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Agricultural vehicles — Standardized access to repair and maintenance information (RMI) —

Part 2: Vehicle on-board diagnostics

Véhicules agricoles — Accès normalisés aux informations relatives à la réparation et à l'entretien (RMI) —

Partie 2: Systèmes de diagnostic embarqué

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*.

A list of all parts in the ISO 22172 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Agricultural vehicles — Standardized access to repair and maintenance information (RMI) —

Part 2: Vehicle on-board diagnostics

1 Scope

This document specifies the access to vehicle on-board diagnostics (OBD) by describing minimum hardware and software requirements including requirements for reprogramming, calibration and configuration after repair works. In addition, it provides hardware and software specifications for diagnostic tools.

This document does not apply to retrofit kits as these kits are not an integrated part of the vehicle.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 11783-2, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 2: Physical layer*

ISO 11783-12, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 12: Diagnostics services*

ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 11898-2, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

ISO 13400-2, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP) — Part 2: Transport protocol and network layer services*

ISO 13400-3, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP) — Part 3: Wired vehicle interface based on IEEE 802.3*

ISO 13400-4, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP) — Part 4: Ethernet-based high-speed data link connector*

ISO 14229-3, *Road vehicles — Unified diagnostic services (UDS) — Part 3: Unified diagnostic services on CAN implementation (UDSonCAN)*

ISO 14229-5, *Road vehicles — Unified diagnostic services (UDS) — Part 5: Unified diagnostic services on Internet Protocol implementation (UDSonIP)*

ISO 14230-1, *Road vehicles — Diagnostic communication over K-Line (DoK-Line) — Part 1: Physical layer*

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*

ISO 15765-2, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 2: Transport protocol and network layer services*

ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 4: Requirements for emissions-related systems*

ISO 22172-1, *Agricultural vehicles — Standardized access to repair and maintenance information (RMI) — Part 1: User interface requirements for web-based information systems*

ISO 22900-2, *Road vehicles — Modular vehicle communication interface (MVCI) — Part 2: Diagnostic protocol data unit (D-PDU API)*

ISO 27145-6, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 6: External test equipment*

SAE J1939-13, *Off-Board Diagnostic Connector*

SAE J1939-73, *Application Layer — Diagnostics*

SAE J1962, *Diagnostic connector*

SAE J2534-2, *Optional Pass-Thru Features*

RP1210 *Programming interface for accessing diagnostic interfaces*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22172-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
diagnostics
process that identifies, with precision, potential malfunction causes

Note 1 to entry: A precise diagnosis can be achieved in several ways, whereby the operator might be requested to perform test actions on vehicle or to enter symptoms.

3.2
diagnostic information
description of an error or symptom and a list of potential causes or hints or further investigation of the same level and content as provided to authorized repairer (AR)

3.3
reprogramming
flashing of software of an ECU, excluding

— the *calibration* (3.4), or

— the configuration of the ECU to maintain the original *configuration* (3.5), or

— the manufacturer's latest required configuration

3.4
calibration
optimizing the functionality of a vehicle by performing adjustments either manually or through automated routines using manufacturer specified processes

3.5
configuration
adjust manufacturer defined parameters of the control unit / system to allow the vehicle to perform as required

4 Symbols and abbreviated terms

API	application programming interface
CAN	controller area network
DoCAN	diagnostic communication over controller area network
DoIP	diagnostic communication over internet protocol
ECU	electronic control unit
EMC	electromagnetic compatibility
IBBC	Implement bus breakaway connector
ISOBUS	communications system for agricultural equipment specified by ISO 11783
FD	flexible data rate
IP	internet protocol
OBD	on-board diagnostic
PC	personal computer
PIN	product identification number
TECU	tractor electronic control unit
UDS	unified diagnostic services
USB	universal serial bus
VCI	vehicle communication interface
VIN	vehicle identification number
VM	vehicle manufacturer
WWH	world-wide harmonized

5 Requirements

NOTE This document refers to ISOBUS which is specified by ISO 11783-2 which is equivalent to SAE J1939-13.

5.1 Vehicle hardware

5.1.1 Diagnostic connectors

The diagnostic connector shall comply with one of the following standards:

— diagnostic connectors according to ISO 11783-2;

NOTE 1 SAE J1939-13 provides the same requirements.

