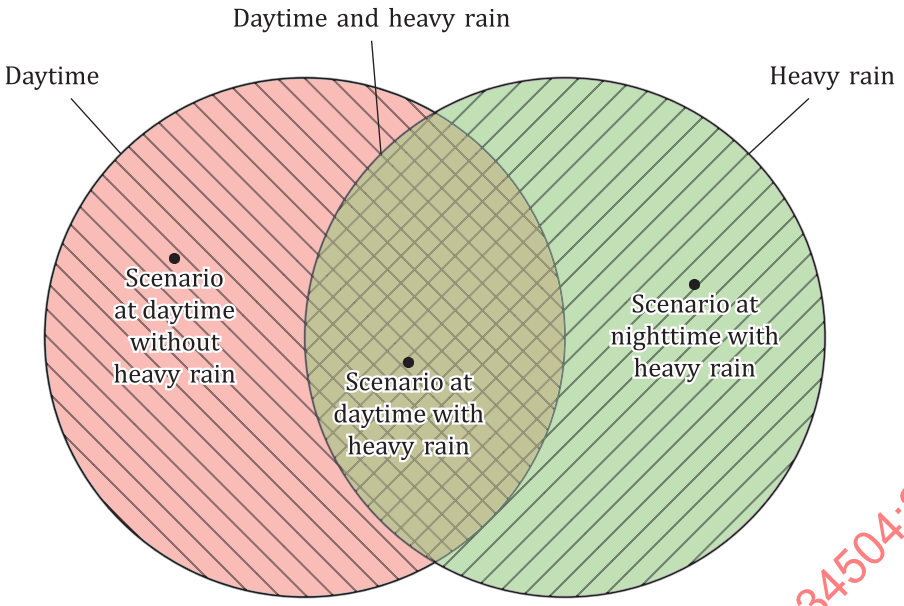


Figure 1 — An example of a relation between scenarios and scenario categories

In addition to tags, the scenario attributes can be used for allocating the scenarios into scenario categories. In that case, a scenario attribute shall be considered as equivalent to a tag. For example, a scenario that contains heavy rain can be categorized into the scenario category "heavy rain" even though the scenario does not contain the tag "heavy rain".

4.4.2 Purpose of tags

The tags of a scenario contain information about the scenario. In order to indicate the purpose of a tag, the kind of information the tag provides shall be indicated. A tag shall address a range of topics, including but not limited to:

a) dynamic entities;

b) scenery elements;

c) environmental conditions;

d) additional information of a scenario;

e) intended test usage.

NOTE 1 Figure 2 visualizes the different groups of tags.

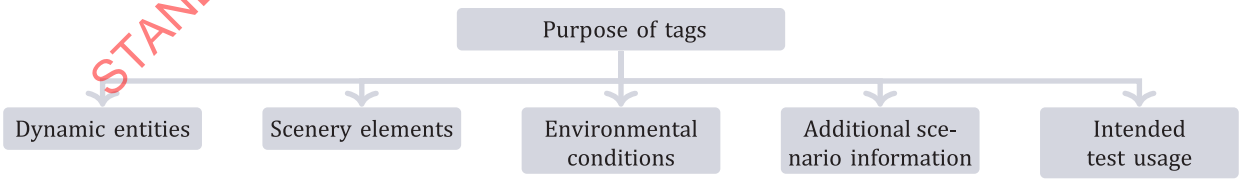
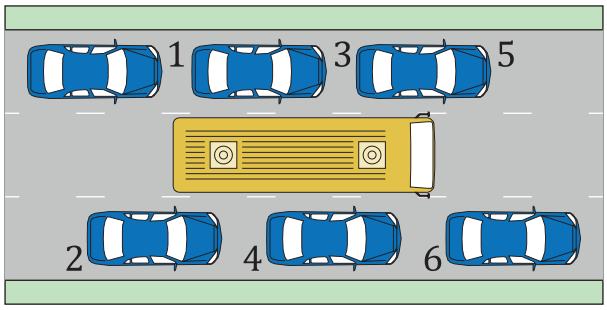


Figure 2 — Groups of tags

NOTE 2 In most cases, the purpose of the tags is to provide qualitative information. Stakeholders can specify more details regarding the quantification of tags. For example, the tag "faster" can be applied to a dynamic entity that is moving "faster" than the subject vehicle. The exact meaning of "faster" is not further specified in this document. A stakeholder can choose to apply the tag if the dynamic entity is moving at a higher speed than the subject vehicle, but it can also, for example, apply the tag only when a dynamic entity is moving with a speed faster than 1 m/s for a duration of at least 1 s.

NOTE 3 To illustrate that the meaning of the tags can be ambiguous, consider the tag “in front of subject”, which is used to indicate that a dynamic entity is in front of the subject vehicle. Consider the bus in Figure 3 as the subject vehicle. Clearly, the tag “in front of subject” does not apply to the left-most car, indicated with the label “car 1”, of Figure 3. However, for “car 6”, the tag applies, since this passenger car is fully in front of the subject vehicle. For the remaining four passenger cars, it depends on how “in front of” is defined. For example, the front of “car 2” is behind the front of the bus, but the front of “car 2” is in front of the rear of the bus. The rear of “car 3” is in front of the rear of the bus. Similarly, the centre of “car 4” is ahead of the centre of the bus and the front of “car 5” is in front of the bus.



Key

1 car 1
2 car 2
3 car 3
4 car 4
5 car 5
6 car 6

Figure 3 — A bus and six passenger cars; it is unclear which cars are in front of the bus

4.4.3 Extension of tags and trees of tags

The tags shall be structured into trees and each layer shall represent a different abstraction level. If a scenario category contains a tag at a certain level, all the lower-level tags may be applicable.

Stakeholders may extend the list of tags if those tags that are specified do not adequately describe a scenario characteristic. While the tags are extensible, any extension which conflicts with the specified tags shall be avoided.

NOTE Even if tags are at the same layer in the same tree of tags, they do not need to be mutually exclusive.

4.4.4 Tags for a dynamic entity

For a dynamic entity, the tags shall address:

a) road user type;

b) longitudinal action;

c) lateral action;

d) mixed action;

e) state or initial state;

f) role of a dynamic entity with respect to the subject vehicle;

g) enhancing conspicuity;

h) visibility;

i) collision information.

If, for a dynamic entity, no tags are mentioned for one or more of the aforementioned items, it shall be assumed that any of the tags of that item may be or may not be applicable for the scenarios that the scenario category comprises.

EXAMPLE A dynamic entity of a scenario category only contains tags for the "road user type". As a result, the scenarios that the scenario category comprises contain at least one dynamic entity with the tags for the "road user type" as specified and this dynamic entity can contain any tag related to "longitudinal action", "lateral action", etc.

4.4.4.1 Road user type

At the top level, the tags for the road user type should be:

a) vehicle;

b) pedestrian;

c) cyclist;

d) animal;

e) inanimate obstacle.

To further specify a vehicle, the following tags can be used:

— passenger car;

— bus;

— school bus;

— truck;

— tram;

— goods vehicle;

— dangerous goods vehicle;

— long, large vehicle;

— vehicle transporting protruding cargo;

— vehicle towing trailers;

— vehicle towing combination trailers;

— special convoy, slow-moving vehicle;

— caravan/recreational vehicle, including towing trailers;

— agricultural vehicle;

— fire truck;

— ambulance;

— police vehicle;

— rescue vehicle;

— street sweeper;

— road sprinkler;

— training car;

— crane, Non-Road Mobile Machinery (NRMM);

— other automated/connected (V2V) vehicle;

— disabled (broken-down) vehicle.

To further specify a pedestrian, the following tags can be used:

— child;

— adult;

— person with disabilities;

— hearing-impaired pedestrian;

— visually-impaired pedestrian;

— road-works crew;

— police officer (on foot);

— person directing traffic;

— person pushing stroller;

— person in wheelchair;

— motorists on the roadside (e.g. person next to stranded vehicle, changing tire).

To further specify a cyclist, the following tags can be used:

— bicyclist;

— e-Bike user;

— skater (roller, skateboard);

— motorcycle;

— moped/scooter;

— powered three-wheeler;

— quadricycle;

— self-balancing scooter.

To further specify an animal, the following tags can be used:

— small size animal;

— medium size animal;

— large size animal.

To further specify an inanimate obstacle, the following tags can be used:

— stationary vehicle;

— debris;

— construction equipment;

— moving obstacle.

NOTE 1 Figure 4 visualizes the tree of tags for the road user type.

NOTE 2 The tags for the road user type are based on ongoing VMAD/FRAV UNECE discussions in the Other Road User workstream[12].

NOTE 3 A moving obstacle can refer to blowing debris like a tumbleweed or a plastic tarp.

NOTE 4 A disabled (broken-down) vehicle can have its emergency lights on, and an emergency triangle can be located behind this vehicle. A stationary vehicle can refer to a parked vehicle.

NOTE 5 For categorizing animals based on their size, the tag “small size animal” can apply to animals shorter and thinner than 0,5 m, while animals larger or wider than 1 m can be tagged with “large size animal”. All other animals are then tagged with “medium size animal”.

NOTE 6 A combination of the tags is also possible, e.g. both “passenger car” and “disabled (broken-down) vehicle" can apply.

