INTERNATIONAL STANDARD

ISO 14229

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Road vehicles — Diagnostic systems — Diagnostic services specification

Véhicules routiers — Systèmes de diagnostic — Spécification des services de diagnostic

Contents

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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, govermental and non-govermental, 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.

Draft International Standards adopted by the technical committee 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.

International Standard ISO 14229 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

Annex A of this International Standard is for information only.

Introduction

This International Standard has been established in order to define common requirements for diagnostic systems, whatever the serial data link is.

To achieve this, it is based on the Open Systems Interconnection (OSI) basic reference model in accordance with ISO 7498 which structures communication systems into seven layers. When mapped on this model, the services used by a diagnostic tester and an electronic control unit (ECU) are broken into

- diagnostic services (layer 7),

- communication services (layers 1 to 6), in accordance with figure 1.

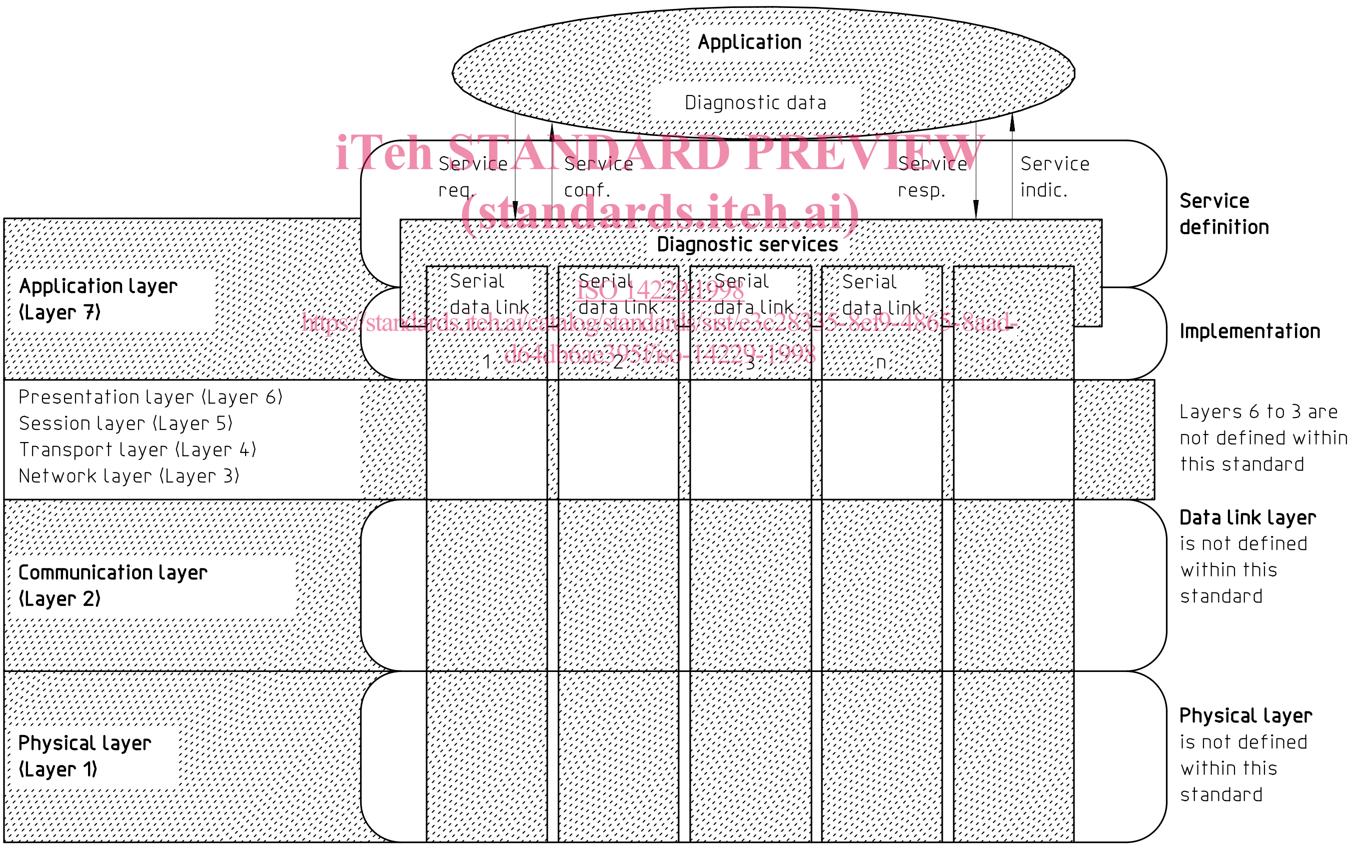

Application
Diagnostic data
Service req.
Service conf.
Service resp.
Service indic.
Service definition
Diagnostic services
Application layer (Layer 7)
Serial data link 1
Serial data link 2
Serial data link 3
Serial data link n
Implementation
Presentation layer (Layer 6)
Session layer (Layer 5)
Transport layer (Layer 4)
Network layer (Layer 3)
Layers 6 to 3 are not defined within this standard
Communication layer (Layer 2)
Data link layer is not defined within this standard
Physical layer (Layer 1)
Physical layer is not defined within this standard