— ISOBUS diagnostic connector according to ISO 11783-2 (ISOBUS diagnostic connectors);

NOTE 2 SAE J1939-13 type 1 provides the same requirements.

— OBD II diagnostic connector according to ISO 15031-3/ISO 13400-4:

  — Type A (12V);

  — Type B (24V).

NOTE 3 SAE J1962 provides the same requirements as ISO 15031-3.

The ISOBUS diagnostic connector should be installed on ISOBUS vehicles and may be installed on non-ISOBUS vehicles.

5.1.2 Power

Battery power – switch or direct – of 12V to 24V on the diagnostic connector is required.

If a diagnostic connector is present on the implement it shall be connected to ECU_PWR. If permanent power is not possible, the implement ECUs shall be capable of its own flashing/configuration and diagnostic processes.

5.1.2.1 Engine bus

The engine connector may be accessed via a separate diagnostic connector complying with SAE J1939-13, ISO 11783-2, ISO 15031-3 or ISO 13400-4.

5.1.2.2 Inaccessible subnets

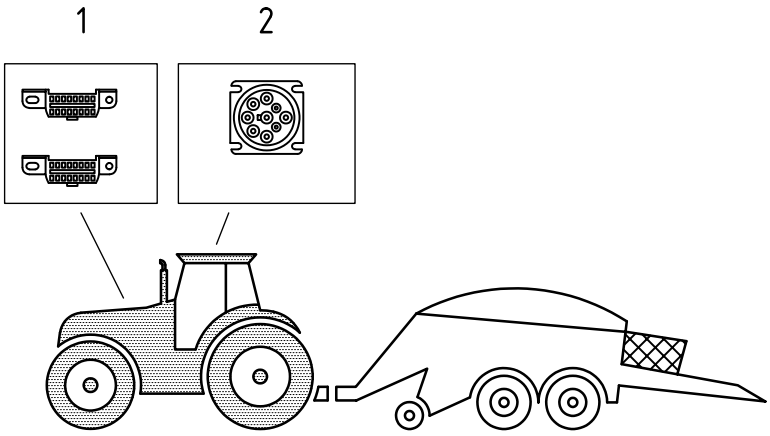
For systems which have subnets which are not accessible from the primary diagnostic interface, and where diagnostic access is required in support of this document, those subnets shall provide a separate diagnostic connector complying with SAE J1939-13, ISO 11783-2, ISO 15031-3 or ISO 13400-4.

5.1.3 Vehicles using ISO 11783 (ISOBUS)

ISOBUS vehicles shall provide the diagnostic information described in ISO 11783-12.

5.1.3.1 ISOBUS tractor

ISOBUS tractors shall have as a minimum one ISOBUS diagnostic connector according to ISO 11783-2. Additional standard connectors such as OBD II and SAE J1939-13 type 2 as shown in Figure 1 are also allowed.



Key

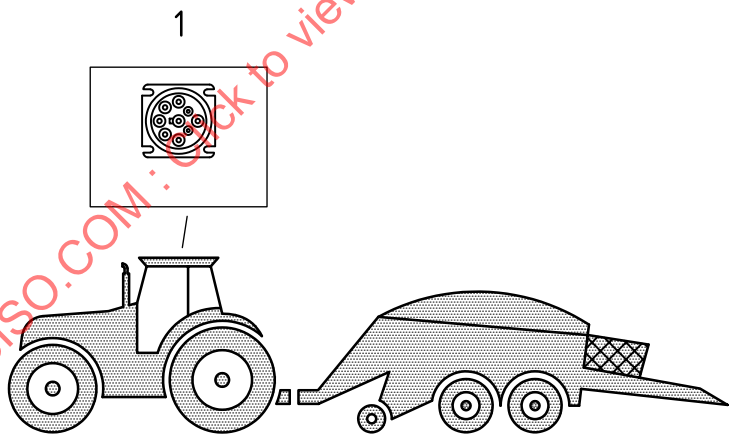
1 OBD II (12V or 24V)

2 ISOBUS diagnostic connector (black or grey)

Figure 1 — Diagnostic connector options on ISOBUS tractors

5.1.3.2 ISOBUS implements

ISOBUS implements should be connected via the ISOBUS tractor SAE J1939-13/ISOBUS connector. Additional diagnostic connectors on the implement are allowed. Power to the implement shall be provided from IBBC of the tractor (see Figures 2 and 6). OBD II diagnostic connector is also allowed (see Figure 7).