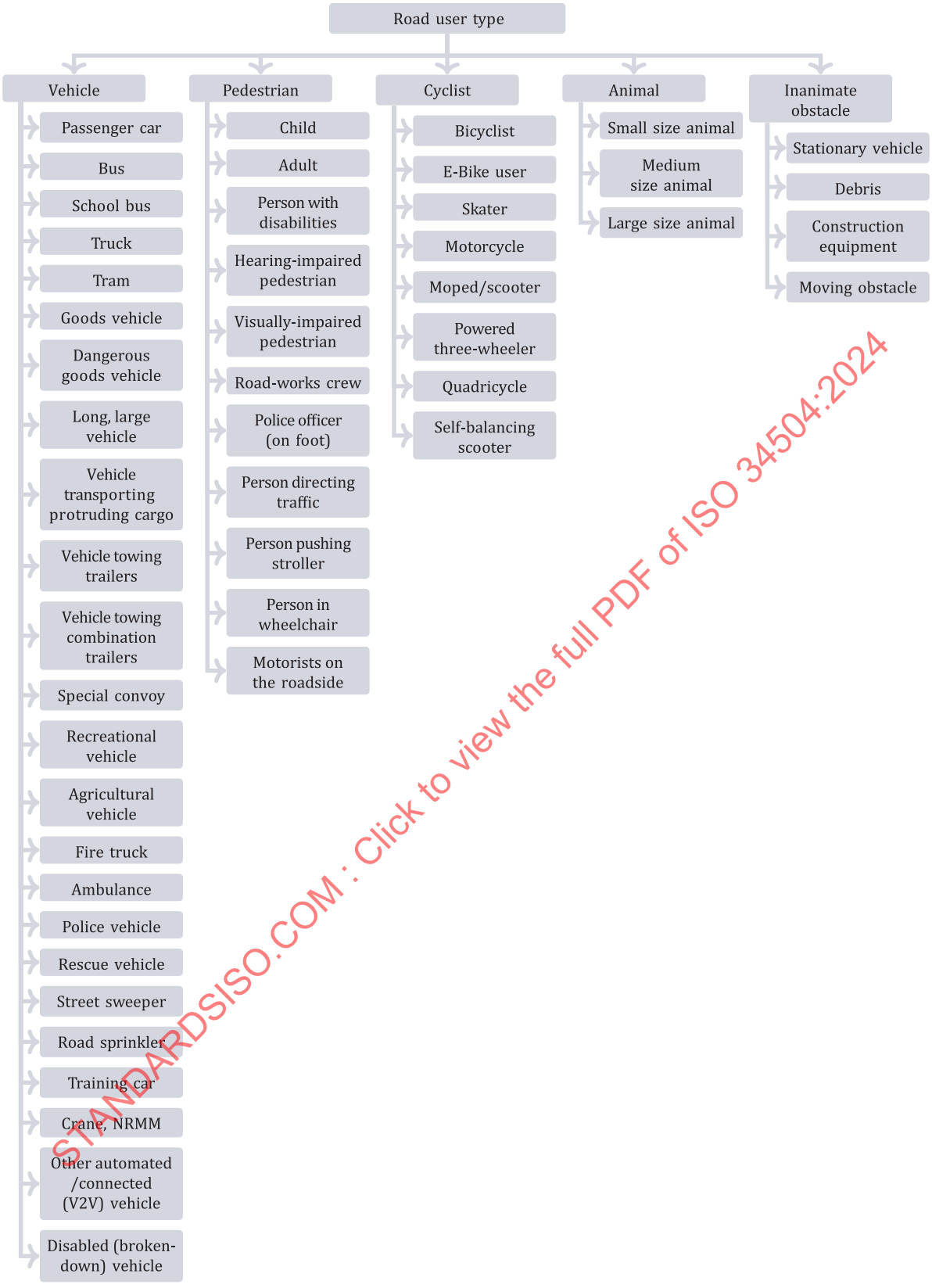


Figure 4 — Tree of tags for the road user type

4.4.4.2 Longitudinal action

At the top level, the tags for the longitudinal action should be:

a) standing still;

b) driving forward;

c) reversing.

To further specify driving forward and reversing, the following tags can be used:

— decelerating;

— keeping speed;

— accelerating.

NOTE 1 The longitudinal action refers to the behaviour of a dynamic entity in the direction in which the dynamic entity is travelling.

NOTE 2 Figure 5 visualizes the tree of tags for the longitudinal action.

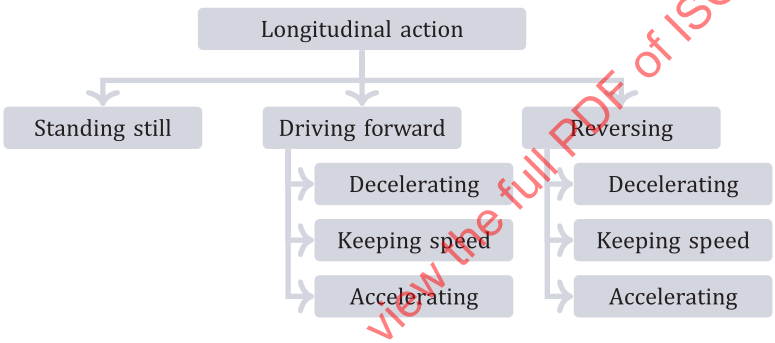


Figure 5 — Tree of tags for the longitudinal action

4.4.4.3 Lateral action

At the top level, the tags for the lateral action should be:

a) following lane;

b) changing lane;

c) turning;

d) swerving;

e) other.

NOTE 1 The lateral action refers to the direction perpendicular to the direction of travel of the dynamic entity. The tag “following lane” is applicable if the dynamic entity stays in its lane. When a dynamic entity changes lane to an adjacent lane, the tag “changing lane” is applicable. The tag “turning” is applicable if the dynamic entity turns. The tag “swerving” is applicable if the dynamic entity moves partly into its adjacent lane without performing a lane change. The tag “other” can be applicable if the dynamic entity performs manoeuvres that are not necessarily related to a lane, such as parking.

To further specify changing lane, the following tags can be used:

a) left;

b) right;

c) double left;

d) double right.

To further specify turning, the following tags can be used:

— left;

— right;

— left U-turn;

— right U-turn.

To further specify swerving, the following tags can be used:

— left;

— right.

NOTE 2 Figure 6 visualizes the tree of tags for the lateral action.

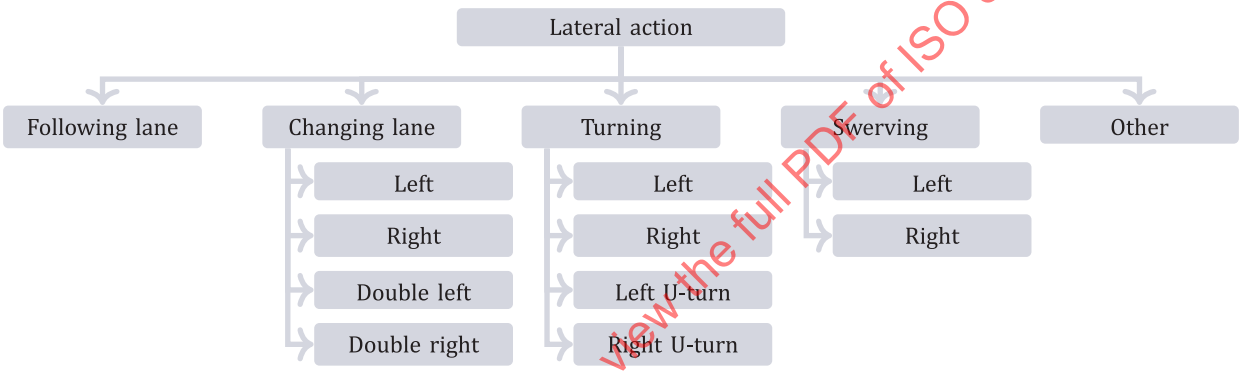


Figure 6 — Tree of tags for the lateral action

4.4.4.4 Mixed action

At the top level, the tag for the mixed action should be:

a) Parking manoeuvre.

NOTE 1 Tags that describe a mixed action can be used to describe combinations of actions that cannot easily be categorized as a longitudinal action, a lateral action, or a combination of these.

NOTE 2 Figure 7 visualizes the tree of tags for the mixed action.

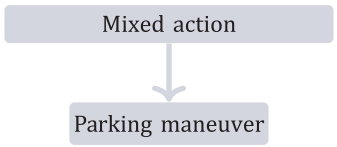


Figure 7 — Tree of tags for the mixed action

4.4.4.5 State or initial state

Tags describing the state or the initial state relative to the subject vehicle(s) shall only be used for dynamic entities other than the subject vehicle(s). In case the scenario does not contain a subject vehicle, the state relative to the subject vehicle(s) shall not be described for a dynamic entity.

NOTE 1 The initial state of the subject vehicle(s) can be described if its behaviour is not described.

At the top level, the tags for the (initial) state should address:

a) (initial) longitudinal position;

b) (initial) lateral position;

c) (initial) direction;

d) (initial) relative speed.

The tags for the (initial) longitudinal position can be:

— in front of the subject vehicle(s);

— beside the subject vehicle(s);

— behind the subject vehicle(s).

At the top level, the tags for the (initial) lateral position can be:

— in the same lane as the subject vehicle(s);

— to the left of the subject vehicle(s);

— to the right of the subject vehicle(s).

To further specify left or right of the subject vehicle, the following tags can be used:

— in the adjacent lane;

— next to the adjacent lane.

At the top level, the tags for the (initial) direction can be:

— similar to the subject vehicle(s);

— oncoming;

— crossing.

To further specify crossing, the following tags can be used:

— from left;

— from right;

— from far side;

— from near side.

NOTE 2 The tag “from left” is used for a dynamic entity whose direction of travel is approximately perpendicular to the direction of travel of the subject vehicle and the heading direction (direction from the rear of dynamic entity to the front) is towards the right. Similarly, the tag “from right” is used for a dynamic entity whose direction of travel is approximately perpendicular to the direction of travel of the subject vehicle and the heading direction (direction from the rear of dynamic entity to the front) is towards the left. The tag “from far side” is used for a dynamic entity for which “from left” (“from right”) applies in right-hand traffic (left-hand traffic) and the tag “from near side” is used for a dynamic entity for which the tag “from right” (“from left”) applies in right-hand traffic (left-hand traffic).

The tags for the (initial) relative speed of the dynamic entity with respect to the speed of the subject vehicle can be:

— similar to the subject vehicle(s);

— faster;

— slower.

NOTE 3 Figure 8 visualizes the tree of tags for the state or the initial state.

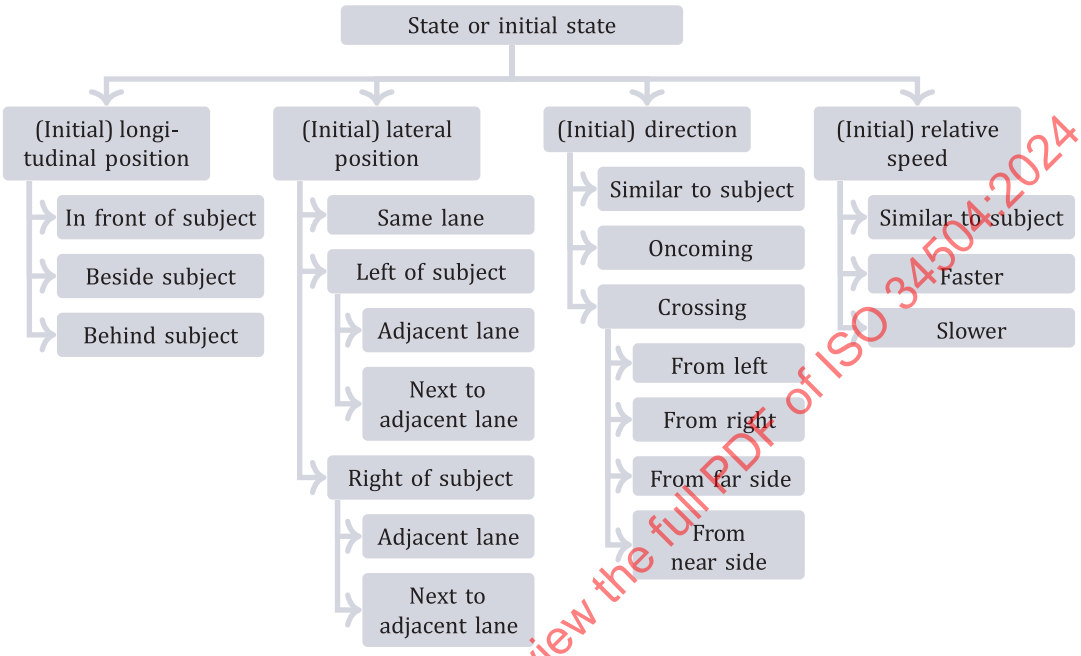


Figure 8 — Tree of tags for the state or the initial state

4.4.4.6 Role of a dynamic entity with respect to the subject vehicle

To describe the role of a dynamic entity with respect to the subject vehicle, the tags should be

a) leading;

b) following;

c) yielding;

d) prioritized;

e) no role.

