BS ISO 27145-3:2012

BSI Standards Publication

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

Part 3: Common message dictionary

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National foreword

This British Standard is the UK implementation of ISO 27145-3:2012. It supersedes DD ISO/PAS 27145-3:2006, which is withdrawn.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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First edition
2012-08-15

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

Part 3: Common message dictionary

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

Partie 3: Dictionnaire de messages communs

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.

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

This first edition of ISO 27145-3 cancels and replaces ISO/PAS 27145-3:2006, 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*

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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 specified in ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 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 ISO 27145-2 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 document reference</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="3">ISO 14229-1, ISO 27145-3</td></tr>
<tr><td>Presentation (layer 6)</td><td colspan="3">ISO 27145-2,
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 terms, data and diagnostic trouble code (DTC) definitions.

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

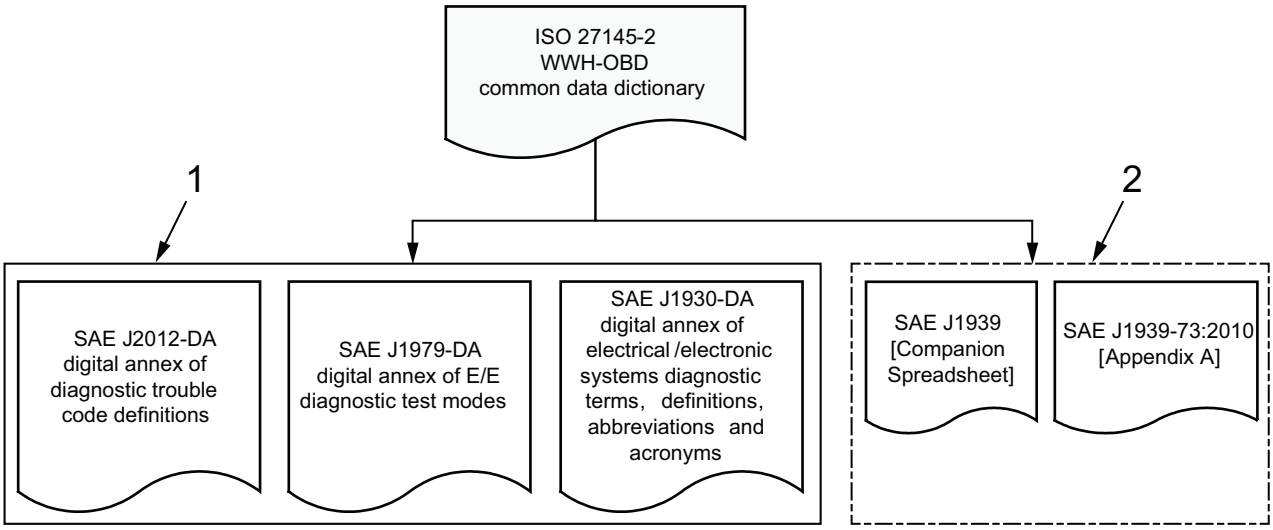
— SAE J1930-DA: this digital annex contains all standardized naming objects, terms and abbreviated terms.

— SAE J1939 Companion Spreadsheet and SAE J1939-73: SAE J1939 Companion Spreadsheet indexes names for suspect parameter numbers (SPNs) that 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 parameter group numbers (PGNs).

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

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

ISO 27145-2 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.

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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

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

Part 3: Common message dictionary

1 Scope

This part of ISO 27145 defines the implementation of a subset of unified diagnostic services (UDS) specified in ISO 14229-1. The diagnostic services are used to communicate the diagnostic data defined in ISO 27145-2.

The subset of unified diagnostic services derives from the requirements stated in the WWH-OBD GTR (Global technical regulation No. 5; see Reference [17]). The common message set defined in this part of ISO 27145 is independent of the underlying transport, network, data link and physical layer. This part of ISO 27145 does not specify any requirements for the in-vehicle network architecture.

