



SURFACE VEHICLE RECOMMENDED PRACTICE

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Permanently or Semi-Permanently Installed
Diagnostic Communication Devices

RATIONALE

SAE J3005-1 is being published as a recommended practice for permanently and semi-permanently installed diagnostic communication devices such as, but not limited to, Remote I/M applications, Portable Emission Measurement Systems (PEMS), GPS systems, Wireless-LAN or Bluetooth interfaces, insurance devices, and Electronic Logging devices. The SAE J3005-1 devices are not intended to be used for SAE J1699-3 vehicle validation testing. The document focuses on OBD-mandated CAN communication protocols, defined in SAE J1979.

It is not the purpose of this document to preclude the use of vehicle manufacturer-specific protocols, PIDs, or connector pins used by vehicle manufacturers. Device manufacturers should check with vehicle manufacturer guidelines before using vehicle manufacturer-specific information.

FOREWORD

The SAE J1962 connector was developed as a standardized connector for use in passenger cars, light duty, medium duty, and heavy duty trucks which, since mandated in 2008 MY, utilize ISO 15765-4 as OBD protocol to access on-board diagnostic information by “generic” test equipment. The access was anticipated to be for short term use in a controlled environment to facilitate a maintenance procedure, e.g., the “generic” test equipment is installed in the vehicle in a workshop and is removed before the vehicle leaves the workshop.

Since then, permanently and semi-permanently installed devices have made use of the standardized connector and data for purposes other than a temporary maintenance procedure.

There are some areas where this can be a problem:

- Disturbance of in-vehicle functionality (internal diagnostic clients, i.e., ECUs; e.g., internal data loggers, telematics gateways requesting information from other ECUs utilizing diagnostic protocol services)
- Disturbance of in-vehicle (normal mode) communication
- Disturbance of vehicle function (e.g., draining of battery)

The intention of SAE J3005-1 is to provide guidelines to device vendors in order to minimize the risk of these problems.

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1. SCOPE

1.1 Purpose

The scope of the document is to define communication best practices in order to minimize problems for the vehicle owner when installing equipment which has a permanently or semi-permanently diagnostic CAN communication device connected to the SAE J1962 connector, or hardwired directly to the in-vehicle network.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1930	Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISO/TR 15031-2
SAE J1962/ISO 15031-3	Diagnostic Connector
SAE J1699/2	Test Cases for OBD-II Scan Tools and I/M Test Equipment
SAE J1699/4	OBD II Communications Anomaly List
SAE J1978	OBD II Scan Tool - Equivalent to ISO/DIS 15031-4: December 14, 2001
SAE J1979	E/E E/E Diagnostic Test Modes
SAE J1979	Digital Annex
SAE J2012/ISO 15031-6	Diagnostic Trouble Code Definitions

2.1.2 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 11898-2	Road Vehicles - Controller Area Network (CAN) - Part 2: High-Speed Medium Access Unit
ISO 14229-2	Part 2: Session Layer Services
ISO 15765-4	Requirements for Emissions-Related Systems
ISO 27145-2	Road Vehicles - Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) Communication Requirements - Part 2: Common Data Dictionary
ISO 27145-3	Road Vehicles - Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) Communication Requirements - Part 3: Common Message Dictionary
ISO 27145-6	Road Vehicles - Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) Communication Requirements - Part 6: External Test Equipment

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

ELD (US)	49 CFR Parts 385,386, 390, and 395
PEMS (Euro VI)	R49 Annex 2 http://ec.europa.eu/enterprise/sectors/automotive/environment/eurovi/
PEMS (US)	40 CFR Part 1065, Subpart J - Field Testing and Portable Emission Measurement Systems
Remote OBD Guidance	September 2010: http://www.obdclearinghouse.com

2.3 Terms and Definitions

2.3.1 Definitions

2.3.1.1 CALID (CALIBRATION IDENTIFICATION)

A part number (or similar) is used to identify the firmware or calibrations.

2.3.1.2 CLASS A

Class A is a malfunction which causes the emissions to exceed the OBD threshold limit during emission tests, used in Euro VI regulation for heavy duty vehicles.

2.3.1.3 CLASS B1

Class B1 is a malfunction which causes the emissions to increase and may exceed the OBD threshold limit during some emission tests, used in Euro VI regulation for heavy duty vehicles.