NOTE 1 The tag “leading” applies to a dynamic entity if the subject vehicle is following that dynamic entity. With one subject vehicle, there can be at most one dynamic entity at a time with the tag “leading”. The tag “following” applies to a dynamic entity if the subject vehicle is the leading vehicle of that dynamic entity. The tag “yielding” applies to a dynamic entity if that dynamic entity gives or should give priority to the subject vehicle. The tag “prioritized” applies to a dynamic entity if the subject vehicle gives or should give priority to that dynamic entity.

To further specify the role of a dynamic entity, the following tags can be used:

— initial role;

— intermediate role;

— final role.

NOTE 2 The tag “initial role” applies when the role is applicable at the start of the scenario. The tag “final role” applies when the role is applicable at the end of the scenario. The tag “intermediate role” applies when the role is applicable neither at the start of the scenario nor at the end of the scenario.

NOTE 3 Figure 9 visualizes the tree of tags for the role of a dynamic entity with respect to the subject vehicle.

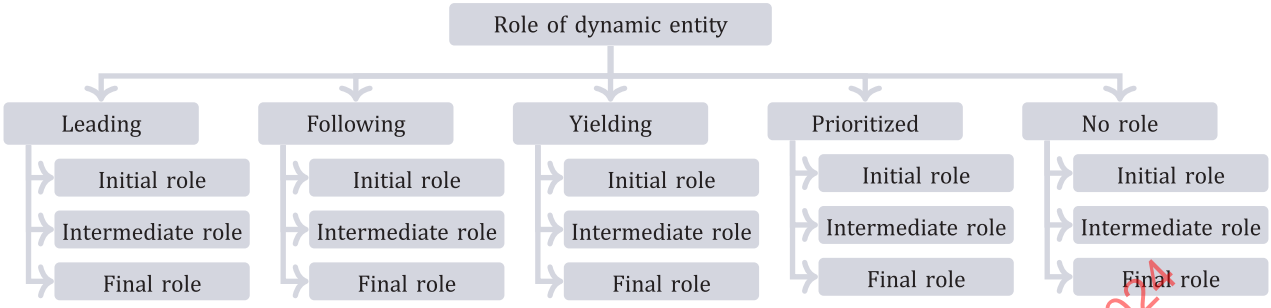


Figure 9 — Tree of tags for the role of a dynamic entity with respect to the subject vehicle

4.4.4.7 Enhancing conspicuity

To describe ways a dynamic entity enhances its conspicuity, the following tags should be used:

a) light;

b) sound;

c) gesture.

To further specify light, the following tags can be used:

— headlight low beam;

— headlight high beam;

— taillight;

— fog light;

— brake light;

— hazard light;

— left signal light;

— right signal light;

— emergency signal light;

— reverse driving light;

— beacon light;

— interior light.

NOTE 1 The current tags do not distinguish between left and right lights except for the signal lights. Stakeholder can expand the list of tags in order to also distinguish, e.g. left headlight low beam from right headlight low beam.

If a tag for specifying the light is not further specified, it should be assumed that the corresponding light is used. To be more specific, stakeholders may use to following tags to specify the state of light:

— on;

— off;

— broken;

— erroneous.

To further specify sound, the following tags can be used:

— horn;

— police whistle;

— police siren;

— ambulance siren;

— fire fighter siren;

— other.

To further specify gesture, the following tags can be used:

— indicate turning left;

— indicate turning right;

— indicate stopping;

— indicate slowing down;

— indicate yielding;

— indicate going through;

— indicate changing lane;

— other.

NOTE 2 Figure 10 visualizes the tree of tags for a dynamic entity's means to enhance its conspicuity. The tags for the state of light, which are subtags for all tags under "light", are not shown in Figure 10 because the figure would otherwise be too large.

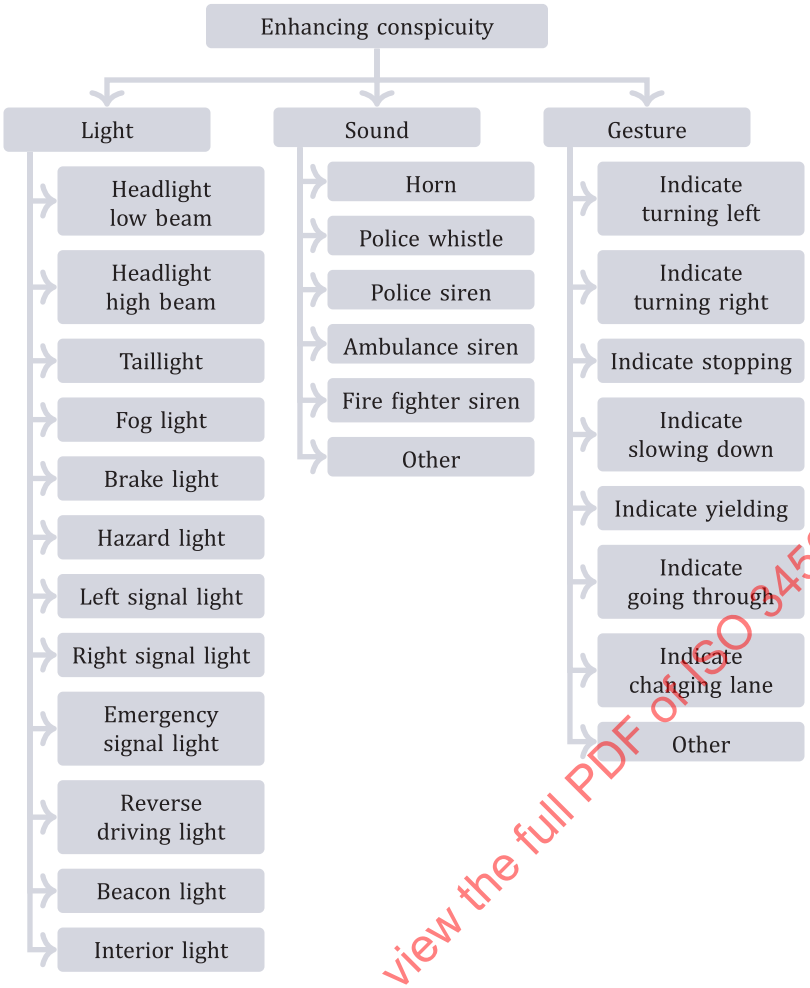


Figure 10 — Tree of tags for describing a dynamic entity's means to enhance its conspicuity

4.4.4.8 Visibility

To describe the visibility of a dynamic entity from the viewpoint of the subject vehicle(s), the following tags should be used:

a) fully in view;

b) partially blocked from view;

c) fully blocked from view.

NOTE 1 These tags can be used for an entity if it applies at any time during a scenario. So if a dynamic entity is for some small duration fully blocked from the viewpoint of the subject vehicle(s), the tag "fully blocked from view" can be applied.

NOTE 2 Figure 11 visualizes the tree of tags for the visibility of a dynamic entity from the viewpoint of the subject vehicle(s).

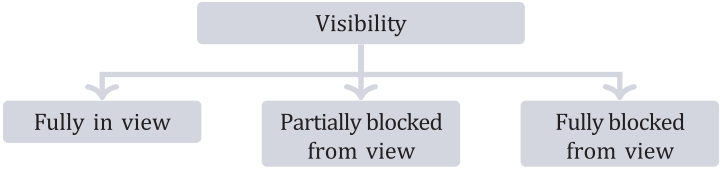


Figure 11 — Tree of tags for describing the visibility of a dynamic entity from the viewpoint of the subject vehicle(s)

4.4.4.9 Collision information

To describe whether a dynamic entity collided within a scenario or not, the following tags should be used:

a) collided;

b) did not collide.

NOTE 1 Collision information refers to historical information, i.e. whether a dynamic entity collided in an observed scenario. In Annex A, an example is provided.

NOTE 2 Figure 12 visualizes the tree of tags for the collision information.

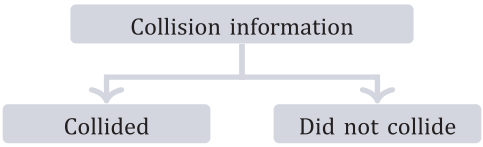


Figure 12 — Tree of tags for describing collision information for a dynamic entity

4.4.5 Tags for the scenery elements

NOTE The tags in this clause are largely based on ISO 34503:2023, Clause 9[7].

To describe the scenery elements, the tags shall address:

a) drivable area type;

b) drivable area geometry;

c) lane specification;

d) drivable area signs;

e) drivable area edge;

f) road surface marking;

g) drivable area surface;

h) junctions;

i) special structures;

j) basic road structures;

k) temporary road structures;

l) geographic area.

If no tags are mentioned for one or more of the aforementioned items, it shall be assumed that any of the tags of that item may or may not be applicable for the scenarios that the scenario category comprises.

EXAMPLE Only a tag related to the “drivable area type” is specified through the tags for a scenario category. In that case, scenarios that the scenario category comprises contain at least the specified tag related to the “drivable area type”. The scenarios can contain any tag related to the other topics. For example, the scenarios may take place at any geographic areas, as long as the specified “drivable area type” applies.

4.4.5.1 Drivable area type

To specify the drivable area type, the following tags should be used:

a) motorway, highway, or interstate;

b) primary road (e.g. dual-carriage way, single carriage way);

c) radial road;

d) distributor road;

e) minor or local road;

f) slip road or off-ramp;

g) parking space;

h) shared space;

i) driveway.

NOTE 1 A motorway, highway, or interstate is a high-traffic road where non-motorized vehicles and pedestrians are prohibited. A radial road is a high-density traffic road that connects a motorway to a distributor road or urban centres. A distributor road connects a radial road with a minor or local road and generally has a low to moderate capacity. A minor road or local road provides access to residential areas and other local developments. These roads carry low volumes of traffic. A slip road is a road that is used to drive on to and off a motorway, highway, or interstate. A parking space is the physical space where one vehicle is parked. A shared space can be shared between the subject vehicle and other dynamic entities, for example, pedestrians or cyclists.

NOTE 2 Figure 13 visualizes the tree of tags for the drivable area type.

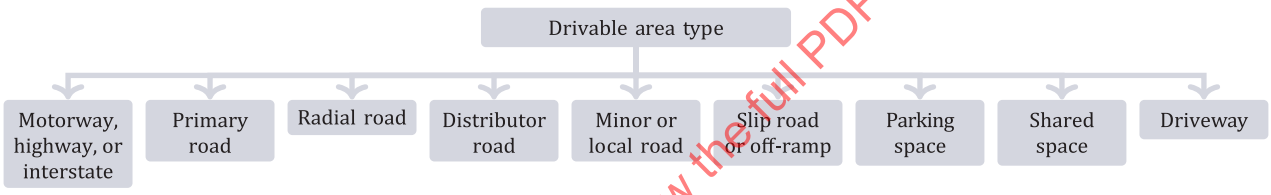


Figure 13 — Tree of tags for the drivable area type

4.4.5.2 Drivable area geometry

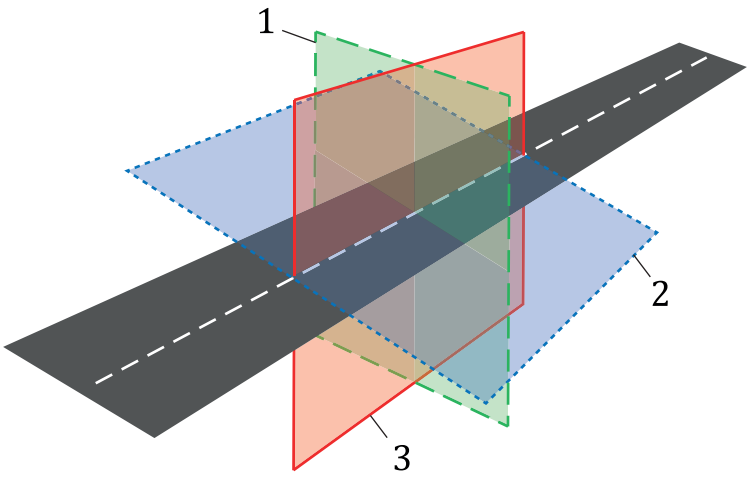
At the top level, the tags for the drivable area geometry should address:

a) horizontal plane;

b) transverse plane;

c) vertical plane.

