BS ISO 27145-2:2012

BSI Standards Publication

Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements

Part 2: Common data dictionary

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National foreword

This British Standard is the UK implementation of ISO 27145-2:2012. It supersedes DD ISO/PAS 27145-2:2006, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/16, Electrical and electronic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISO 27145-2

First edition
2012-08-15

Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements —

Part 2: Common data dictionary

Véhicules routiers — Mise en application des exigences de communication pour le diagnostic embarqué harmonisé à l'échelle mondiale (WWH-OBD) —

Partie 2: Dictionnaire de données communes

Reference number
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Contents

Page

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 27145-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This first edition of ISO 27145-2 cancels and replaces ISO/PAS 27145-2:2006, which has been technically revised.

ISO 27145 consists of the following parts, under the general title *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements*:

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

— *Part 2: Common data dictionary*

— *Part 3: Common message dictionary*

— *Part 4: Connection between vehicle and test equipment*

The following parts are under preparation:

— *Part 6: External test equipment*

0 Introduction

0.1 Overview

The ISO 27145 series includes the communication between the vehicle's on-board diagnostics (OBD) systems and external test equipment within the scope of the World-Wide Harmonized On-Board Diagnostics Global Technical Regulations (WWH-OBD GTR).

It has been established in order to apply the unified diagnostic services (specified in ISO 14229-1) to WWH-OBD systems.

The ISO 27145 series includes the communication between the vehicle's WWH-OBD systems and external (off-board) "generic" test equipment within the scope of the country-specific regulatory requirements.

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model in ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. Where mapped on this model, the services specified by ISO 27145 are divided into

— diagnostic services (layer 7), specified in ISO 27145-3 with reference to ISO 14229-1,

— presentation layer (layer 6), specified in this part of ISO 27145 with reference to SAE J1930-DA, SAE J1939 Companion Spreadsheet (SPNs), SAE J1939-73:2010, Appendix A (FMIs), SAE J1979-DA and SAE J2012-DA,

— session layer services (layer 5), specified in ISO 14229-2,

— transport layer services (layer 4), specified in ISO 27145-4 with reference to ISO 13400-2, ISO 15765-2 and ISO 15765-4,

— network layer services (layer 3), specified in ISO 27145-4 with reference to ISO 15765-4, ISO 15765-2 and ISO 13400-2,

— data link layer (layer 2), specified in ISO 27145-4 with reference to ISO 11898-1, ISO 11898-2, ISO 15765-4, ISO 13400-3 and IEEE 802.3, and

— physical layer (layer 1), specified in ISO 27145-4 with reference to ISO 11898-1, ISO 11898-2, ISO 15765-4, ISO 13400-3 and IEEE 802.3,

in accordance with Table 1.

Table 1 — WWH-OBD specification reference applicable to the OSI layers

<table>
<tr><th>Applicability</th><th>OSI seven layer</th><th colspan="3">WWH-OBD reference</th></tr>
<tr><td rowspan="7">Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="3">ISO 14229-1, ISO 27145-3</td></tr>
<tr><td>Presentation (layer 6)</td><td colspan="3">This part of ISO 27145,
SAE J1930-DA, SAE J1939 Companion Spreadsheet (SPNs),
SAE J1939-73:2010, Appendix A (FMIs), SAE J1979-DA, SAE J2012-DA</td></tr>
<tr><td>Session (layer 5)</td><td colspan="3">ISO 14229-2</td></tr>
<tr><td>Transport (layer 4)</td><td rowspan="2">ISO 15765-2 DoCAN,
ISO 15765-4 DoCAN</td><td rowspan="4">ISO 27145-4</td><td rowspan="2">ISO 13400-2 DoIP
TCP and IP</td></tr>
<tr><td>Network (layer 3)</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">ISO 11898-1 CAN DLL,
ISO 11898-2 CAN HS,
ISO 15765-4 DoCAN</td><td rowspan="2">ISO 13400-3 DoIP,
IEEE 802.3</td></tr>
<tr><td>Physical (layer 1)</td></tr>
</table>

0.2 SAE document reference concept

ISO 27145 makes reference to several SAE documents which contain the relevant terms, data and diagnostic trouble code (DTC) definitions.

ISO 27145-2 defines a common data dictionary for the ISO 27145 series, according to the definitions in the following documents (see Figure 1):

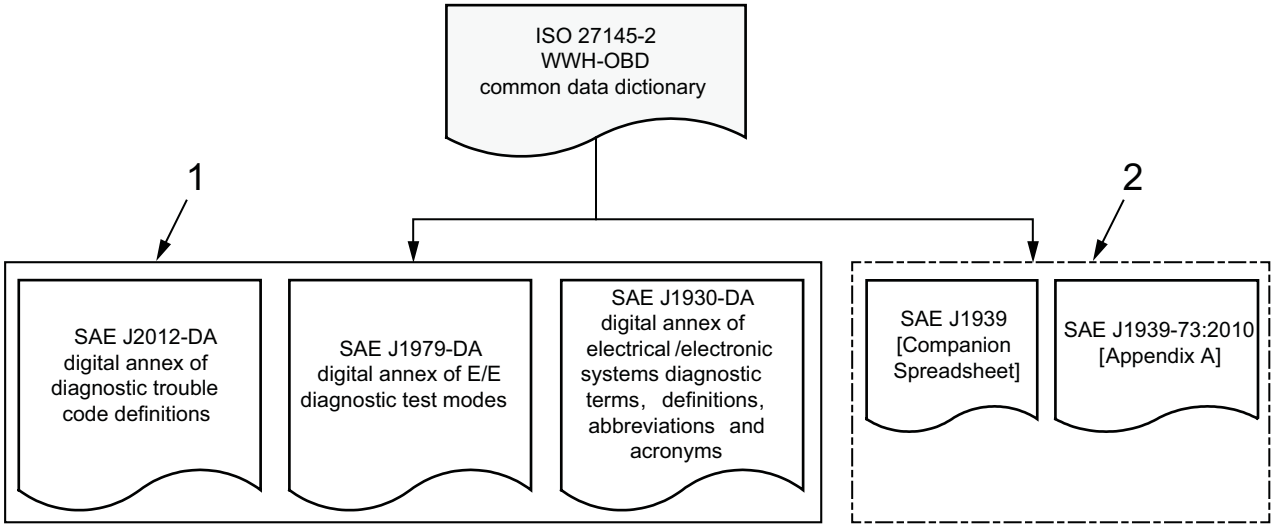
— SAE J1930-DA: this digital annex contains all standardized naming objects, terms and abbreviations.

— SAE J1939 Companion Spreadsheet and SAE J1939-73: SAE J1939 Companion Spreadsheet indexes names for suspect parameter numbers (SPNs), which provide an alternative presentation format for SAE J2012-DA DTCs. SPNs are combined with failure mode indicators (FMIs) to form the full alternative presentation. FMIs are described in SAE J1939-73:2010, Appendix A.

NOTE The SAE J1939 Companion Spreadsheet is a document which supplements the SAE J1939 family of standards and contains SPNs and PGNs.

— SAE J1979-DA: this digital annex contains all standardized data items such as data identifiers (DIDs), test identifiers (TIDs), monitor identifiers (MIDs) and info type identifiers (ITIDs).

— SAE J2012-DA: this digital annex contains all standardized data items such as DTC definitions and failure type byte (FTB) definitions.



Key

1 SAE digital annexes: data definitions

2 SAE J1939 series of documents: DTC definitions

Figure 1 — SAE digital annex document reference

0.3 SAE digital annex revision procedure

New regulatory requirements drive new in-vehicle technology to lower emissions, improve safety, etc. It is important to standardize new technology-related OBD monitor data and diagnostic trouble codes in order 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.

This part of ISO 27145 references a "Change request form" for use with new data items to be defined by the SAE task force for standardization. It is intended that the standardized data items be defined in SAE J1930-DA, SAE J1979-DA, SAE J2012-DA and SAE J1939. It is intended that the documents be published on the SAE store website once the information has been balloted and approved.

The revision request forms and instructions for updating the registers to ISO 27145 can be obtained on the following data registration websites.

— For SAE J1930-DA: http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS7

  The column entitled "Resources" shows a document with the title: J1930-DA_Revision_Request_Form.doc. Double click on the name to download the document with the filename: "SAE_J1930-DA_Revision_Request_Form.doc".

— For SAE J1939: http://www.sae.org/

  Search "J1939 Request", select "J1939 Request Processing Group", and select " J1939 Request Processing Form and Guidelines".

— For SAE J1979-DA: http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS14

  The column entitled "Resources" shows a document with the title: J1979-DA_Revision_Request_Form.doc. Double click on the name to download the document with the filename: "SAE_J1979-DA_Revision_Request_Form.doc".

— For SAE J2012-DA: http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS9

  The column entitled "Resources" shows a document with the title: J2012-DA_Revision_Request_Form.doc. Double click on the name to download the document with the filename: "SAE_J2012-DA_Revision_Request_Form.doc".

It is intended that the revision request form be filled out with the request.

It is intended that e-mails with completed revision request forms as attachments be sent to:

E-mail: saej1930@sae.org

E-mail: saej1979@sae.org

E-mail: saej2012@sae.org

E-mail: saej1939@sae.org

INTERNATIONAL STANDARD **ISO 27145-2:2012(E)**

Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements —

Part 2:
Common data dictionary

1 Scope

This part of ISO 27145 defines all regulatory data elements of the ISO 27145 series. The data elements are used to provide the external test equipment with the diagnostic status of the vehicle on-board diagnostics (VOBD) system in the vehicle. All data elements are communicated with the unified diagnostic services as defined in ISO 27145-3. The data elements are diagnostic trouble codes (DTCs), data identifiers (DIDs) and routine identifiers (RIDs). The mapping from parameter identifiers (PIDs), monitor identifiers (MIDs) and info type identifiers (ITIDs) is described in this part of ISO 27145.

If new legislated WWH-OBD GTR modules are established, it is intended that ISO 27145 be applicable with possible extensions, which can be included in this part of ISO 27145, can be specified as enhancements of the SAE Digital Annexes or can even be part of other referenced documents which are intended to include the applicable data definitions.

ISO 27145 is intended to become the single communication standard for access to OBD-related information (VOBD). To allow for a smooth migration from the existing communication standards to this future world-wide communication standard, the communication concept as specified in ISO 27145-4 is based on two different data links: ISO 15765-4 and ISO 13400 (all parts).

In view of the usage of standard network layer protocols, future extensions to optional physical layers (e.g. wireless) are possible.

NOTE It is expected to extend ISO 27145-4 as necessary upon introduction of additional communication media.

ISO 27145-4 is the entry point to establish communication with the vehicle. Based on the results of the initialization, the external test equipment determines which protocol and diagnostic services are supported by the vehicle's emissions-related system, i.e.

— legislated OBD: ISO 15031 series, and

— legislated WWH-OBD: ISO 27145.

Vehicles according to ISO 27145 provide VOBD system support as envisioned for WWH-OBD by Global Technical Regulation (GTR) No. 5.

