

TECHNICAL REFERENCE

Autonomous vehicles

– Part 2 : Safety

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SMRT
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Foreword

This Technical Reference (TR) was prepared by the Working Group on Safety appointed by the Technical Committee on Automotive under the direction of the Manufacturing Standards Committee.

TR 68 is intended to support the development of AV technology and deployments and consists of the following parts under the generic title “Autonomous vehicles”:

Part 1 – Basic behaviour

Sets out fundamental behaviours AVs should exhibit while driving on public roads in order to co-exist safely with entities on the roads such as other vehicles, cyclists, and pedestrians.

Part 2 – Safety

Sets out the safe design and continuing safety management process requirements, supported by competent personnel and organisational quality certifications that organisations should have in place so that the AVs driving on public roads are inherently safe and behave in the manner that they are designed to.

Part 3 – Cybersecurity principles and assessment framework

Sets out principles and assessment framework for organisations to support development and management of AVs. The assessment framework is intended to provide a cybersecurity safeguard for AVs to satisfy prior to on-road deployment.

Part 4 – Vehicular data types and formats

Sets out what data, resolution, capture frequency and the format in which they should be transmitted so that there is seamless communication between sending party and receiving party.

This TR is a provisional standard made available for application over a period of three years. The aim is to use the experience gained to update the TR so that it can be adopted as a Singapore Standard. Users of the TR are invited to provide feedback on its technical content, clarity and ease of use. Feedback can be submitted using the form provided in the TR. At the end of the three years, the TR will be reviewed, taking into account any feedback or other considerations, to further its development into a Singapore Standard if found suitable.

Figure 4 of this TR is based on Figure 9 of ISO/PAS 21448:2019, “Road vehicles – Safety of the intended functionality”.

Attention is drawn to the possibility that some of the elements of this Technical Reference may be the subject of patent rights. Enterprise Singapore shall not be held responsible for identifying any or all of such patent rights.

NOTE

1. *Singapore Standards (SSs) and Technical References (TRs) are reviewed periodically to keep abreast of technical changes, technological developments and industry practices. The changes are documented through the issue of either amendments or revisions.*
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Technical Reference for autonomous vehicles – Part 2: Safety

0 Introduction

Safety is one of the key issues of future automobile development. With more functionalities being developed, there is a need to address the systems engineering aspect of these developments to facilitate the introduction of autonomous driving.

This TR describes a set of minimal safety provisions to be met by autonomous vehicle developers, original equipment manufacturers (OEMs), and/or operators at the organisational level that align with international practices, while taking into consideration local conditions. These are applicable to processes that impact the safety of the autonomous systems, including systems for managing one or more autonomous vehicle (AVs) operating on public roads, and are intended to cover autonomous driving systems and vehicles that operate or aim to operate as defined in SAE J3016_201806.

This TR is applicable to the following:

- AV developers/operators;
- Testing, inspection and certification bodies;
- Government agencies / local authorities;
- Engineering and consulting companies.

Automation driving levels, automated driving system (ADS), operational design domain (ODD), and dynamic driving task (DDT) are defined in SAE J3016_2018

1 Scope

The purpose of this TR is to give the safety provisions for autonomous vehicles (AVs) deployed on public roads. Specifically, the use case of deployment in Singapore is considered.

The TR can be subdivided into two major fields:

- a) Design and production quality; and
- b) Safe operation in the context of specific applications in Singapore.

To stipulate system-level safety in order to ensure:

- a) functional and operational safety requirements of vehicles are met;
- b) system safety is applicable to the operation design domain in which the vehicle operates;
- c) the vehicle developer, system integrator and system operator are competent organisations with an appropriate quality management system in place supported by competent personnel; and
- d) that appropriate safety goals are in place to guide safety assurance at the system level.

See Figure 1 for the scope chart.

The TR does not differentiate between vehicles being built from scratch and conventional homologated vehicles, which have been equipped with additional driving automation system/technology (see SAE J3016_201806) to increase the supported level of driving automation within SAE's scale.