NOTE 1 The horizontal plane refers to the plane parallel to the road surface. The vertical plane refers to the plane parallel to an imaginary straight wall along the road. The transverse plane refers to the plane with its normal in the directional of driving. Figure 14 visualizes the three planes in case of a straight road.



Key

1 transverse plane
2 horizontal plane
3 vertical plane

Figure 14 — Different planes for describing the geometry of the drivable area.

The tags for the horizontal plane can be:

— straight;

— curved.

To further specify curved, the following tags can be used:

— left;

— right.

The tags for the transverse plane can be:

— divided;

— undivided;

— pavements;

— barriers on road edges;

— types of lanes together;

— superelevation/banking.

The tags for the vertical plane can be:

— up-slope;

— down-slope;

— level plane.

NOTE 2 Figure 15 visualizes the tree of tags for the drivable area geometry.

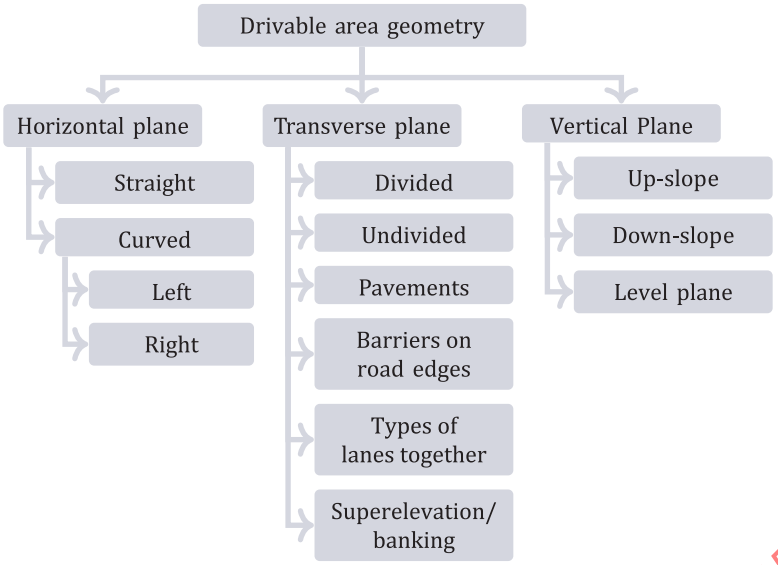


Figure 15 — Tree of tags for the drivable area geometry

4.4.5.3 Lane specification

At the top level, the tags for the lane specification should address:

a) lane type;

b) number of lanes;

c) minimum number of lanes;

d) traffic direction;

e) restriction.

The tags for the lane type can be:

— normal;

— High-Occupancy Vehicle (HOV);

— bidirectional;

— biking;

— border;

— bus;

— connecting ramp;

— curb;

— driving;

— entry;

— exit;

— median;

— off-ramp;

— on-ramp;

— parking;

— rail;

— restricted;

— road works;

— shoulder;

— sidewalk;

— stop;

— taxi;

— tram.

NOTE 1 The lane types are based on the enumeration of lane types in Reference [13]. A bidirectional road can be a driving lane on a narrow road which can be used in both directions. A bidirectional road can also be a continuous two-way left turn left on multi-lane roads (e.g. on US road networks). A border lane describes a hard border at the edge of the road that has the same height as the drivable lane. A connecting ramp lane is a ramp connecting two highways or motorways. A curb lane is a lane consisting of curbstones. A driving lane describes a "normal" drivable road that is not one of the other types. Entry and exit lanes are lanes parallel to the main road and intended for traffic entering and exiting the main road, respectively. A median lane is a lane between driving lanes in opposite directions, typically used on large roads to separate the traffic. An off-ramp lane is a lane leading away from a highway or motorway onto rural/urban roads and vice versa for an on-ramp lane. A restricted lane is a lane on which cars are not meant to drive but has the same height as the drivable lanes. Typically, a restricted lane is separated with lines and often there are additional striped lines on it. A sidewalk is a lane on which pedestrians can walk safely.

The tags for the number of lanes can be:

— 1 lane;

— 2 lanes;

— 3 lanes;

— 4 lanes;

— 5 lanes;

— 6 lanes.

Instead of specifying the exact number of lanes, it is possible to indicate the minimum number of lanes. The tags for the minimum number of lanes can be:

— 1 lane;

— 2 lanes;

— 3 lanes;

— 4 lanes;

— 5 lanes;

— 6 lanes.

The tags for the traffic direction can be:

— right-hand traffic;

— left-hand traffic.

The tags for the restriction can be:

— height restriction;

— weight restriction;

— width restriction;

— vehicle type restriction.

NOTE 2 Figure 16 visualizes the tree of tags for the lane specification.

Figure 16 — Tree of tags for the lane specification

4.4.5.4 Drivable area signs

At the top level, the tags for the drivable area signs should be:

a) information sign;

b) regulatory sign;

c) warning sign;

d) supplementary sign.

NOTE 1 A supplementary sign is a sign mounted below a “parent sign”. This can be a sign to indicate that a road is closed (here, the “road closed” sign is the “parent sign”) for a specific type of vehicle (here, the type of vehicle is specified using the supplementary sign).

To further specify each of the above tags, the following tags can be used:

— variable;

— uniform;

— full-time;

— temporary;

— corrupted;

— blurred;

— local specific.

EXAMPLE Smart highways or motorways can change their speed limits depending on external factors. In this case, the tag “variable” applies. The tag “temporary” applies for signs that are only present temporarily. The tag “full-time” applies for signs that are permanently present, even if the sign itself has a temporal character, e.g. a speed reduction at certain times.

NOTE 2 A corrupted sign indicates a change in meaning, e.g. half of the number 50 is visible, which changes a 50 km/h sign into a 5 km/h sign due to the loss of the “0”. The cause of the change can be aging or manipulation. A blurred sign can be caused by, for example, aging of the sign or vandalism.

NOTE 3 A combination of the tags is also possible. For example, both “variable” and “full-time” can apply.

NOTE 4 Figure 17 visualizes the tree of tags for the drivable area signs.

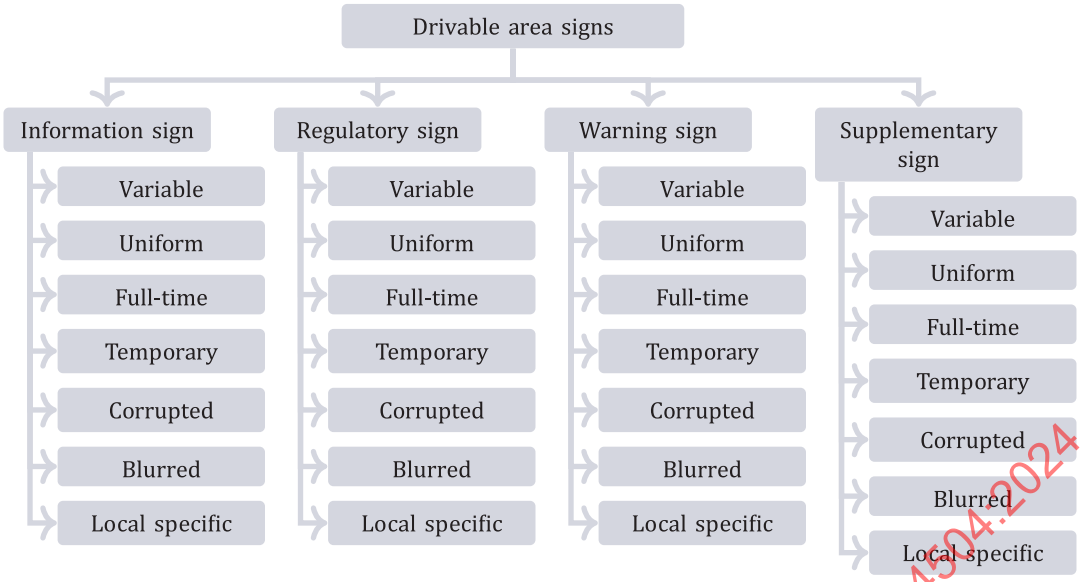


Figure 17 — Tree of tags for the drivable area signs

4.4.5.5 Drivable area edge

To specify the drivable area edge, the following tags should be used:

a) line markers;

b) shoulder;

c) solid barriers (e.g. grating, rails, curb, cones);

d) no edge;

e) unstructured.

NOTE 1 Drivable area edge is the outermost edge of the drivable area in which a vehicle is meant to travel.

To further specify line markers, the following tags can be used:

— permanent;

— temporary.

NOTE 2 In some countries, temporary road surface markings have a different colour than permanent. Moreover, in case the temporary road surface marking is incompatible with other traffic symbols, the temporary road surface marking has priority over other traffic symbols.

To further specify shoulder, the following tags can be used:

— paved;

— gravel;

— grass;

— snowbanks;

— covered by snow.

To further specify solid barriers, the following tags can be used:

— grating;

— rails;

— curb;

— cones;

— barrels.

NOTE 3 Unstructured drivable area edge includes damaged edge, rocks, etc.

NOTE 4 Figure 18 visualizes the tree of tags for the drivable area edge.

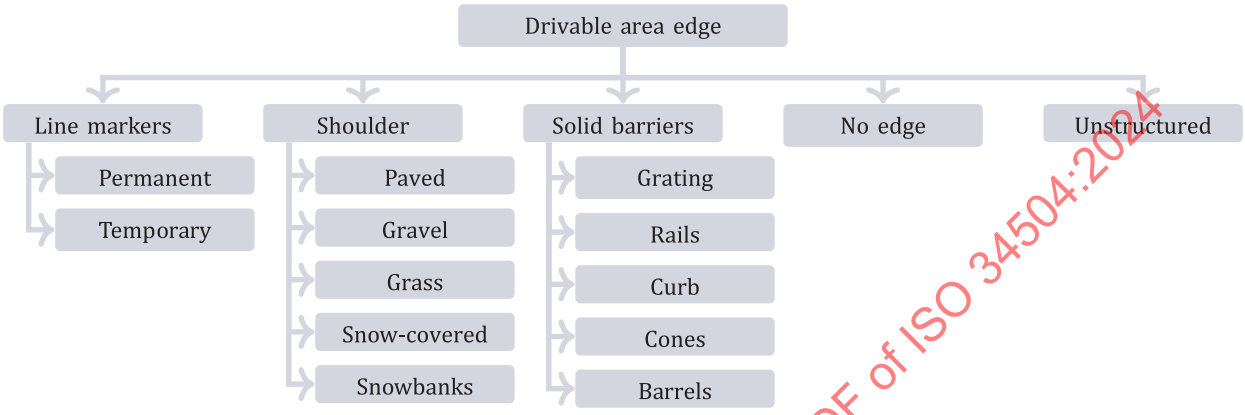


Figure 18 — Tree of tags for the drivable area edge

4.4.5.6 Road surface marking

At the top level, the tags for the road surface marking should address:

a) line marker;

b) line type;

c) line colour;

d) quality;

e) marker type.

