
**Road vehicles — Communication
between vehicle and external equipment
for emissions-related diagnostics —**

**Part 3:
Diagnostic connector and related
electrical circuits, specification and use**

*Véhicules routiers — Communications entre un véhicule et un
équipement externe pour le diagnostic relatif aux émissions —*

*Partie 3: Connecteur de diagnostic et circuits électriques associés:
spécifications et utilisation*



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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 15031-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 15031 consists of the following parts, under the general title *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics*:

- *Part 1: General information*
- *Part 2: Terms, definitions, abbreviations and acronyms*
- *Part 3: Diagnostic connector and related electrical circuits, specification and use*
- *Part 4: External test equipment*
- *Part 5: Emissions-related diagnostic services*
- *Part 6: Diagnostic trouble code definitions*
- *Part 7: Data link security*

Introduction

The various parts of ISO 15031, when taken together, provide a coherent, consistent set of specifications for facilitating emissions-related diagnostics. ISO 15031-2 to ISO 15031-7 are based on recommended practices of the society of automotive engineers (SAE). This part of ISO 15031 is based on SAE J1962:02/98, *Diagnostic Connector*.

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Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 3: Diagnostic connector and related electrical circuits, specification and use

1 Scope

This part of ISO 15031 specifies a minimum set of requirements for a diagnostic connector used in communication between vehicle and external equipment for emissions-related diagnostics. Its aim is to promote the use of a common diagnostic connector throughout the motor vehicle industry. The diagnostic connection consists of two mating connectors, the vehicle connector and the external test equipment connector. Applicable to all types of road vehicles, the connector specified has no positive locking feature and is intended for short-term diagnostic connection only.

This part of ISO 15031 specifies functional requirements for

- a) the vehicle connector, separated into the four principal areas of
 - 1) connector location/access,
 - 2) connector design,
 - 3) connector contact allocation, and
 - 4) electrical requirements for connector and related electrical circuits, and
- b) the external test equipment connector, separated into the three principal areas of
 - 1) connector design,
 - 2) connector contact allocation, and
 - 3) electrical requirements for connector and related electrical circuits.

The dimensional requirements of the vehicle connector are given as a minimum specification, to allow design freedom.

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 8092-2:2000, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 2: Definitions, test methods and general performance requirements*

ISO 8092-3, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 3: Tabs for multi-pole connections — Dimensions and specific requirements*

ISO 9141-2, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information*

ISO 14230-4, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 4: Requirements for emission-related systems*

ISO 15031-4, *Road vehicles — Communication between vehicle and external test equipment for emissions-related diagnostics — Part 4: External test equipment*

ISO 15765-4, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 4: Requirements for emissions-related systems*

ISO 16750-2, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads*

SAE J1850 (all parts), *Class B Data Communication Network Interface*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

- 3.1 connection**
two mated connectors or contacts
- 3.2 connector**
assembly of contact and housing which terminates conductors for the purpose of providing connection and disconnection to a suitable mating connector
- 3.3 contact**
conductive element in a connector (including means for cable attachment) which mates with a corresponding element to provide an electrical path
- 3.4 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
- EXAMPLE Receptacle, sleeve.
- 3.5 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
- EXAMPLE Tab, pin, blade.

4 Vehicle connector location/access

4.1 General

This clause specifies vehicle connector location variations based upon vehicle weight classification and connector type (Type A or B). It should be recognized that country or regional governments could mandate a connector location which supersedes these provisions.

4.2 Consistency of location

4.2.1 Vehicle connectors Type A

4.2.1.1 Passenger cars and light duty vehicles

The connector shall be located in the passenger or driver's compartment in the area bounded by the driver's end of the instrument panel to 300 mm beyond the vehicle centreline, attached to the instrument panel and easy to access from the driver's seat. The preferred location is between the steering column and the vehicle centreline. The vehicle connector shall be mounted to facilitate mating and unmating.