Key

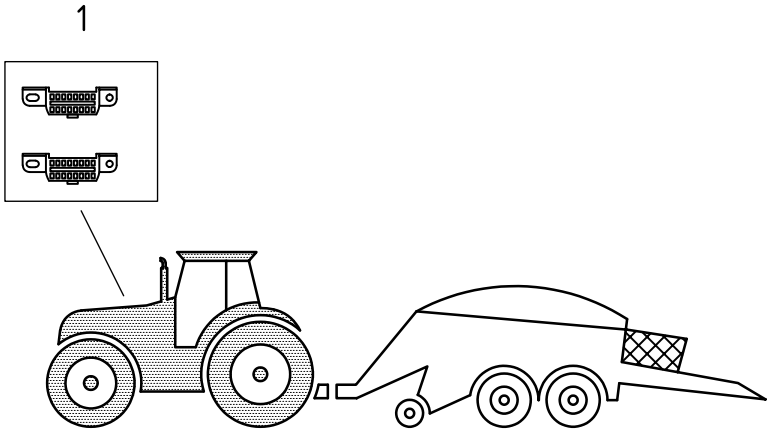
1 ISOBUS diagnostic connector (black or grey)

Figure 2 — ISOBUS implements

5.1.4 Vehicles not using ISO 11783 (Non-ISOBUS)

5.1.4.1 Non-ISOBUS tractor

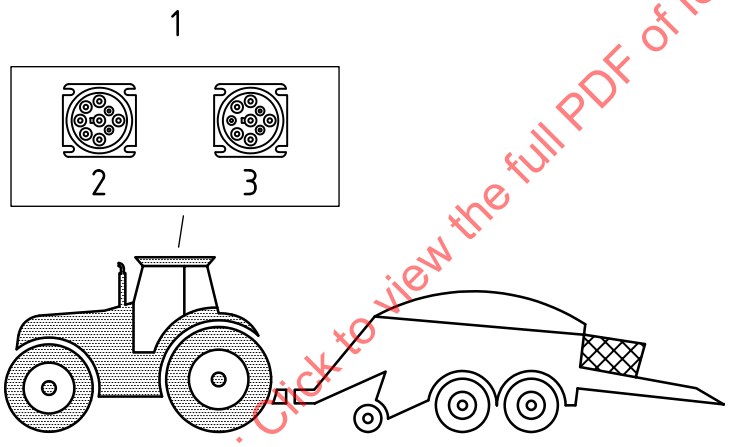
Non-ISOBUS tractors shall at a minimum have a standard diagnostic connector as shown in Figures 3 and 4. It is allowed to have another standard diagnostic connector simultaneously as shown in Figure 5.



