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

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

*Véhicules routiers — Communications entre un véhicule et
un équipement externe quant au diagnostic relatif aux émissions —*

Partie 1: Informations générales et définition de cas d'usage



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 15031-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 15031-1:2001), 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*

ISO 15031 provides an implementer with all documents and references required to support the implementation of legislated on-board diagnostics (OBDS) in accordance with the requirements set forth in the country-specific emissions regulation.

- ISO 15031-1 provides general information and use case definitions and an overview of the document set along with the use case definitions and a common set of resources (definitions, references) for use by all subsequent parts.
- ISO 15031-2 is a guide to terms, definitions, abbreviations and acronyms used in emissions-related diagnostics, with respect to the communication between road vehicles and external equipment used in that field. It also specifies a procedure for constructing new terms. As it gives recommended usage of diagnostic terms applicable to electrical/electronic systems, it also makes reference to related mechanical terms, definitions, abbreviations and acronyms.

- ISO 15031-3 specifies a minimum set of requirements for a diagnostic connector used in communication between vehicle and external equipment for emissions-related diagnostics.
- ISO 15031-4 provides requirements to be fulfilled by any external test equipment connected to the vehicle.
- ISO 15031-5 provides the data reporting requirements of (OBD) regulations in the United States and Europe, and any other region that may adopt similar requirements in the future. ISO 15031-5 specifies:
 - message formats for request and response messages,
 - timing requirements between request messages from external test equipment and response messages from vehicles, and between those messages and subsequent request messages,
 - behaviour of both the vehicle and external test equipment if data is not available,
 - a set of diagnostic services, with corresponding content of request and response messages, to satisfy OBD regulations.
- ISO 15031-6 provides uniformity for standardized Diagnostic Trouble Codes (DTC) that electrical/electronic (OBD) systems of motor vehicles are required to report when malfunctions are detected. It further provides guidance for uniform messages (text descriptor) associated with these codes.
- ISO 15031-7 specifies a standard mechanism for limiting access to particular vehicle services (such as those intended for use only within the original manufacturing plant).

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. Parts 2 through 7 are based on SAE recommended practices. This part of ISO 15031 provides an introduction to the series of International Standards and the reference to the SAE Digital Annexes (DA).

Such standardization is of benefit to many sectors of the automotive industry, including service technicians who are required to work on a variety of vehicle types and component suppliers who wish to provide similar products to several vehicle manufacturers.

Some of the documents have a wider scope than just purely emissions-related issues. The legislator is the adequate authority to make the appropriate references.

ISO 15031 includes the communication between the vehicle's on-board diagnostic (OBD) systems and an external (off-board) "generic" test equipment within the scope of the emissions-related OBD legislation.

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 layers in accordance with Table 1:

- 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 (OBD);
 - ISO 27145-2, SAE J2012-DA (WWH-OBD);
- session layer services (layer 5), specified in
 - ISO 14229-2 support ISO 15765-4 and ISO 14230-4 protocol;
 - ISO 14229-2 are not applicable to the SAE J1850 and ISO 9141-2 protocols;
- transport layer services (layer 4), specified in
 - ISO 15765-4, ISO 15765-2 Transport protocol and network layer services;
 - SAE J1850 defined in ISO 15031-5;
 - ISO 9141-2 defined in ISO 15031-5;
 - ISO 14230-4 defined in ISO 15031-5;

- network layer services (layer 3), specified in
 - ISO 15765-4, ISO 15765-2 Transport protocol and network layer services;
 - SAE J1850 defined in ISO 15031-5;
 - ISO 9141-2 defined in ISO 15031-5;
 - ISO 14230-4 defined in ISO 15031-5;
- data link layer (layer 2), specified in
 - ISO 15765-4, ISO 11898-1 and ISO 11898-2;
 - SAE J1850;
 - ISO 9141-2;
 - ISO 14230-2;
- physical layer (layer 1), specified in
 - ISO 15765-4, ISO 11898-1 and ISO 11898-2;
 - SAE J1850;
 - ISO 9141-2;
 - ISO 14230-1.

