INTERNATIONAL STANDARD

ISO 15031-5

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

Part 5: Emissions-related diagnostic services

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

Partie 5: Services de diagnostic relatif aux émissions

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 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication.*

This third edition cancels and replaces the second edition (ISO 15031-5:2011), 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

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 SAE recommended practices. This part of ISO 15031 is based on SAE J1979.

This International Standard includes the communication between the vehicle's On-Board Diagnostic (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 this International Standard are broken into the following layers in accordance with Table 1.

— Diagnostic services (layer 7), specified in the following:
  — this part of ISO 15031;
  — ISO 27145-3 (WWH-OBD).
— Presentation layer (layer 6), specified in the following:
  — ISO 15031-2, SAE J1930-DA;
  — this part of ISO 15031, SAE J1979-DA;
  — ISO 15031-6, SAE J2012-DA;
  — ISO 27145-2, SAE J2012-DA.
— Session layer services (layer 5), specified in the following:
  — 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 the following:
  — ISO 15765-2;
  — SAE J1850 defined in this part of ISO 15031;
  — ISO 9141-2 defined in this part of ISO 15031;
  — ISO 14230-4, defined in this part of ISO 15031.
— Network layer services (layer 3), specified in the following:
  — ISO 15765-2;
  — SAE J1850 defined in this part of ISO 15031;
  — ISO 9141-2 defined in this part of ISO 15031;
  — ISO 14230-4 defined in this part of ISO 15031.
— Data link layer (layer 2), specified in the following:
  — ISO 15765-4, ISO 11898-1, and ISO 11898-2;

- SAE J1850;
- ISO 9141-2;
- ISO 14230-2.

— Physical layer (layer 1), specified in the following:

- ISO 15765-4, ISO 11898-1, and ISO 11898-2;
- SAE J1850;
- ISO 9141-2;
- ISO 14230-1.

Table 1 — Legislated emissions-related OBD/WWH[a]-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 layers according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="6">ISO 15031-5/SAE J1979</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</td><td colspan="3">ISO 27145-2</td></tr>
<tr><td colspan="6">SAE J1930-DA, SAE J1979-DA, SAE J2012-DA</td><td colspan="3">SAE J1930-DA, SAE J1979-DA, SAE J2012-DA</td></tr>
<tr><td>Session (layer 5)</td><td colspan="3">Not applicable</td><td colspan="5">ISO 14229-2</td></tr>
<tr><td>Transport (layer 4)</td><td colspan="3" 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 15765-4</td><td rowspan="2">ISO 13400-2</td></tr>
<tr><td>Network (layer 3)</td><td rowspan="2">ISO 15765-2</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 11898-1, ISO 11898-2</td><td rowspan="2">ISO 11898-1, ISO 11898-2</td><td rowspan="2">ISO 13400-3</td></tr>
<tr><td>Physical (layer 1)</td><td>ISO 14230-1</td></tr>
<tr><td colspan="10">[a] World-Wide Harmonized.</td></tr>
</table>

SAE document reference concept

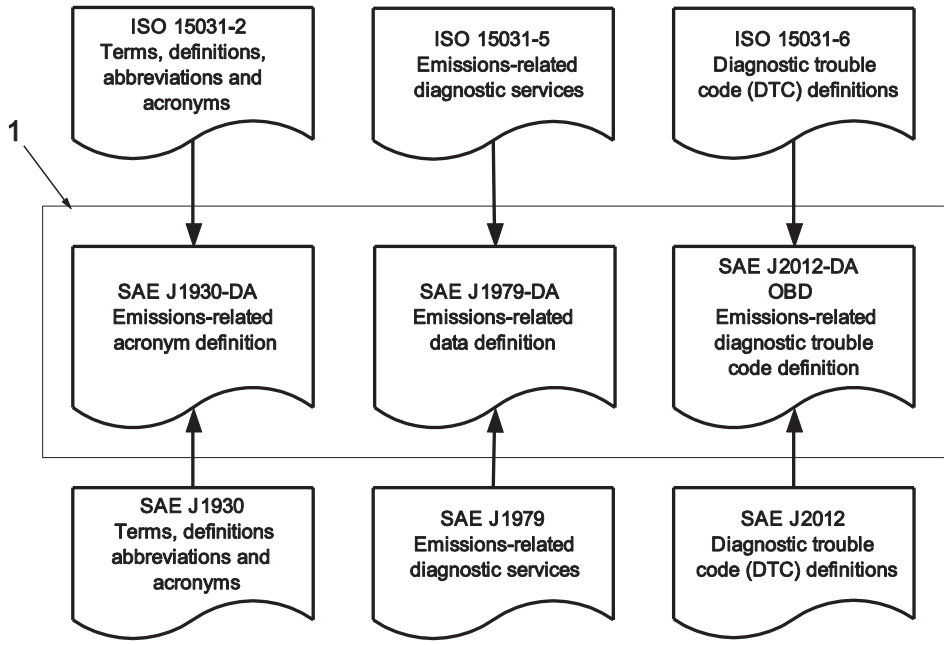
ISO 15031 references several SAE documents which contain all terms, data, and DTC (diagnostic trouble code) definitions. This is illustrated in Figure 1.