2.3.1.4 CLASS B2

Class B2 is a malfunction which causes the emissions to increase but not exceed the OBD threshold limit, used in Euro VI regulation for heavy duty vehicles.

2.3.1.5 CONTINUOUS-MI (CONTINUOUS MALFUNCTION INDICATOR)

Continuous-MI is when the MIL is commanded to be on for an emission relevant fault of Class A, or if an emission-relevant fault of Class B1 has been detected during 200 engine operation hours, used in Euro VI regulation for heavy duty vehicles.

2.3.1.6 CVN (CALIBRATION VERIFICATION NUMBER)

Checksum of the emission related part of the application firmware in the ECU or the calibration data set.

2.3.1.7 DID (DATA IDENTIFIER)

A DID is a fixed pointer to a parameter in the firmware; it can be read, written to, or controlled.

2.3.1.8 ELD (ELECTRONIC LOGGING DEVICES)

Electronic logging device (ELD) means a device or technology that automatically records a driver's driving time and facilitates the accurate recording of the driver's hours of service.

2.3.1.9 ECU (ELECTRONIC CONTROL UNIT)

An ECU is an on-board (in-vehicle network) computer for vehicle functions.

2.3.1.10 GTR (GLOBAL TECHNICAL REGULATION)

GTR is the regulation which has been the base document for the Euro VI regulation for heavy duty vehicles.

2.3.1.11 I/M (INSPECTION AND MAINTENANCE)

Periodic inspection is a cyclic inspection of the vehicle; this includes emission check.

2.3.1.12 INTRUSIVE DIAGNOSTIC SERVICE

An intrusive diagnostic service is a diagnostic service which will affect the normal functionality of the ECU or the vehicle.

2.3.1.13 ITID (INFORMATION TYPE IDENTIFIER)

A type of DID which contains static or semi-static information, as defined by SAE J1979-DA.

2.3.1.14 ND (NOMADIC DEVICE)

A nomadic device is a portable/mobile communication device (e.g., smartphone or tablet).

2.3.1.15 NON-INTRUSIVE DIAGNOSTIC SERVICE

A non-intrusive diagnostic service is a diagnostic service which does not alter or change the functionality of an ECU, system, or the vehicle. Examples of non-intrusive services are read data services, e.g., Service 0x01, Service 0x06, or Service 0x09 of SAE J1979.

2.3.1.16 NV MEMORY (NON-VOLATILE MEMORY)

Non-volatile memory keeps its data when there is no supply voltage (e.g., flash memory).

2.3.1.17 PEMS (PORTABLE EMISSION MEASUREMENT SYSTEM)

As defined in 40 CFR, Part 1065, subpart K:

Portable emission measurement system (PEMS) means a measurement system consisting of portable equipment that can be used to generate brake-specific emission measurements during field testing or laboratory testing.

2.3.1.18 PERMANENTLY CONNECTED DIAGNOSTIC COMMUNICATION DEVICE

Refers to a device which is hardwired into the in-vehicle wire harness (e.g., in taxi vehicles) for a long time; i.e., it is connected for days, not hours, and during normal vehicle operation. The permanently connected diagnostic communication device can often only be removed by a service technician.

2.3.1.19 PID (PARAMETER IDENTIFIER)

PID is an older term for DID, defined in SAE J1979-DA.

2.3.1.20 REMOTE DEVICE

A remote device is a device which gathers data and sends it to a remote location using wireless technology.

2.3.1.21 REMOTE OBD

Remote OBD program is a remote I/M program defined by OBD Clearinghouse.

2.3.1.22 SEMI-PERMANENTLY CONNECTED DIAGNOSTIC COMMUNICATION DEVICE

Refers to a device which is plugged in into the SAE J1962 connector during normal vehicle operation. The difference between a permanently connected device and a semi-permanently connected diagnostic communication device is that the latter may be removed after some time by just disconnecting it from the SAE J1962 connector.

2.3.1.23 SHORT-MI (SHORT MALFUNCTION INDICATOR)

Short-MI is when the MIL is commanded to be on for an emission relevant fault of Class B1 or B2. The MIL is just illuminated for a short time during engine start.