Table 1 — Legislated emissions-related OBD/WWH¹⁾-OBD diagnostic specifications applicable to the OSI layers

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

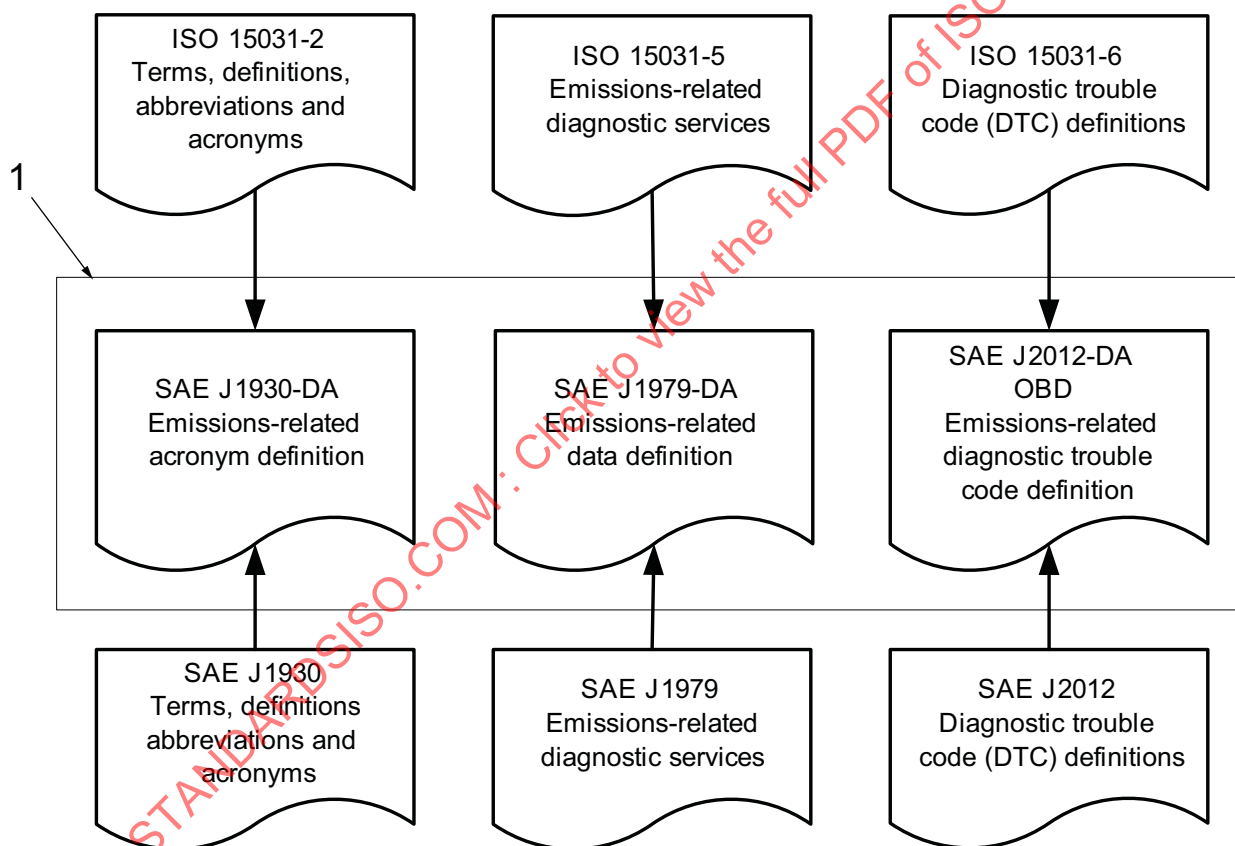
1) World-Wide Harmonized.

0.2 SAE document reference concept

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

This is illustrated in Figure 1. Additional information on the content of the referenced documents is given below:

- SAE J1930: the 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: the 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 PIDs, Test Ids, Monitor Ids and InfoType Ids.
- SAE J2012: the document is concerned with the procedure for defining emissions-related DTCs. It references SAE J2012-DA, which contains all standardized data items like DTCs and ETBs.



Key

- 1 SAE Digital Annexes

Figure 1 — SAE Digital Annex document reference

0.3 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.

ISO 15031-2, ISO 15031-5 and ISO 15031-6 reference a “Change Request Form” to be used for new data items to be defined by the SAE task force for standardization. The standardized data items will be defined in SAE J1930-DA, SAE J1979-DA and SAE J2012-DA. Once the information has been balloted and approved the documents will be published on the SAE Store Web Site.

The revision request forms and instructions for updating the registers to all parts of ISO 15031 can be obtained on the Registration Authority's website at:

- for Part 2: <http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS7>
The column titled “Resources” shows a document with the title: J1930-DA_Revision_Request_Form.doc. Double click on the name and you will be asked to download the document with the filename: SAE_J1930-DA_Revision_Request_Form.doc
- for Part 5: <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
- for Part 6: <http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS9>
The column titled “Resources” shows a document with the title: J2012-DA_Revision_Request_Form.doc. Double click on the name and you will be asked to download the document with the filename: SAE_J2012-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:

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755 West Big Beaver Road
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Troy, MI 48084-4093, USA
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Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 1: General information and use case definition

1 Scope

This part of ISO 15031 gives an overview of the structure and the partitioning of ISO 15031, and shows the relation between the different parts. It also defines the corresponding SAE recommended practices and reference to the SAE Digital Annexes. The terminology defined in this part of ISO 15031 is common for all parts of ISO 15031.