The tags for the line marker can be:

— permanent;

— temporary.

NOTE 1 In some countries, temporary road surface markings have a different colour than permanent. Moreover, in case the temporary road surface marking is incompatible with other traffic symbols, the temporary road surface marking has priority over other traffic symbols.

The tags for the line type can be:

— solid;

— broken;

— botts dots.

NOTE 2 In case of multiple line types, tags can be combined. For example, “solid broken” indicates that a solid line is followed by a broken line. When combining line types, the first line type refers to the line to the inside (i.e. leftmost line in case of right-hand traffic).

The tags for the line colour can be:

— white;

— yellow;

— red;

— green;

— blue;

— orange.

The tags for the quality can be:

— missing;

— poor quality;

— good quality.

The tags for the marker type can be:

— mechanical;

— paint;

— stones;

— thermoplastic;

— polymer tape;

— epoxy.

NOTE 3 Figure 19 visualizes the tree of tags for the road surface marking.

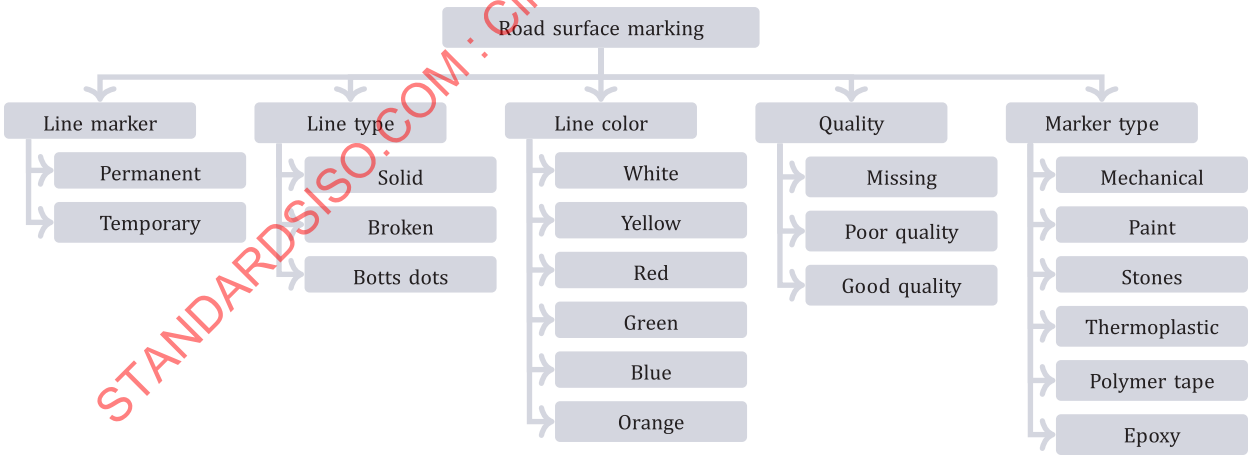


Figure 19 — Tree of tags for the road surface marking

4.4.5.7 Drivable area surface

At the top level, the tags for the drivable area surface should address:

a) drivable area surface type;

b) drivable area surface features;

c) drivable area induced surface condition.

The tags for the drivable area surface type can be:

— loose (e.g. gravel, earth, sand, snow);

— segmented (e.g. concrete slabs, granite setts, cobblestones);

— uniform (e.g. asphalt).

The tags for the drivable area surface features can be:

— crack;

— pothole;

— rut;

— swell;

— raised manhole cover.

The tags for the drivable area induced surface conditions can be:

— icy;

— flooded;

— standing water;

— snow on surface;

— wet;

— surface contamination.

NOTE 1 Flooded drivable area results when the amount of water arriving on the drivable area is greater than the capacity of the drainage facilities that take it away. Standing water tends to occur if there is a depression in the drivable area. A wet surface is soaked but there is no standing water. Surface contamination can include the presence of leaves, oil, mud or rocks. Surface contamination can be due to oil spills, sand on surface, etc.

NOTE 2 Figure 20 visualizes the tree of tags for the drivable area surface.

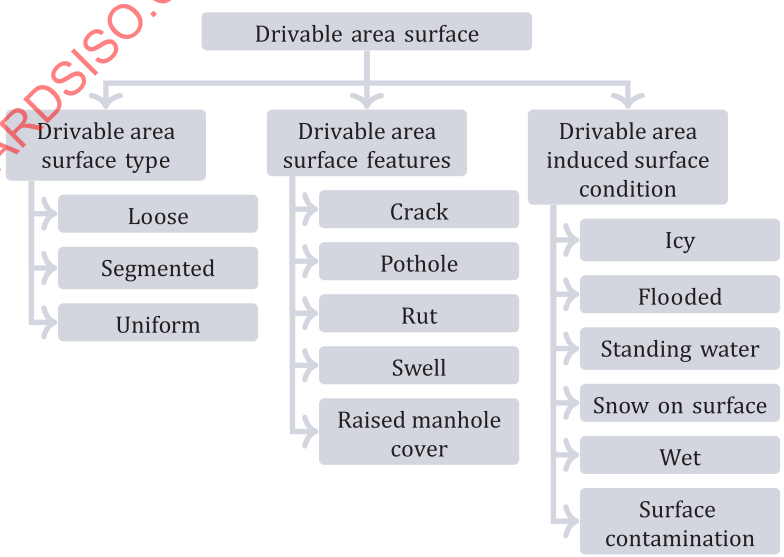


Figure 20 — Tree of tags for the drivable area surface

4.4.5.8 Junctions

At the top level, the tags for the junctions should be:

a) roundabout;

b) intersection.

NOTE 1 Junctions are areas on the map where two or more roads meet. Roundabouts are a special type of intersection.

To further specify a roundabout, the following tags can be used:

— mini;

— compact;

— normal;

— large;

— double.

NOTE 2 A mini roundabout is a small roundabout in low-speed environments and inscribed circle diameter (ICD) of less than 28 m. The ICD is the diameter of the largest circle that can be inscribed within the roundabout kerbs. Compact roundabout is a roundabout with a central island of at least 4 m diameter and an ICD between 28 m and 36 m. A compact roundabout has a single drivable area lane entry and exit on each arm. A normal roundabout is a roundabout with a central island of at least 4 m diameter, and an ICD between 100 m and 28 m and has more than one drivable area lane entry and exit on at least one of the arms. A large roundabout is a roundabout with a central island, and an ICD in excess of 100 m and with multiple drivable area lane entry and exits at all or some of the approaches. A double roundabout comprises of two roundabouts which are separated by a short link.

To further specify any of the above roundabouts, the following tags can be used:

— signalized;

— non-signalized, modern roundabout;

— non-signalized, nonconforming traffic circle.

NOTE 3 A signalized roundabout is a roundabout that is controlled by traffic light signals. A modern roundabout is a roundabout at which entering traffic yields to circulating traffic and a nonconforming traffic circle is a roundabout at which entering traffic cuts off circulating traffic.

To further specify an intersection, the following tags can be used:

— T-junction;

— Y-junction;

— crossroad;

— staggered;

— grade separated;

— other.

NOTE 4 A T-junction is a three-way intersection where one road joins another road at a right angle without crossing it. A Y-junction is a three-way intersection where one road joins another road at an acute angle without crossing it. A crossroad is where two roads cross each other to form a junction. A crossroad can be comprising the two roads with equal rights or a major road (i.e. traffic has the right of way) and a minor road (i.e. traffic must yield to the traffic on the major road). A staggered junction is a junction arrangement where the major road (i.e. traffic has the right of way) is continuous through the junction and two opposing minor roads (i.e. traffic must yield to the traffic on the major road) form priority junctions that are offset from one another. A grade separated junction is a junction that has at least two road links at different levels to keep conflicting traffic flow apart, and usually involves the provision of a structure (e.g. bridge or a tunnel) to accommodate road crossing. For special types of junctions, such as the 'Michigan left'[21], the tag "Other" under "Intersection" can be used. See Figure 21 for examples of the different types of intersections.

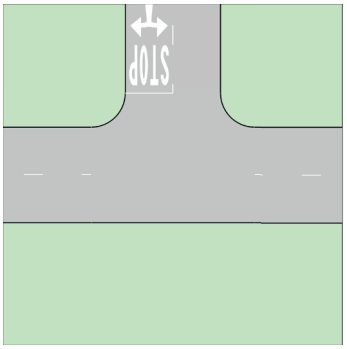


Figure 21 — a) T-junction

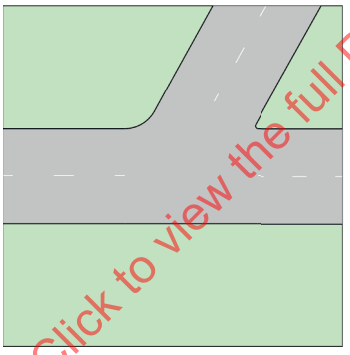


Figure 21 — b) Y-junction

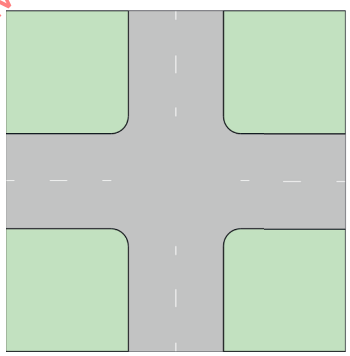


Figure 21 — c) Crossroad

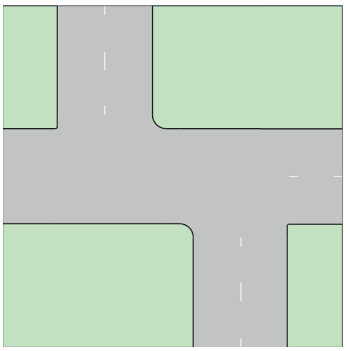


Figure 21 — d) Staggered intersection

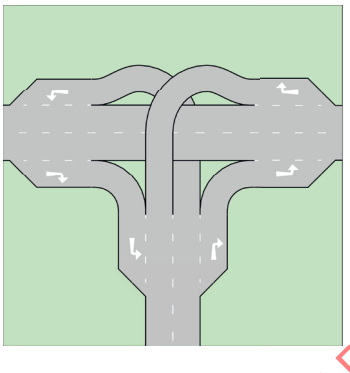


Figure 21 — e) Grade-separated intersection

Figure 21 — Examples of different types of intersections

To further specify any of the above intersections, the following tags can be used:

— signalized;

— non-signalized.

NOTE 5 Figure 22 and Figure 23 visualize the trees of tags for a roundabout and an intersection, respectively.