IMPORTANT — Use cases deriving from country-specific implementation of GTR No. 5 into local legislation are not included in this part of ISO 27145.

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

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

ISO 27145-1, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 1: General information and use case definition*

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

ISO 27145-4, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 4: Connection between vehicle and test equipment*

SAE J1939, *Companion Spreadsheet*

SAE J1939-73:2010, *Application layer — Diagnostics*

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 following terms and definitions given in ISO 27145-1 and ISO 14229-1 apply.

3.1.1
calibration identifier
CALID
identification code for the software installed in the electronic control unit

3.1.2
calibration verification number
CVN
server/ECU calculated verification number used to verify the integrity of the software in the electronic control unit

3.1.3
central gateway
CGW
electronic control unit that connects in-vehicle communication networks

3.1.4
data identifier
DID
indicator making reference to a data item in the server

1) To be published. (Revision of ISO 14229-1:2006)

3.1.5
diagnostic trouble code
DTC
value making reference to a specific fault in a system implemented in the server

NOTE It is defined in SAE J2012-DA or as SPN and FMI as defined in SAE J1939 Companion Spreadsheet and SAE J1939-73:2010, Appendix A.

3.1.6
info type identifier
ITID
indicator making reference to identification information

EXAMPLE Calibration identifier in the server.

NOTE The ITIDs are defined in SAE J1979-DA.

3.1.7
malfunction indicator
MI
display or gauge that clearly informs the driver of the vehicle in the event of a malfunction/failure

NOTE Additional details are included in the WWH-OBD GTR.

3.1.8
monitor identifier
MID
indicator making reference to an OBD monitor function

NOTE An example of an OBD monitor function is a misfire monitor in the server. The MID is defined in SAE J1979-DA.

3.1.9
standard/manufacturer monitor test identifier
SMTID
OBD identifier which is defined in SAE J1979-DA or by the vehicle manufacturer

3.1.10
parameter identifier
PID
unique identifier used to refer to a specific data value within a server

3.1.11
routine identifier
RID
identifier making reference to a routine function

NOTE 1 An example of a routine function is an evaporation monitor routine in the server.

NOTE 2 Routine identifiers are defined in SAE J1979-DA.

3.1.12
suspect parameter number
SPN
numeral that identifies a particular element, a fault associated with a component, such as a sensor, or a parameter associated with an ECU

3.1.13
uniform resource locator
URL
uniform resource identifier which, in addition to identifying a resource, provides a means of locating the resource by describing its primary access mechanism

NOTE An example of primary access mechanism is its network location.

3.2 Abbreviated terms

CALID	calibration identification
CAN	controller area network
CGW	central gateway
CM	conversion method
CVN	calibration verification number
DID	data identifier
DoCAN	diagnostics communication over controller area network
DoIP	diagnostics communication over internet protocol
DP	data parameter
DP_DB	data parameter data byte
DTC	diagnostic trouble code
ECM	engine control module
ECU	electronic control unit
ECUNAME	electronic control unit name
EVAP	evaporative system
FMI	failure mode indicator
FTB	failure type byte
GTR	global technical regulation
ITID	info type identifier
IUPT	in-use performance tracking
ITP	info type parameter
ITP_DB	info type parameter data byte
MI	malfunction indicator
MID	monitor identifier
Mod	module
MP	monitor parameter
MP_DB	monitor parameter data byte
N/A	not applicable
OC	occurrence count
Param	parameter
PID	parameter identifier
req	requirement
RID	routine identifier

RP_DB	routine parameter data byte
SF	sub-function
SID	service identifier
SMTID	standard/manufacturer monitor test identifier
SPN	suspect parameter number
URL	uniform resource locator
VIN	vehicle identification number
VOBD	vehicle on-board diagnostics
WWH-OBD	world-wide harmonized on-board diagnostics

4 Conventions

The ISO 27145 series is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731) as they apply to diagnostic services.

5 Document overview

Figure 2 shows the reference documents for the ISO 27145 series.

The ISO 27145 series specifies or includes the following references.

a) ISO 27145-1 specifies the general structure of the ISO 27145 series and the WWH-OBD GTR applicable use cases.

b) This part of ISO 27145 specifies the common data dictionary with references to the following documents:

   1) SAE J1930-DA, which defines the terms, definitions, abbreviated terms, etc.;

   2) SAE J1939 Companion Spreadsheet, which specifies the SPNs;

   3) SAE J1939-73:2010, Appendix A, which specifies the FMIs;

   4) SAE J1979-DA, which specifies all data items;

   5) SAE J2012-DA, which specifies the DTC definitions and FTB definitions.

NOTE The SAE J1939 series of documents are concerned with the definition of emissions-related SPNs and FMIs for use as DTCs.

c) ISO 27145-3 specifies the diagnostic services defined in ISO 14229-1 that are applicable to WWH-OBD GTR.

d) ISO 14229-2 specifies the standardized service primitive interface to separate application and session layers from protocol transport and network layers.

e) ISO 27145-4 specifies the initialization procedure and includes references to

   1) ISO 15765-4 DoCAN, and

   2) ISO 13400 (all parts) DoIP.

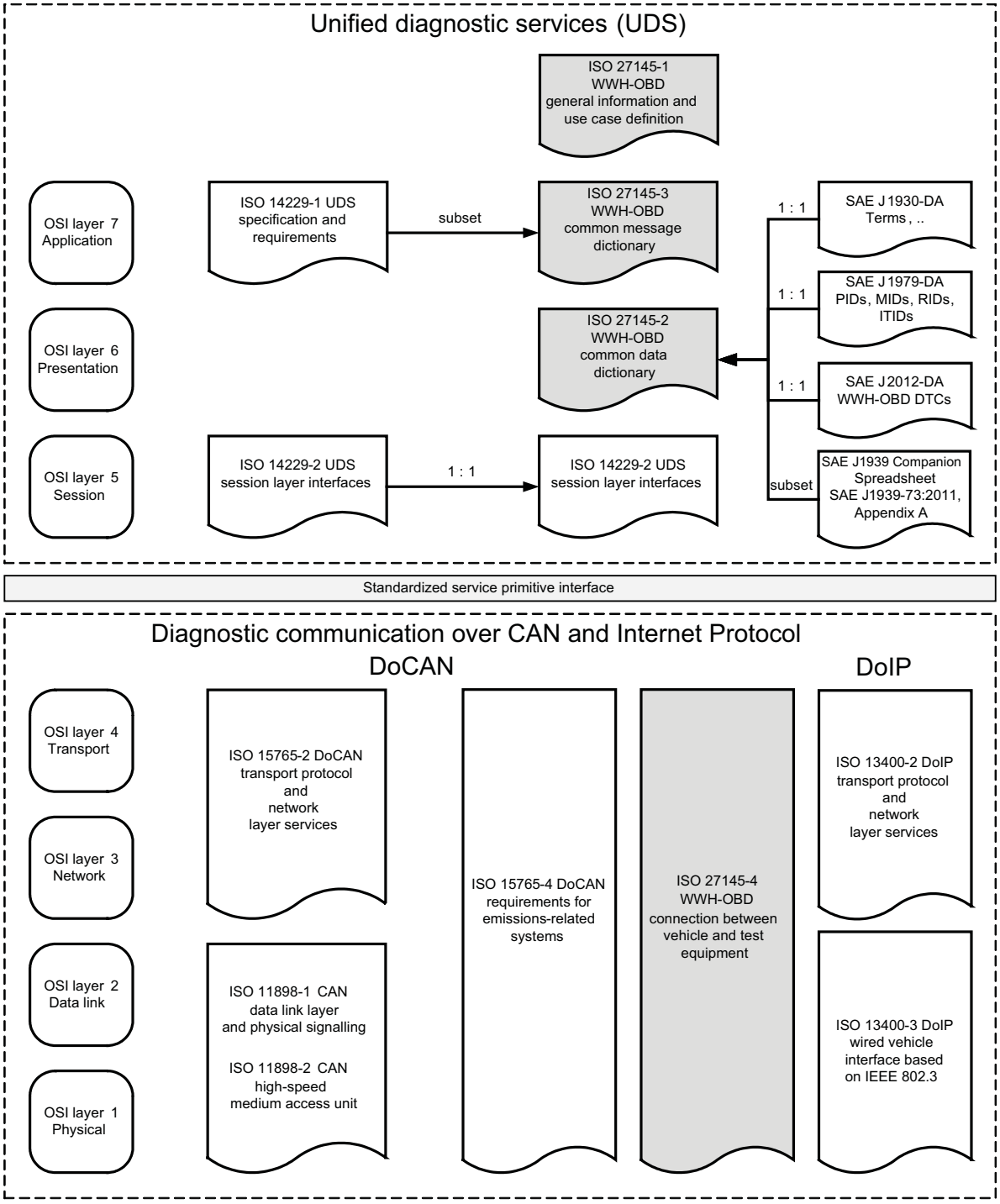


Figure 2 — Reference documents for implementation of WWH-OBDonCAN and WWH-OBDonIP according to the OSI model

6 Common data dictionary requirements

6.1 Data range layout

This subclause specifies the reserved ranges for DIDs and RIDs.

IMPORTANT — DIDs and RIDs do not share the same 2-byte range.

ISO 14229-1 reserves the DID/MID/ITID/RID ranges.

6.2 Diagnostic trouble code (DTC) range layout

This subclause specifies the data range layout for DTCs, which is backward compatible to the existing standards:

— the DTC definition in SAE J2012-DA for all BaseDTCs and FailureTypeBytes (FTB);

— the DTC definition in SAE J1939 Companion Spreadsheet (SPN), and SAE J1939-73:2010, Appendix A (FMI).

This part of ISO 27145 defines a 3-byte DTC range, which consists of a BaseDTC number and a FailureTypeByte (FTB), both defined in SAE J2012-DA, or an SPN and an FMI, both defined in SAE J1939 Companion Spreadsheet (SPN) and SAE J1939-73:2010, Appendix A.

Figure 3 depicts an overview of the DTC range definitions.

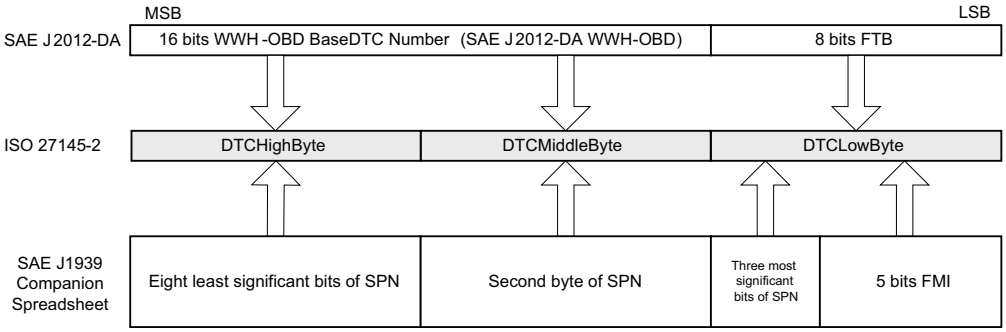


Figure 3 — Overview of the DTC range definitions

Table 2 provides an overview of the available DTC range as specified in SAE J2012-DA and SAE J1939 Companion Spreadsheet (SPN) and SAE J1939-73:2010, Appendix A (FMI).