This part of ISO 15031 also describes the use cases applicable to the communication between vehicle and external test equipment for emissions-related diagnostics.

2 Normative references

The following referenced documents are indispensable for the application 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/IEC 7498-1:1994, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO/IEC 10731:1994, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

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

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

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 15031-7, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 7: Data link security*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1

calibration identifier

CALID

identification code for a specific software/calibration contained in a server/electronic control unit (ECU)

NOTE If regulations require calibration identifications for emission-related software, those shall be reported in a standardized format as specified in SAE J1979-DA.

3.1.2

calibration verification number

CVN

server/ECU calculated verification number of a calibration identification number to verify the integrity of the software/calibration contained in a server/ECU

NOTE If regulations require calibration identifications for emission-related software, those shall be reported in a standardised format as specified in ISO 15031-2.

3.1.3

diagnostic service

information exchange initiated by a client (external test equipment) in order to require diagnostic information from a server (ECU) or to modify its behaviour for diagnostic purposes

NOTE This is also the equivalent of test mode or mode.

3.1.4

emissions-related DTC

DTC

DTC which is set when a malfunction causes vehicle emissions to exceed legislated emission thresholds or is otherwise required to be set as specified by on-board diagnostics legislation (e.g. disables another part of the diagnostic system)

NOTE Normally, the malfunction indicator (MI) is illuminated at the same time as the emissions-related DTC is set. The determination of which DTCs are emissions-related is made by the vehicle manufacturer for each vehicle, as specified by on-board diagnostic legislation.

3.1.5

I/M station

I/M

inspection and maintenance station to test roadworthiness of the emissions-related systems in the vehicle

3.1.6

malfunction indicator

MI

indicator which clearly informs the driver of the vehicle in the event of a malfunction

3.1.7

on-board diagnostics

OBD

system that monitors some or all computer input and control signals

NOTE Signal(s) outside of the predetermined limits imply a fault in the system or in a related system.

3.1.8**server**

function that is part of an electronic control unit that provides the diagnostic services

NOTE This part of ISO 15031 differentiates between the server (i.e. the function) and the electronic control unit so that this part of ISO 15031 remains independent from the implementation.

3.1.9**vehicle identification number****VIN**

identification number specific and unique to each vehicle following the applicable legal provisions of each national/regional authority

3.2 Abbreviated terms

CALID	calibration identifier
CAN	controller area network
CARB	California Air Resources Board
CVN	calibration verification number
DoCAN	Diagnostic communication over CAN
DoK-Line	Diagnostic communication over K-Line
DTC	diagnostic trouble code
ECU	electronic control unit
I/M	inspection and maintenance
ISO	International Organization for Standardization
K-Line	UART-based communication data link
MI	malfunction indicator
OBD	on-board diagnostic
OSI	open systems interconnection
SAE	Society of Automotive Engineers
UDS	unified diagnostic services
VIN	vehicle identification number

4 Conventions

ISO 15031 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731:1994) as they apply for diagnostic services.

5 Document overview

Table 2 defines the partitioning of ISO 15031 and the relation between ISO 15031-1 through ISO 15031-7 and related SAE recommended practices.

Table 2 — Reference between ISO and SAE standards

ISO		SAE		
ISO Master document		SAE Master document		Digital Annex
ISO 15031-1	General information	No equivalent standard		—
ISO 15031-2	Guidance on terms, definitions, abbreviations and acronyms	SAE J1930	Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations and Acronyms	SAE J1930-DA
ISO 15031-3	Diagnostic connector and related electrical circuits, specification and use	SAE J1962	Diagnostic Connector	—
ISO 15031-4	External test equipment	SAE J1978	OBD II Scan Tool	—
ISO 15031-5	Emissions-related diagnostic services	SAE J1979	E/E Diagnostic Test Modes	SAE J1979-DA
ISO 15031-6	Diagnostic trouble code definitions	SAE J2012	Diagnostic Trouble Code Definitions	SAE J2012-DA
ISO 15031-7	Data link security	SAE J2186	E/E Data Link Security	—

ISO 15031-2, ISO 15031-5 and ISO 15031-6 are master documents and do not define any related data in the annexes. The related data are defined in the referenced SAE Digital Annexes. These Digital Annexes are developed, updated and maintained by the SAE task forces.