4.2.1.2 Heavy duty vehicles

4.2.1.2.1 Trucks

The connector shall be located in the passenger or driver's compartment in the area bounded by the driver's end and the co-driver's end of the instrument panel, including the outer side. It shall be attached to the instrument panel and easy to access from the driver's seat or from the co-driver's seat or from the outside. The vehicle connector shall be mounted to facilitate mating and unmating.

4.2.1.2.2 Buses

For left-hand-driven and right-hand-driven buses and coaches *without* co-driver's seat, the connector shall be located in the area bounded by the driver's end and front passenger door-sided end of the instrument panel, including the outer side or behind the driver in the partition wall, in an area bounded by the driver's compartment, with access from the driver's seat.

For left-hand-driven and right-hand-driven buses and coaches *with* co-driver's seat, the connector shall be located in the area bounded by the driver's end and the co-driver's end of the instrument panel, including the outer side or behind the driver in the partition wall, in an area bounded by the driver's compartment, with access from the driver's seat.

4.2.2 Vehicle connectors Type B

4.2.2.1 Light duty vehicles

The connector shall be located in the passenger or driver's compartment in the area bounded by the driver's end and the co-driver's end of the instrument panel, including the outer side, and an imagined line 750 mm beyond the vehicle centreline. It shall be attached to the instrument panel and shall be easily accessed from the driver's seat or from the co-driver's seat or from the outside. The vehicle connector shall be mounted to facilitate mating and unmating.

4.2.2.2 Heavy duty vehicles

4.2.2.2.1 Trucks

The connector shall be located in the passenger or driver's compartment in the area bounded by the driver's end and the co-driver's end of the instrument panel, including the outer side. It shall be attached to the

instrument panel and easy to access from the driver's seat or from the co-driver's seat or from the outside. The vehicle connector shall be mounted to facilitate mating and unmating.

4.2.2.2.2 Buses

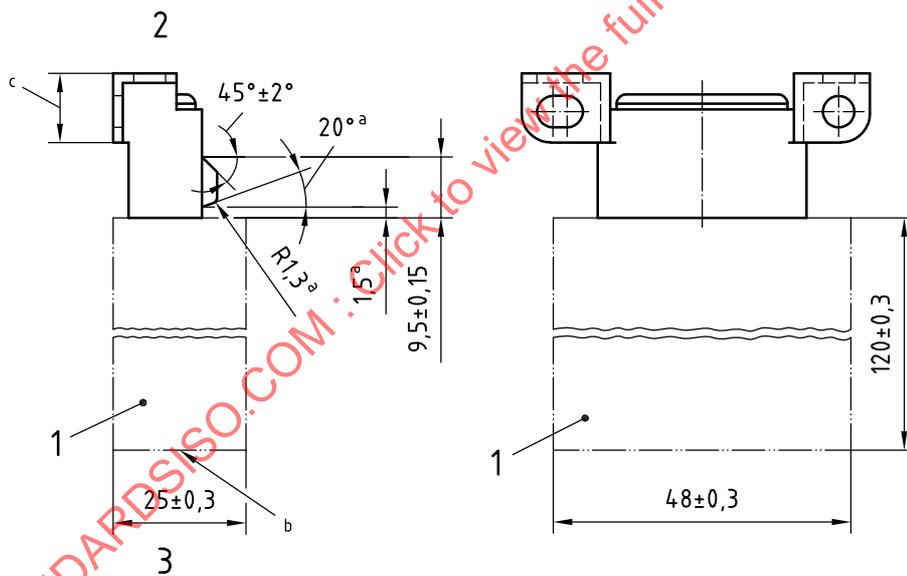
For left-hand-driven and right-hand-driven buses and coaches *without* co-driver's seat, the connector shall be located in the area bounded by the driver's end and front-passenger-door side end of the instrument panel, including the outer side or behind the driver in the partition wall, in an area bounded by the driver's compartment, with access from the driver's seat.