Table 2 — WWH-OBD DTC ranges as defined in this part of ISO 27145

DTC range	BaseDTC range	FTB/FMI range	DTC mnemonic	Description
0x000000 – 0xFFFFFF	16 bits = 2^{16}-1 = 65535	FTB: 8 bits 2^8 = 256	SAE_J2012-DA_ DTCFormat_04	DTCs as defined in SAE J2012-DA WWH-OBD
0x000000 – 0xFFFFFF	19 bits = 2^{19}-1 = 524287	FMI: 5 bits 2^5 = 32	SAE_J1939-73_DTCFormat	SPNs as defined in SAE J1939, Companion Spreadsheet, and FMIs as defined in SAE J1939-73:2010, Appendix A

7 Data identifier and routine identifier data record requirements

7.1 Data identifier and routine identifier definitions

7.1.1 ISO 14229-1 and SAE J1979-DA DID/RID mapping

The DIDs and RIDs are of different size depending on the specification from which they derive:

— SAE J1979-DA specifies 1-byte DIDs (PIDs, MIDs, ITIDs) and RIDs;

— ISO 14229-1:—, Annex C, supports 2-byte DIDs and RIDs.

Figure 4 shows how the 2-byte data identifier and routine identifier are defined based on the SAE J1979-DA specification.

The "low byte" of the 2-byte identifier is derived from the 1-byte SAE J1979-DA defined identifiers. The "high byte" of the 2-byte data identifier is defined in ISO 14229-1.

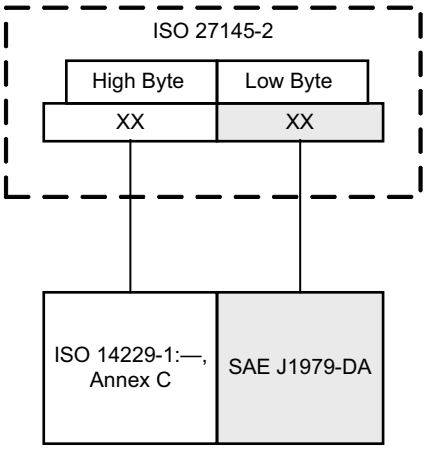


Figure 4 — 2-byte DID and RID assembly

7.1.2 DID (PID, MID and ITID) and RID-supported definition

The vehicle system supports a subset of DID (PID, MID, ITID) and RID based on the emissions regulation to which the vehicle shall comply.

The concept of supporting DIDs (PIDs, MIDs, ITIDs) is carried out with service ReadDataByIdentifier with the DID (PID, MID, ITID) (low byte = 0x00/0x20/0x40/0x60/0x80/0xA0/0xC0) as specified in SAE J1979-DA.

The concept of supporting RIDs is carried out with service RoutineControl with the RID (low byte = 0x00) as specified in SAE J1979-DA.

7.2 DID and RID data record definition

7.2.1 Supported data types

7.2.1.1 General

The message format as specified in ISO 27145-3 uses a 2-byte DID in service ReadDataByIdentifier as a label for a dataRecord[] including the data parameters, e.g. PID data, MID data, ITID data.

The message format as specified in ISO 27145-3 uses a 2-byte RID in service RoutineControl as a label for a routineStatusRecord[] including the data parameters, e.g. RID data.

A data parameter can either be of status type (discrete) or of measured type (analogue).

Status specifies the present state of a multi-state parameter or function as a result of action taken by the transmitting server. This action is the result of a calculation, which uses local and/or network "measured" and "status" information.

EXAMPLE 1 Status-type data are: engine brakes are enabled, cruise control is active, the cruise control is in the "set" state of operation (as opposed to a measured indication that the "set" switch contacts are closed), diagnostic trouble codes, torque/speed control override modes, desired speed/speed limit, engine torque mode, engine's desired operating speed, engine's operating speed asymmetry adjustment, etc..

Measured data convey the current value of a parameter as measured or observed by the transmitting server to determine the condition of the defined parameter.

EXAMPLE 2 Measured-type data are: boost pressure, ignition on/off, cruise set switch activated, maximum cruise speed, cruise set speed, engine speed, % load at current speed, etc..

A RoutineControl can be either to request which routines are implemented in the server or to request that the server start executing a routine.

EXAMPLE 3 RoutineStatusRecords are: Evaporative system leak test; Diesel particulate filter regeneration.

7.2.1.2 ISO LATIN 1 ASCII character set

The servers shall implement those characters which are required to report information as specified in SAE J1979-DA.

7.2.2 dataRecord[] structure definition

7.2.2.1 Overview

The dataRecord[] is included in the response message of the ReadDataByIdentifier service as specified in ISO 27145-3.

A dataRecord[] consists of one of the following three dataRecords[] and each dataRecord[] is specified by a DID:

— PID dataRecord[] SAE J1979-DA Parameter Identifier data record including Data Parameter(s) (DP), or

— MID dataRecord[] SAE J1979-DA Monitor Identifier data record including Monitor Parameter(s) (MP), or

— ITID dataRecord[] SAE J1979-DA InfoType Identifier data record including InfoType Parameter(s) (ITP).

IMPORTANT — The DID dataRecord always starts with A_Data byte #4 because it is preceded by the Service Identifier (SID) of the message and the 2-byte Data Identifier (DID).

7.2.2.2 PID dataRecord[] with SAE J1979-DA PID data

Table 3 specifies the PID dataRecord[] with SAE J1979-DA derived parameters.

Table 3 — PID dataRecord[] definition

A_Data byte	Parameter name	Cvt	Byte Value	Mnemonic
	PID dataRecord[] = [			PID_DREC_
#4	DP_DB#1	M	0x00-0xFF	DP_DB#1
:	:	:	:	:
#n	DP_DB#k]	C_1	0x00-0xFF	DP_DB#k
C_1: The parameter is only present if defined in the PID dataRecord[] of the referenced PID in SAE J1979-DA.				

See ISO 27145-3 for the definition of the ReadDataByIdentifier service.

Table 4 specifies the parameters of the PID dataRecord[] included in the positive response message of the ReadDataByIdentifier service.

Table 4 — PID dataRecord[] response message data parameter definition

Definition
PID dataRecord[] This parameter is used by the ReadDataByIdentifier positive response message to provide the requested data record values to the client. The content of the PID dataRecord[] is defined in SAE J1979-DA.
DP_DB#1–#k (Data Parameter Data Byte) The Data Parameter data may consist of analogue (A/D converter), discrete (input/output states) or internal WWH-OBD system data.

7.2.2.3 MID dataRecord[] with SAE J1979-DA Monitor ID data

Table 5 specifies the MID dataRecord[] with SAE J1979-DA derived parameters.

Table 5 — MID dataRecord[] definition

A_Data byte	Parameter name		Cvt	Byte value	Mnemonic
	MID dataRecord[]#1 = [				MID_DREC#1_
#4	MP_SMTID;	Monitor Param. Std/Manuf. Test ID	M	0x00-0xFF	MP_SMTID
#5	MP_UASID;	Monitor Param. Unit and Scaling ID	M	0x00-0xFF	MP_UASID
#6	MP_TVHI;	Monitor Param. Test Value (HB)	M	0x00-0xFF	MP_TVHI
#7	MP_TVLO;	Monitor Param. Test Value (LB)	M	0x00-0xFF	MP_TVLO
#8	MP_MINTLHI;	Monitor Param. Min. Test Limit (HB)	M	0x00-0xFF	MP_MINTLHI
#9	MP_MINTLLO;	Monitor Param. Min. Test Limit (LB)	M	0x00-0xFF	MP_MINTLLO
#10	MP_MAXTLHI;	Monitor Param. Max. Test Limit (HB)	M	0x00-0xFF	MP_MAXTLHI
#11	MP_MAXTLLO;	Monitor Param. Max. Test Limit (LB)	M	0x00-0xFF	MP_MAXTLLO
	]				
:	:		:	:	:
	MID dataRecord[]#k = [				MID_DREC#k_
#n-7	MP_SMTID;	Monitor Param. Std/Manuf. Test ID	C_1	0x00-0xFF	MP_SMTID
#n-6	MP_UASID;	Monitor Param. Unit and Scaling ID	C_1	0x00-0xFF	MP_UASID
#n-5	MP_TVHI;	Monitor Param. Test Value (HB)	C_1	0x00-0xFF	MP_TVHI
#n-4	MP_TVLO;	Monitor Param. Test Value (LB)	C_1	0x00-0xFF	MP_TVLO
#n-3	MP_MINTLHI;	Monitor Param. Min. Test Limit (HB)	C_1	0x00-0xFF	MP_MINTLHI
#n-2	MP_MINTLLO;	Monitor Param. Min. Test Limit (LB)	C_1	0x00-0xFF	MP_MINTLLO
#n-1	MP_MAXTLHI;	Monitor Param. Max. Test Limit (HB)	C_1	0x00-0xFF	MP_MAXTLHI
#n	MP_MAXTLLO;	Monitor Param. Max. Test Limit (LB)	C_1	0x00-0xFF	MP_MAXTLLO
	]				

C_1: The parameter is only present if the monitor referred to by the MID uses more than one Monitor Parameter Standard/Manufacturer Test ID (MP_SMTID).

Multiple Monitor Parameter Standard/Manufacturer Test IDs may be supported for a single OBD Monitor ID. In such a case, a MID dataRecord[] is included in the response message for each Monitor Parameter Standard/Manufacturer Test ID supported by the OBD Monitor ID.

NOTE The second and following MID dataRecords[] are not preceded by the 2-byte Monitor Identifier (MID). Those MID dataRecords[] include Monitor Parameter Standardized/Manufacturer Test ID (MP_SMTID) specific data. An MID can make reference to more than one MP_SMTID.

See ISO 27145-3 for definition of the ReadDataByIdentifier service.

Table 7 specifies the parameters of the MID dataRecord[] included in the positive response message of the ReadDataByIdentifier service.