Figure 2 illustrates the document references.

The protocol initialization identifies whether ISO 15765-4 DoCAN or SAE J1850 or ISO 14230-4 DoK-Line or ISO 9141-2 is the data link layer supported by the vehicle. ISO 15031 references the standards as an applicable data link for emissions-related OBD.

ISO 15031-5 specifies the applicable emissions-related diagnostic services. This part of ISO 15031 specifies the data record structures and references SAE J1930-DA, SAE J1979-DA and SAE J2012-DA which include all emissions-related OBD data definitions.

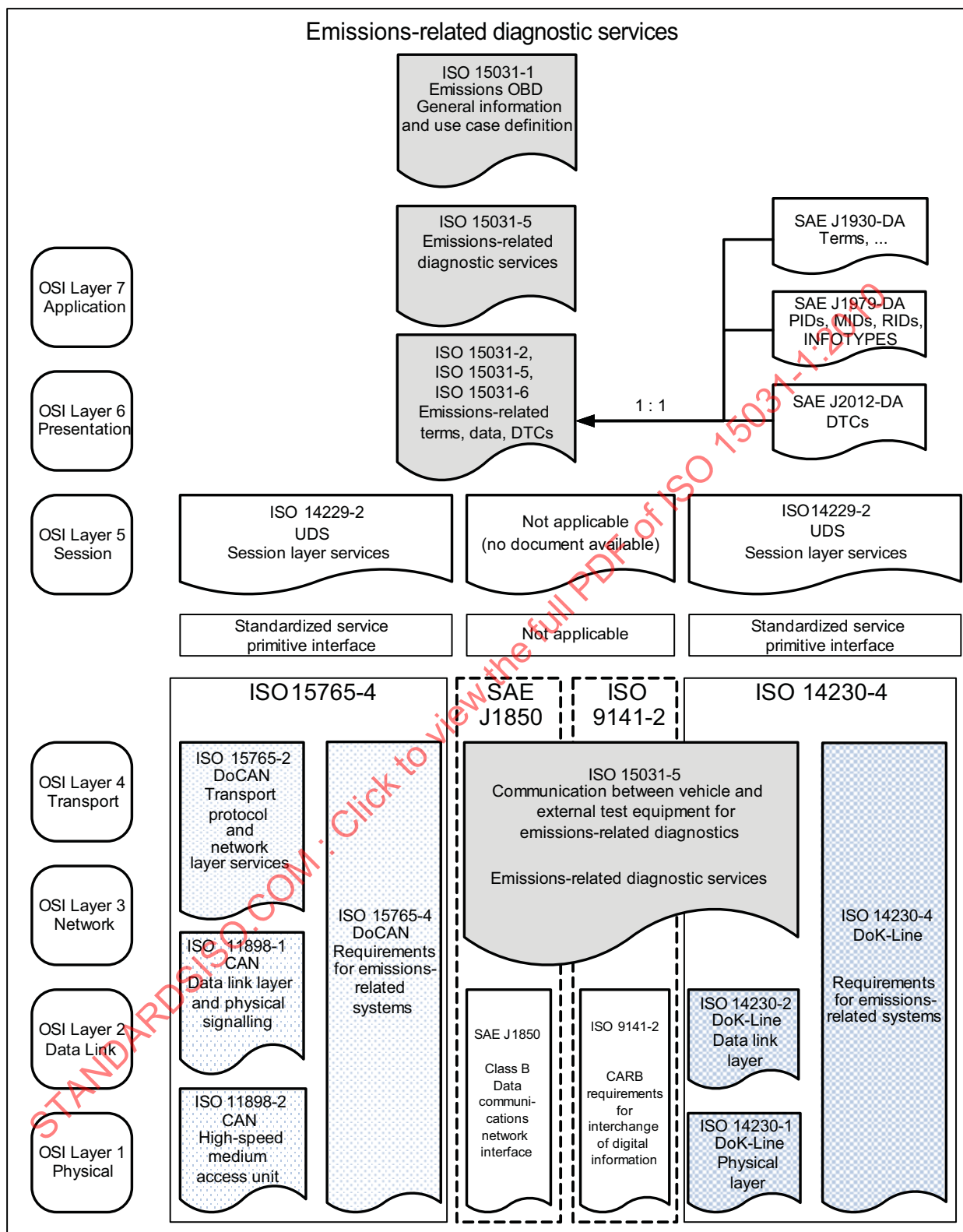


Figure 2 — Implementation of emissions-related OBD in OSI model

6 Emissions-related OBD use case overview and principles

6.1 Overview

The OBD system is required to make available vehicle diagnostic information under several different use cases as specified by the legislation. These use cases provide the implementer with guidance in the implementation of the OBD system and methodology used on the vehicle to make the required data available.