For left-hand-driven and right-hand-driven buses and coaches *with* co-driver's seat the connector shall be located in the area bounded by the driver's end and the co-driver's end of the instrument panel, including the outer side or behind the driver in the partition wall, in an area bounded by the driver's compartment, with access from the driver's seat.

4.3 Ease of access

Access to the vehicle connector shall not require a tool for the removal of an instrument panel cover, connector cover, or any barriers. The vehicle connector shall be fastened and located so as to permit a one-handed/blind insertion of the mating external test equipment connector. Figure 1 illustrates the diagnostic connector access area for mated connection in the vehicle.

Dimensions in millimetres



Key

- 1 access area
- 2 cable end
- 3 mating end
- a Nominal values.
- b Access to mating end to be clear in this area for the connecting external test equipment connector.
- c Mounting features shown are for guidance only.

Figure 1 — Vehicle diagnostic connector access area

4.4 Visibility

The vehicle connector shall be out of the occupant's (front and rear seat) normal line of sight, but easily visible to a crouching technician.

4.5 Vehicle operation

Attachment of any external test equipment to the vehicle connector shall not preclude normal physical and electrical operation of the vehicle.

5 Vehicle and external test equipment connector design

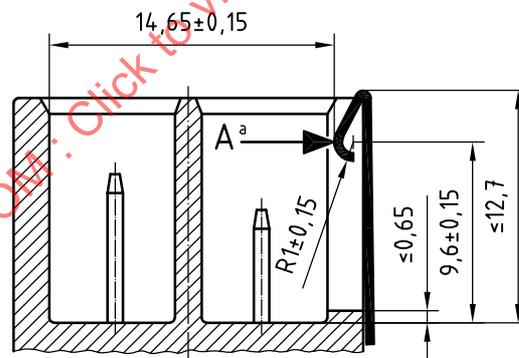
5.1 Dimensions

For the basic dimensions of the vehicle connector and the external test equipment connector, see Figures 2 and 3. For the physical dimensions of both Type A connectors, see Annex A; for both Type B connectors, see Annex B.

The Type A external test equipment connector shall be mateable with the Type A vehicle connector: compliance of the electrical, mechanical and climatic performances of the connection shall be guaranteed.

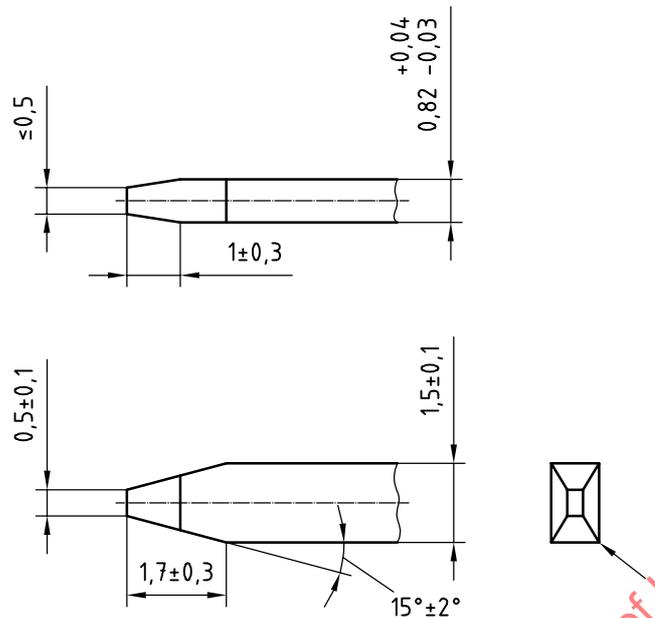
The Type B external test equipment connector shall be mateable with both the Type A vehicle connector and the Type B vehicle connectors: compliance of the electrical, mechanical and climatic performances of the connection shall be guaranteed.