Key

1 OBD II (12V or 24V)

Figure 3 — Tractor with non-ISOBUS OBD



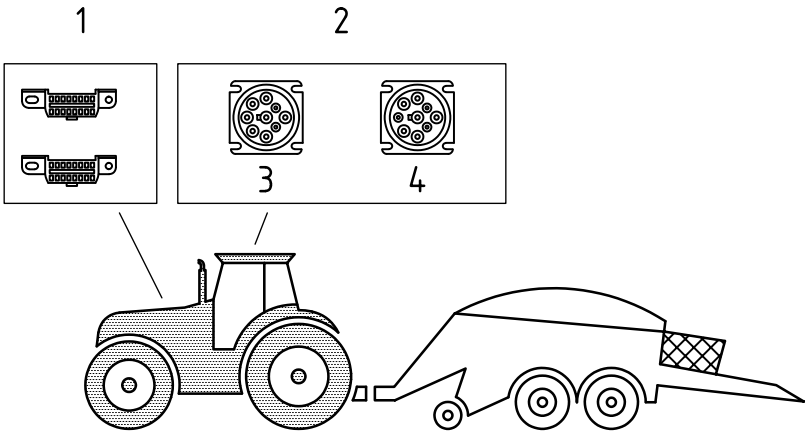
Key

1 diagnostic connectors

2 ISO 11783-2 (black or grey)

3 SAE J1939-13 type 2 (green)

Figure 4 — Tractor with non-ISOBUS diagnostic connectors



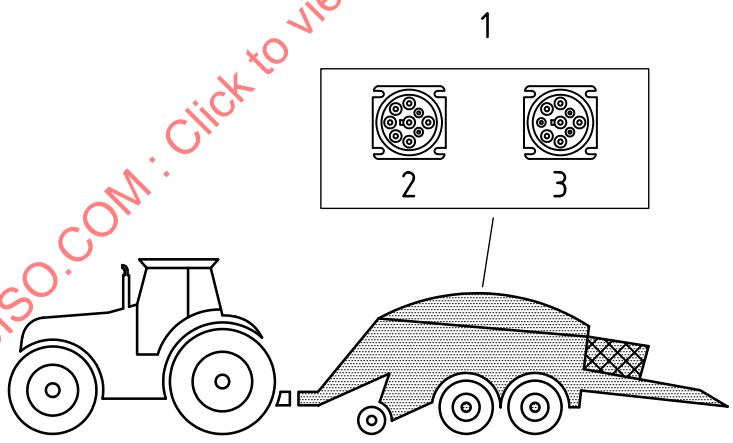
Key

1 OBD II (12V or 12V)
2 diagnostic connectors
3 ISO 11783-2 (black or grey)
4 SAE J1939-13 type 2 (green)

Figure 5 — Tractor with non-ISOBUS OBD and diagnostic connectors

5.1.4.2 Non-ISOBUS implements

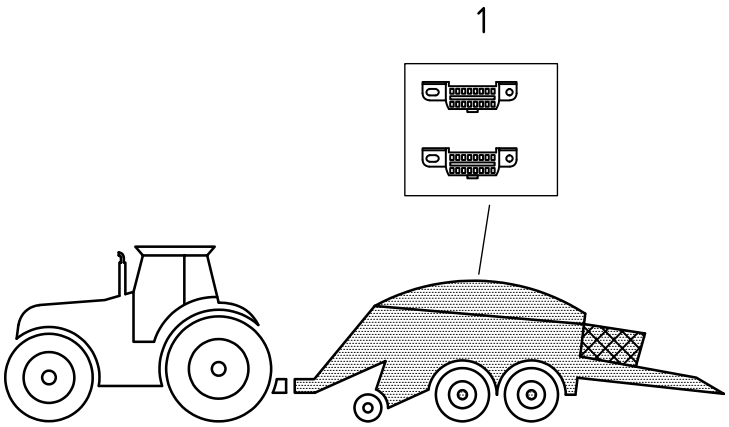
On a non-ISOBUS implement, a standard diagnostic connector shall be available for diagnostics purpose. The diagnostic connector should conform with ISO 11783-2:2019, 7.6.5.



Key

1 diagnostic connectors
2 ISO 11783-2 (black or grey)
3 SAE J1939-13 type 2 (green)

Figure 6 — Implement with non-ISOBUS diagnostic connectors



Key

1 OBD II (12V or 24V)

Figure 7 — Implement with non-ISOBUS OBD II connector

5.2 Vehicle software

5.2.1 Protocols

5.2.1.1 General

One of the following standard protocols shall be used:

- Communication protocols
  - ISO 11783
  - Raw CAN [ISO 11898 (all parts)]
  - SAE J1939
- Diagnostics protocols
  - ISO 11783-12 – ISOBUS
  - SAE J1939-73
  - DoCAN–UDS or KWP on CAN ISO 15765-2, ISO 14229-3, ISO 14230-1, ISO 14229-5
    - Implementation of UDS or KWP on SAE J1939 or ISOBUS is possible
    - ISO 27145-6 (WWH-OBD)
  - DoIP–UDS on IP (ISO 13400-2, ISO 14229-3, ISO 14229-5)

The three standard APIs (TMC RP1210, SAE J2534, and ISO 22900-2) are specified in 6.2.1.

5.2.1.2 ISOBUS products

ISOBUS vehicles shall provide the diagnostic information described in ISO 11783-12.

5.2.1.3 Engine related systems

Specific diagnostics protocol definition for engine related systems are not available.

5.2.2 Vehicle identification number

To communicate the vehicle identification one of the following standards should be used:

— ISO 10261 specifying PIN;

— ISO 3779 and ISO 3780 specifying VIN.

5.2.3 Communication

If provided, the VIN/PIN should be sent on request by minimum one control function of a vehicle (for example TECU of a tractor or the Working Set Master of an implement).