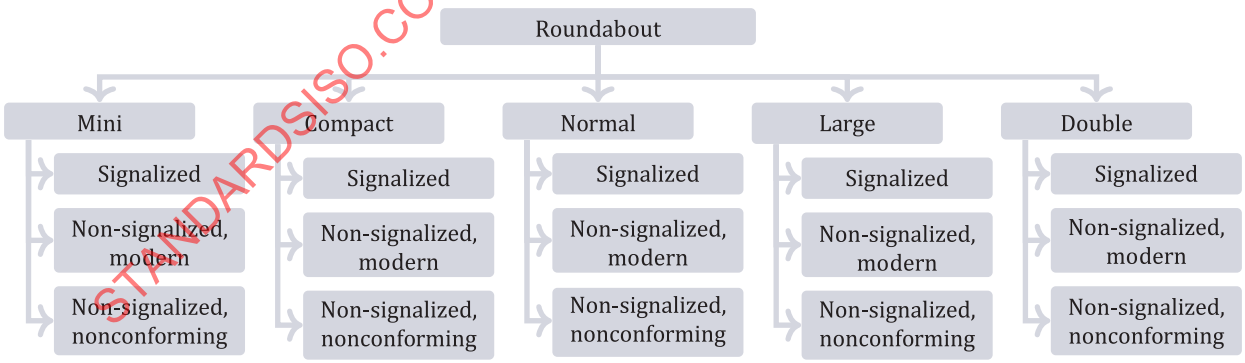


Figure 22 — Tree of tags for a roundabout

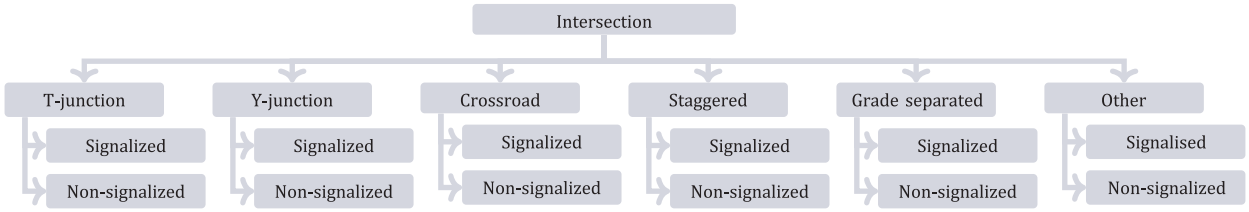


Figure 23 — Tree of tags for an intersection

4.4.5.9 Special structures

To specify a special structure, the following tags should be used:

a) automatic access control;

b) bridge;

c) pedestrian crossing;

d) rail crossing;

e) tunnel;

f) toll plaza;

g) parking area;

h) parking garage;

i) skyway;

j) ferry drive-aboard ramp.

NOTE Figure 24 visualizes the tree of tags for a special structure.

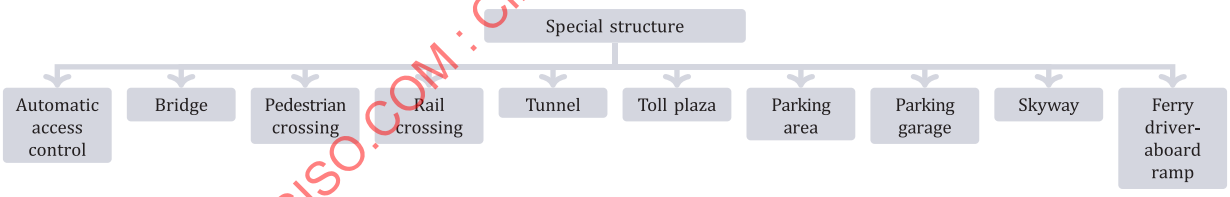


Figure 24 — Tree of tags for a special structure

4.4.5.10 Basic road structure

To specify a basic road structure, the following tags should be used:

a) building;

b) streetlight;

c) street furniture (e.g. bollards);

d) vegetation.

NOTE 1 Basic road structures are structures that are present on the drivable area surface or near the edge of the drivable area surface.

NOTE 2 Figure 25 visualizes the tree of tags for a basic road structure.

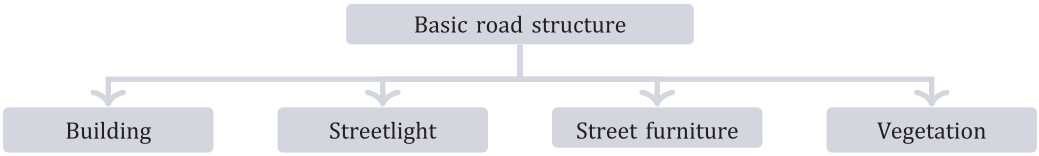


Figure 25 — Tree of tags for a fixed road structure

4.4.5.11 Temporary road structure

To specify a temporary road structure, the following tags should be used:

a) construction site detour;

b) road work;

c) road signage;

d) emergency corridor.

NOTE 1 Temporary road structures can be placed on the road due to local requirements or accidents, which include temporary emergency signage which obstruct or impact normal driving.

NOTE 2 Figure 26 visualizes the tree of tags for a temporary road structure.

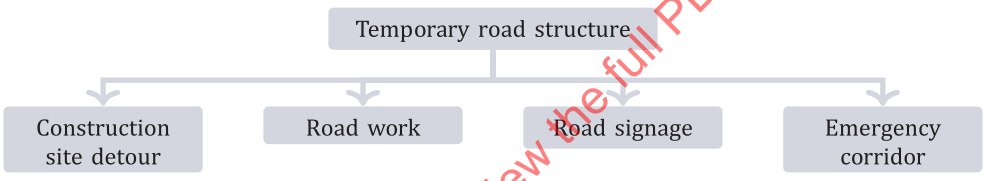


Figure 26 — Tree of tags for a temporary road structure

4.4.5.12 Geographic area

To specify the location at which the scenario is taking place, a stakeholder can use tags that specify the geographic area. These tags may refer to continents and countries. To further distinguish the geographic area, the stakeholder can use the administrative divisions that apply to the country, e.g. the province, state, district, or region.

4.4.6 Tags for the environment conditions

NOTE The tags in this clause are largely based on ISO 34503:2023, Clause 10 [7].

For the environmental conditions, the tags shall address:

a) weather;

b) particulates;

c) illumination;

d) connectivity;

e) traffic density.

If no tags are mentioned for one or more of the aforementioned items, it shall be assumed that any of the tags of that item may or may not be applicable for the scenarios that the scenario category comprises.

EXAMPLE Only a tag related to the "weather" is specified through the tags for a scenario category. In that case, scenarios that the scenario category comprises contain at least the specified tag related to the "weather". The scenarios can contain any tag related to the other topics. For example, the scenarios may contain any tag related to the "illumination", as long as the specified "weather" tag applies.

4.4.6.1 Weather

At the top level, the tags for the weather should address:

a) wind;

b) precipitation.

To specify wind, the following tags can be used:

— constant wind;

— gust.

To specify the wind speed and the gust speed, the following tags can be used:

— no constant wind/no gust;

— calm;

— light air;

— light breeze;

— gentle breeze;

— moderate breeze;

— fresh breeze;

— strong breeze;

— near gale;

— gale;

— strong gale;

— storm;

— violent storm;

— hurricane force.

NOTE 1 The above categorization is based on the Beaufort scale, see Chapter 5 of Reference [14].

NOTE 2 The wind speed is characterized as an average over a specified time interval (recommended 2 to 10 min) and the gust speed is characterized as the peak value of a 3 s rolling mean wind speed.

NOTE 3 Stakeholders can use other categorizations of the wind speed and the gust speed. For example, no wind, low wind, medium wind, and high wind.

To specify precipitation, the following tags can be used:

— rainfall;

— snowfall;

— freezing rain.

To specify the rainfall, the following tags can be used:

— no rain;

— light rain;

— moderate rain;

— heavy rain;

— violent rain;

— cloudburst.

To specify snowfall, the following tags can be used:

— no snowfall;

— light snow;

— moderate snow;

— heavy snow;

— heaviest snow.

To specify freezing rain, the following tags can be used:

— sleet;

— graupel;

— hail.

NOTE 4 For a possible way to classify rainfall and snowfall, see ISO 34503:2023, Clause 10 [7].

NOTE 5 Figure 27 visualizes the tree of tags for the weather.

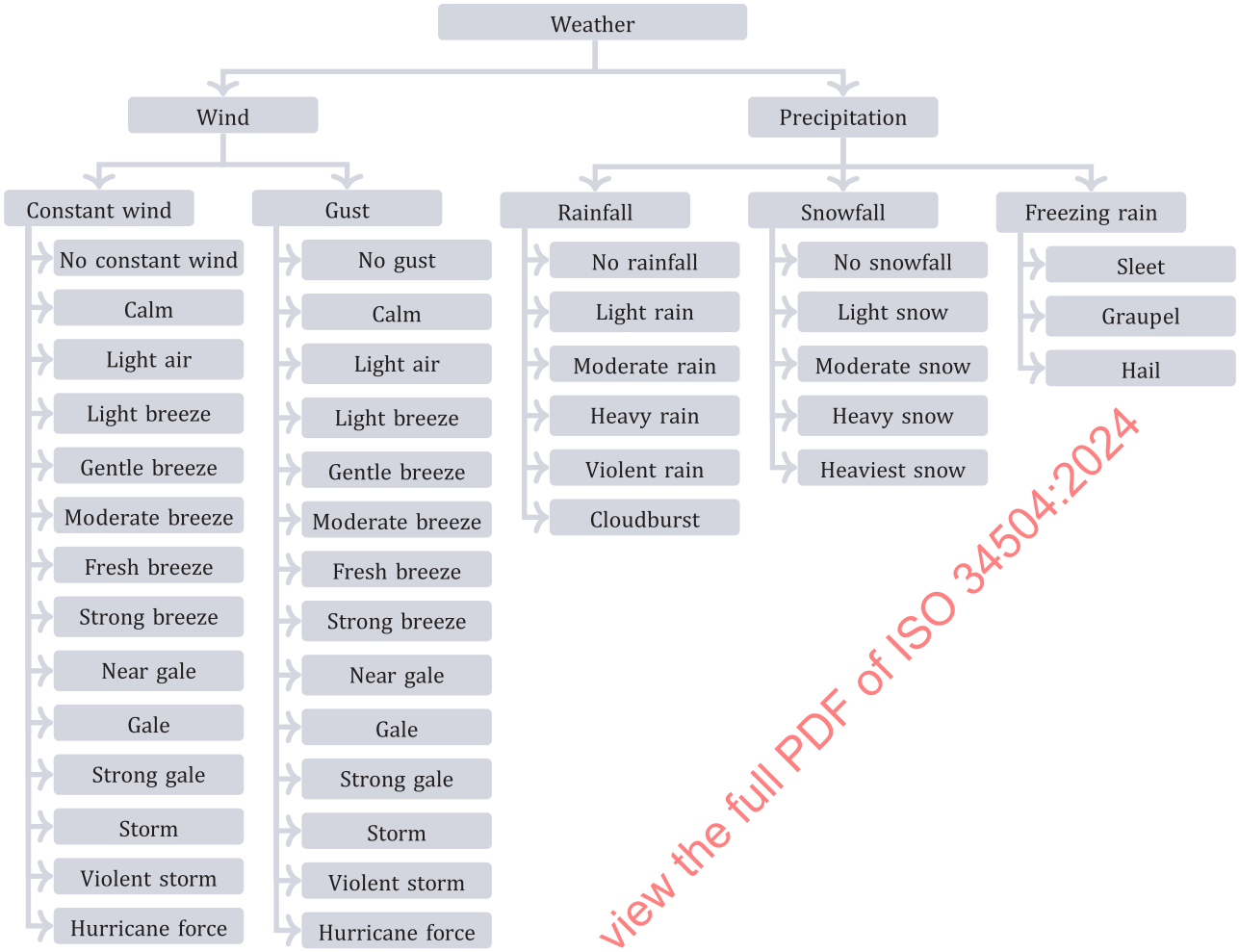


Figure 27 — Tree of tags for the weather

4.4.6.2 Particulates

To specify particulates, the following tags should be used:

a) non-precipitating water droplets (i.e. mist/fog);

b) sand and dust;

c) smoke and pollution;

d) volcanic ash;

e) water spray;

f) blowing debris.

