INTERNATIONAL STANDARD

ISO 15031-7

Second edition
2013-07-15

Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 7: Data link security

Véhicules routiers — Communications entre un véhicule et un équipement externe pour le diagnostic relatif aux émissions —

Partie 7: Sécurité de la liaison de données

Reference number
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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. www.iso.org/directives.

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 15031-7:2001) of which has been technically revised.

ISO 15031 consists of the following parts, under the general title *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics*:

— *Part 1: General information and use case definition*

— *Part 2: Guidance on terms, definitions, abbreviations and acronyms*

— *Part 3: Diagnostic connector and related electrical circuits, specification and use*

— *Part 4: External test equipment*

— *Part 5: Emissions-related diagnostic services*

— *Part 6: Diagnostic trouble code definitions*

— *Part 7: Data link security*

Introduction

0.1 Overview

ISO 15031 consists of a number of parts which, taken together, provide a coherent self-consistent set of specifications to facilitate emissions-related diagnostics. ISO 15031-1 provides an introduction to the series of International Standards. ISO 15031-2 through ISO 15031-7 are based on Society of Automative Engineers (SAE) recommended practices. This part of ISO 15031 is based on SAE J2186:1996, *E/E Data Link Security*.

The ISO 15031 document set includes the communication between the vehicle's On-Board Diagnostics (OBD) systems and test equipment implemented across vehicles within the scope of the legislated emissions-related OBD.

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model in accordance with ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 15031 are broken into the following:

— Diagnostic services (layer 7), specified in:
  — ISO 15031-5 (emissions-related OBD);
  — ISO 27145-3 (WWH-OBD);
— Presentation layer (layer 6), specified in:
  — ISO 15031-2, SAE J1930-DA;
  — ISO 15031-5, SAE J1979-DA;
  — ISO 15031-6, SAE J2012-DA;
  — ISO 27145-2, SAE J2012-DA;
— Session layer services (layer 5), specified in:
  — ISO 14229-2 supports ISO 15765-4 DoCAN and ISO 14230-4 DoK-Line protocols;
  — ISO 14229-2 is not applicable to the SAE J1850 and ISO 9141-2 protocols;
— Transport layer services (layer 4), specified in:
  — DoCAN: ISO 15765-2 Transport protocol and network layer services;
  — SAE J1850: ISO 15031-5 Emissions-related diagnostic services;
  — ISO 9141-2: ISO 15031-5 Emissions-related diagnostic services;
  — DoK-Line: ISO 14230-4, ISO 15031-5 Emissions-related diagnostic services;
— Network layer services (layer 3), specified in:
  — DoCAN: ISO 15765-2 Transport protocol and network layer services;
  — SAE J1850: ISO 15031-5 Emissions-related diagnostic services;
  — ISO 9141-2: ISO 15031-5 Emissions-related diagnostic services;
  — DoK-Line: ISO 14230-4, ISO 15031-5 Emissions-related diagnostic services;
— Data link layer (layer 2), specified in:
  — DoCAN: ISO 15765-4, ISO 11898-1, ISO 11898-2;

- SAE J1850;
- ISO 9141-2;
- DoK-Line: ISO 14230-2;

— Physical layer (layer 1), specified in:

- DoCAN: ISO 15765-4, ISO 11898-1, ISO 11898-2;
- SAE J1850;
- ISO 9141-2;
- DoK-Line: ISO 14230-1;

in accordance with Table 1.

Table 1 — Legislated emissions-related OBD/WWH-OBD diagnostic specifications applicable to the OSI layers

<table>
<tr><th>Applicability</th><th>OSI 7 layers</th><th colspan="6">Emissions-related OBD communication requirements</th><th colspan="3">Emissions-related WWH-OBD communication requirements</th></tr>
<tr><td rowspan="8">Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="6">ISO 15031-5</td><td colspan="3">ISO 27145-3</td></tr>
<tr><td rowspan="2">Presentation (layer 6)</td><td colspan="6">ISO 15031-2, ISO 15031-5, ISO 15031-6
SAE J1930-DA / SAE J1979-DA</td><td colspan="3">ISO 27145-2
SAE J1930-DA / SAE J1979-DA</td></tr>
<tr><td colspan="6">SAE J2012-DA</td><td colspan="3">SAE J2012-DA</td></tr>
<tr><td>Session (layer 5)</td><td colspan="2">Not Applicable</td><td colspan="4">ISO 14229-2</td></tr>
<tr><td>Transport (layer 4)</td><td colspan="2" rowspan="2">ISO 15031-5</td><td rowspan="2">ISO 14230-4</td><td rowspan="2">ISO 15765-2</td><td rowspan="3">ISO 15765-4</td><td>ISO 15765-2</td><td rowspan="3">ISO 27145-4</td><td rowspan="2">ISO 13400-2</td></tr>
<tr><td>Network (layer 3)</td><td rowspan="2">ISO 11898-1, ISO 11898-2</td><td rowspan="2">ISO 11898-1, ISO 11898-2</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">SAE J1850</td><td rowspan="2">ISO 9141-2</td><td>ISO 14230-2</td><td rowspan="2">ISO 13400-3</td></tr>
<tr><td>Physical (layer 1)</td><td>ISO 14230-1</td></tr>
</table>