Table 6 — MID dataRecord response message data parameter definition

Definition
MID dataRecord[] (#1 to #k) This parameter is used by the ReadDataByIdentifier positive response message to provide the requested data record values to the client. The content of the MID dataRecord[] is defined in this part of ISO 27145.
MP_SMTID (Monitor Parameter Standardized and Manufacturer Test ID) The Standardized and Manufacturer Defined Test ID is a 1-byte parameter. Many OBD monitors have multiple tests, which are carried out in either a serial or parallel manner. If a monitor uses multiple OBD Monitor ID/Test ID combinations and it is possible for them not to be completed at the same time, the following method shall be used to update the stored test results at the time of monitor completion: After the monitor completes, update all Monitor ID/Test ID combinations (or "test results") which were utilized by the monitor with appropriate passing or failing results. If a test result (or “Monitor ID/Test ID”) was not utilized during this monitoring event, set the Test Values and Minimum and Maximum Test Limits to their initial values (0x0000, test not completed). Test results from the previously completed monitoring events shall not be mixed with test results from the currently completed monitoring event. In some cases, test results (or "Monitor ID/Test ID combinations") are displayed as being incomplete even though the monitor (as indicated by PID 0xF441) was successfully completed and either passed or failed. In other cases, some Test IDs show passing results while others show failing results after the monitor (as indicated by PID 0x41) was successfully completed and failed. Note that OBD-II regulations prohibit a passing monitor from showing any failing test results. If an initial, serial test indicates a failure and a subsequent retest of the system indicates a passing result, the test that was utilized to make the passing determination should be displayed, while the failing test that was utilized to make the initial determination should be reset to its initial values (0x0000, test not completed). EXAMPLE A serial monitor, e.g. an evaporative system monitor, can fail for a large evaporative system leak and never continue to test for small leaks or very small leaks. In this case, the Test ID for the large leak shows a failing result, while the small leak test and the very small leak test show incomplete. As an example of the parallel monitor, a purge valve flow monitor can pass by having a large rich lambda shift, a large lean lambda shift or a large engine r/min increase. If the purge valve is activated and a large rich lambda shift occurs, the Test ID for the rich lambda shift shows a passing result while the other two Test IDs show incomplete. Since some Test IDs for a completed monitor can show incomplete, DPID "Monitor status this driving cycle" shall be used to determine monitor completion status.
MP_UASID (Monitor Parameter Unit and Scaling ID) The Unit and Scaling ID is a 1-byte identifier for making reference to the scaling and unit to be used by the external test equipment to calculate and display the test values (results), Minimum Test Limit, and the Maximum Test Limit for the Standardized and Manufacturer Defined Test ID requested. All standardized Unit And Scaling IDs are specified in SAE J1979-DA.
MP_TVHI and MP_TVLO (Monitor Parameter Test Value) Test Value (Result) — This value is a 2-byte parameter and shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Test Value shall be within the Minimum and Maximum Test Limit to indicate a "Pass" result.
MP_MINTLHI and MP_MINTLLO (Monitor Parameter Minimum Test Limit High and Low) The Minimum Test Limit is a 2-byte parameter and shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Unit and Scaling IDs are specified in SAE J1979-DA. The Minimum Test Limit shall be the minimum value for the monitor identified by the On-Board Diagnostic Monitor ID. For the Standardized Test IDs that are constant values, the Minimum Test Limit shall be the same value as reported for the Test Value. The following conditions apply: — if the Test Value is less than the Minimum Test Value, this results in a "Fail" condition; — if the Test Value equals the Minimum Test Value, this results in a "Pass" condition; — if the Test Value is greater than the Minimum Test Value, this results in a "Pass" condition.
MP_MAXTLHI and MP_MAXTLLO (Monitor Parameter Maximum Test Limit High and Low) The Maximum Test Limit is a 2-byte parameter and shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Unit and Scaling IDs are specified in SAE J1979-DA. The Maximum Test Limit shall be the maximum value for the monitor identified by the OBD Monitor ID. For the Standardized Test IDs, that are constant values, the Maximum Test Limit shall be the same value as reported for the Test Value. The following conditions apply: — if the Test Value is less than the Maximum Test Value, this results in a "Pass" condition; — if the Test Value equals the Maximum Test Value, this results in a "Pass" condition; — if the Test Value is greater than the Maximum Test Value, this results in a "Fail" condition.

7.2.2.4 ITID dataRecord[] with SAE J1979-DA InfoType ID data

Table 7 specifies the ITID dataRecord[] with SAE J1979-DA derived parameters.

Table 7 — ITID dataRecord[] definition

A_Data byte	Parameter name		Cvt	Byte value	Mnemonic
	ITID dataRecord[]#1 = [				ITID_DREC_
#4	ITP_DB#1;	InfoType Param. Data Byte #1	C_1	0x00-0xFF	ITP_DB#1
#5	ITP_DB#2;	InfoType Param. Data Byte #2	C_1	0x00-0xFF	ITP_DB#2
:		:	:	:	:
#n	ITP_DB#k;	InfoType Param. Data Byte #k	C_1	0x00-0xFF	ITP_DB#k
	]				
C_1: The parameter is only present if defined in the ITID dataRecord[] of the referenced ITID in SAE J1979-DA.					

See ISO 27145-3 for the definition of the ReadDataByIdentifier service.

Table 8 specifies the InfoType parameters of the ITID dataRecord[] included in the positive response message of the ReadDataByIdentifier service.

Table 8 — ITID dataRecord[] response message data parameter definition

Definition
ITID dataRecord[]
This parameter is used by the ReadDataByIdentifier positive response message to provide the requested data record values to the client. The content of the ITID dataRecord[] is defined in SAE J1979-DA.
ITP_DB (InfoType Parameter Data Byte)
The InfoType Parameter data may consist of VIN, CALID, CVN, ECUNAME, IUPT and other InfoType data expected to be defined in the future.

7.2.3 RID routineStatusRecord[] definition

Table 9 specifies the RID routineStatusRecord[] with SAE J1979-DA derived parameters.

Table 9 — RID routineStatusRecord[] definition

A_Data byte	Parameter name		Cvt	Byte value	Mnemonic
	RID routineStatusRecord[] = [				RID_DREC_
#6	RP_DB#1;	routineStatus #1	C_1	0x00-0xFF	RP_DB#1
:		:	:	:	:
#n	RP_DB#k;	routineStatus #k	C_1	0x00-0xFF	RP_DB#k
	]				
C_1: The routineStatus #1–#k shall only be included in the RID routineStatusRecord[] if specified for the routineIdentifier (RID) in SAE J1979-DA.					

IMPORTANT — The RID routineStatusRecord[] always starts with A_Data byte #6 because it is preceded by the Service Identifier 1-byte (SID) of the message, 1-byte sub-function, 2-byte routineIdentifier (RID) and the 1-byte routineInfo (see ISO 27145-3) parameter.

See ISO 27145-3 for the definition of the RoutineControl service.

Table 10 specifies the parameters of the RID routineStatusRecord[] included in the positive response message of the service RoutineControl.

Table 10 — RID routineStatusRecord[] response message data parameter definition

Definition
RID routineStatusRecord[] This parameter is used by the RoutineControl positive response message to provide the requested data record values to the client. The content of the RID routineStatusRecord[] is defined in SAE J1979-DA.
RP_DB (Routine Parameter Data Byte) The Routine Parameter data (routineStatus #1 – routineStatus #k) are defined in SAE J1979-DA for each routineIdentifier (RID).

8 Diagnostic trouble code definition

8.1 Overview

The ReadDTCInformation service as specified in ISO 27145-3 defines a 3-byte diagnostic trouble code format in order to provide backward compatibility to the:

— SAE J2012-DA defined DTC format;

— SAE J1939 Companion Spreadsheet (SPN) and SAE J1939-73:2010, Appendix A (FMI), defined DTC format.

Each DTC format is supported by the ReadDTCInformation or ClearDTCInformation service as specified in ISO 27145-3. Each DTC format is identified by the DTCFormatIdentifier as specified in ISO 27145-3.

Figure 5 illustrates the mapping of DTCs defined by SAE J2012-DA and SAE J1939 Companion Spreadsheet (SPN) and SAE J1939-73:2010, Appendix A, into the ISO 27145-3 format.

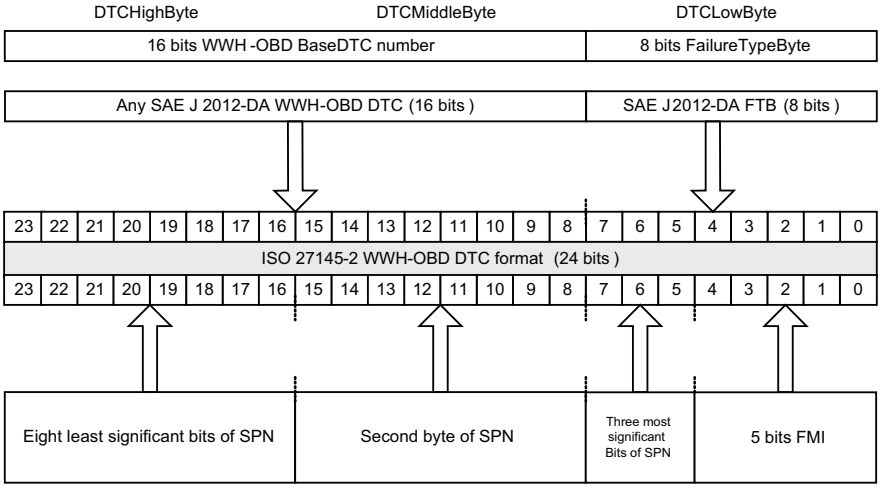


Figure 5 — Overview of DTC format mapping

8.2 SAE J2012-DA and SAE J1939-73 DTCs

8.2.1 SAE J2012-DA DTC format definition

SAE J2012-DA defines 3-byte DTCs (2-byte BaseDTC + 1-byte FTB). Each DTC number represents a unique fault and is associated with a unique fault description.

The DTCFormatIdentifier of the ReadDTCInformation response message as defined in ISO 27145-3 shall be set to "SAE_J2012-DA_DTCFormat_04 = 0x04".

Figure 6 illustrates the mapping of DTCs which derive from SAE J2012-DA and use the standardized definition of the FTB to define different failure types of a BaseDTC.

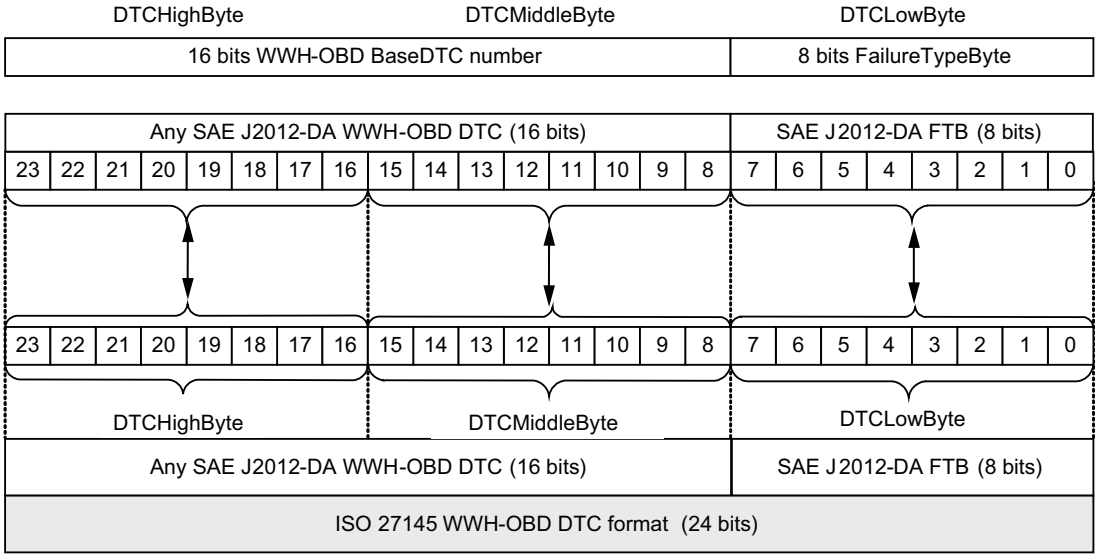


Figure 6 — Mapping of SAE J2012-DA DTC into 3-byte DTC format

The mapping of the SAE J2012-DA DTC into 3-byte DTC format is based on the following requirements:

a) bit 15 to bit 0 of the SAE J2012-DA BaseDTC are mapped into bit 23 to bit 8 (high byte and middle byte) of the WWH-OBD DTC, where bit 23 is the most significant bit;

b) bit 7 to bit 0 represent the value of the FTB as defined in SAE J2012-DA.