Dimensions in millimetres



^a A force applied as shown by the arrow "A" shall deflect the clip outward for a distance of $2,5 \pm 0,15$; the clip shall recover to its original position. The connector shall be in accordance with 5.10.4 c) with the spring clip in place.

Figure 2 — Spring clip detail (optional)



Dimensions of the 1,5 × 0,8 blade according to ISO 8092-3 are also acceptable.

^a $\geq 0,15 \times 45^\circ$ to eliminate burrs.

Figure 3 — Blade detail

5.2 Number of contacts

The vehicle connector and the external test equipment connector shall each be capable of accommodating 16 contacts.

5.3 Contact requirements

5.3.1 Contact types

The vehicle connector shall consist of female contacts that will mate with the male blade contacts of the external test equipment connector.

5.3.2 Contact spacing

Contact spacing shall be in accordance with Annexes A and B.

5.4 Connector mating

The external test equipment connector contact mating shall be designed so that the signal ground and the chassis ground contacts of the external test equipment connector make electrical contact prior to any other test equipment connector contacts making electrical contact. On the disconnect cycle, these same two contacts shall not lose electrical contact until all of the other contacts have been disconnected.

5.5 Connector shape/features

The mating portions of both the vehicle connector and the external test equipment connector shall be “D”-shaped. The connectors shall have easily discernible polarization features to allow for easy connection in a one-handed/blind operation.

The vehicle connector and the external test equipment connector shall have latching features that ensure that the external test equipment connector will remain mated when properly connected. The latching feature shall be designed to provide a positive feel when the external test equipment connector is fully seated. The latching feature shall not require the activation of any levers on either connector to mate or unmate. Pulling on the external test equipment connector in the disconnecting direction to separate the two mated connectors shall not result in any damage to either connector.

5.6 Spring clip

An optional spring clip in accordance with Figure 2 may be used on the external test equipment connector.

5.7 Temperature class

The minimum temperature range for the selected material shall be Class 2, in accordance with the environmental temperature range specified in ISO 8092-2:2000, Table 3, i.e. $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$.

5.8 External test equipment connector cycle life

The external test equipment manufacturer shall specify the minimum number of mating cycles the external test equipment connector is capable of while meeting the requirements.

5.9 Strain relief

The external test equipment connector shall have strain relief features for the cable connected to it.

5.10 Contact and connector parameters and performance requirements

5.10.1 Preconditioning

Take unused samples and perform 200 mating cycles before applying the test given in 5.10.5 and the requirements given in 5.10.3 and 5.10.4.

5.10.2 Functional parameters for contacts

These are as follows:

- a) the blade size for the external test equipment connector shall be in accordance with Figure 3;
- b) the minimum current-carrying capacity for contacts shall be 10 A d.c. at $20\text{ }^{\circ}\text{C}$;
- c) the temperature range shall be $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ (Class 2 of the environmental temperature range according to ISO 8092-2:2000, Table 3);
- d) the voltage range shall be in accordance with ISO 16750-2;
- e) the contact system shall accept a cross-sectional area of cable conductors of up to $0,75\text{ mm}^2$ and 18 AWG.

5.10.3 Performance requirements for contacts

The contact system (i.e. mated contact pairs) shall meet the performance requirements given in a) and b) of this subclause, following performance of each of the environmental exposures according to 5.10.5. Tests of connection resistance shall be in accordance with ISO 8092-2:2000, 4.8.1.1.

- a) Resistance interface (measured at 1 A): 3 m Ω maximum.

- b) Resistance cable-to-cable per contact pair: 10 mΩ at initial mating when tested with a constant current source of 1 A in accordance with ISO 8092-2:2000, 4.8.1.3.
- c) Recommended connection resistance at low current: 100 mΩ at initial mating when tested with a constant current source of 100 μA in accordance with ISO 8092-2:2000, 4.8.1.2.