0.2 SAE document reference concept

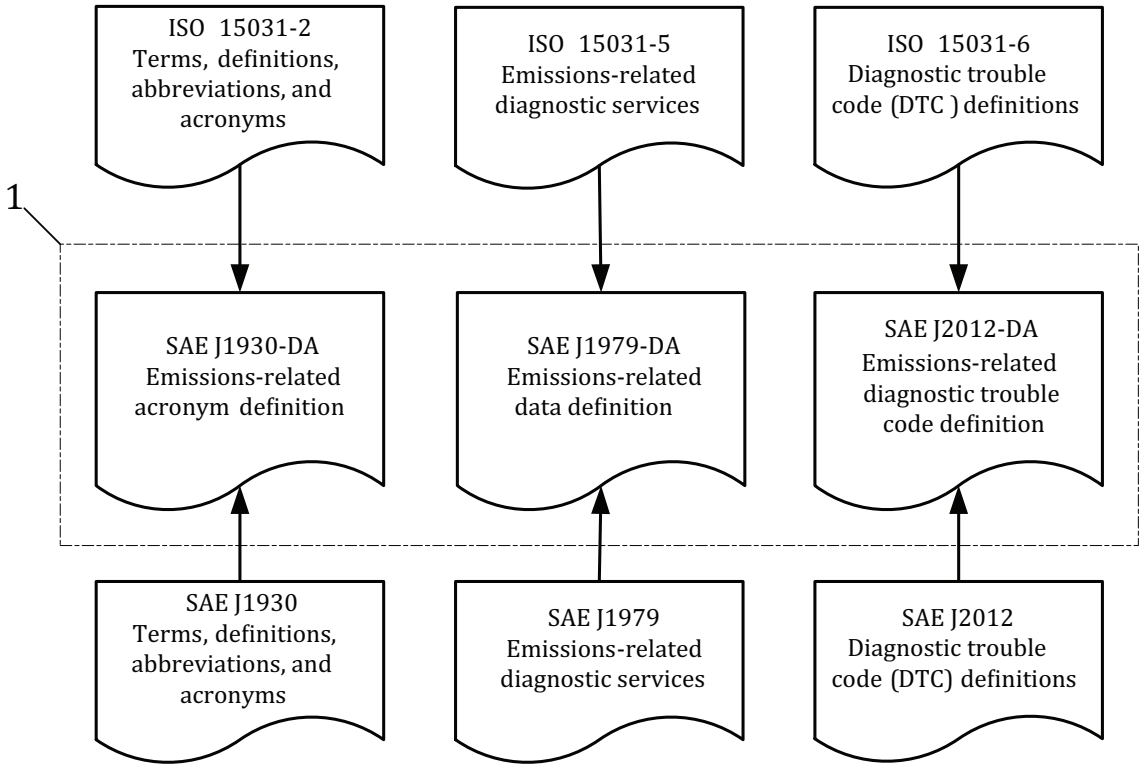
ISO 15031 references several SAE documents which contain all terms, data, and diagnostic trouble code (DTC) definitions.

See Figure 1 with the following definition of content in ISO 15031-2, ISO 15031-5, and ISO 15031-6:

— SAE J1930: this document is concerned with a procedure for naming objects and systems and with the set of words from which names are built. It references SAE J1930-DA which contains all standardized naming objects, terms, and abbreviations.

— SAE J1979: this document is concerned with the definition of emissions-related diagnostic services (diagnostic test modes). It references SAE J1979-DA which contains all standardized data items like Parameter IDs, Test IDs, Monitor IDs, and InfoType IDs.

— SAE J2012: this document is concerned with the procedure for defining emissions-related diagnostic trouble codes. It references SAE J2012-DA which contains all standardized data items like DTCs and failure type bytes (FTBs).



Key

1 SAE Digital Annexes

Figure 1 — SAE Digital Annex document reference

OBD regulations require passenger cars and light, medium, and heavy-duty trucks to support a minimum set of diagnostic information to external (off-board) "generic" test equipment.