5.3 Support of IO

5.3.1 VM specific diagnostics and reprogramming tool

Specific diagnostics and reprogramming tools as provided by the VM to the AR may be used. IO shall get non-discriminatory access to the same information and tools as available to the AR.

5.3.2 Generic diagnostic tools

VM shall support the creation of generic diagnostic tools, and this support shall be based on a contract with IO.

For reprogramming capabilities, and the design of the diagnostic tool, Annex A should be applied.

6 Generic diagnostic tool

6.1 Diagnostic tool hardware

6.1.1 General requirements standard VCI

6.1.1.1 Environmental requirements standard VCI

The following environmental requirements should be met:

— stocking temperature range −20 °C to +50 °C;

— operating temperature 0 °C to +50 °C;

— protection class IP 54 minimum;

— full galvanic isolation between interface to service PC and vehicle (for signal interfaces as well as for power supply);

— compliance with normative EMC requirements;

— protection against load dump/surges ± 100 V continuous;

— operational from 8 V to 32 V.

6.1.1.2 Functional requirements standard VCI

Continuous operation capabilities shall be provided.

6.1.1.3 VCI user interface

The Standardized VCI shall support indication for the following:

— VCI Power/operation;

— connection to service PC established;

— connection to vehicle established.

by using visual indication.

6.1.1.4 Firmware update

The standard VCI shall support VCI firmware updates.

6.1.1.5 Built-in VCI

A built-in VCI, integrated into the vehicle, meeting the minimum requirements for connecting to the vehicle in the same manner as an independent VCI may be used.

Any VM specific implementation of the diagnostic API shall be provided by the VM.

This built-in VCI shall not remove the requirements for the standard diagnostic connector. The built-in VCI shall not interfere with any of the following:

— diagnostic functions that can be performed through the standard VCI;

— VCI drivers;

— diagnostic runtime stacks.

A built-in VCI should support at least one of the defined APIs (e.g. TMC RP1210, SAE J2534 and ISO 22900-2) to facilitate diagnostic connections to ISOBUS machines connected on the ISO 11783 network.

6.1.2 Interfaces

6.1.2.1 General

The standard VCI shall support the following vehicle interfaces:

— bus

— network

6.1.2.2 Bus interfaces

The standard VCI shall support the following related to bus interfaces:

— Minimum 2 simultaneous CAN channels:

  — ISOBUS (ISO 11898-2 250 kBit/s);

  — Internal tractor or internal implement bus;

  — ISO 15765 [ISO 11898-2 250 kBit/s (no auto-detection) or 500 kBit/s auto detection];

— No termination inside the VCI or VCI cable;

— Dual CAN wire only (not below 250 Kbit/s);

— High-speed CAN only (not below 250 Kbit/s);

— Support passive mode (listen only);

— CAN FD (ISO 11898-1);

— Support baud rate detection (as specified in ISO 15765-4 for OBD on CAN).

6.1.2.3 Network interfaces

A standard VCI shall support at least one Ethernet interface 100Base-TX for DoIP, including activation line. Ethernet Activation Line for DoIP shall support determination of Ethernet pin option #1 or #2 and option detection via Ethernet activation line (ISO 13400-3). Option #1 and #2 have different pin assignments.

6.1.2.4 Diagnostic connectors

All mandatory diagnostic connectors given in 5.1.1 shall be supported. It is optional to support multiple connectors (e.g. ISO 13400-4 and SAE J1939/ISOBUS) in parallel.

6.1.2.5 Pinning

The pinning on the diagnostic connector of a standard VCI shall be switchable (on, off, inactive, high impedance), if necessary, and shall support dynamic assignment to interfaces (multiplexer).

NOTE The pinning on the vehicle side is defined by the VM.

6.1.2.6 Multiple diagnostic connectors

The standard VCI shall use the described vehicle connectors to connect to tractor and/or implement for communication:

— Standard VCI hardware:

  — Switch – optional;

  — Matrix – optional (not vehicle responsibility);

— Matrix Unit for the communication channels:

  — To switch the right assignment to the diagnostic connector;

  — To switch only the communication units to the diagnostic connector where the access is allowed and known (for example tractor-bus can have different physical layers and baud rates).

Handling of cable pins shall be covered at diagnostic API level.

6.1.2.7 Power

The standard VCI shall be powered via the diagnostic connector (see 5.1.1) or via the USB port.