This part of ISO 27145 is compatible with ISO 14229-1 and includes provisions to support the data set of SAE J1979-DA and SAE J2012-DA WWH-OBD.

This part of ISO 27145 is intended for use with ISO 27145-4, which is the entry point for the protocol initialization and is based on two different data links:

— Diagnostic communication over Controller Area Network (DoCAN), ISO 15765-1, ISO 15765-2, ISO 15765-4;

— Diagnostic communication over Internet Protocol (DoIP), ISO 13400 (all parts).

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

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 (all parts);

— legislated WWH-OBD: ISO 27145 (all parts).

This part of ISO 27145 includes capabilities required to satisfy OBD regulations for multiple regions, vehicle types, model years, and engine types. Those regulations are not yet final for some regions and are expected to change in the future. This part of ISO 27145 does not attempt to interpret the regulations and does not include applicability of the included diagnostic services and data parameters for various vehicle applications. It is intended that users of this part of ISO 27145 verify the applicability of each of its clauses for a specific vehicle, engine, model year and region.

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, *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*

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

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*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 27145-1, ISO 27145-2, ISO 14229-1 and the following apply.

3.1.1
global technical regulation
GTR
agreement establishing global technical regulations for wheeled vehicles and equipment and parts that can be fitted and/or used on wheeled vehicles

3.2 Abbreviated terms

ASCII	American standard code for information interchange
CDTC	confirmed DTC
DID	diagnostic data identifier
DoCAN	diagnostic communication over controller area network
DoIP	diagnostic communication over internet protocol
DTC	diagnostic trouble code
DTCHB	DTC high byte
DTCLB	DTC low byte
DTCMB	DTC middle byte
DTCS	DTC severity
ECM	engine control module
ECU	electronic control unit
FMI	failure mode indicator
FTB	failure type byte
GTR	global technical regulations
MI	malfunction indicator
N/A	not applicable
PDTC	pending DTC
PDU	protocol data unit

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RID	routine identifier
SFID	sub-function identifier
SID	service identifier
SODTC	status of DTC
SPN	suspect parameter number
TNCSLC	test not completed since last clear
TNCTOC	test not completed this operation cycle
UDS	unified diagnostic services
VIN	vehicle identification number
WUC	warm-up cycle
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 use cases applicable to WWH-OBD GTR.

b) ISO 27145-2 specifies the common data dictionary with references to:

   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 1979-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 is concerned with the definition of emissions-related SPNs and FMIs for use as DTCs.

c) This part of ISO 27145 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;

   2) ISO 13400 (all parts) DoIP.

