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Road vehicles — Software update engineering

Véhicules routiers — Ingénierie de mise à jour du logiciel

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ISO 24089:2023

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Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 General terminology.....	1
3.2 Terms related to the software update operation.....	5
4 Organizational level requirements	5
4.1 Objectives.....	5
4.2 General.....	5
4.3 Requirements and recommendations.....	6
4.3.1 Governance.....	6
4.3.2 Continuous improvement.....	6
4.3.3 Information sharing.....	6
4.3.4 Supporting processes.....	7
4.3.5 Auditing.....	8
4.4 Work products.....	8
5 Project level requirements	8
5.1 Objectives.....	8
5.2 General.....	8
5.3 Requirements and recommendations.....	9
5.3.1 Project management.....	9
5.3.2 Tailoring and rationale.....	9
5.3.3 Interoperability.....	9
5.3.4 Integrity.....	10
5.4 Work products.....	10
6 Infrastructure level requirements	10
6.1 Objectives.....	10
6.2 General.....	10
6.3 Requirements and recommendations.....	11
6.3.1 Managing risk.....	11
6.3.2 Managing vehicle configuration information.....	11
6.3.3 Communicating software update campaign information.....	11
6.3.4 Processing software update packages.....	12
6.4 Work products.....	12
7 Vehicle and vehicle systems level requirements	13
7.1 Objectives.....	13
7.2 General.....	13
7.3 Requirements and recommendations.....	13
7.3.1 Managing risks.....	13
7.3.2 Managing vehicle configuration information.....	14
7.3.3 Communicating software update campaign information.....	14
7.3.4 Processing software update packages.....	14
7.4 Work products.....	16
8 Software update package requirements	16
8.1 Objectives.....	16
8.2 General.....	17
8.3 Requirements and recommendations.....	17
8.3.1 Identification of targets and the contents for the software update package.....	17
8.3.2 Assembly of the software update package.....	18
8.3.3 Verification and validation of the software update package.....	18

8.3.4	Approval for release of the software update package	18
8.4	Work products	19
9	Software update campaign requirements	19
9.1	Objectives	19
9.2	General	19
9.3	Requirements and recommendations	19
9.3.1	Software update campaign preparation	19
9.3.2	Software update campaign execution	21
9.3.3	Software update campaign completion	23
9.4	Work products	23
	Bibliography	24

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ISO 24089:2023

<https://standards.iteh.ai/catalog/standards/sist/a6c9aa6b-b6a3-492b-8c80-b276867df239/iso-24089-2023>

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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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 32, *Electrical and electronic components and general system aspects*.

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

Electronic control units and software of increasing complexity have become essential to the operation of road vehicles in recent years. This software is often updated to increase functionality and maintain the safety and cybersecurity of road vehicles.

Today, in-vehicle software is updated in a workshop by skilled persons or automatically over-the-air by the vehicle user. With the increased frequency of software update campaigns, it is important to have individual vehicle configuration information. Therefore, the establishment and application of software update engineering is important to ensure software quality, cybersecurity, and safety.

Software update engineering activities occur throughout the life cycle of vehicles.

This document provides vocabulary, objectives, requirements, and guidelines related to software update engineering as a foundation for common understanding throughout the supply chain. By applying requirements and recommendations in this document, the following benefits can be achieved for software update engineering:

- safety and cybersecurity are addressed in software update operations in road vehicles;
- establishment of processes, including goal setting, planning, auditing, process monitoring, process measurement, and process improvement;
- shared awareness of safety and cybersecurity among related parties.

Figure 1 shows the overview of this document.