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 such as 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 such as DTCs and FTBs (failure type bytes).



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.

SAE J1979-DA (OBD) Digital Annex

This part of ISO 15031 references SAE J1979-DA. SAE J1979-DA is concerned with the definition of the following:

— Parameter Identifiers (PIDs);

— Test IDentifiers (TIDs);

— OBD Monitor Identifiers (OBDMIDs);

— Unit and Scaling Identifiers (UASIDs);

— INFOTYPEs (INFOTYPEs).

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 this part of ISO 15031 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 file name:

SAE_J1979-DA_Revision_Request_Form.doc

Fill out the revision request form with your request.

Please send an e-mail with the completed revision request form as an attachment to:

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

Part 5: Emissions-related diagnostic services

1 Scope

This part of ISO 15031 is intended to satisfy the data reporting requirements of On-Board Diagnostic (OBD) regulations in the United States and Europe and any other region that may adopt similar requirements in the future. This part of ISO 15031 specifies

a) message formats for request and response messages,

b) timing requirements between request messages from external test equipment and response messages from vehicles and between those messages and subsequent request messages,

c) behaviour of both the vehicle and external test equipment if data are not available, and

d) a set of diagnostic services, with corresponding content of request and response messages, to satisfy OBD regulations.

This part of ISO 15031 includes capabilities required to satisfy OBD requirements for multiple regions, model years, engine types, and vehicle types. Those regulations are not yet final for some regions and are expected to change in the future. This part of ISO 15031 makes no attempt to interpret the regulations and does not include applicability of the included diagnostic services and data parameters for various vehicle applications. The user of this part of ISO 15031 is responsible for verifying the applicability of each clause of this part of ISO 15031 for a specific vehicle, engine, model year, and region.

This part of ISO 15031 specifies diagnostic services and functionally addressed request/response messages required to be supported by motor vehicles and external test equipment for diagnostic purposes which pertain to motor vehicle emission-related data. Any external test equipment meeting the requirements of ISO 15031-4 use these messages to retrieve emissions-related information from the vehicle.

Each clause in this part of ISO 15031 which specifies additional details to existing clauses of ISO 9141-2, ISO 14230-4, SAE J1850, and ISO 15765-4 supersede those specifications.

This part of ISO 15031 references SAE J1979-DA (Digital Annex), which includes all definitions of PIDs, OBDMIDs, TIDs, and INFOTYPEs.

This part of ISO 15031 provides the mechanism to satisfy the requirements included in the country-specific regulations and not all capabilities included in this part of ISO 15031 are required by the country-specific regulations. This part of ISO 15031 is not considered a final authority for interpretation of the regulations. Therefore, readers should determine the applicability of capabilities defined in this part of ISO 15031 for their own specific needs.

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 9141-2:1994, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information*

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

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

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

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14229-2, ISO 14230-2, ISO 15031-2, and ISO 15765-2 and the following apply.

3.1.1
absolute throttle position sensor
value intended to represent the throttle opening

Note 1 to entry: For systems where the output is proportional to the input voltage, this value is the percent of maximum input signal. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input signal. Throttle position at idle usually indicates greater than 0 % and throttle position at wide open throttle usually indicates less than 100 %.

3.1.2
bank
specific group of cylinders sharing a common control sensor

Note 1 to entry: Bank 1 always contains cylinder number 1 and bank 2 the opposite bank.

Note 2 to entry: If there is only one bank, the DTCs for bank #1 DTCs are used and the word bank may be omitted. With a single “bank” system utilizing multiple sensors, bank #1 DTCs are used in identifying the sensors as #1, #2, and #3 in order as they move further away from the cylinder.