Figure 1 — Mapping of the diagnostic services on the OSI Model

This International Standard contains references to SAE publications, which are regularly amended/updated without any visible change (neither in the numbering, nor any additive letter, etc.). To ensure precisely to which particular edition this International Standard refers, annex A gives the precise dates of the SAE publications used.

Road vehicles — Diagnostic systems — Diagnostic services specification

1 Scope

This International Standard specifies common requirements of diagnostic services which allow a diagnostic tester to control diagnostic functions in an on-vehicle electronic control unit (e.g. electronic fuel injection, automatic gearbox, anti-lock braking system, etc.) connected on a serial data link embedded in a road vehicle.

It specifies generic services which allow the diagnostic tester to stop or to resume non-diagnostic message transmission on the data link.

This International Standard does not apply to non-diagnostic message transmission, nor to use of the communication data link between two electronic control units.

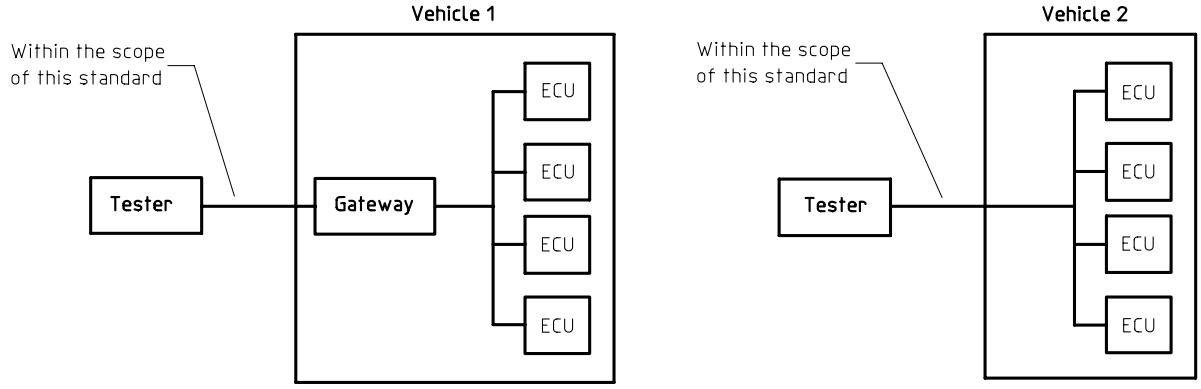
This International Standard neither specifies implementation requirements, numerical values of services and parameters, nor requirements for the communication services.

The vehicle diagnostic architecture of this International Standard applies to

— a single tester that may be temporarily or permanently connected to the on-vehicle diagnostic data link, and

— several on-vehicle electronic control units connected directly or indirectly.

See figure 2.



In vehicle 1, the ECUs are connected over an internal data link and indirectly connected to the diagnostic data link through a gateway. This standard applies to the diagnostic communications over the diagnostic data link; the diagnostic communications over the internal data link may conform to this standard or to another protocol.

In vehicle 2, the ECUs are directly connected to the diagnostic data link.

Figure 2 — Vehicle diagnostic architecture

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreement based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Definitions and abbreviations

3.1 Terms defined in other standards

3.1.1
type
named set of values

3.1.2
bitstring type
type whose values are strings (sequences) of bits

NOTE — The bitstring type is used if no range is defined except the number of bits used (e.g. diagnostic trouble codes could be represented by a sequence of bits).

3.1.3
integer type
a simple type with distinguished values which are the positive and the negative whole numbers, including zero

NOTE — The range of type integer is not specified.

3.1.4
diagnostic trouble code
numerical common identifier for a fault condition identified by the on-board diagnostic system [SAE J 1930]

3.2 Additional definitions

3.2.1
diagnostic service
information exchange initiated by a client in order to require diagnostic information from a server or/and to modify its behaviour for diagnostic purpose

3.2.2
client
function that is part of the tester and that makes use of the diagnostic services

NOTE — A tester normally makes use of other functions such as data base management, specific interpretation, man-machine interface.

