DRAFT INTERNATIONAL STANDARD

ISO/DIS 13400-4

ISO/TC **22**/SC **31**

Secretariat: **DIN**

Voting begins on:
2015-07-07

Voting terminates on:
2015-10-07

Road vehicles - Diagnostic communication over Internet Protocol (DoIP) —

Part 4:
Ethernet Diagnostic Connector

Véhicules routiers - Communication de diagnostic sur protocole Internet (DoIP) —

Partie 4: Connecteur Ethernet de Diagnostic

ICS: 43.040.10; 43.180

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 13400 consists of the following parts, under the general title *Road vehicles — Diagnostic communication over Internet Protocol (DoIP)*:

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

— *Part 2: Transport protocol and network layer services*

— *Part 3:* IEEE 802.3 *based wired vehicle interface*

— *Part 4: Ethernet-based high-speed data link connector*

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Introduction

Vehicle diagnostic communication has been developed starting with the introduction of the first legislated emission-related diagnostics and has evolved over the years now covering various use cases ranging from emission-related diagnostics to vehicle manufacturer specific applications like calibration or electronic component software updates.

With the introduction of new in-vehicle network communication technologies the interface between the vehicle's electronic control units and the external test equipment has been adapted several times to address the specific characteristics of each new network communication technology requiring optimized data link layer definitions and transport protocol developments in order to make the new in-vehicle networks usable for diagnostic communication.

With increasing memory size of electronic control units and the demand to update this increasing amount of software and an increasing number of functions provided by these control units, technology of the connecting network and buses has been driven to a level of complexity and speed similar to computer networks. New applications (x-by-wire, infotainment) require high band-width and real time networks (like FlexRay, MOST) which cannot be adapted anymore to be the direct interface to a vehicle. This requires gateways to route and convert messages between the in-vehicle networks and the vehicle interface to external test equipment.

The intent of this documents set is to describe a standardized vehicle interface which

— separates in-vehicle network technology from the external test equipment vehicle interface requirements to allow for a long-term stable external vehicle communication interface,

— utilizes existing industry standards to define a long-term stable state-of-the-art communication standard usable for legislated diagnostic communication as well as for manufacturer specific use cases,

— can easily be adapted to new physical and data link layers by using existing adaptation layers.

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 14229 are divided into

— unified diagnostic services (layer 7), specified in ISO 14229-1, ISO 14229-5, ISO 27145-3,

— presentation (layer 6):

— for enhanced diagnostics, specified by the vehicle manufacturer,

— for WWH-OBD: specified in ISO 27145-2, SAE J1930-DA, SAE J1979-DA, SAE J2012-DA,

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

— transport protocol (layer 4), specified in ISO 13400-2,

— network layer (layer 3) services, specified in ISO 13400-2,

— physical and data link services (layers 1 and 2), specified in ISO 13400-3,

in accordance with Table 1.

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Table 1 — Enhanced and legislated WWH-OBD diagnostic specifications applicable to the OSI layers

Applicability	OSI 7 layers	Vehicle manufacturer enhanced diagnostics	WWH-OBD document reference
Seven layer according to ISO 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-5, ISO 14229-1	ISO 27145-3; ISO 14229-1
	Presentation (layer 6)	Vehicle manufacturer specific	ISO 27145-2, SAE J1930-DA, SAE J1979-DA, SAE J2012-DA
	Session (layer 5)	ISO 14229-2	ISO 14229-2
	Transport (layer 4)	ISO 13400-2	ISO 13400-2
	Network (layer 3)		
	Data link (layer 2)	ISO 13400-3	ISO 13400-3
	Physical (layer 1)		

The application layer services covered by ISO 14229-5 have been defined in compliance with diagnostic services established in ISO 14229-1, but are not limited to use only with them.

The transport and network layer services covered by ISO 13400-2 have been defined to be independent of the physical layer implemented.

For other application areas, ISO 13400-3 can be used with any Ethernet physical layer.

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Road vehicles - Diagnostic communication over Internet Protocol (DoIP) —

Part 4:
Ethernet Diagnostic Connector

1 Scope

This part of ISO 13400 specifies a minimum set of diagnostic Ethernet connector requirements which are based on the ISO 15031-3 Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits: specification and use. The ISO 15031-3 diagnostic connector is referenced by legislation in many countries.

The diagnostic connection specified in this part of ISO 13400 consists of two mating connectors, the vehicle connector and the external test equipment connector as specified in ISO 15031-3.

This part of ISO 13400 specifies:

— the functional requirements for the vehicle connector. These functional requirements are separated into two principal areas: connector contact allocation, and electrical requirements for connector and related electrical circuits,

— the functional requirements for the external test equipment connector. These functional requirements are separated into two principal areas: connector contact allocation and electrical requirements for connector and related electrical circuits.

Two (2) different connector layouts and pin-outs are specified in this part of ISO 13400:

a) Annex A (normative) Ethernet pin assignment option #1

b) Annex B (normative) Ethernet pin assignment option #2

Historically, option #1 is specified to meet Ethernet pin assignment of road vehicles already launched onto the market and may be used to resolve conflicts with vehicle manufacturer-specific usage of discretionary pins e.g. pins 1 and 9.

Option #2 is specified to meet the Ethernet pin assignment of road vehicles to resolve conflicts with vehicle manufacturer-specific usage of discretionary pins e.g. pins 3 and 11.

A discovery/identification and activation method of the vehicle's Ethernet via the "Ethernet Activation Line" is specified in part 3 of ISO 13400.

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

SAE J1962:07/2012, Diagnostic Connector

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3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13400-1 and the following apply.

3.1.1
connection
two mated connectors or contacts.

3.1.2
connector
assembly of contact and housing which terminates conductors for the purpose of providing connection and disconnection to a suitable mating connector.

3.1.3
contact
conductive element in a connector (including means for cable attachment) which mates with a corresponding element to provide an electrical path.

3.1.4
female contact
electrical contact (including means for cable attachment) intended to make electrical engagement on its inner surface and to accept entry of a male contact thus forming an electrical connection. Examples: receptacle, sleeve.

3.1.5
male contact
electrical contact (including means for cable attachment) intended to make electrical engagement on its outer surface and to enter a female contact thus forming an electrical connection. Examples: tab, pin, blade.

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3.2 Abbreviated terms

CAN	Controller Area Network

4 Conventions

ISO 13400 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731:2004 [1]) as they apply for diagnostic services.

5 Connector requirements

5.1 General information

Vehicle manufacturers of road vehicles have the choice to implement one of two different Ethernet connector layouts and pin assignments. This is needed to meet the in-vehicle electrical architecture design.

Discovery/identification of the vehicle's Ethernet option (configuration) is a requirement for external test equipment in order to properly connect to the Ethernet without causing any damage either to the vehicles or external test equipment bus circuitry. In addition, any bus interference like bus errors must be avoided.

The solution for external test equipment to identify the vehicle's Ethernet option is based on reading the vehicle's identification signal provided on the "Ethernet activation line" available on the diagnostic connector prior to enabling the multiplexer switches to establish an electrical Ethernet connection to the vehicle's Ethernet.

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5.2 Normative references to ISO 15031-3

This part of ISO 13400 specifies additional requirements to support ISO 13400-1, ISO 13400-2 and ISO 13400-3 to be implemented when accessed through the ISO 15031-3 diagnostic connector.

5.3 Ethernet specific requirements

The Ethernet connector layout, pin assignment information and simplified test equipment circuitry example for Ethernet option #1 is specified in Annex A.

The Ethernet connector layout, pin assignment information and simplified test equipment circuitry example for Ethernet option #2 is specified in Annex B.

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