The encoding is defined in SAE J2012-DA.

IMPORTANT — ISO 27145-3 defines the SAE_J2012-DA_DTCFormat_04. This parameter indicates the DTC format used by the server(s) of the external test equipment.

8.2.2 SAE J1939 DTC format definition

8.2.2.1 Mapping definition

SAE J1939 defines a 4-byte DTC (19 bits SPN + 5 bits FMI + 1 bit CM + 7 bits OC). The Conversion Method (CM) and Occurrence Count (OC) are not included in the DTC format as defined in this part of ISO 27145. The relevant DTC information for this part of ISO 27145 is represented by the SPN and the FMI, including a unique fault description.

A 5-bit state encoded FMI is part of the 3-byte DTC. Each state of the FMI has a unique failure mode description. The combination of the SPN and FMI provides the description of the DTC.

Figure 7 illustrates the mapping from a DTC of the SAE J1939-73 CAN frame into the DTC format of this part of ISO 27145.

The encoding of the DTC is defined in SAE J1939-73.

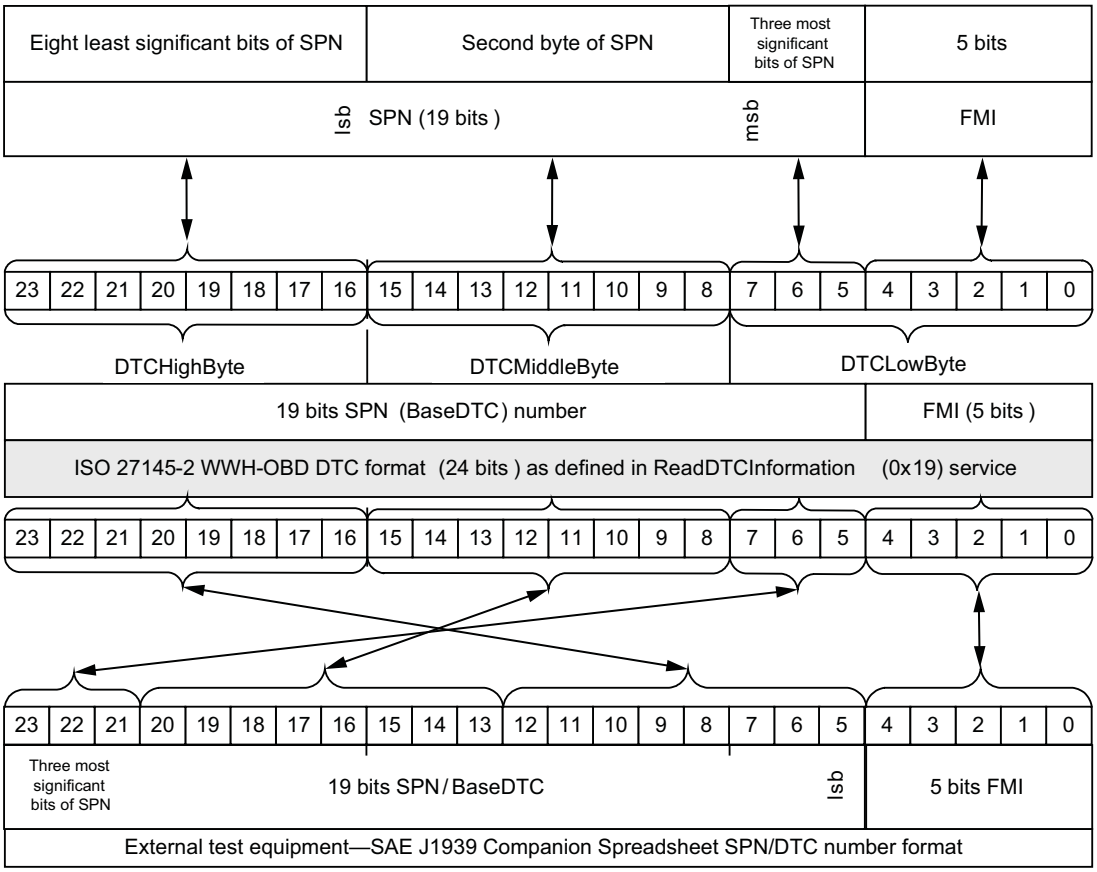


Figure 7 — Mapping of SAE J1939 Companion Spreadsheet SPN and SAE J1939-73 FMI into 3-byte DTC format

The mapping of DTC information derived from SAE J1939 Companion Spreadsheet (SPN), and SAE J1939-73:2010, Appendix A (FMI), into the format specified in service (0x19) ReadDTCInformation is a 1:1 copy of the SAE J1939 SPN and FMI values.

The external test equipment shall perform the following mapping to provide an SAE J1939-compliant decimal DTC (SPN and FMI) number:

a) bit 23 to bit 16 of the DTCHighByte shall be mapped to bit 12 to bit 5 of the 24 bit DTC conversion buffer in the external test equipment,

b) bit 15 to bit 8 of the DTCMiddleByte shall be mapped to bit 20 to bit 13 of the 24 bit DTC conversion buffer in the external test equipment,

c) bit 7 to bit 5 of the DTCLowByte shall be mapped to bit 23 to bit 21 of the 24 bit DTC conversion buffer in the external test equipment,

d) bit 4 to bit 0 of the DTCLowByte shall be mapped to bit 4 to bit 0 of the 24 bit DTC conversion buffer in the external test equipment;

IMPORTANT — ISO 27145-3 defines the SAE_J1939-73_DTCFormat. This parameter indicates the DTC format used by the server(s) of the external test equipment.

8.2.2.2 Mapping example

This example maps an SAE J1939-defined DTC in the DTC format defined by this part of ISO 27145. The SPN 1208d defined by SAE J1939 Companion Spreadsheet represents the "Pre-Filter Oil Pressure".

Table 11 shows an example of the SAE J1939-defined SPN and FMI.

Table 11 — SAE J1939-defined SPN and FMI example

DTC description	Mnemonic	Decimal	Hexadecimal	Binary
Suspect parameter number	SPN	1208	0x04B8	000 00000100 10111000 (19 bits)
Failure mode identifier	FMI	3	0x3	00011 (5 bits)
Occurrence count (N/A)	OC	10	0xA	0001010 (7 bits)
Conversion method (N/A)	CM	---	---	0 (1 bit)
N/A = Not applicable for mapping to single DTC format				

The example shows:

— the server-defined SAE J1939 DTC format and values,

— the DTC data bytes in the SAE J1939 and values, and

— the DTC data bytes in the DTC format and values defined by this part of ISO 27145.

Table 12 shows an example of the SAE J1939 Companion Spreadsheet derived SPN and FMI-defined DTC.

Table 12 — SAE J1939 Companion Spreadsheet derived SPN and FMI-defined DTC example

SAE J1939 Companion Spreadsheet defined SPN/DTC																															
Eight least significant bits of SPN (bit 7 most significant)								Second byte of SPN (bit 7 most significant)								Three most significant bits of SPN and the FMI (bit 7 SPN MSB and bit 4 FMI MSB)								Not applicable for mapping example							
SPN																				**FMI**					**CM**	**OC**					
23			**...**				**16**	**15**			**...**				**8**	**7**	**6**	**5**	**4**		**...**		**0**	**7**			**...**				**0**
1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0

Figure 8 shows an example of the mapping of an SPN defined by SAE J1939 Companion Spreadsheet (SPN) and an FMI defined by SAE J1939-73:2010, Appendix A (FMI), into a 3-byte DTC format, as defined by this part of ISO 27145.

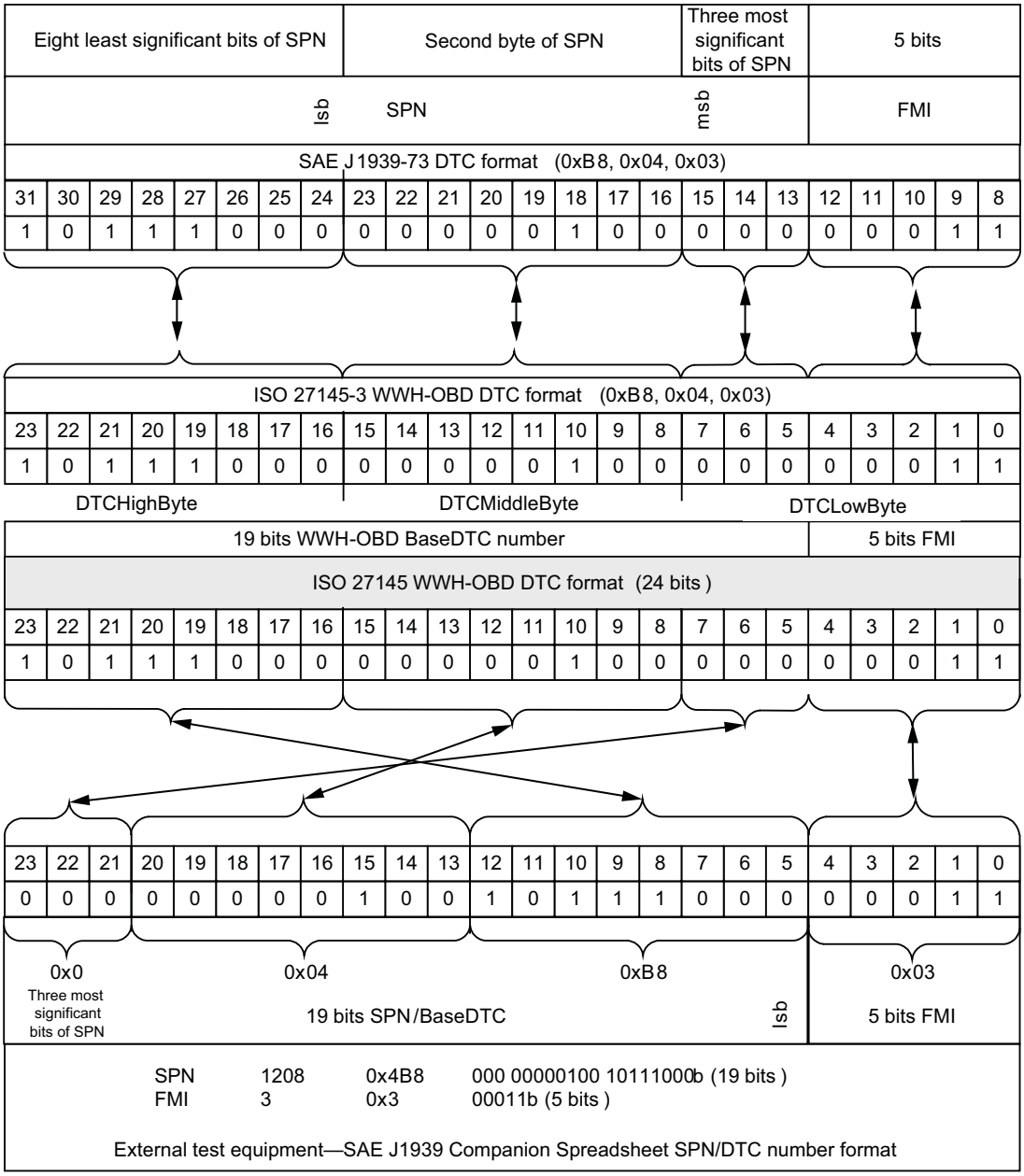


Figure 8 — Mapping of native SAE J1939 Companion Spreadsheet SPN and FMI into the 3-byte DTC format

9 Presentation layer requirements

This clause defines the requirements for the presentation layer of an ECU. This is the layer which is implementing the data conversion requirements for the diagnostic protocol (e.g. DID content, and access to the fault memory and DTCSnapshot data).