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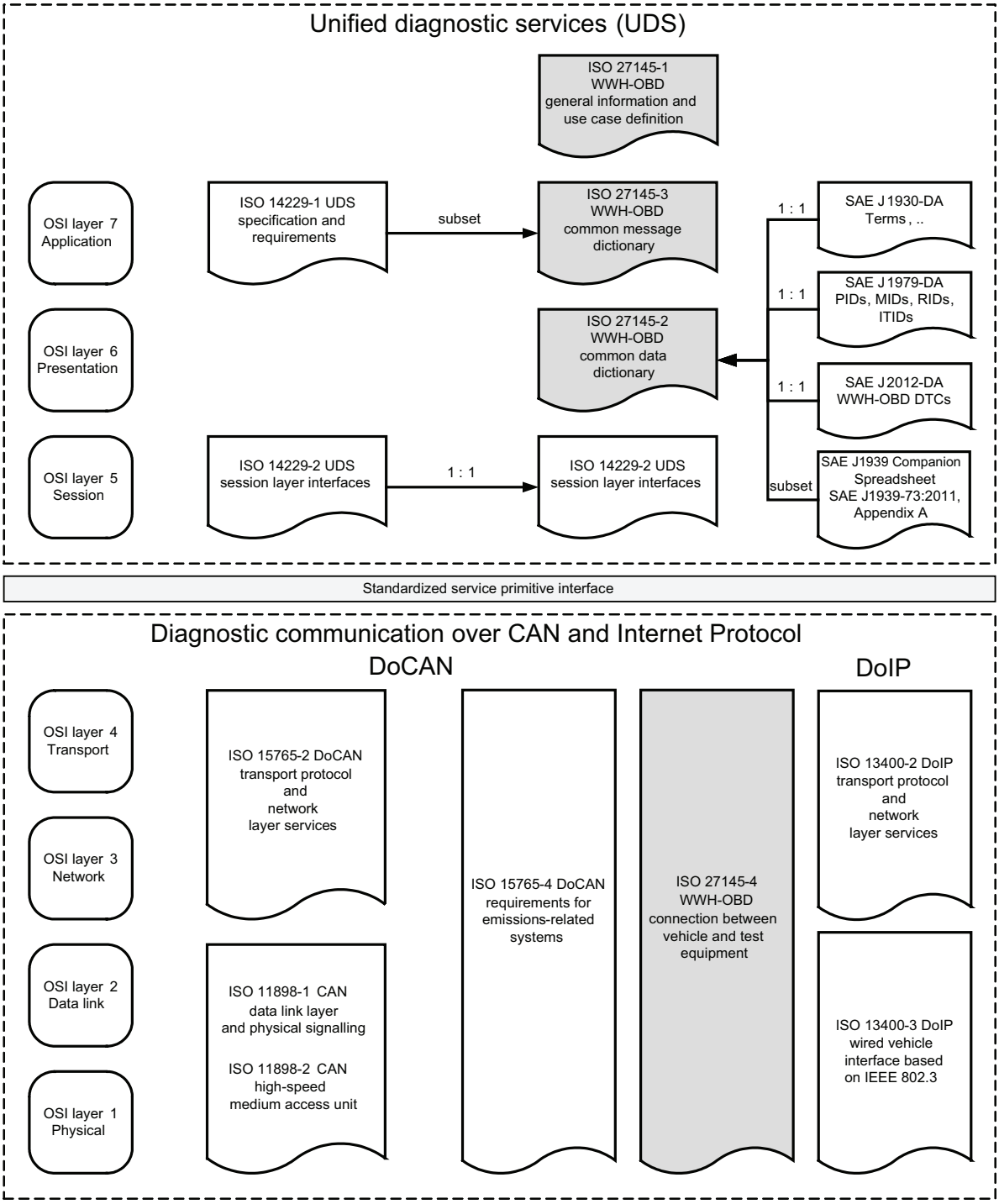

Figure 2 — Reference documents for implementation of WWH-OBDonCAN and WWH-OBDonIP according to the OSI model

6 Unified diagnostic services (UDS) applicable to WWH-OBD

6.1 General

This clause defines how the diagnostic services defined in ISO 14229-1 apply to ISO 27145. For each applicable service, the applicable sub-function and data parameters are defined.

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Subclauses 6.3 to 6.8 define additional requirements and/or restrictions for the ISO 14229-1 services that are supported for WWH-OBD in this part of ISO 27145.

NOTE The sub-function parameter definitions take into account that the most significant bit is used for the suppressPosRspMsgIndicationBit parameter, as defined in ISO 14229-1.

6.2 UDS on WWH-OBD overview

This part of ISO 27145 applies the diagnostic services defined in ISO 14229-1 for WWH-OBD-compliant implementations. Table 2 references the ISO 14229-1 services that apply to UDS implementations which meet WWH-OBD requirements.

Table 2 contains all services that apply from ISO 14229-1. For each service, the required support for sub-functions and data parameters is defined. Implementation of additional services from ISO 14229-1, that are not listed in Table 2, is entirely at the discretion of the implementer, except where local regulations define additional requirements. Additional detail for each service is given by the subclause referenced in the rightmost column of Table 2.