5.10.4 Connector system performance requirements

The connector system shall meet the performance requirements given in a) to e) of this subclause, following performance of each of the environmental exposures according to 5.10.5. Measurements shall be taken at room temperature (23°C ± 5°C).

- a) Insulation resistance between adjacent contacts tested in accordance with ISO 8092-2:2000, 4.12: ≥ 20 MΩ.
- b) Contact retention in housing tested in accordance with ISO 8092-2:2000, 4.7.1: ≥ 80 N.
- c) Connection and disconnection force tested in accordance with ISO 8092-2:2000, 4.3.1, fully equipped with 16 contact pairs: ≤ 88 N.
- d) Connector mating force with 16 contact pairs
 - 1) without spring clip: ≤ 110 N;
 - 2) with spring clip: ≤ 142 N (see Figure 1).
- e) Polarization features shall prevent mismating of connectors when a force of 300 N is applied.

The vehicle connector mounting feature shall withstand a force of 300 N applied to the connector mating area in the direction of the connecting and disconnecting process without mechanical and electrical problems.

5.10.5 Accelerated environmental exposures for the vehicle connector

Accelerated environmental testing shall be conducted for the vehicle connector when not mated to the external test equipment connector. Perform each environmental exposure, a) to d), as follows, with separate sample groups. After exposure, the vehicle connector shall be mated to the original external test equipment connector for the performance tests given in 5.10.3 and 5.10.4.

a) Thermal cycling

Subject the sample to 1 000 cycles as follows (see ISO 8092-2:2000, 4.22):

- 1) 30 min at a temperature of -40 °C ± 2 °C;
- 2) 10 s max. transition time;
- 3) 30 min at a temperature of 110 °C ± 2 °C;
- 4) 10 s max. transition time.

b) Temperature/humidity cycling

Subject the sample to 15 cycles as follows (see ISO 8092-2:2000, 4.10).

- 1) Hold the chamber temperature at $t_c = (23 \pm 5) \text{ °C}$ and at 45 % to 75 % RH (relative humidity) for 4 h.
- 2) Raise t_c to $(55 \pm 2) \text{ °C}$ at 95 % to 99 % RH within 0,5 h.

- 3) Hold t_c at (55 ± 2) °C at 95 % to 99 % RH for 10 h.
- 4) Lower t_c to (-40 ± 2) °C within 2,5 h (during this period the relative humidity is uncontrolled).
- 5) Hold t_c at (-40 ± 2) °C for 2 h (during this period the relative humidity is uncontrolled).
- 6) Raise t_c to (85 ± 2) °C within 1,5 h from (-40 ± 2) °C (during this period the relative humidity is uncontrolled).
- 7) Hold t_c at (85 ± 2) °C for 2 h (during this period the relative humidity is uncontrolled).
- 8) Allow to return to room temperature of (23 ± 5) °C within 1,5 h (during this period, the relative humidity is uncontrolled).

Alternative test for temperature/humidity cycling — 15 cycles of the following:

- 1) 16 h at 95 % RH and 40 °C;
- 2) 2 h at -40 °C;
- 3) 2 h at $+85$ °C;
- 4) 4 h at room temperature.

c) Mechanical shock

Apply three shocks at 50 g in each of the three mutually perpendicular axes of the connector.

d) Vibration

Sinusoidal $(1,5 \pm 0,15)$ mm amplitude by 15 g for 2 h in each of the three mutually perpendicular axes at room temperature.

6 Contact allocation and specifications for related electrical circuits

6.1 Vehicle and external test equipment connector contact designation and general allocation

See Figure 4 and Table 1 for vehicle connector and external test equipment contact designations.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16

Figure 4 — Contact designation for vehicle connector mating end view

6.2 General contact allocation

See Table 1 for a summary of contact allocations.