All application-specific requirements for data content and formatting shall be supported as defined in this part of ISO 27145.

Annex A
(normative)

DID (PID, MID, ITID) and RID supported definition

This annex specifies standardized hex values for use in the request message for services ReadDataByIdentifer (PID/MID/ITID) and RoutineControl (RID) to retrieve supported DIDs (PIDs, MIDs, ITIDs) and RIDs (see Table A.1).

For each legislated OBD/WWH-OBD service (e.g. ReadDataByIdentifier, RoutineControl) which requires the determination of "supported" information, the external test equipment shall update its list of expected responding legislated OBD/WWH-OBD server(s)/ECU(s) prior to any DID/RID parameter requests.

IMPORTANT — A WWH-OBD GTR compliant server/ECU shall only reply (positive response message) to a PID, MID, ITID and RID-supported request if the server/ECU supports at least one data parameter, monitor parameter, info type parameter or routine parameter.

Table A.1 — Supported DID (PID/MID/ITID) and RID definition

Supported DID (PID/MID/ITID) and RID				Scaling/bit Number of data bytes = 4 bit evaluation		
service (0x22) DID			service (0x31) RID	Data A–D.Bit	Value	DID (PID/MID/ITID) and RID-supported
PID	MID	ITID				
0xF400	0xF600	0xF800	0xE000	A.7 A.6 : D.0	0x01 0x02 : 0x20	0 = not supported 1 = supported
0xF420	0xF620	0xF820	0xE020	A.7 A.6 : D.0	0x21 0x22 : 0x40	0 = not supported 1 = supported
0xF440	0xF640	0xF840	0xE040	A.7 A.6 : D.0	0x41 0x42 : 0x60	0 = not supported 1 = supported
0xF460	0xF660	0xF860	0xE060	A.7 A.6 : D.0	0x61 0x62 : 0x80	0 = not supported 1 = supported
0xF480	0xF680	0xF880	0xE080	A.7 A.6 : D.0	0x81 0x82 : 0xA0	0 = not supported 1 = supported
0xF4A0	0xF6A0	0xF8A0	0xE0A0	A.7 A.6 : D.0	0xA1 0xA2 : 0xC0	0 = not supported 1 = supported

Table A.1 (*continued*)

Supported DID (PID/MID/ITID) and RID				Scaling/bit Number of data bytes = 4 bit evaluation		
service (0x22) DID			service (0x31) RID	Data A–D.Bit	Value	DID (PID/MID/ITID) and RID-supported
PID	MID	ITID				
0xF4C0	0xF6C0	0xF8C0	0xE0C0	A.7 A.6 : D.0	0xC1 0xC2 : 0xE0	0 = not supported 1 = supported
0xF4E0	0xF6E0	0xF8E0	0xE0E0	A.7 A.6 : D.0	0xE1 0xE2 : 0xFF 0x00	0 = not supported 1 = supported
0xF500	0xF700	N/A	0xE100	A.7 A.6 : D.0	0x01 0x02 : 0x20	0 = not supported 1 = supported
0xF520	0xF720	N/A	0xE120	A.7 A.6 : D.0	0x21 0x22 : 0x40	0 = not supported 1 = supported
0xF540	0xF740	N/A	0xE140	A.7 A.6 : D.0	0x41 0x42 : 0x60	0 = not supported 1 = supported
0xF560	0xF760	N/A	0xE160	A.7 A.6 : D.0	0x61 0x62 : 0x80	0 = not supported 1 = supported
0xF580	0xF780	N/A	0xE180	A.7 A.6 : D.0	0x81 0x82 : 0xA0	0 = not supported 1 = supported
0xF5A0	0xF7A0	N/A	0xE1A0	A.7 A.6 : D.0	0xA1 0xA2 : 0xC0	0 = not supported 1 = supported
0xF5C0	0xF7C0	N/A	0xE1C0	A.7 A.6 : D.0	0xC1 0xC2 : 0xE0	0 = not supported 1 = supported
0xF5E0	0xF7E0	N/A	0xE1E0	A.7 A.6 : D.1 D.0	0xE1 0xE2 : 0xFF '0'	0 = not supported 1 = supported

Not all DIDs (PIDs/MIDs/ITIDs)/RIDs are applicable or supported by all WWH-OBD ECUs. DID (PID/MID/ITID)/RID 0xF400/0xF600/0xF800/0xE000 is a bit-encoded value which indicates for each WWH-OBD ECU which DIDs (PIDs/MIDs/ITIDs)/RIDs are supported.

DIDs (PID/MID/ITID/RID) 0xF400/0xF600/0xF800/0xE000 indicate support for DIDs (PIDs/MIDs/ITIDs/RIDs) from 0xF401/0xF601/0xF801/0xE001 to 0xF420/0xF620/0xF820/0xE020.

DIDs (PIDs/MIDs/ITIDs/RIDs) 0xF420/0xF620/0xF820/0xE020 indicate support for DIDs (PIDs/MIDs/ITIDs/RIDs) 0xF421/0xF421/0xF621/0xF821/0xE021 to 0xF440/0xF440/0xF640/0xF840/0xE040, etc..

DIDs (PIDs/MIDs/ITIDs/RIDs) 0xF4E0/0xF6E0/0xF8E0/0xE0E0 indicate support for DIDs (PIDs/MIDs/ITIDs/RIDs) 0xF4E1/0xF6E1/0xF8E1/0xE0E1 to 0xF4FF/0xF6FF/0xF8FF/0xE0FF.

DIDs (PIDs/MIDs/RIDs) in the range of 0xF500/0xF700/0xE100 use the same supported concept and shall be requested with a separate ReadDataByIdentifier service.

Figure A.1 shows the bit mapping of supported PIDs, MIDs, ITIDs and RIDs.

Figure A.1 — Bit mapping of supported PIDs, MIDs, ITIDs and RIDs

Annex B
(normative)

WWH-OBD server/ECU supported mandatory DID

Data parameter to support external test equipment initialization sequence.

The purpose of the external test equipment initialization sequence is to automatically detect whether the vehicle is compliant to legislated WWH-OBD GTR requirements.

The legislated WWH-OBD GTR server(s) indicate their compliance by supporting a specific PID and value upon request by the external test equipment.

IMPORTANT — The legislated WWH-OBD-compliant server(s) shall respond to ISO 27145-3 ReadDataByIdentifier service (0x22) with DID "protocol identification" (0xF810) request with the response data equal to ISO 14229-1 UDS (0x01).

Annex C
(informative)

GTR WWH-OBD emissions system parameters

Table C.1 includes the GTR WWH-OBD emissions-related system (GTR No. 5) mnemonic data parameters to be supported by GTR WWH-OBD-compliant vehicles.

Table C.1 — Annex A of GTR requirement — ECE/TRANS/180/Add.5

Requirement number	Annex A of GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	Mod.	Section	SID	Mnemonic	DID/SF
1	**Erasing OBD information** The OBD system shall clear recorded OBD information in accordance with the provisions of the specific modules, where this request is provided via the external repair test equipment. OBD information shall not be erased by disconnection of the vehicle's battery/batteries.	A	4.4.2	0x14	group-OfDTC	0xFFFF 33
2	**Component monitoring (input/output components/systems)**	B	4.2.2	N/A	N/A	N/A
3	**Recorded information** The information recorded by the OBD system shall be available upon off-board request in the following package manner:	B	4.7.1	N/A	N/A	N/A
	a) information about the engine state;	B	4.7.1	N/A	N/A	N/A
	b) information about emissions-related malfunctions;	B	4.7.1	N/A	N/A	N/A
	c) information for diagnosis and repair.	B	4.7.1	N/A	N/A	N/A
4	**Information about the engine state** This information provides an enforcement agency with the malfunction indicator status and associated data (e.g. continuous-MI counter, readiness). The OBD system shall provide all information for the external roadside check test equipment to assimilate the data and provide an enforcement agent with the following information, which shall be accessible in read-only format (i.e. no clearing):	B	4.7.1.1	N/A	N/A	N/A
	a) discriminatory/non-discriminatory display strategy	B	4.7.1.1	0x22	PID	0xF490
	b) VIN (vehicle identification number)	B	4.7.1.1	0x22	ITID	0xF802
	c) presence of a continuous-MI	B	4.7.1.1	0x22	PID	0xF490
	d) readiness of the OBD system	B	4.7.1.1	0x22	PID	0xF490
	e) number of engine operating hours during which a continuous-MI was last activated (continuous-MI counter)	B	4.7.1.1	0x22	PID	0xF490

Table C.1 (*continued*)