6.1.2.8 Interface to PC

The VCI shall support one of the following interfaces:

— USB 2.0 or higher

— Ethernet (IEEE 802.3)

— Wi-Fi

  — IEEE 802.11 a/b/g/n/h with infrastructure and access point mode

  — Encryption: WEP, WPA and WPA2/PSK

  — Authentication: EAP-PEAP, EAP-TLS, EAP-TTLS

— Bluetooth 4.0 or higher

Other interfaces may be used in combination with the above interfaces.

6.1.2.9 ISOBUS

ISOBUS vehicles should be diagnosed via the tractor using diagnostic connector according to ISO 11783-2. Additional standard diagnostic connectors directly mounted on the implement may be used to diagnose the implement as shown in Figure 8.

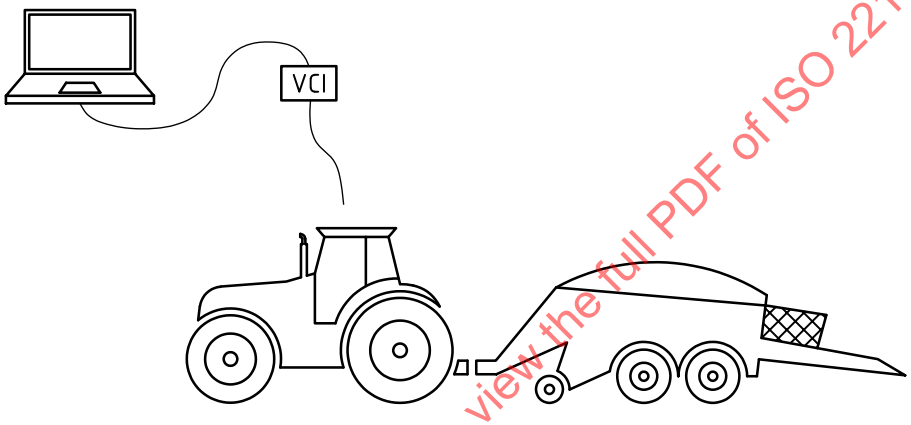


Figure 8 — ISOBUS products

6.1.2.10 Non-ISOBUS

Non-ISOBUS vehicles should be diagnosed on the vehicle itself directly. Implements may be diagnosed via the tractor as a secondary diagnostic path as shown in Figure 9.

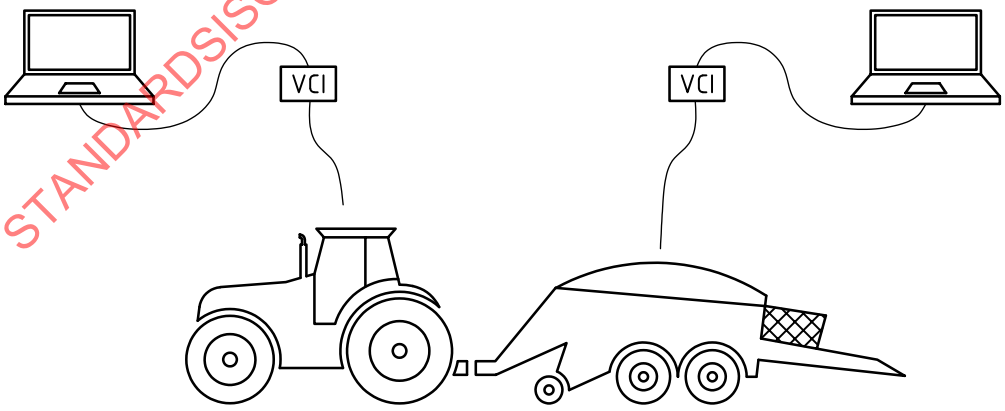


Figure 9 — Non-ISOBUS products

6.1.3 PC

6.1.3.1 PC hardware

The provider of the diagnostic tool shall specify minimum PC requirements to operate the tool. This shall include hardware and communication interface requirements such as

— Processor: minimum … GHz

— RAM: minimum … GB RAM

— Hard Disc: minimum … GB

— Display: …pixel

— USB …

— Ethernet …

— Wi-Fi …

— Bluetooth …

Access to the internet shall be available to be able to receive updates.