Table 1 — General contact allocation

Contact	General allocation
1	Discretionary ^a
2	Bus positive line of SAE J1850 ^b
3	Discretionary ^a
4	Chassis ground
5	Signal ground
6	CAN_H line of ISO 15765-4 ^b
7	K line according to ISO 9141-2 and ISO 14230-4 ^b
8	Discretionary ^a
9	Discretionary ^a
10	Bus negative line of SAE J1850 ^b
11	Discretionary ^a
12	Discretionary ^a
13	Discretionary ^a
14	CAN_L line of ISO 15765-4 ^b
15	L line according to ISO 9141-2 and ISO 14230-4 ^b
16	Permanent positive voltage

^a Assignment of Contacts 1, 3, 8, 9, 11, 12 and 13 in the vehicle connector is left at the discretion of the vehicle manufacturer.

^b Note, for Contacts 2, 6, 7, 10, 14 and 15 the related diagnostic communication assignments are shown. These contacts may also be used for alternate assignments in the vehicle connector. See 6.3 and 6.5 for further information.

6.3 Vehicle connector contact allocation

6.3.1 Vehicle connector contacts 1, 3, 8, 9, 11, 12 and 13

Allocation of Contacts 1, 3, 8, 9, 11, 12 and 13 of the vehicle connector is left at the discretion of the vehicle manufacturer.

6.3.2 Vehicle connector contact 2

If SAE J1850 10,4 VPW (variable pulse width) is used in a vehicle to supply OBD (on-board diagnosis) required communication services, then Contact 2 of the vehicle connector shall be the SAE J1850 10,4 VPW signal connection.

If SAE J1850 41,6 PWM (pulse width modulation) is used in a vehicle to supply OBD required communication services, then Contact 2 of the vehicle connector shall be the bus positive signal of the SAE J1850 41,6 PWM connection.

However, if neither SAE J1850 10,4 VPW nor SAE J1850 41,6 PWM is used for that purpose, then assignment of the contact is left at the discretion of the vehicle manufacturer, provided the assignment does not interfere with the operation of, nor cause damage to, the tools conforming to ISO 15031-4.

6.3.3 Vehicle connector contact 4

Contact 4 of the vehicle connector is designated chassis Ground and shall be connected electrically to the vehicle chassis such as to provide power ground for external test equipment taking current according to ISO 15031-4.

NOTE See 6.5.3 for use of this contact.

6.3.4 Vehicle connector contact 5

Contact 5 of the vehicle connector is designated signal Ground and shall be implemented in the vehicle connector such as to provide a ground reference for the communication transceivers in external test equipment and as a possible power ground for test equipment taking current as in ISO 15031-4.

Its implementation in the vehicle shall take into consideration noise contributions and node-to-node voltage offset limitations of the OBD communication interface used in the vehicle. A battery minus (-), common vehicle clean signal Ground, "clean", "logic", or other connection points within a vehicle that minimize node-to-node voltage offsets and noise should be used.

NOTE See 6.5.4 for use of this contact.

6.3.5 Vehicle connector contact 6

If ISO 15765-4 CAN is used in a vehicle to supply OBD required communication services, then Contact 6 of the vehicle connector shall be the CAN-High bus signal connection.

However, if ISO 15765-4 is not used for that purpose, then assignment of the contact is left at the discretion of the vehicle manufacturer, provided the assignment does not interfere with the operation of, nor cause damage to, tools conforming to ISO 15031-4.

6.3.6 Vehicle connector contact 7

If a two-wire or one-wire ISO 9141-2 or ISO 14230-4 interface is used in a vehicle to supply OBD required communication services, then Contact 7 of the vehicle connector shall be the K line of the interface.

However, if neither interface is used for that purpose, then assignment of the contact is left at the discretion of the vehicle manufacturer, provided the assignment does not interfere with the operation of, nor cause damage to, tools conforming to ISO 15031-4.