Require-ment number	GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	**Mod.**	**Section**	**SID**	**Mne-monic**	**DID/SF**
5	**Information about active emissions-related malfunctions** This information provides any inspection station with a subset of engine-related OBD data, including the malfunction indicator status and associated data (MI counters), a list of active/confirmed malfunctions of classes A and B and associated data (e.g. B1-counter). The OBD system shall provide all information for the external inspection test equipment to assimilate the data and provide an inspector with the following information, which shall be accessible in read-only format (i.e. no clearing):	B	4.7.1.2	N/A	N/A	N/A
	a) the GTR (and revision) number	B	4.7.1.2	0x22	ITID	0xF811
	b) discriminatory/ non-discriminatory display strategy	B	4.7.1.2	0x22	PID	0xF490
	c) the VIN (vehicle identification number)	B	4.7.1.2	0x22	ITID	0xF802
	d) the MI status	B	4.7.1.2	0x22	PID	0xF490
	e) the readiness of the OBD system	B	4.7.1.2	0x22	PID	0xF490
	f) the number of warm-up cycles and number of engine operating hours since recorded OBD information was last cleared	B	4.7.1.2	0x22	PID	0xF430 0xF44E
	g) the number of engine operating hours during which a continuous-MI was last activated (continuous-MI counter)	B	4.7.1.2	0x22	PID	0xF490
	h) the cumulated operating hours with a continuous-MI (cumulative continuous-MI counter)	B	4.7.1.2	0x22	PID	0xF493
	i) the value of the B1 counter with the highest number of engine operating hours;	B	4.7.1.2	0x22	PID	0xF490
	j) the confirmed and active DTCs for Class A malfunctions	B	4.7.1.2	0x19	SF	0x42
	k) the confirmed and active DTCs for Classes B (B1 and B2) malfunctions	B	4.7.1.2	0x19	SF	0x42
	l) the confirmed and active DTCs Class B1 malfunctions	B	4.7.1.2	0x19	SF	0x42
	m) the software calibration identification(s)	B	4.7.1.2	0x22	ITID	0xF804
	n) the calibration verification number(s)	B	4.7.1.2	0x22	ITID	0xF806

Table C.1 (*continued*)

Requirement number	GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	**Mod.**	**Section**	**SID**	**Mnemonic**	**DID/SF**
6	**Information for repair** This information provides repair technicians with all OBD data specified in this module (e.g. freeze frame information). The OBD system shall provide all information for the external repair test equipment to assimilate the data and provide a repair technician with the following information:	B	4.7.1.3	N/A	N/A	N/A
	a) the GTR (and revision) number	B	4.7.1.3	0x22	ITID	0xF811
	b) the VIN (vehicle identification number)	B	4.7.1.3	0x22	ITID	0xF802
	c) the malfunction indicator status	B	4.7.1.3	0x22	PID	0xF491
	d) the readiness of the OBD system	B	4.7.1.3	0x22	PID	0xF490 0xF401[a] 0xF441
	e) number of warm-up cycles and number of engine operating hours since recorded OBD information was last cleared	B	4.7.1.3	0x22	PID	0xF430 0xF44E
	f) monitor status (i.e. disabled for the rest of this drive cycle, completed this drive cycle or not completed this drive cycle) since last engine shut-off for each monitor used for readiness status	B	4.7.1.3	0x22	PID	0xF441
	g) the number of engine operating hours since the malfunction indicator has been activated (continuous-MI counter)	B	4.7.1.3	0x22	PID	0xF491
	h) the confirmed and active DTCs for Class A malfunctions	B	4.7.1.3	0x19	SF	0x42
	i) the confirmed and active DTCs for Classes B (B1 and B2) malfunctions;	B	4.7.1.3	0x19	SF	0x42
	j) the cumulated operating hours with a continuous-MI (cumulative continuous-MI counter)	B	4.7.1.3	0x22	PID	0xF493
	k) the value of the B1 counter with the highest number of engine operating hours	B	4.7.1.3	0x22	PID	0xF491
				0x19	SF	0x06, 0x90
	l) the confirmed and active DTCs for Class B1 malfunctions and the number of engine operating hours from the B1-counter(s)	B	4.7.1.3	0x19	SF	0x42
				0x19	SF	0x06, 0x90
				0x22	PID	0xF491
	m) the confirmed and active DTCs for Class C malfunctions	B	4.7.1.3	0x19	SF	0x42
	n) the pending DTCs and their associated classes	B	4.7.1.3	0x19	SF	0x42
	o) the previously active DTCs and their associated classes	B	4.7.1.3	0x19	SF	0x42
	p) real-time information on OEM selected and supported sensor signals, internal and output signals	B	4.7.1.3	N/A	N/A	N/A
	q) the freeze frame data requested by this module	B	4.7.1.3	N/A	N/A	N/A
	r) the software calibration identification(s)	B	4.7.1.3	0x22	ITID	0xF804
	s) the calibration verification number(s)	B	4.7.1.3	0x22	ITID	0xF806
	The OBD system shall clear all the recorded malfunctions of the engine system and related data (operating time information, freeze frame, etc.) in accordance with the provisions of this module, where this request is provided via the external repair test equipment.	B	4.7.1.3	0x14	group OfDTC	0xFFFF 33

Table C.1 (*continued*)

Require-ment number	GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	**Mod.**	**Section**	**SID**	**Mne-monic**	**DID/SF**
7	**Freeze frame information** If required by a contracting party, the OBD system may provide access to a subset of the following requirements:	B	4.7.1.4	N/A	N/A	N/A
	At least one freeze frame of information shall be stored at the time which either a potential DTC or a confirmed and active DTC is stored at the decision of the manufacturer. The manufacturer is allowed to update the freeze frame information whenever the pending DTC is detected again.	B	4.7.1.4	0x19	SF	0x04, record # 0x00
	The freeze frame shall provide the operating conditions of the vehicle at the time of malfunction detection and the DTC associated with the stored data.	B	4.7.1.4	0x19	SF	0x04, record # 0x00
	Storage of freeze frame information associated with a Class A malfunction shall take precedence over information associated with a Class B1 malfunction, which shall take precedence over information associated with a Class B2 malfunction and likewise for information associated with a Class C malfunction. The first malfunction detected shall take precedence over the most recent malfunction unless the most recent malfunction is of a higher class.	B	4.7.1.4	0x19	SF	0x04, record # 0x00
8	**Readiness** Readiness shall be set to "complete" whenever a monitor or a group of monitors addressed by this status has/have run since the last erasing by request of an external OBD scan-tool. Readiness shall be set to "not complete" by erasing the fault code memory of a monitor or group of monitors by request of an external scan-tool.	B	4.7.1.5	N/A	N/A	N/A
	Normal engine shutdown shall not cause the readiness to change.	B	4.7.1.5	N/A	N/A	N/A
	The manufacturer may request, subject to approval by the certification authority, that the ready status for a monitor be set to indicate "complete" without the monitor having completed, if monitoring is disabled for a multiple number of operating sequences due to the continued presence of extreme operating conditions (e.g. cold ambient temperatures, high altitudes). Any such request shall specify the conditions for monitoring system disablement and the number of operating sequences which can pass without monitor completion before ready status can be indicated as "complete".	B	4.7.1.5	N/A	N/A	N/A

Table C.1 (*continued*)

Requirement number	GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	Mod.	Section	SID	Mnemonic	DID/SF
9	**Data stream information** If required by a contracting party, the OBD system may provide access to a subset of the following requirements.	B	4.7.2	N/A	N/A	N/A
	Upon request, the OBD system shall make the information available to a scan tool in real time (actual signal values should be used in favour of surrogate values).	B	4.7.2	N/A	N/A	N/A
	For the purposes of the calculated load and torque parameters, the OBD system shall report the most accurate values which are calculated within the applicable electronic control unit (e.g. the engine control computer).	B	4.7.2	N/A	N/A	N/A
	Access to OBD information Access to OBD information shall be possible by means of a wired connection. OBD data shall be provided by the OBD system upon request using a scan tool which complies with the requirements of the applicable standards mentioned in module A, annex 1 (communication with external tester).	B	4.7.3	N/A	N/A	N/A
	Erasing/resetting OBD information by a scan tool On request of the scan tool, the following data shall be erased or reset to the value specified in this GTR from the computer memory: — MI status (value to be reset); — readiness of the OBD system (value to be reset); — number of engine operating hours since the malfunction indicator has been activated (continuous MI-counter) (data to be erased); — all DTCs (data to be erased); — the value of the B1 counter with the highest number of engine operating hours (value to be reset); — the number of engine operating hours from the B1-counter(s) (value to be reset); — the freeze frame data requested by this module/ECU (data to be erased).	B	4.7.4	0x14	group OfDTC	0xFFFF33
12	Calculated load (engine torque as a percentage of maximum torque available at the current engine speed)	B	GTR #5 Module B, Annex 5, Table 1; 4.7.1.4, 4.7.2	0x22	PID	0xF404
	Driver's demand engine torque (as a percentage of maximum engine torque)	B		0x22	PID	0xF461
	Actual engine torque (calculated as a percentage of maximum engine torque, e.g. calculated from commanded injection fuel quantity)	B		0x22	PID	0xF462
	Reference engine maximum torque	B		0x22	PID	0xF463
	Reference maximum engine torque as a function of engine speed	B		0x22	PID	0xF464
	Engine coolant temperature (or equivalent)	B		0x22	PID	0xF467
	Engine speed	B		0x22	PID	0xF40C
	Time elapsed since engine start	B		0x22	PID	0xF41F

Table C.1 (*continued*)

Require-ment number	GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	Mod.	Section	SID	Mne-monic	DID/SF
13	Driver's demand engine torque (as a percentage of maximum engine torque)	B	GTR #5 Module B, Annex 5, Table 2, 4.7.1.4, 4.7.2	0x22	PID	0xF461
	Actual engine torque (calculated as a percentage of maximum engine torque, e.g. calculated from commanded injection fuel quantity)	B		0x22	PID	0xF462
	Reference engine maximum torque	B		0x22	PID	0xF463
	Reference maximum engine torque as a function of engine speed	B		0x22	PID	0xF464
	Time elapsed since engine start	B		0x22	PID	0xF41F
14	Fuel level	B	GTR #5 Module B, Annex 5; Table 3; 4.7.1.4, 4.7.2	0x22	PID	0xF42F
	Engine oil temperature	B		0x22	PID	0xF45C
	Vehicle speed	B		0x22	PID	0xF40D
	Engine control computer system voltage (for the main control chip)	B		0x22	PID	0xF442
15	Absolute throttle position/intake air throttle position (position of valve used to regulate intake air)	B	GTR #5 Module B, Annex 5, Table 4; 4.7.1.4, 4.7.2	0x22	PID	0xF46A
	Diesel fuel control system status in case of a close loop system (e.g. in case of a fuel pressure close loop system)	B		0x22	PID	0xF492
	Fuel rail pressure	B		0x22	PID	0xF46D
	Injection control pressure (i.e. pressure of the fluid controlling fuel injection)	B		0x22	PID	0xF46E
	Representative fuel injection timing (beginning of first main injection)	B		0x22	PID	0xF45D
	Commanded fuel rail pressure	B		0x22	PID	0xF46D
	Commanded injection control pressure (i.e. pressure of the fluid controlling fuel injection)	B		0x22	PID	0xF46E
	Intake air temperature	B		0x22	PID	0xF468
	Ambient air temperature	B		0x22	PID	0xF446
	Turbocharger inlet/outlet air temperature (compressor and turbine)	B		0x22	PID	0xF475 0xF476
	Turbocharger inlet/outlet pressure (compressor and turbine)	B		0x22	PID	0xF46F 0xF470 0xF473
	Charge air temperature (post intercooler, if fitted)	B		0x22	PID	0xF477
	Actual boost pressure	B		0x22	PID	0xF470
	Air flow rate from mass air flow sensor	B		0x22	PID	0xF466
	Commanded exhaust gas recirculation (EGR) valve duty cycle/position, (provided EGR is so controlled)	B		0x22	PID	0xF469
	Actual EGR valve duty cycle/position	B		0x22	PID	0xF469
	PTO status (active or not active)	B		0x22	PID	0xF465
	Accelerator pedal position	B		0x22	PID	0xF44A 0xF44B