6.2 Standard diagnostic tool software

6.2.1 Standard APIs

6.2.1.1 General

A VM diagnostic application shall support at least one of the standard software APIs (e.g. TMC RP1210, SAE J2534, ISO 22900-2).

VM may use the Raw CAN (ISO 11898-1 and ISO 11898-2) interface of the standard API interface to implement any kind of VM specific diagnostic protocol. If a VM uses a specific diagnostic protocol, implementation information shall be provided to the IO. See Figure 10.

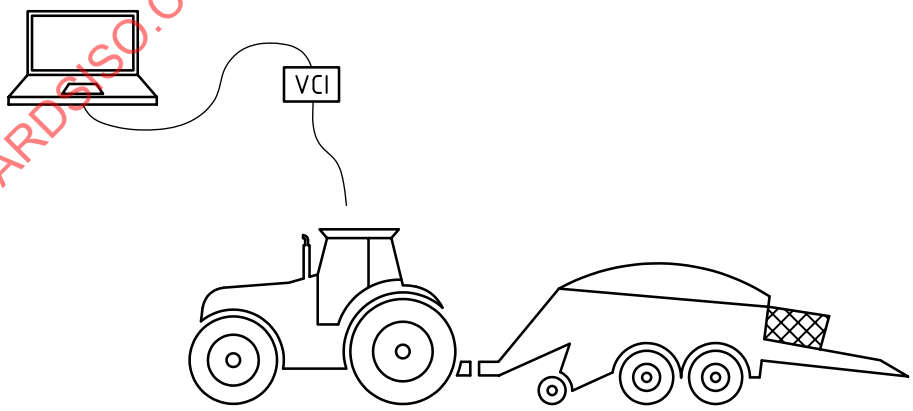


Figure 10 — Standard VCI software API

6.2.1.2 TMC RP1210

The TMC RP1210 shall support the Raw CAN protocol.

6.2.1.3 Pass Thru

The SAE J2534-2 Pass Thru shall support the following protocols:

— Raw CAN

— UDS on CAN according to ISO 14229-3 on ISO 15765-2 or on SAE J1939

— KWP2000 on CAN

6.2.1.4 ISO 22900-2 D-PDU API

The ISO 22900-2 D-PDU API shall support the following protocols:

— Raw CAN

— UDS on CAN (ISO 14229-3 on ISO 15765-2 or on SAE J1939)

— KWP2000 on CAN

— UDS on IP (ISO 14229-5 or ISO 13400-2)

6.2.2 Standard VCI APIs

6.2.2.1 Protocols

All standard protocols given in 5.2.1 shall be supported.

VM specific protocols are allowed. Other protocols are not used for the VCI but may be supported for VM specific legacy machinery. CAN based protocols can be realized by Raw CAN function of the VCI in combination with application specific handling of the VM specific protocol.

NOTE ISOBUS is not fully covered until the VCI APIs are made available. Information for VM specific protocols to be agreed between IO and VM by contract (see ISO 22172-1:2020, 7.7).

6.2.2.2 Multiplexing

The VCI shall support multiplexing on CAN bus.

The VCI shall start in a safe mode.

Multiplexing on CAN bus is allowed on the API standard (RP1210) if pinning is predetermined.

6.2.3 Coexistence of software

6.2.3.1 General

The tool software shall not influence the software interfaces from other VCI manufacturers on the same PC.

6.2.3.2 Other diagnostic applications

If any VM-specific software is to be installed on the IO client it shall act in such a way that the functionality of the IO PC is unaffected when the VM software is not running, except for VM installed software files.

In cases where the VM software installations on the IO client side cannot be performed without IO cooperation, the IO shall take the necessary steps to facilitate the installation following the instructions from the VM.

6.2.3.3 Other VCI interfaces

The VM RMI website shall inform the user about the VCI APIs supported. The tool software shall not influence the software from other VCI manufacturers on the same PC.

6.2.3.4 Coexisting requirements

Any specific software on the IO client shall be responsible for resetting the PC system configuration to the same state as it was before it started, excepting the specific software configuration and general-purpose services and processes.

6.2.3.5 Removal of specific software

The specific software is responsible for removing installed software files, data, registry entries and folders when the user requests to uninstall the VM software.

6.2.4 Operating system and web application requirements

Diagnostic tools should be operational on current, common operating systems and/or internet browsers. Functionality should be maintained as operating systems and browsers are updated.