Table 2 — Overview of applicable ISO 14229-1 UDS and data ranges

UDS name (ISO 14229-1)	SID value	SFID value	Sub-function name	Comment	Ref.
Data transmission functional unit					
ReadDataByIdentifier	0x22	—	N/A	This service provides read capabilities for static and dynamic data.	6.5
Stored data transmission functional unit					
ReadDTCInformation	0x19	0x04	reportDTCSnapshotRecordBy-DTCNumber	This service provides read capabilities for DTC information.	6.6
		0x06	reportDTCExtendedData-RecordByDTCNumber	The sub-functions are mandatory for WWH-OBD-compliant servers.	
		0x42	reportWWHOBDDTCByMask-Record		
ClearDiagnostic-Information	0x14	—	N/A	This service provides clear DTC information capability. To clear emissions system group information, the parameter groupOfDTC = 0xFFFF33.	6.7
Remote activation of routine functional unit					
RoutineControl	0x31	0x01	startRoutine	This service provides control capability for routines. This sub-function is mandatory for WWH-OBD-compliant servers.	6.8

6.3 Electronic control unit (ECU) response message length too long

If the ECU response message exceeds the length supported by the underlying network layer that has been implemented, a negative response code 0x14 shall be sent by the ECU instead of a positive response message.

6.4 Message byte order

Alphanumeric data derived from SAE J1979-DA and SAE J2012-DA shall be transmitted with the most significant byte first (MSB).

Unless otherwise specified, alphanumeric characters shall conform to the ISO Latin 1 ASCII character set as specified in ISO 27145-2.

See ISO 27145-2 for the message byte order for DTCs according to SAE J1939 Companion Spreadsheet (SPN) and SAE J1939-73:2010, Appendix A (FMI).

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6.5 ReadDataByIdentifier (0x22) service

6.5.1 General

This part of ISO 27145 complies with the requirements of ISO 14229-1. Subclause 6.5.2 defines additional requirements or imposes restrictions applicable to the service referenced.

6.5.2 WWH-OBD-specific requirements

6.5.2.1 Requirement — Minimum number of DIDs per request to be supported

Table 3 specifies a minimum number of DIDs per request that shall be supported by the server(s) as part of a request message of the service ReadDataByIdentifier, even if the server(s) might not have support for the data referenced by the DID(s).

Table 3 — Requirement definition: Minimum number of DIDs per request to be supported by a server

Requirement name	**Minimum number of DIDs per request to be supported by a server**
Affects	WWH-OBD server(s)
Brief description	The ReadDataByIdentifier service allows the client to request data record values from the server(s) identified by one or more DIDs. The client request message contains one or more DataIdentifier values that identify data record(s) maintained by the server (see ISO 27145-2). Upon receiving a ReadDataByIdentifier request, the server shall access the data elements of the records specified by the DID parameter(s) and transmit their value in one single ReadDataByIdentifier positive response message containing the associated dataRecord parameter(s).
Requirement	The server shall support at least six DIDs simultaneously in a request and response message if requested by the external test equipment.

6.6 ReadDTCInformation (0x19) service

6.6.1 General

This part of ISO 27145 complies with the requirements of ISO 14229-1. Subclause 6.6.2 defines additional requirements or imposes restrictions applicable to the service referenced.

6.6.2 WWH-OBD-specific requirements

6.6.2.1 Requirement — DTC format identification

Table 4 specifies the two DTC formats which shall be supported by the GTR WWH-OBD-compliant server(s) and external test equipment.

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Table 4 — Requirement definition: DTC format identification

Requirement name	**DTC format identification**
Affects	Client(s), WWH-OBD server(s)
Brief description	The DTCFormatIdentifier defined in ISO 14229-1 is a 1-byte parameter value which defines the format of a DTC reported by the server.
Requirement	DTCs reported by services and sub-functions in accordance with ISO 27145 shall always use only one of the two formats specified in ISO 27145-2: — SAE_J2012-DA_DTCFormat_04: This parameter value identifies the WWH-OBD DTC format reported by the server, as defined in the SAE J2012-DA specification. — SAE_J1939-73_DTCFormat: This parameter value identifies the DTC format reported by the server, as defined in the SAE J1939-73 specification. The values of the DTCFormatIdentifier are specified in ISO 14229-1.