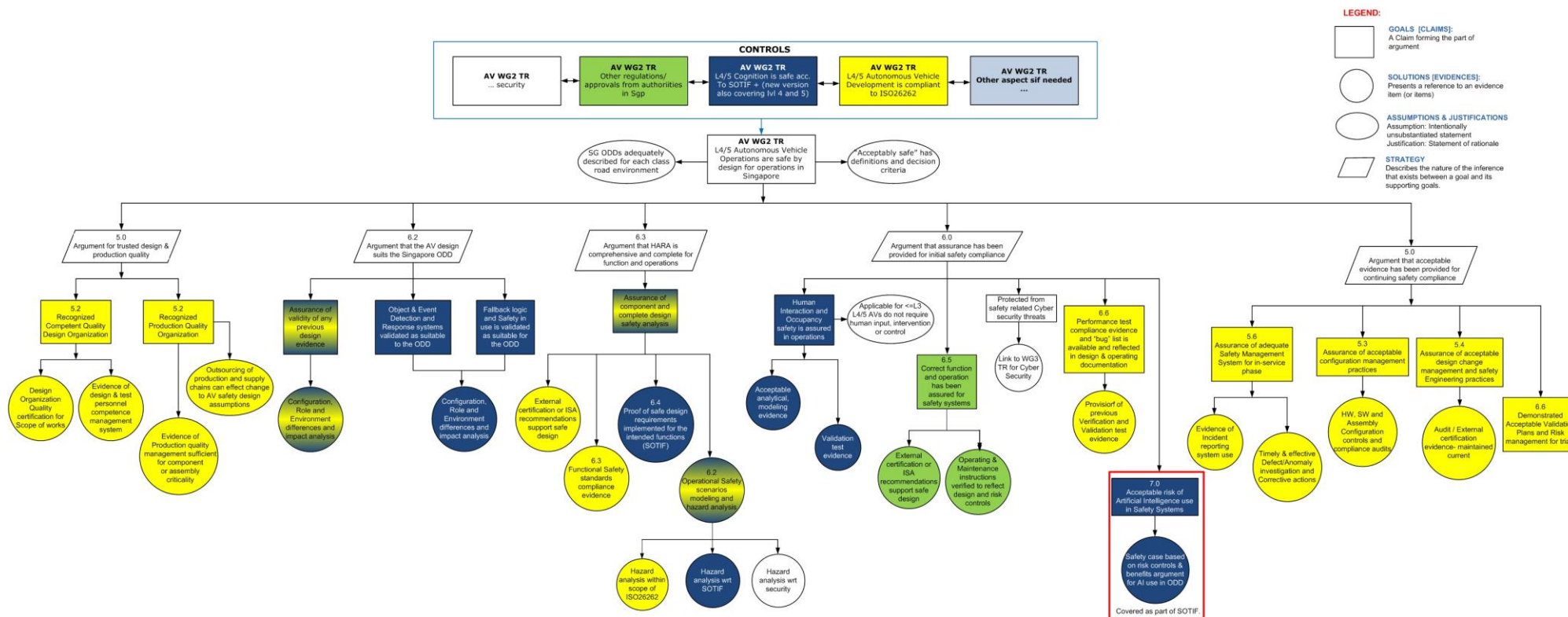


Figure 1 – Scope chart

2 Normative references

The following referenced documents are relevant for the application of this TR. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Automotive SPICE	Automotive SPICE Process Assessment/Reference Model
IATF 16949:2016	Quality management system for organizations in the automotive industry
IEC 62443-3-3	Industrial communication networks. Network and system security
ISO 9000:2015	Quality management systems – Fundamentals and vocabulary
ISO 9001:2015	Quality management systems Requirements
ISO/IEC/IEEE 12207:2017	Systems and software engineering – Software life cycle processes
ISO 10007:2017	Quality management – Guidelines for configuration management
ISO/IEC 17024:2012(en)	Conformity assessment – General requirements for bodies operating certification of persons
ISO 26262:2011	Road vehicles – Functional safety
ISO/PRF PAS 21448	Road vehicles – Safety of the intended functionality
SAE J3016_201609	Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles
SAE J3016_201806	Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems

There are various relevant standards available, as referenced in the clause above. AV developers/operators are expected to follow and establish those best practice standards. However, they are not considered to provide adequate coverage for challenges within safety systems for AVs operating in high risk environments and for AV approval and deployment in Singapore's regulatory framework and eco-system in the following required areas:

- a) Quality Management System;
- b) Safety Management System;
- c) Human Machine Interface;
- d) Artificial Intelligence.

Hence, this TR is intended to extend the normatively referenced standards to include the above areas for AVs.