6.2 OBD use case clusters

The following is a summary of the use cases applicable to emissions-related OBD systems.

Table 3 provides an overview of the main emissions-related OBD use cases. A main emissions-related OBD use case cluster may have one or more use case definitions.

Table 3 — OBD main use case clusters

No.	Main title of use case cluster	Brief description
1	Information about emissions-related malfunctions for the purpose of inspection	The purpose of this information package is to provide access to the data set specified as necessary by the OBD legislation to determine vehicle readiness and characterize the malfunctions detected by the OBD system.
2	Information related to diagnosis for the purpose of repair	The purpose of this information package is to provide access to all OBD data required by the OBD legislation and available from the OBD system.

7 Emissions-related OBD use case definition

7.1 UC 1 — Information about emissions-related malfunctions

7.1.1 UC 1.1 — Information about emission-related confirmed DTC(s)

Table 4 describes the use case of retrieving confirmed DTC(s) by an external test equipment which might either be an I/M test system or a repair technician's scan tool.

Table 4 — UC 1.1 Information about emissions-related confirmed DTC(s)

Actor	Any repair technician, any inspection station (I/M station).
Goal	This information will provide any inspection station with engine-related OBD data including the MI status and associated data, a list of diagnostic trouble codes and associated data.
Use case input	Perform VIN upload, read MI status, read confirmed DTC(s), read readiness status of OBD system, read continuous-MI counter and cumulated operating hours with a continuous-MI.
Use case output	— The VIN. — The MI status. — The DTCs with confirmed status. — The readiness status of the OBD system.
Brief description	The OBD system shall provide the data items as required by the emissions-related module(s) and in the format as specified in ISO 15031 and associated SAE J1930-DA, SAE J1979-DA and SAE J2012-DA for the external inspection test equipment to assimilate the data and provide an inspector with the information.

7.1.2 UC 1.2 — Information about emissions-related pending DTC(s)

Table 5 describes the use case of retrieving pending DTC(s) by an external test equipment which might either be an I/M test system or a repair technician's scan tool.

Table 5 — UC 1.2 Information about emissions-related pending DTC(s)

Actor	Any repair technician.
Goal	The goal of obtaining pending DTC(s) detected during current or last completed driving cycle for emissions-related components/systems is used to assist the service technician after a vehicle repair, and after clearing diagnostic information, by reporting test results after a single driving cycle.
Use case input	Perform VIN upload, read MI status, read pending DTC(s), read readiness status of OBD system, read continuous-MI counter and cumulated operating hours with a continuous-MI.
Use case output	— The VIN. — The MI status. — The DTCs with pending status. — The readiness status of the OBD system.
Brief description	Pending diagnostic trouble codes may be reported after a vehicle repair, after clearing diagnostic information and after a single driving cycle. If this is the case the test(s) failed during the driving cycle, and the DTC(s) associated with that test is (are) reported. A DTC with pending status does not necessarily indicate a faulty component/system. If test results indicate a failure after additional driving, then the MI will be illuminated and a DTC will be set and reported with confirmed status, indicating a faulty component/system.

7.1.3 UC 1.3 — Information about emissions-related permanent DTC(s)

Table 6 describes the use case of retrieving permanent DTC(s) by an I/M test system.

Table 6 — UC 1.3 Information about emissions-related permanent DTC(s)

Actor	Any inspection station (I/M station).
Goal	The intended use of this data is to prevent vehicles from passing an in-use inspection simply by disconnecting the battery or clearing DTCs with an external test equipment (scan tool) prior to the inspection. The presence of permanent DTCs at an inspection without the MIL illuminated is an indication that a proper repair was not verified by the vehicle on-board monitoring system.
Use case input	Perform VIN upload, read MI status, read permanent DTC(s), read readiness status of OBD system, read continuous-MI counter and cumulated operating hours with a continuous-MI.
Use case output	— The VIN. — The MI status. — The DTCs with permanent status. — The readiness status of the OBD system.
Brief description	Permanent DTC(s) are DTCs that are "confirmed" and are retained in the non-volatile memory of the server/ECU until the appropriate monitor for each DTC has determined that the malfunction is no longer present and is not commanding the MI on. The permanent DTC information is used to verify a successful repair and the readiness of the vehicle's emissions-related OBD system to perform an I/M test. The permanent DTC is read-only and can not be cleared.