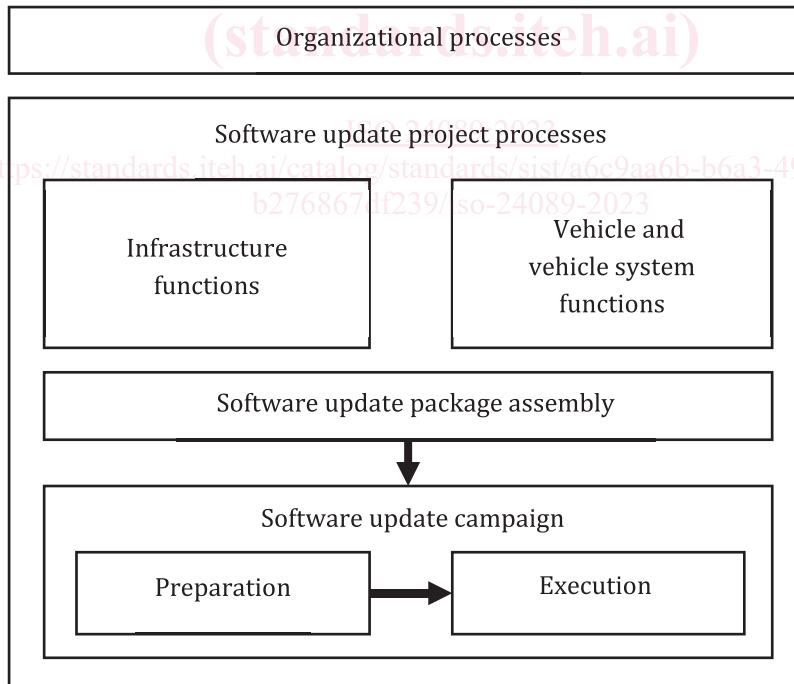


Figure 1 — Overview of this document

In this document, clauses are structured using the following approach:

- each process is defined and implemented before it is executed;
- each process is established, documented and maintained.

This document describes the following activities:

- implementation of organizational level processes for software update engineering;
- implementation of software update project level processes for each software update project;
- definitions of functions for the vehicle and infrastructure to support the activities and processes of this document;
- assembly of software update packages using functions in the infrastructure;
- preparation and execution of software update campaigns using functions in the vehicle and infrastructure.

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Road vehicles — Software update engineering

1 Scope

This document specifies requirements and recommendations for software update engineering for road vehicles on both the organizational and the project level.

This document is applicable to road vehicles whose software can be updated.

The requirements and recommendations in this document apply to vehicles, vehicle systems, ECUs, infrastructure, and the assembly and deployment of software update packages after the initial development.

This document is applicable to organizations involved in software update engineering for road vehicles. Such organizations can include vehicle manufacturers, suppliers, and their subsidiaries or partners.

This document establishes a common understanding for communicating and managing activities and responsibilities among organizations and related parties.

The development of software for vehicle functions, except for software update engineering, is outside the scope of this document.

Finally, this document does not prescribe specific technologies or solutions for software update engineering.

2 Normative references

[ISO 24089:2023](#)

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 26262-6, *Road vehicles — Functional safety — Part 6: Product development at the software level*

ISO 26262-8, *Road vehicles — Functional safety — Part 8: Supporting processes*

ISO/SAE 21434, *Road vehicles — Cybersecurity engineering*

3 Terms and definitions

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

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

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

3.1 General terminology

3.1.1

compatibility

capability of *software* (3.1.15) to be executable on *vehicle systems* (3.1.25) without conflicts

Note 1 to entry: Compatibility can be checked by *vehicle configuration information* (3.1.24).

**3.1.2
condition**

criteria required for a *software update operation* (3.1.19) to be completed successfully

Note 1 to entry: Conditions can include *compatibility* (3.1.1), *safe vehicle state* (3.1.13), *in-vehicle resources* (3.1.11), and external resources.

EXAMPLE The presence of a *skilled person* (3.1.14) during a software update operation.

**3.1.3
corrective action**

action to eliminate or contain a problem or failure

**3.1.4
cybersecurity**

road vehicle cybersecurity

context in which assets are sufficiently protected against threat scenarios to *vehicle systems* (3.1.25) of road vehicles and *infrastructure* (3.1.10) required to support *software update engineering* (3.1.18)

Note 1 to entry: In this document, for the sake of brevity, the term cybersecurity is used instead of road vehicle cybersecurity.

[SOURCE: ISO/SAE 21434:2021, 3.1.9, modified — “to items of road vehicles, their functions and their electrical or electronic components” has been replaced by “to vehicle systems of road vehicles and infrastructure required to support software update engineering” and the Note 1 to entry has been modified.]

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**3.1.5
cybersecurity risk**

effect of uncertainty on *cybersecurity* (3.1.4) expressed in terms of attack feasibility and impact

[SOURCE: ISO/SAE 21434:2021, 3.1.29]

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**3.1.6
dependency**

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effect of *software* (3.1.15) for one *vehicle system* (3.1.25) on the same or other *vehicle systems* (3.1.25)

Note 1 to entry: A dependency can generate a *condition* (3.1.2) in the metadata of a *software update package* (3.1.20).

EXAMPLE A communication interface between two *electronic control units (ECUs)* (3.1.7).

**3.1.7
ECU**

electronic control unit

embedded device in a vehicle whose *software* (3.1.15) can be updated

**3.1.8
functional safety**

absence of unreasonable risk due to hazards caused by malfunctioning behaviour of *vehicle systems* (3.1.25)

[SOURCE: ISO 26262-1:2018, 3.67, modified — “E/E” was replaced by “vehicle”.]

**3.1.9
functional safety risk**

combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: ISO 26262-1:2018, 3.128, modified — The term has been modified from “risk” to “functional safety risk” for the scope of this document.]