0.3 SAE J1979-DA (Digital Annex)

This part of ISO 15031 references the SAE J1979-DA. The SAE J1979-DA is concerned with the definitions of

— Parameter Identifiers (PIDs),

— Test Identifiers (TIDs),

— OBD Monitor Identifiers (OBDMIDs),

— Unit and Scaling Identifiers (UASIDs), and

— INFOTYPEs (INFOTYPEs).

0.4 SAE Digital Annex revision procedure

New emissions-related regulatory requirements drive new in-vehicle technology to lower emissions. New technology related OBD monitor data and DTCs need to be standardized to support the external (off-board) "generic" test equipment. All relevant information is proposed by the automotive industry represented by members of the appropriate SAE task force.

The revision request form and instructions for updating the Registers to ISO 15031-5 can be obtained on the Registration Authority's website at:

http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS14

The column titled “Resources” shows a document with the title: J1979-DA_Revision_Request_Form.doc. Double click on the name and you will be asked to download the document with the filename:

SAE_J1979-DA_Revision_Request_Form.doc

Fill out the revision request form with your request.

Please send an email with the completed revision request form as an attachment to:

SAE Headquarters

755 West Big Beaver Road

Suite 1600

Troy, MI 48084-4093, USA

Fax: +1 (248) 273-2494

Email: saej1979@sae.org

Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 7: Data link security

1 Scope

This part of ISO 15031 gives guidelines for the protection of road vehicle modules from unauthorized intrusion through a vehicle diagnostic data link. These security measures offer vehicle manufacturers the flexibility to tailor their security to their own specific needs and do not exclude other, additional measures.

This part of ISO 15031 applies to vehicle modules whose solid-state memory contents are able to be altered from outside the electronic module through a diagnostic data communication link. Such alteration could potentially damage a vehicle's electronics or other components, placing at risk its compliance with government legislation or the vehicle manufacturer's interests in respect of security.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9141-2, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information*

ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 11898-2, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

ISO 14229-2, *Road vehicles — Unified diagnostic services (UDS) — Part 2: Session layer services*

ISO 14230-2, *Road vehicles — Diagnostic communication over K-Line (DoK-Line) — Part 2: Data link layer*

ISO 14230-4, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 4: Requirements for emission-related systems*

ISO 15031-2, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 2: Guidance on terms, definitions, abbreviations and acronyms*

ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*

ISO 15031-6, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 6: Diagnostic trouble code definitions*

ISO 15765-2, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 2: Transport protocol and network layer services*

ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 4: Requirements for emissions-related systems*

ISO 27145-2, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 2: Common data dictionary*

ISO 27145-3, *Road vehicles -- Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 3: Common message dictionary*

ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

SAE J1850-DA, *Digital Annex of Class B Data Communications Network Interface*

SAE J1930-DA, *Digital Annex of Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms*

SAE J1979-DA, *Digital Annex of E/E Diagnostic Test Modes*

SAE J2012-DA, *Digital Annex of Diagnostic Trouble Code Definitions and Failure Type Byte Definitions*

3 Terms, definitions, and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 15031-2 and the following apply.

3.1 Terms and definitions

3.1.1
unsecured functions
standard diagnostic functions provided by the vehicle manufacturer and controlled and protected by the on-board controller

EXAMPLE Reprogramming of selected items such as the clearing of fault codes.

3.1.2
secured functions
restricted functions whose access requires unlocking the on-board controller

EXAMPLE Programming of vehicle emission systems such as fuel/ignition maps, anti-theft systems, and odometer.

3.1.3
seed
pseudorandom data value sent from the on-board controller to the external test equipment and processed by the security algorithm to produce the key

3.1.4
key
data value giving access to the secured functions sent from the external test equipment to the on-board controller in response to the seed

3.1.5
false access attempt
FAA
incorrect key received by the on-board controller

3.1.6
delay time
DT
time period inserted between access attempts

3.2 Abbreviated terms

DT delay time

FAA false access attempt

4 Conventions

ISO 15031 is based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) as they apply for diagnostic services.

5 Document overview

Figure 2 illustrates the emissions-related OBD on ISO 15765-4, SAE J1850, ISO 9141-2, and ISO 14230-4 document reference. The protocol initialization identifies whether ISO 15765-4 DoCAN, SAE J1850, ISO 14230-4 DoK-Line, or ISO 9141-2 is the data link layer supported by the vehicle. ISO 15031 references the International Standards as an applicable data link for emissions-related OBD.