3.2.3
server
function that is part of an ECU and that provides the diagnostic services

NOTE — This International Standard differentiates between the server (i.e. the function) and the ECU so that it remains independent of the implementation.

3.2.4
tester
system that controls functions such as test, inspection, monitoring, or diagnosis of an on-vehicle ECU

NOTE — Testers may be dedicated to a specific type of operators (e.g. a scan tool dedicated to garage mechanics or a test tool dedicated to assembly plant agents). They may also be dedicated to several or to all types of operators.

3.2.5
diagnostic data
data that is located in the memory of an ECU which may be inspected and/or possibly modified by the tester (diagnostic data includes analogue inputs and outputs, digital inputs and outputs, intermediate values and various status information)

EXAMPLE — Examples of diagnostic data: vehicle speed, throttle angle, mirror position, system status, etc.

Two types of values are defined for diagnostic data:

— the current value: the value currently used by (or resulting from) the normal operation of the ECU;

— a stored value: an internal copy of the current value made at specific moments (e.g. when a malfunction occurs or periodically); this copy is made under the control of the ECU. The ECU is not obliged to keep internal copies of its data for diagnostic purposes, in which case the tester may only request the current value.

3.2.6
diagnostic session
level of diagnostic functionality provided by the server

EXAMPLE — Defining a repair shop or development testing session selects different ECU functionality (e.g. access to all memory locations may only be allowed in the development testing session).

3.2.7
diagnostic routine
routine that is embedded in an ECU and that may be started by a Server upon a request from the Client

EXAMPLE — It could either run instead of a normal operating program, or could be enabled in this mode and executed with the normal operating program. In the first case, normal operation for the Server is not possible. In the second case, multiple diagnostic routines may be enabled that run while all other parts of the ECU are functioning normally.

3.2.8
record
one or more diagnostic data elements that are referred to together by a single means of identification

EXAMPLE — A snapshot including various input/output data and trouble codes is an example of a record.

3.2.9
freeze frame
record of datas stored at the occurrence of an event

NOTE — Services defined allow the tester to request data stored in a freeze frame.

EXAMPLE — A freeze frame may be used to store the context of the ECU's operation either at periodic moments or at the occurrence of a malfunction. The Server may maintain several freeze frames (e.g. the same context may be stored several times as a trace of the N latest malfunctions, or each freeze frame may consist of a different context).

3.2.10
functional unit
set of functionally close or complementary diagnostic services

The following functional units have been identified:

- diagnostic management: this functional unit allows the initialization and the termination of a sequence of diagnostic interchanges between a client and a server;

- data transmission: this functional unit allows a client to request the server for the current values of a record. This functional unit may be used to request identification information;

- stored data transmission: this functional unit allows a client to request the server for the stored values of a record (for instance, the diagnostic trouble codes). A server may store record values (either periodically or at the occurrence of a malfunction) in a freeze frame. This freeze frame may be cleared upon request from the client. If the server supports multiple freeze frames then the client may trace the server's operation;

- input/output control: this functional unit allows the client to control the input and output peripherals of the ECU where the server is present;

- remote activation of routine: this functional unit allows the client to control specific diagnostic routines on the ECU where the server is present;

- upload download : this functional unit allows the client to control the transfer of large blocks of data to or from the server.

3.3 Abbreviations

OSI Open Systems Interconnection.
ECU Electronic Control Unit.

EXAMPLE — Systems considered as electronic control units: anti-lock braking system (ABS), engine management system, etc.

PID Parameter IDentifier.

4 Convention

4.1 Interactions

This International Standard is guided by the conventions adopted in the OSI service conventions (ISO/IEC 10731) as they apply to the diagnostic services. These conventions specify the interactions between the service user and the service provider. Information is passed between the service user and the service provider by service primitives, which may convey parameters.

The distinction between service and protocol is shown in figure 3.