NOTE Figure 28 visualizes the tree of tags for the particulates.

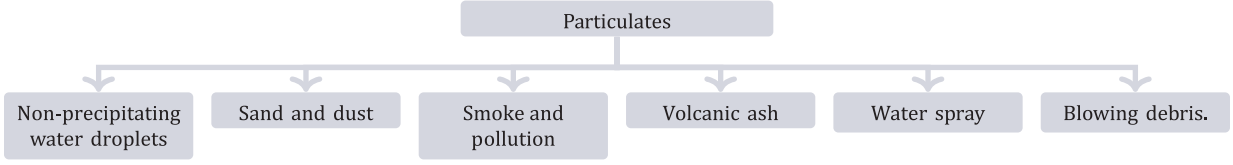


Figure 28 — Tree of tags for particulates

4.4.6.3 Illumination

At the top level, the tags for the illumination should address:

a) time of the day;

b) cloudiness;

c) artificial illumination;

d) direct sun glare.

To specify the time of the day, the following tags can be used:

— daytime;

— night time;

— low-ambient lighting condition.

NOTE 1 Daytime is referred to as a condition where the ambient illuminance is greater than 2 000 lx. Night time is referred to as a condition where the ambient illuminance is less than 1 lx. Low-ambient lighting condition is when ambient light is between daytime and night time.

To specify the cloudiness, the following tags can be used:

— clear;

— partly cloudy;

— overcast.

To specify artificial illumination, the following tags can be used:

— streetlight;

— oncoming vehicle light;

— indoor light (e.g. parking facilities);

— other.

NOTE 2 Figure 29 visualizes the tree of tags for the illumination.

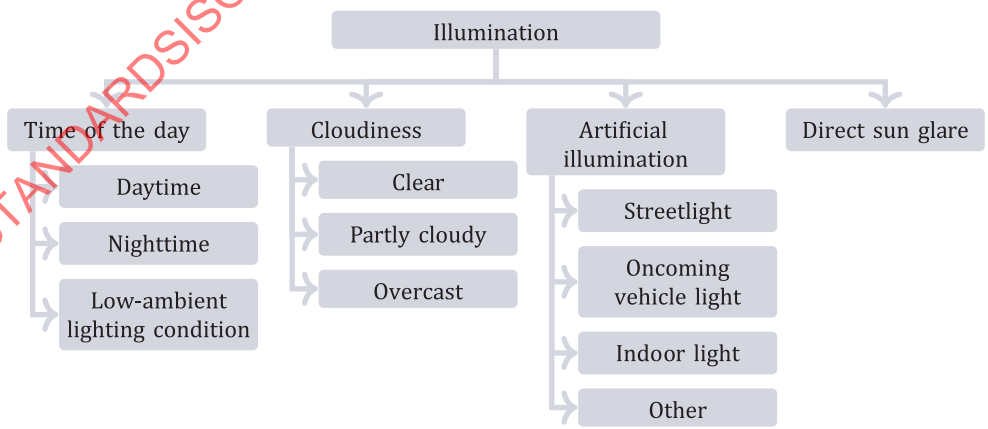


Figure 29 — Tree of tags for the illumination

4.4.6.4 Connectivity

At the top level, the tags for the connectivity should address:

a) communication;

b) positioning.

To specify the communication connectivity, the following tags can be used:

— Vehicle to Vehicle communication (V2V);

— Vehicle to Infrastructure communication (V2I);

— Vehicle to Pedestrian communication (V2P);

— Vehicle to Network communication (V2N);

— Vehicle to Others communication (V2O).

To further specify V2V, V2I, V2P, V2N, and V2O, the following tags can be used:

— cellular (e.g. 2G, 2.5G, 3G, 4G, 5G);

— satellite;

— 802.11p-based Wi-Fi;

— short range communication, e.g. dedicated short-range communications (DSRC), intelligent transport systems (ITS-G5), Sidelink PC5.

To specify the positioning connectivity, the following tags can be used:

— Galileo;

— GLObal Navigation Satellite System (GLONASS);

— Global Positioning System (GPS);

— RTK;

— BeiDou Navigation Satellite System (BDS);

— Quasi-Zenith Satellite System (QZSS).

NOTE Figure 30 visualizes the trees of tags for the connectivity.

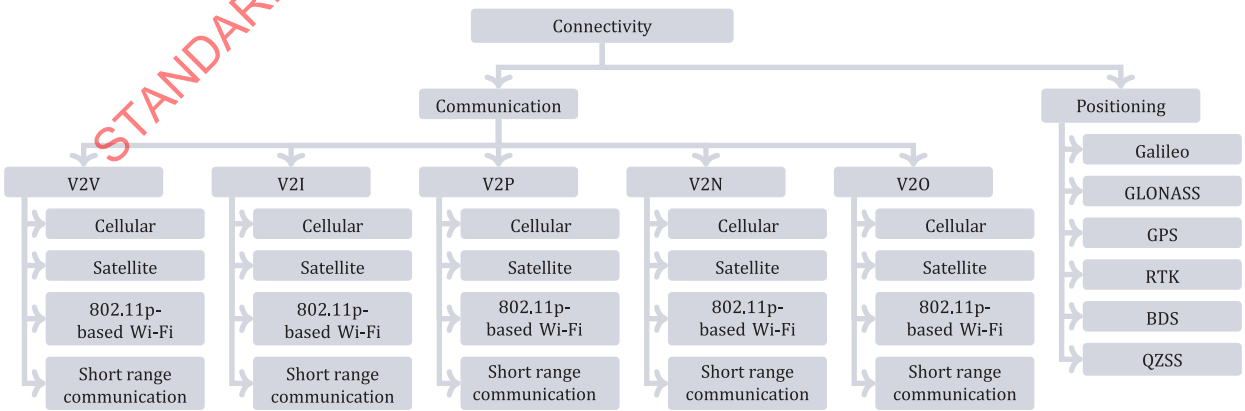


Figure 30 — Tree of tags for the connectivity

4.4.6.5 Traffic density

To specify the traffic density, the following tags should be used:

a) low traffic density;

b) medium traffic density;

c) high traffic density.

EXAMPLE 1 Low traffic density can indicate less than 20 vehicles per kilometre per lane and high traffic density can indicate more than 50 vehicles per kilometre per lane.

EXAMPLE 2 Low traffic density can indicate less than 20 dynamic entities within a radius of 50 m of the subject vehicle(s) and high density can indicate more than 50 dynamic entities within a radius of 50 m of the subject vehicle(s).

NOTE Figure 31 visualizes the tree of tags for the traffic density.

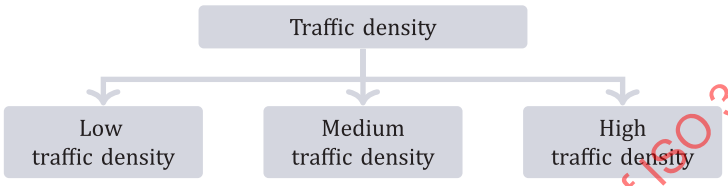


Figure 31 — Tree of tags for the traffic density

4.4.7 Tags for additional information of a scenario

For providing additional information of a scenario, the tags shall address:

a) scenario usage;

b) scenario source;

c) intended execution platform;

d) indicator;

e) abstraction level;

f) scenario type.

If no tags are mentioned for one or more of the aforementioned items, it shall be assumed that any of the tags of that item may or may not be applicable for the scenarios that the scenario category comprises.

EXAMPLE Only a tag related to the "scenario usage" is specified through the tags for a scenario category. In that case, scenarios that the scenario category comprises contain at least the specified tag related to the "scenario usage". The scenarios can contain any tag related to the other topics. For example, the scenarios may contain any type of tag related to "indicator", as long as the specified "weather" applies.

4.4.7.1 Scenario usage

To clarify the scope of a scenario, the usage of a scenario within an assessment may be labelled via tags. The following tags should be used when indicating what type of performance aspect can be assessed with the corresponding scenario:

a) safety;

b) quality;

c) correctness of functionality;

d) virtual test platform verification (e.g. ISO 19365).

To further specify safety, the following tags can be used:

— functional safety;

— SOTIF;

— behavioural safety;

— post-crash behaviour and risk minimal state;

— passive safety;

— cybersecurity.

To further specify quality, the following tags can be used:

— comfortability;

— availability;

— reliability;

— efficiency;

— other.

NOTE Figure 32 visualizes the tree of tags for the scenario usage.

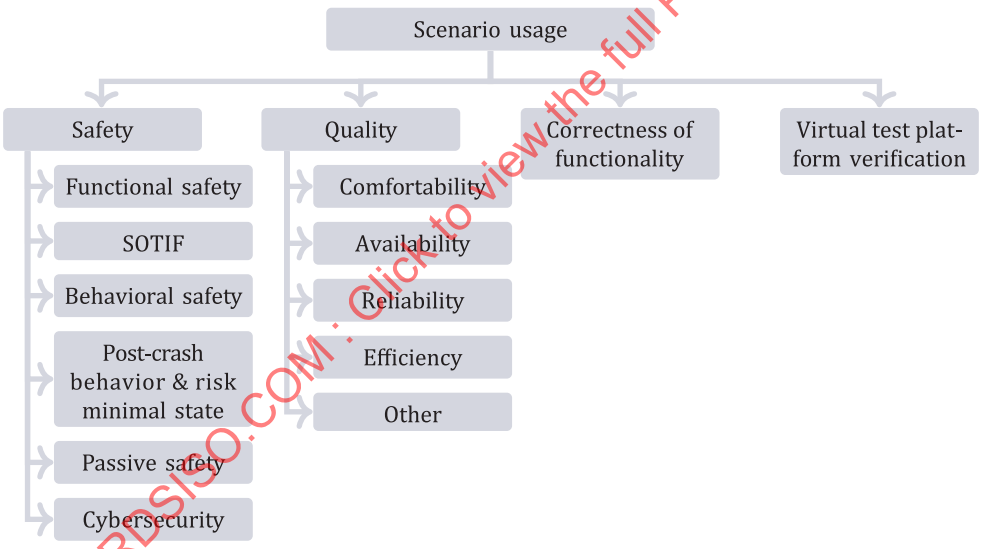


Figure 32 — Tree of tags for the scenario usage

4.4.7.2 Scenario source

A scenario may be labelled with a tag describing the source of the scenario. At the top level, the tags for the source of a scenario should be:

a) laws, regulations, and standards;

b) Field Operational Test (FOT) data;

c) crash data;

d) consumer protection test;

e) manually created;

f) automatically created;

g) proprietary;

h) unknown.