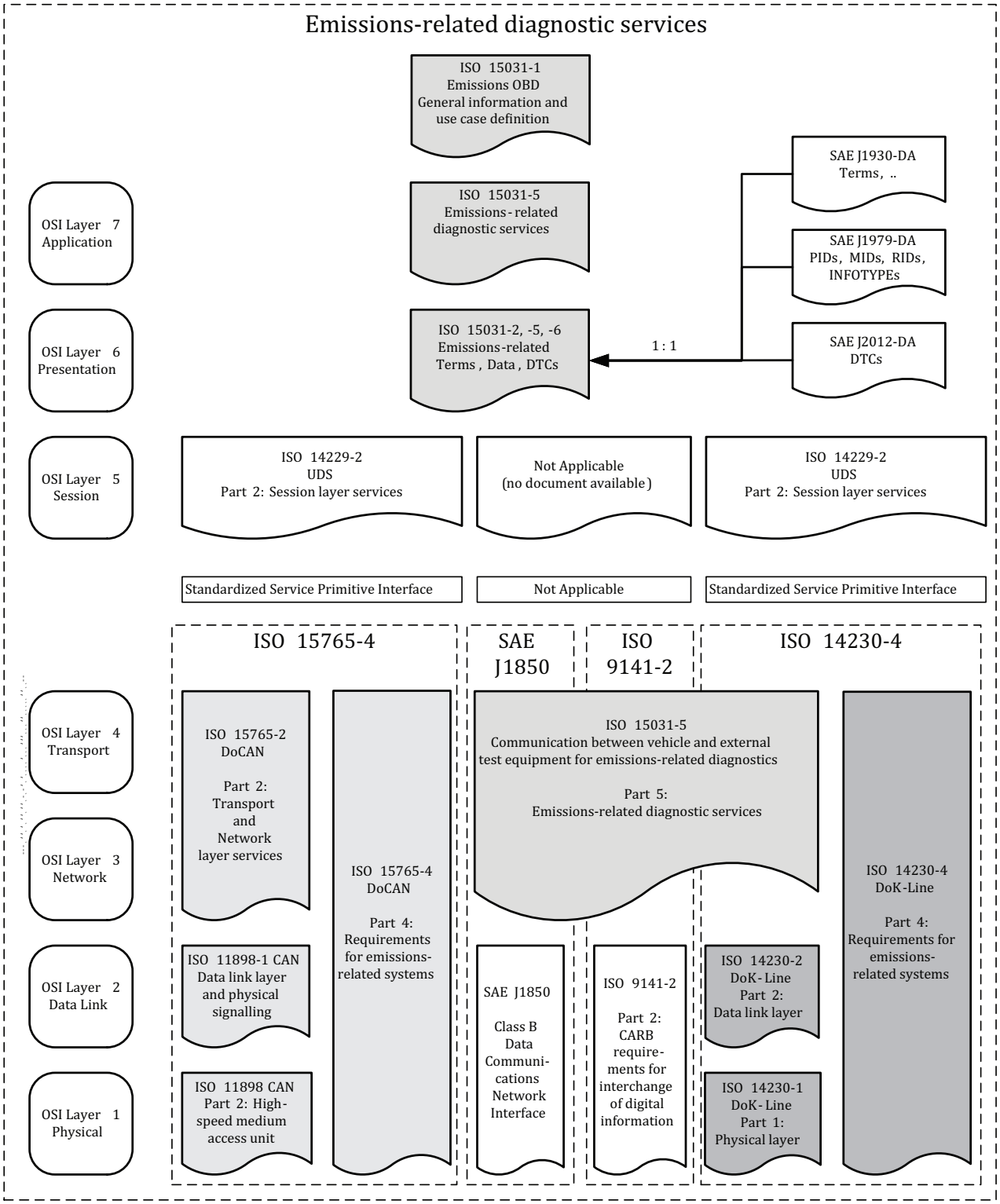


Figure 2 — Emissions-related OBD on ISO 15765-4, SAE J1850, ISO 9141-2, and ISO 14230-4 document reference according to the OSI model

6 Technical requirements

6.1 General

The unlocking of the on-board controller shall be a prerequisite for accessing certain critical on-board control functions.

NOTE This part of ISO 15031 does not specify the functions or information to be secured, leaving this to the vehicle manufacturer.

The only access permitted to the on-board controller when a function is locked shall be through the product-specific software, thus permitting the software to protect itself and the rest of the vehicle control system from unauthorized intrusion. Different on-board functions may be protected by separate seed-key combinations.

The security measures shall not prevent normal diagnostic communications between the external device and the on-board controller.

6.2 Security characteristics

The security measure may be incorporated in any communications protocol. Special commands shall be provided via the diagnostics communication link for unlocking the on-board controller.

Disclosure of the seed-key relationship and size should be limited to persons authorized by the vehicle manufacturer.

6.3 Security implementation

An example implementation of security access can be found in ISO 14229-1.

Bibliography

[1] ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

[2] ISO 15031-1, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 1: General information and use case definition*

[3] ISO 15031-3, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits, specification and use*

[4] ISO 15031-4, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 4: External test equipment*

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