Table C.1 (*continued*)

Requirement number	GTR requirement — ECE/TRANS/180/Add.5 (dated 23 January 2007)			This part of ISO 27145		
	Requirement description	Mod.	Section	SID	Mnemonic	DID/SF
15	Redundant absolute pedal position	B	GTR #5 Module B, Annex 5, Table 4; 4.7.1.4, 4.7.2	0x22	PID	0xF45A
	Instantaneous fuel consumption	B		0x22	PID	0xF45E
	Commanded/target boost pressure (if boost pressure used to control turbo operation)	B		0x22	PID	0xF470
	DPF inlet pressure	B		0x22	PID	0xF47A 0xF47B
	DPF outlet pressure	B		0x22	PID	0xF47A 0xF47B
	DPF delta pressure	B		0x22	PID	0xF47A 0xF47B
	Engine-out exhaust pressure	B		0x22	PID	0xF473
	DPF inlet temperature[a]	B		0x22	PID	0xF47C
	DPF outlet temperature[a]	B		0x22	PID	0xF47C
	Engine-out exhaust gas temperature[a]	B		0x22	PID	0xF478 0xF479
	Turbocharger/turbine speed	B		0x22	PID	0xF474
	Variable geometry turbo position	B		0x22	PID	0xF471
	Commanded variable geometry turbo position	B		0x22	PID	0xF471
	Wastegate valve position	B		0x22	PID	0xF472
	Air:fuel ratio sensor output	B		0x22	PID	0xF48C[b]
	Oxygen sensor output	B		0x22	PID	0xF48C[b]
	NOx sensor output	B		0x22	PID	0xF483

NOTE This table only provides an overview of how this part of ISO 27145 and ISO 27145-3 can be used to fulfil the WWH-OBD GTR. There is no guarantee that this table is complete with respect to the most recent version of the WWH-OBD GTR or different local legislations. The notation "N/A" indicates that a specific legislative requirement described in the requirement description column does not contain a communication requirement and it is the responsibility of the vehicle manufacturer to ensure that these non-communication requirements are implemented according to the applicable regulation.

[a] PID 0xF401 is mandatory in the case of servers which support more than Comprehensive Components Monitoring. If the server supports only Comprehensive Components Monitoring, then PID 0xF401 is optional.

[b] It is the responsibility of the vehicle manufacturer to choose the correct oxygen sensor and air/fuel ration sensor DID(s) depending on the signal from the respective sensor.

Annex D
(normative)

GTR WWH-OBD DTCExtendedDataRecord content

The DTCExtendedDataRecord 0x90 - FailureSpecificB1Counter shall be requested by the external test equipment using service "ReadDTCInformation (0x19)" with sub-function "reportDTCExtendedDataRecord-ByDTCNumber (0x06)".

Table D.1 specifies the FailureSpecificB1Counter.

Table D.1 — FailureSpecificB1Counter response data parameter definition

Definition
FailureSpecificB1Counter
The FailureSpecificB1Counter provides an individual B1 counter, supported by the system. The counter provides the number of hours during which the B1 failure has been confirmed and active.
Data length: 2 bytes
Resolution: 0,1 h/bit, 0 offset
Data range: 0 to 6553,5 h

Annex E
(informative)

Definition guidelines for new DID (PID, MID, ITID) assignments

E.1 Received signal validity implementation guidelines

The data parameters defined in this part of ISO 27145 are based on system functionality and are independent of the electronic system architecture implemented by the vehicle manufacturer.

A data record specified by a DID and defined in SAE J1979-DA includes a set of data parameters, e.g. analogue and discrete parameters which are grouped together to provide a valuable set of information to the external test equipment to meet the use case definitions as specified in ISO 27145-1. The definition of validity status for each DID is defined in SAE J1979-DA.

Table E.1 defines the validity encoding of a signal parameter data specified by the DID. This validity encoding scheme is recommended for application to DID definitions in SAE J1979-DA as part of the data parameter definition.

Table E.1 — Received signal validity status definition

Validity status	Description
Valid and un-defaulted data signal	This is a valid data signal. Data is un-defaulted and represents the raw value.
Networked data unavailable	The data signal cannot be received due to a faulty network. The data signal is unavailable. The transmitted value can either represent the last known valid value or the default value used by the fail-safe strategy.
Invalid remote sub-node data signal	The data signal is received from a remote sub-node and this single status represents the following two cases: — the data signal is invalid because of a faulty remote sub-node circuit; — this includes signals still under evaluation as valid after the signal has been identified as invalid (e.g. engine coolant temperature can need a soak start to evaluate whether or not the sensor is stuck at high temperature). For both cases, the data bytes shall represent the transmitted value received from the remote sub-node.
Unsupported/data signal not available	The data signal is not supported or not available by system design. If the data parameter represents an analogue signal, each data byte of the data parameter shall be set to 0xFF. If the data parameter represents a discrete signal, 2 bits shall be defined and set to "1b" (unsupported, not available, not installed).

E.2 Remotely received sub-node information and validity

The data parameters defined in this part of ISO 27145 are based on system functionality and are independent of the electronic system architecture implemented by the vehicle manufacturer.

A data record specified by a DID and defined in SAE J1979-DA includes a set of data parameters, e.g. analogue and discrete parameters which are grouped together to provide a valuable set of information to the external test equipment to meet the use case definitions as specified in ISO 27145-1.

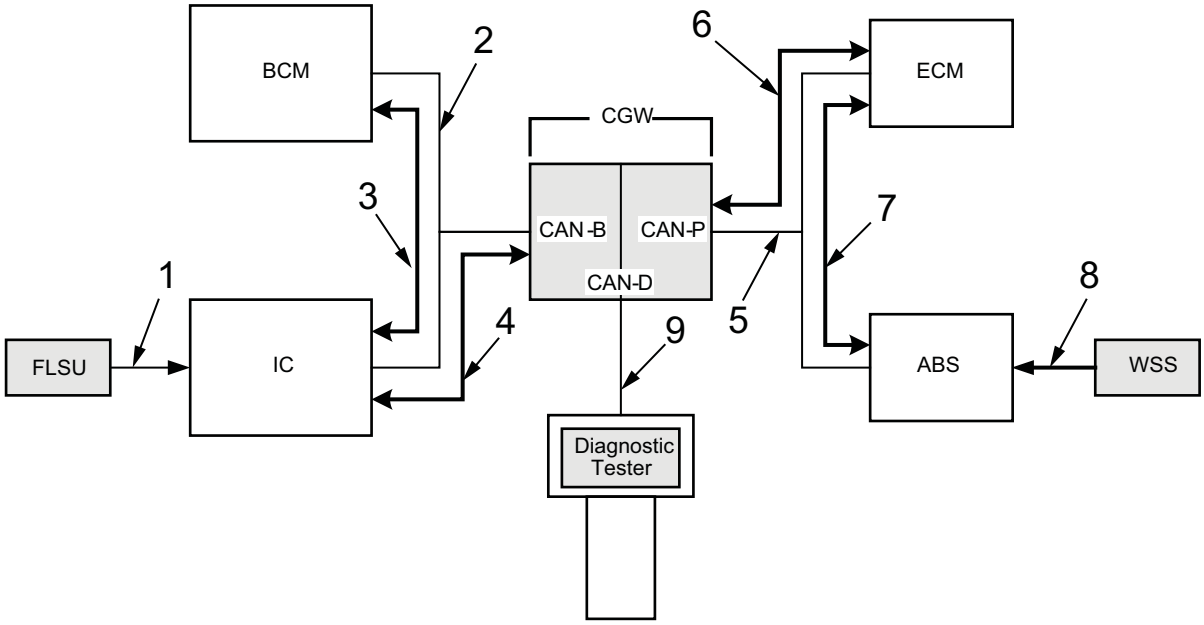
Sensors and switches can be hard-wired to the server, which is connected to the external test equipment or connected to a remote sub-node, which communicates via a subnet to the server. Since system functions can be distributed across several remote sub-nodes and partially implemented in the server, which is connected to the external test equipment, it is important that all data parameters based on sensed signals provide validity status information where reported to the external test equipment.

Table E.2 describes possible failure conditions.

Table E.2 — Possible fault case description of Fuel Level Sending Unit input via network message

Fault case	Failure mode	Failure conditions
1	Loss of Fuel Level Sending Unit data (functionally impacts Powertrain CAN network operation)	Fuel Level Sending Unit electrical circuit continuity failure (low, high or open circuit) Fuel Level Sending Unit rationality failure (inactive, stuck or erratic performance)
2	Loss of IC messages (functionally impacts both BODY CAN and POWERTRAIN CAN network operation)	IC internal failure BODY CAN transceiver hardware failure BODY CAN electrical circuit continuity failure (dual open circuit)
3	Loss of CGW (Central Gateway) BODY CAN messages (functionally impacts POWERTRAIN CAN network operation)	CGW internal failure BODY CAN transceiver hardware failure BODY CAN electrical circuit continuity failure (dual open circuit)
4	Loss of CGW POWERTRAIN CAN messages (functionally impacts BODY CAN network operation)	CGW internal failure POWERTRAIN CAN transceiver hardware failure POWERTRAIN CAN electrical circuit continuity failure (low, high or open circuit)
5	Loss of ABS messages (functionally impacts both BODY CAN and POWERTRAIN CAN network operation)	ABS internal failure POWERTRAIN CAN transceiver hardware failure POWERTRAIN CAN electrical circuit continuity failure (low, high or open circuit)
6	Loss of Wheel Speed Sensor data (functionally impacts both BODY CAN and POWERTRAIN CAN network operation)	Wheel Speed Sensor electrical circuit continuity failure (low, high or open circuit) Wheel Speed Sensor rationality failure (inactive, stuck or erratic performance)

Figure E.1 illustrates a possible configuration of providing fuel level and vehicle speed information to the external test equipment.



Key

1 fuel level sending unit connected to instrument cluster via A/D hardwire link
2 body CAN bus
3 IC sends fuel level data to BCM
4 IC sends fuel level data to CGW
5 powertrain CAN bus
6 ECM sends wheel speed data to CGW
7 ABS sends wheel speed data to ECM via Powertrain CAN bus
8 wheel speed sensor connected to ABS via Powertrain CAN (networked wheel speed read for ECM)
9 diagnostic CAN bus

ABS Anti-lock brake control module
BCM Body Control module
CAN-B Body CAN bus
CAN-P Powertrain CAN bus
CAN-D Diagnostic CAN bus
CGW Central gateway
ECM Engine control module
FLSU Fuel level sending unit
IC Instrument cluster
WSS Wheel speed sensor

Figure E.1 — Example of fuel level sending unit input via network message

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