6.6.2.2 Requirement — Support of DTCStatusAvailabilityMask parameter

Table 5 specifies the bits which are defined in the same way as for statusOfDTC and which represent the status bits that are supported by GTR WWH-OBD-compliant server(s). Bits that are not supported by the server(s) shall be set to 0.

Table 5 — Requirement definition: Support of DTCStatusAvailabilityMask parameter

Requirement name	**Support of DTCStatusAvailabilityMask parameter**
Affects	WWH-OBD server(s)
Brief description	The DTCStatusAvailabilityMask parameter indicates the statusOfDTC bits supported by GTR WWH-OBD-compliant server(s). NOTE It is up to the manufacturer to support additional bits per DTC as deemed necessary to fully support their diagnostics.
Requirement	The GTR WWH-OBD-compliant server shall support at least the following statusOfDTC parameter bits per DTC: — bit 2, pendingDTC (PDTC); — bit 3, confirmedDTC (CDTC); — bit 4, testNotCompletedSinceLastClear (TNCSLC); — bit 6, testNotCompletedThisOperationCycle (TNCTOC). The values of the DTCStatusAvailabilityMask parameter are specified in ISO 14229-1.

6.6.2.3 Requirement — Support of DTCSeverityAvailabilityMask parameter

Table 6 specifies the bits which are defined in the same way as for DTCSeverity and DTC Class and which represent the status bits that are supported by GTR WWH-OBD-compliant server(s). Bits that are not supported by the server(s) shall be set to 0.

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Table 6 — Requirement definition: Support of DTCSeverityAvailabilityMask parameter

Requirement name	**Support of DTCSeverityAvailabilityMask parameter**
Affects	WWH-OBD server(s)
Brief description	The DTCSeverityAvailabilityMask parameter indicates the DTC Class bits supported by GTR WWH-OBD-compliant server(s).
Requirement	The GTR WWH-OBD-compliant server shall support at least the following DTC Class parameter bits: — bit 1, Class_1 (Class A); — bit 2, Class_2 (Class B1); — bit 3, Class_3 (Class B2); — bit 4, Class_4 (Class C). The values of the DTC Class parameter are specified in ISO 14229-1.

6.6.2.4 Requirement — Request mask handling of DTC Severity Mask Record

The requirements specified in this section allow for the implementation of the malfunction classification concept defined in the GTR WWH-OBD, Module B, section 4.5 (see Reference [17]).

Table 7 specifies the WWH-OBD GTR DTC masking requirements. The following definitions apply:

— AND, OR logical operation;

— & bitwise AND;

— && logical AND;

— == equal to (comparison operator);

— = assignment operator;

— != not equal to.

6.6.2.5 GTR WWH-OBD DTC status diagram

Figure 3 shows an implementation example of the GTR WWH-OBD DTC state timings depending on operation cycle and monitoring results. Additionally, the diagram describes related states of the DTC status bits defined by ISO 14229-1/ISO 27145. Finally, the diagram illustrates how the client displays GTR WWH-OBD-compliant DTC states based on the ISO 14229-1 status bit definitions. Reusing the DTC status bit definitions forces a specific implementation of the GTR WWH-OBD DTC status requirements but fully satisfies them.

The following conditions apply:

— A DTC will be reported as “Confirmed & Active” for this operation sequence where the malfunction occurs again after the DTC has been reported as “Previously Active”.

— Since the DTC status is changed from “Previously Active” to “Confirmed & Active” one operation sequence earlier than required, presuming the DTC was in “Previously Active” state, the related MI (short/continuous) illuminates one operation sequence prior to when required.

— The warm-up cycle counter indicating the number of cycles during which a DTC was in “Previously Active” status (aging counter) counts upward from zero (0) only if the related MI has been de-activated.

The implementation shown in Figure 3 is an example and for illustration purposes only. It shows the discriminatory malfunction indicator (MI) for Class B2 malfunctions.

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