3.1.3
base fuel schedule
fuel calibration schedule programmed into the powertrain control module or PROM when manufactured or when updated by an off-board source, prior to any learned on-board correction

3.1.4
calculated load value
⟨spark ignition vehicles⟩ typically an indication of the current airflow divided by peak airflow at wide open throttle as a function of rpm, where airflow is corrected for altitude and ambient temperature

Note 1 to entry: Both spark ignition and compression ignition vehicles can use an alternate definition that substitutes engine torque in place of airflow in the calculation.

Note 2 to entry: This definition provides a number (without unit) and provides the service technician with an indication of the percent engine capacity that is being used.

3.1.5
client
function that is part of the tester and that makes use of the diagnostic services

Note 1 to entry: A tester normally makes use of other functions such as database management, specific interpretation, and man-machine interface.

3.1.6
continuous monitoring
sampling at a rate no fewer than two samples per second

Note 1 to entry: If, for control purposes, a computer input is sampled less frequently, the signal of the component may instead be evaluated each time sampling occurs.

3.1.7
convention
Cvt
column integrated in each message table which marks each parameter included

Note 1 to entry: The following conventions are used: C = Conditional: the parameter marked “C” in a request/response message is present only under a condition specified in the bottom row of the message table; M = Mandatory: the parameter marked “M” in a request/response message table is always present; U = User (optional): the parameter marked “U” in a request/response message table is supplied depending on dynamic usage by the manufacturer. The convention recommends a mnemonic, which might be used for implementation. In no case is the specified mnemonic ever a mandatory requirement for any implementation.

3.1.8
electronic control unit
ECU
generic term for any electronic control unit

3.1.9
emissions-related 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 1 to entry: 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.

3.1.10
fuel trim
FT
feedback adjustments to the base fuel schedule

Note 1 to entry: Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. These long-term adjustments compensate for vehicle differences and gradual changes that occur over time.

3.1.11
negative numbers
signed binary, the most significant bit (MSB) of the binary number used to indicate positive (0)/negative (1)

Note 1 to entry: 2's complement: negative numbers are represented by complementing the binary number and then adding 1.

EXAMPLE $-0,99 = 8001_{16} = 1000\ 0000\ 0000\ 0001_2$

$0 = 0000_{16} = 0000\ 0000\ 0000\ 0000_2$

$+0,99 = 7FFF_{16} = 0111\ 1111\ 1111\ 1111_2$

Note 2 to entry: (−0,99) + (+0,99) = 0.

3.1.12
number
expressed by this symbol "#"

3.1.13
P2, P3 timing parameter
application timing parameters for the ECU(s) and the external test equipment

3.1.14
$P2_{CAN\_min}$ timing parameter
CAN application timing parameter with the minimum value for the ECU(s) and the external test equipment to start the response message

3.1.15
$P2_{CAN\_max}$ timing parameter
CAN application timing parameter with the maximum value for the ECU(s) and the external test equipment to indicate a response message

3.1.16
$P2_{reload}$ timing parameter
CAN application timing parameter with the maximum value ($P2_{CAN\_max}$) for external test equipment only

3.1.17
server
function that is part of an ECU that provides the diagnostic services

Note 1 to entry: This part of ISO 15031 differentiates between the server, i.e. the function, and the electronic control unit so that it remains independent from the implementation.

3.1.18
service
information exchange initiated by a client (external test equipment) in order to require diagnostic information from a server (ECU) and/or to modify its behavior for diagnostic purposes

Note 1 to entry: This is also the equivalent of test mode or mode.

3.2 Abbreviated terms

.con confirmation

.ind indication

.req request

CRC	cyclic redundancy check
CVN	calibration verification number
DTC	diagnostic trouble code
ECM	engine control module
ERR	error detection byte
EWMA	exponential weighted moving average
FF	first frame
ISR	interrupt service routine
LSB	least significant bit
MI	malfunction indicator
MIL	malfunction indicator light
MSB	most significant bit
N_PDU	network protocol data unit
N/A	not applicable
NRC	negative response code
NVRAM	non-volatile memory
OBDMID OBD	monitor identifier
PID	parameter identifier
PCI	protocol control information
RSP	in-frame response
SF	single frame
SOM	start of message
T_AE	virtual transport interface address extension
T_Data [ ]	virtual transport interface data field
T_Mtype	virtual transport interface message type
T_Length	virtual transport interface length information
T_PDU	virtual transport interface protocol data unit
T_Result	virtual transport interface result
T_SA	virtual transport interface source address
T_TA	virtual transport interface target address
T_TAtype	virtual transport interface target address type