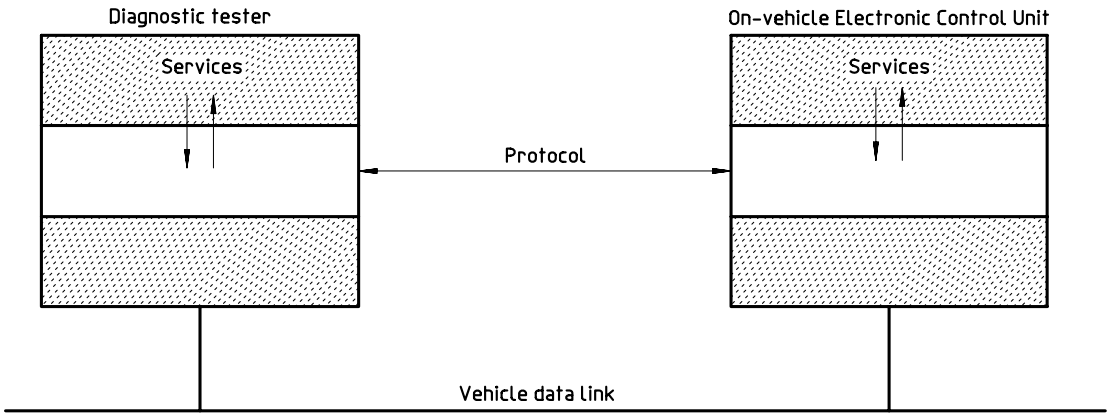


Figure 3 — Services and protocol

4.2 OSI service

This International Standard makes use of the following conventions defined in ISO/IEC 10731 as they apply to the diagnostic services:

- Service primitive: a service is transferred to or from the diagnostic layer by passing a service primitive across the layer interface.

- Service user: the service user is the diagnostic application which requests the service of the diagnostic layer. For diagnostic services described in this International Standard, it is always the client.

- Service provider: the service provider is the diagnostic application which responds to the service requested by the service user. For diagnostic services described in this International Standard, it is always the server.

- Request primitive: the request transfers the service from the service user to the diagnostic layer.

- Indication primitive: the indication transfers the service from the diagnostic layer to the service provider.

- Response primitive: the response transfers an answer to an indication primitive from the service provider to the diagnostic layer.

- Confirmation primitive: the confirmation transfers an answer to a request primitive from the diagnostic layer to the service user.

These conventions are shown in figure 4.

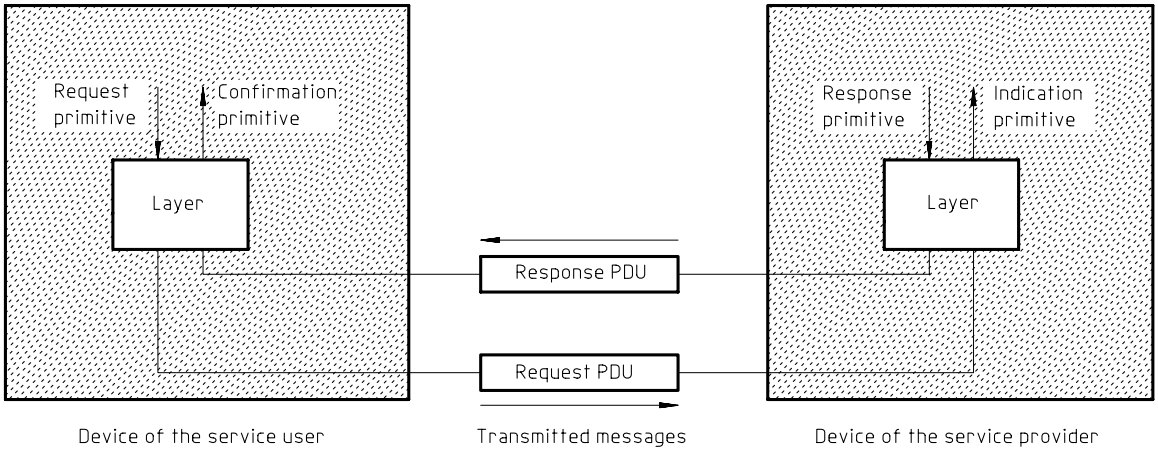


Figure 4 — Description of OSI service convention

4.3 Service description

ReadDataByCommonIdentifier request	M
Record common identifier	M
Transmission mode	U
ReadDataByCommonIdentifier positive response	S
Record common identifier	M
Record value	M
ReadDataByCommonIdentifier negative response	S
Response code	M
Record common identifier[1)]	U
Transmission mode[1)]	U/C
1) Parameters of the request shall be repeated together. C = condition: parameter may be present only if it was already in the request.	

In all requests and responses, Client and Server Identifiers are mandatory, unless the service was performed on a point-to-point communication. They are not shown in the table 1.

NOTE — The parameter Server Identifier may be included in the initialization phase for a point-to-point communication (it will depend on the implementation).

Under the **"Service name" request** are listed the parameters specific to the service request/indication.

Under the **"Service name" positive response** are listed the parameters specific to the service response/confirmation in case the requested service has succeeded.

Under the **"Service name" negative response** are listed the parameters specific to the service response/confirmation in case the requested service has failed.

Parameters are indented under the service name.

For a given primitive, the presence of each parameter is described by one of the following values:

M mandatory;

U user option: the parameter shall or shall not be supplied, depending on dynamic usage by the manufacturer;

C conditional: the presence of the parameter depends upon other parameters within the service;

S mandatory (unless specified otherwise) selection of a parameter from a parameter list.