6.3.7 Vehicle connector contact 10

If an SAE J1850 41,6 PWM interface is used in a vehicle to supply OBD required communication services, then Contact 10 of the vehicle connector shall be the bus negative signal of the SAE J1850 41,6 PWM interface.

However, if the interface is not used for that purpose, then assignment of the contact is left at the discretion of the vehicle manufacturer, provided the assignment does not interfere with the operation of, nor cause damage to, tools conforming to ISO 15031-4.

6.3.8 Vehicle connector contact 14

If ISO 15765-4 CAN is used in a vehicle to supply OBD required communication services, then Contact 14 of the vehicle connector shall be the CAN-Low bus signal connection.

However, if ISO 15765-4 is not used for that purpose, then assignment of the contact is left at the discretion of the vehicle manufacturer, provided the assignment does not interfere with the operation of, nor cause damage to, tools conforming to ISO 15031-4.

6.3.9 Vehicle connector contact 15

If a two-wire ISO 9141-2 or ISO 14230-4 interface is used in a vehicle to supply OBD required communication services, then Contact 15 of the vehicle connector shall be the L line of the ISO 9141-2 or ISO 14230-4 interface.

However, if neither interface is used in a vehicle for that purpose, then assignment of the contact is left at the discretion of the vehicle manufacturer, provided it does not interfere with the operation of, nor cause damage to, tools conforming to ISO 15031-4.

6.3.10 Vehicle connector contact 16

Contact 16 of the vehicle connector is designated to provide permanent positive voltage for the external test equipment, both for power and also as a reference for K-line communications. This connection should be protected by the use of a fuse or other circuit protection element. This circuit may be grouped with other circuits.

The following shall apply:

- a) for the usage of Type A connectors according to Annex A, the nominal supply voltage at Contact 16 shall be 12 V d.c. and the current supply supported shall be $\geq 4,0$ A;
- b) for the usage of Type B connectors according to Annex B, the nominal supply voltage at Contact 16 shall be 24 V d.c. and the current supply supported shall be $\geq 2,0$ A.

6.4 Vehicle connector contact protection

The vehicle manufacturer should provide circuit protection in the event that the contacts of the vehicle connector are shorted together. This protection is limited to the ranges of voltages present at the vehicle connector before the external test equipment connector is mated to it.

6.5 External test equipment connector contact allocations and requirements for related circuits

6.5.1 External test equipment connector contacts 1, 3, 8, 9, 11, 12 and 13

The use of external test equipment connector contacts 1, 3, 8, 9, 11, 12 and 13 is left at the discretion of the test equipment manufacturer.

The contacts, seen from the point of connection to the vehicle, shall normally be in a high impedance state, i.e. > 500 k Ω impedance relative to signal ground and > 500 k Ω impedance relative to chassis ground.

Before the condition of these external test equipment connector contacts is changed from this high impedance state, the external test equipment user or equipment or both shall verify the proper usage of these vehicle connector contacts.

6.5.2 External test equipment connector contacts 2, 6, 7, 10, 14 and 15

Assignment and use of external test equipment connector contacts 2, 6, 7, 10, 14 and 15 shall be compatible with the assignment and use of their mating contact in the vehicle connector (see 6.3).

6.5.3 External test equipment connector contact 4

Contact 4 of the external test equipment connector is designated chassis Ground. This contact may be used by the external test equipment as a power ground. Implementation of this contact in the external test equipment connector is optional.

6.5.4 External test equipment connector contact 5

Contact 5 of the external test equipment connector is designated signal Ground. This contact shall be used by the ISO 15031-4 external test equipment as the signal ground reference for vehicle communication transceivers.

External test equipment shall not draw more than 1,5 A through this contact.

NOTE The 1,5 A limit refers to the use of the external test equipment covered by ISO 15031 (e.g. support of the requirements of ISO 15031-4). Support of other uses of the ISO 15031-3 connectors (e.g. shorting a manufacturer discretionary contact to ground) is not affected by this limitation.