3.1.10**infrastructure**

processes and information systems managing any combination of *software update operations* (3.1.19), *software update campaigns* (3.1.16), documentation, and *vehicle configuration information* (3.1.24), including both digital and manual activities

Note 1 to entry: Infrastructure can include any combination of servers, tools, and manual activities used in the software update operation.

3.1.11**in-vehicle resource**

vehicle or *electronic control unit (ECU)* (3.1.7) available properties relevant for *software update engineering* (3.1.18)

EXAMPLE Available or remaining computational power, network capacity, RAM capacity, storage capacity, or battery capacity.

3.1.12**recipient**

individual instance of a vehicle, *vehicle system* (3.1.25), or *electronic control unit (ECU)* (3.1.7) that receives a *software update package* (3.1.20) during a *software update campaign* (3.1.16)

3.1.13**safe vehicle state**

vehicle operating mode based on *conditions* (3.1.2) for performing *software update operations* (3.1.19) without an unreasonable level of risk

Note 1 to entry: Safe vehicle state can be different depending on the *conditions* (3.1.2) required for the *software update package* (3.1.20).

Note 2 to entry: Safe vehicle state can vary based on the software update operation step being performed.

EXAMPLE The motor is off, the parking brake is applied.

3.1.14**skilled person**

individual with relevant technical education, training or experience to execute *software update operations* (3.1.19)

Note 1 to entry: A skilled person can be a mechanic in a workshop.

Note 2 to entry: A skilled person can be authorized or certified for their specialized training or be a skilled *vehicle user* (3.1.26).

[SOURCE: ISO 10209:2022, 3.14.36, modified — The phrase “to enable them to perceive risks and avoid hazards occurring during use of a product” has been replaced by “to execute software update operations”.]

3.1.15**software**

computer programs and associated data intended for *installation* (3.2.2) on vehicles, *vehicle systems* (3.1.25), or *electronic control units (ECUs)* (3.1.7), that may be dynamically written or modified during execution

[SOURCE: NIST SP 800-53, modified — The phrase “intended for installation on vehicles, vehicle systems, or electronic control units (ECUs)” was added.]

3.1.16**software update campaign**

sequence of identifying *targets* (3.1.23) and resolving *recipients* (3.1.12); distributing *software update packages* (3.1.20); and monitoring and documenting results of *software update operations* (3.1.19)

3.1.17

software update distribution method

mechanism for delivery of a *software update package* (3.1.20) during a *software update campaign* (3.1.16)

Note 1 to entry: The software update distribution method can be wired (e.g. tool, USB flash drive), wireless (e.g. cellular or Wi-Fi) or hardware replacement.

Note 2 to entry: Hardware replacement can be replacing an *electronic control unit (ECU)* (3.1.7) with the effect of *software* (3.1.15) version replacement.

3.1.18

software update engineering

application of a systematic and managed approach to the processes of planning, development, and deployment of *software update packages* (3.1.20)

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.3810, modified — “disciplined, quantifiable” was replaced by “and managed”, and “development, operation and maintenance of software” was replaced by “processes of development, planning, and deployment of software update packages”.]

3.1.19

software update operation

steps involved in *receipt* (3.2.1), *installation* (3.2.2) and *activation* (3.2.3) of *software update packages* (3.1.20) in a vehicle, *vehicle systems* (3.1.25), or *electronic control units (ECUs)* (3.1.7)

3.1.20

software update package

set of *software* (3.1.15) and associated metadata that is intended to be deployed to one or more vehicles, *vehicle systems* (3.1.25), or *electronic control units (ECUs)* (3.1.7)

3.1.21

software update project

set of *software update engineering* (3.1.18) activities for one or more *targets* (3.1.23)

Note 1 to entry: Activities can include developing or adapting the *infrastructure* (3.1.10), vehicle capabilities, or processes described in this document.

Note 2 to entry: A software update project can encompass multiple *software update campaigns* (3.1.16).

3.1.22

tailor

to omit or perform an activity in a different manner compared to its description in this document

[SOURCE: ISO/SAE 21434:2021, 3.1.32]

3.1.23

target

one or more classes of vehicles, *vehicle systems* (3.1.25), or *electronic control units (ECUs)* (3.1.7) determined by *vehicle configuration information* (3.1.24)

3.1.24

vehicle configuration information

comprehensive accounting of hardware versions, *software* (3.1.15) versions and configuration parameters in a vehicle

3.1.25

vehicle system

functional group of one or more *electronic control units (ECUs)* (3.1.7) and attached hardware

Note 1 to entry: Attached hardware can be, for example, a sensor, actuator or light, that is not an ECU.

EXAMPLE Braking system or infotainment system.