NOTE 1 Crash data can refer to accident databases, such as the German In-Depth Accident Study (GIDAS)[2], the Community database on Accidents on the Roads in Europe (CARE)[3], the Initiative for the GLobal harmonization of Accident Data (IGLAD)[4], road safety from the government of the United Kingdom[5], and the National Automotive Sampling System (NASS) General Estimates System (GES) from the United States[6]. Crash data can also refer to the literature regarding accident analysis, such as Reference [15]. Consumer protection test can refer to tests originating from, amongst others, the New Car Assessment Programme (NCAP) or the Insurance Institute for Highway Safety (IIHS).

To further specify laws, regulations, and standard, the following tags can be used:

— UNECE regulation;

— national law;

— international standard;

— national standard.

NOTE 2 Figure 33 visualizes the tree of tags for the scenario source.

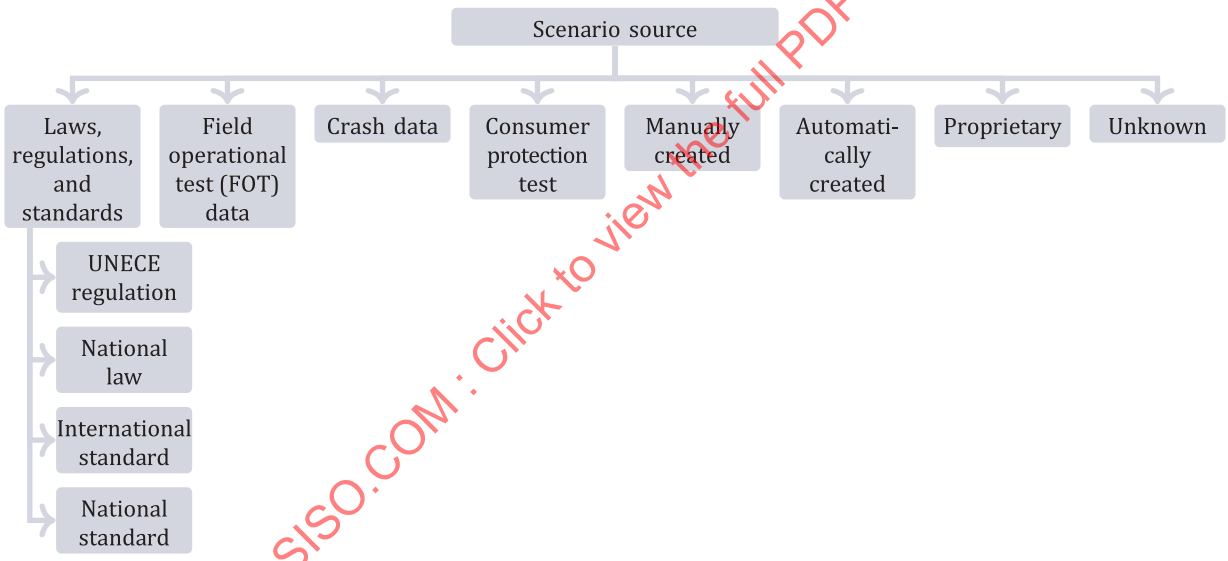


Figure 33 — Tree of tags for the scenario source

4.4.7.3 Intended execution platform

Scenarios may be designed for a specific execution platform. If the scenario is intended for a specific execution platform, any of the following tags should be used:

a) virtual test platform;

b) the X-in-the-loop (XiL) test platform;

c) proving ground test;

d) public road test.

To further specify the XiL test platform, the following tags can be used:

— Model in the Loop (MiL);

— Software in the Loop (SiL);

— Hardware in the Loop (HiL);

— Driver in the Loop (DiL);

— Vehicle in the Loop (ViL).

NOTE 1 Following Reference [11], the virtual test platform refers to the execution of the test scenario using simulation models. The difference with a XiL test platform is that with the latter, one or more real elements are used in the tests instead of their modelled counterparts. A proving ground test refers to a physical environment that is not open to the public, e.g. a test track. A public road test refers to a test on the public roads.

NOTE 2 Figure 34 visualizes the tree of tags for the intended execution platform.

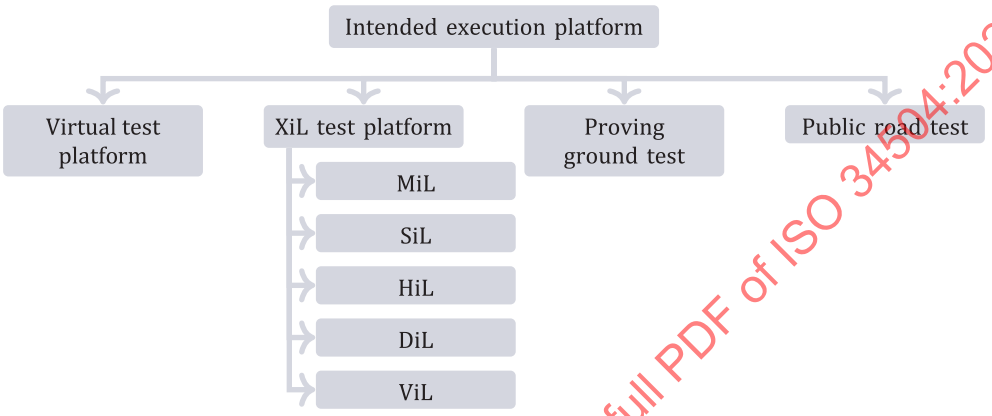


Figure 34 — Tree of tags for the intended execution platform

4.4.7.4 Indicator

A test scenario may contain indicators to evaluate the performance of an ADS. To label the type of indicator, the following tags should be used:

a) safety;

b) comfort;

c) efficiency.

To further specify a safety indicator, the following tags can be used:

— time-to-collision (TTC);

— time headway (THW);

— distance;

— post-encroachment time (PET).

NOTE 1 In Reference [16], a review of different safety indicators for automated driving is presented.

To further specify a comfort indicator, the following tags can be used:

— longitudinal acceleration;

— longitudinal jerk;

— lateral acceleration;

— lateral jerk.

NOTE 2 These above indicators can also be safety indicators.

To further specify an efficiency indicator, the following tags can be used:

— time;

— energy;

— emission.

NOTE 3 Figure 35 visualizes the tree of tags for an indicator.

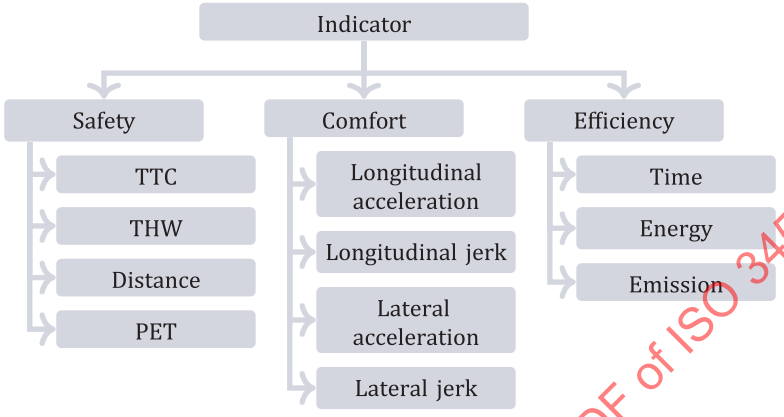


Figure 35 — Tree of tags for the indicator to evaluate the performance of an ADS

4.4.7.5 Abstraction level

To specify the abstraction level, the following tags should be used:

a) functional;

b) abstract;

c) logical;

d) concrete.

NOTE Figure 36 visualizes the tree of tags for the abstraction level.

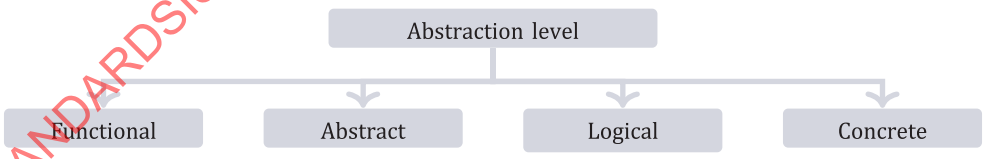


Figure 36 — Tree of tags for the abstraction level

4.4.7.6 Scenario type

To specify the scenario type, the following tags should be used:

a) nominal;

b) critical;

c) failure.

NOTE 1 A nominal scenario is a scenario representing usual and/or expected objects, object behaviour, and/or road conditions[20]. A critical scenario is a scenario representing unusual and/or unexpected objects, object behaviour, and/or road conditions[20]. A failure scenario is a scenario representing a system failure that compromises the capability of the ADS to perform the entire dynamic driving task[20].

NOTE 2 Figure 37 visualizes the tree of tags for the scenario type.

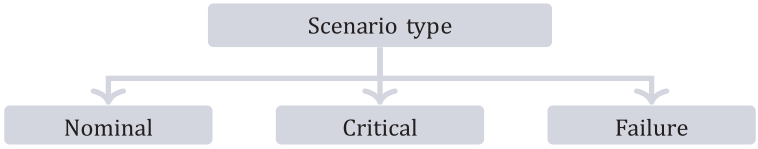


Figure 37 — Tree of tags for the scenario type

4.4.8 Tags for the intended test usage

The tags related to a dynamic entity (4.4.4), the scenery (4.4.5), or the environmental conditions (4.4.6) all describe the content of a scenario. To apply a tag to a scenario that does not apply to the content of a scenario, but rather to the intended test usage, this shall be indicated by using the tag "intended test usage" as the top-level tag.

EXAMPLE The scenario description does not contain rain. The scenario description might not contain any information about the weather. However, the intended usage of the scenario is to test a functionality during rainy conditions. To indicate this, the tag "moderate rain" can be used while at the top-level, the tag "intended test usage" is used, as shown in Figure 38.

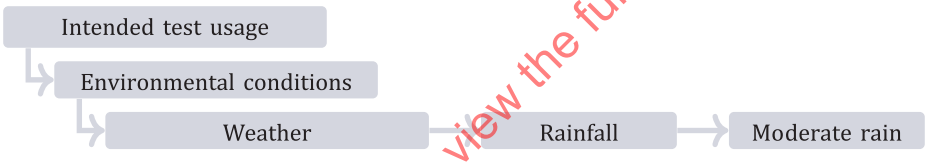


Figure 38 — Example of describing the intended usage of a scenario in moderate rainfall

4.4.9 Using tags for specifying scenario categories

If a scenario category is defined using tags, then the scenario category shall comprise all scenarios that include the same tags.

NOTE 1 If a scenario category X comprises a scenario x, it means that scenario x contains at least the tags that are used to define scenario category X. Scenario x can have additional tags that are not part of the scenario category X.

EXAMPLE 1 The scenario category with the tag "roundabout" comprises all scenarios that include the tag "roundabout".

When using tags to define a scenario category, logical rules, e.g. NOT or OR, may be used. When listing multiple tags without explicit usage of logical rules, it shall be assumed that all tags apply, i.e. the logical AND applies.

According to 4.4.2, first the purpose of the tags shall be listed. Next, the first top-level tag that applies shall be mentioned, then, if applicable, the lower-level tag(s).