6.5.5 External test equipment connector contact 16

Contact 16 of the external test equipment connector is designated as permanent positive voltage and is available to supply operating power and a reference voltage to the external test equipment.

6.6 External test equipment connector contact protection

All circuits connected to the contacts of the external test equipment connector should be protected to the extent that no damage to these circuits will occur if any contact of the external test equipment connector

- is connected to Contact 16 of the vehicle connector, as permanent positive voltage for a current up to 10 A,
- is connected to Contact 4 of the vehicle connector, vehicle chassis Ground, or
- is connected to Contact 5 of the vehicle connector, vehicle signal Ground.

6.7 Minimum impedance between external test equipment connector contacts 4 and 5, and external surface of external test equipment

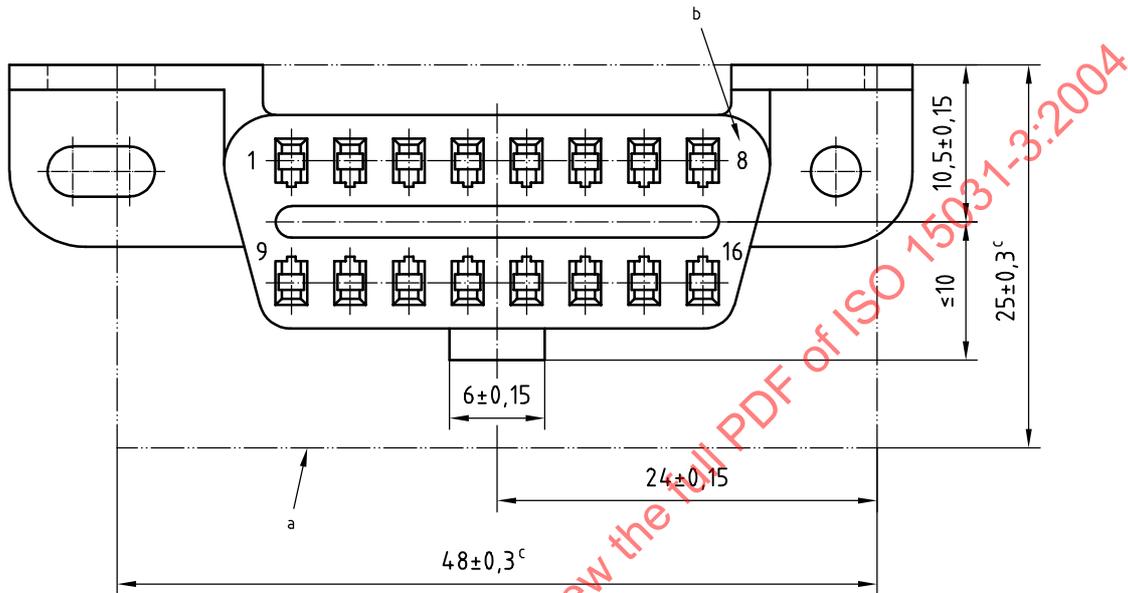
The minimum impedance shall be 1 M Ω between each of the following:

- external test equipment connector contacts 4 and 5;
- external test equipment connector contact 4 and the external surface of the external test equipment;
- external test equipment connector contact 5 and the external surface of the external test equipment.

Annex A
(normative)

Diagnostic connections — Type A

Dimensions in millimetres



- a Access to the mating end shall be clear in this area for the connecting external test equipment connector.
- b Circuit identification shall be, at minimum, 1,3 mm and 0,1 mm raised characters.
- c Access area.

Figure A.1 — Vehicle connector Type A

- a See Figure 1 for mating connector clearance.
- b Blade detail: see Figure 3.
- c Construction shown is for guidance only.
- d Alignment tab detail.
- e Blades No. 4 and No. 5 have extended length for ground circuit application.
- f No draft.

Figure A.2 — Type A external test equipment connector *(continued)*

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