4.3.3 Service procedure

This subclause provides a description of the actions performed by the client and the server.

4.4 Functional unit table

Similar services are grouped into a functional unit. The description of each functional unit includes a table which lists its services.

5 Parameter specification

5.1 General purpose parameters

The structure of a service makes reference to parameters exchanged between server and client when the service is in progress.

The parameters of general purpose are specified in this clause. Parameters specific to a functional unit are specified in the corresponding clause.

This International Standard gives a list for some parameters (e.g. the response code parameter). Outside this list, some other parameter may be reserved either for future definition in the revision of this standard or for the system designer's specific use.

5.2 Server identifier

This parameter identifies a server. This clause neither specifies the list of possible server identifiers, nor defines a specific means for the client to get this list.

EXAMPLE 1 — Example of server identifiers are : ABS, engine management system.

EXAMPLE 2 — A server (e.g. the engine control) may be implemented in one ECU or distributed in several ECUs. An ECU may include only one server or several servers. At present, in most cases, a server is implemented in one ECU, and there is only one server in each ECU.

5.3 Client identifier

This parameter identifies a client. This clause neither specifies the list of possible client identifiers, nor defines a specific means for the server to get this list.

EXAMPLE — Example of client identifier: Scan tool.

5.4 Local identifier and common identifier

This subclause differentiates between local identifiers and common identifiers for the identification of a record, input/output or routine.

A common identifier is understood in the same way by all servers supporting this identifier.

The interpretation of a local identifier is server-specific.

EXAMPLE — The parameter identifier (PID) used by SAE J2190 and SAE J1979 are a sub-set of the record common identifier. For instance, in the SAE J1979 Recommended Practice, PID $0B identifies the intake manifold absolute pressure for every system. This data could be assigned a specific local identifier on some systems.

5.5 Memory address and routine address

This parameter identifies a specific server memory or routine location. It contains all the necessary information to address any memory or routine location including memory type (e.g. RAM, EEPROM, etc.) or memory paging.

5.6 Response code

The response code parameter is used within the negative response to indicate that the server could not complete the request.

The standard list for this parameter is described in the subclauses below.

5.6.1 General reject

The service is rejected but the server does not specify the reason of the rejection.

5.6.2 Service not supported

It indicates that the requested action will not be taken because the server does not support the requested service.

EXAMPLE — The client requests a service of an advanced functional unit (e.g. data transfer) which is not supported.

5.6.3 Subfunction not supported or invalid format

It indicates that the server does not support the arguments of the requested service or the format of the argument bytes do not match the prescribed format for the specified service.

EXAMPLE — The client requests a ReadDataByLocalIdentifier service, but the specified record local identifier value is not supported by this server.

5.6.4 Busy - RepeatRequest

The server has understood the service request, but it cannot execute at this time and will not start. In order to get a positive response the client should repeat the request later.

EXAMPLE — This response code indicates that the server is temporarily too busy to perform the requested operation. In this circumstance repetition of the request will eventually result in an affirmative response. This code may be returned while a server is in the process of clearing stored codes or fetching information.

5.6.5 Conditions not correct or request sequence error

It indicates that the requested action will not be taken because the server prerequisite conditions are not met. This request may elicit an affirmative response at another time. This code may occur when sequence-sensitive requests are issued in the wrong order.

5.6.6 Routine Not Complete or Service In Progress

This response code is used to indicate that the message was properly received and the service is in process, but not yet completed.

EXAMPLE — Whenever completion of the requested operation will exceed the maximum response time limit, it is appropriate to use the routine Not Complete or Service In Progress response code to lengthen the acceptable response period.

5.6.7 Request out of range

It indicates that the requested action will not be taken because the server detects the request message contains a data byte which attempts to substitute a value beyond its range of authority.

EXAMPLE — Attempting to modify a data byte of 111 when the data is only defined to 100.

5.6.8 Security access denied

The service is rejected because the server's security strategy has not been satisfied by the client.

5.6.9 Invalid key

It indicates that security access has not been given because the server's security key was not matched by the client (this counts as an attempt to gain security access).

5.6.10 Exceed number of attempts

It indicates that the requested action will not be taken because the client has unsuccessfully attempted to gain security access more times than the server's security strategy will allow.

5.6.11 Required time delay not expired

It indicates that the requested action will not be taken because the client’s latest attempt to gain security access was initiated before the server’s required time-out period had elapsed.

5.6.12 Download not accepted

This response code indicates that an attempt to download to a server's memory cannot be accomplished due to some fault condition.