2.3.1.24 TAMPERING

Tampering is when someone tries to mislead the system, e.g., by connecting a remote device to an incorrect vehicle, or by using an ECU sending false information to the remote device.

2.3.1.25 TELEMATICS

Telematics typically is any integrated use of telecommunications and informatics for sending, receiving, and storing information via telecommunication devices for application in vehicles.

2.3.1.26 VIN (VEHICLE IDENTIFICATION NUMBER)

Number used to identify a vehicle, according to ISO 3779.

2.3.1.27 INFRASTRUCTURE

Infrastructure is used by this document as the equipment used to receive the data sent by the remote OBD devices, transport the information, and to store it in a database used by regulatory agencies. It is the term for handling the information off-board.

2.3.2 Symbols

Deg: degrees

g/s: grams per second

Hz: hertz

KPa: kilopascal

ms: milliseconds

mW: milliwatt

μA: microampere

Nm: newton meter

%: percent

rpm: revolutions per minute

V: volt

3. TECHNICAL REQUIREMENTS

3.1 Mechanical Requirements

The size of the connected part of the device shall fit into the space defined by SAE J1962.

The device shall not interfere with normal driving, i.e., the size must be such that it does not interfere with the vehicle operations or cause injuries during collision.

3.2 Electrical Requirements

The device shall adhere to the electrical requirements of the SAE J1962 connector and for CAN, the electrical requirements in ISO 15765-4, and the electrical characteristics as defined in ISO 11898-2. The device manufacturer shall respect the maximum cable length, the capacitance, and the physical termination of the CAN bus.

OBD-defined pins 6 and 14 in SAE J1962 are allowed to be used for CAN-based devices. The device vendor shall utilize equipment with high impedance for all other pins, as recommended in SAE J1962.

The device shall go into a low power mode when the vehicle is in power save mode. When in this mode, the device should not exceed an average current consumption of 100 μ A at nominal 12.0 V permanent voltage systems (i.e., average wattage of 1.2 mW). Higher power consumption will affect the vehicle's battery and may affect its ability to start.

There are a variety of methods that can be used by the remote device to determine when it shall enter a "low power" mode. The exact method(s) will be application-specific, but here are some examples:

- No responses are received to requests.
- No messages are detected for 5000 ms.
- The information in the response indicates engine rpm=0 and vehicle speed=0 for a specified time.
- There is no movement measured for a period measured by the accelerometers in the nomadic device or in the wireless interface.
- The device can monitor if battery voltage is less than; e.g., 13 V (for a 12 V system).

NOTE: It is not possible to detect a higher voltage (e.g., 13 V for a 12 V system) in vehicles which utilize 48 V systems, since the 12 V voltage is regulated from the 48 V and does not change when the engine is running.

- There is no connection to the nomadic device.
- If the vehicle manufacturer can support ignition key signal (if supported by the vehicle) on a DLC pin.
- The device loses its wireless connection, i.e., no signaling is done on the wireless interface.

NOTE: Care must be taken since devices may interrupt OBD evaporative monitoring, which can be executed in: after run, after run low power mode, or after a wake up of the vehicle network after from a vehicle manufacturer-predefined time.

There are a variety of methods that can be used by the remote device to determine when it could exit a "low power" mode. The exact method(s) will be application specific, but here are some examples:

- An increase of battery voltage from 12 V to above 13 V for 12 V systems.
- Wireless connection or signaling initiated by the remote device used for long range communication.
- Ignition key information (if supported by the vehicle).

- Accelerometers in the remote device detect movement.
- The remote device needs to run internal management operations.

3.3 Communication Requirements (Vehicle Communication)

The device shall fulfill the requirements of SAE J1978/ISO 15031-4 and SAE J1699/2 in order to not disturb the in-vehicle communication, and shall utilize the initialization sequence of ISO 15765-4 in order to establish communication before sending diagnostic requests.

NOTE: The reason is that on-board clients may check for the initialization sequence in order to stop their communication if an external client is connected.

It is only possible to connect one external device, which sends diagnostic requests, to the diagnostic connector at a given time, i.e., a split cable with two diagnostic communication devices attached will not work if the cable doesn't include logic to disable one of the external devices, or if the permanent OBD device can go into a bus monitoring state when it detects another device communicating on the CAN bus.

The device communicating on CAN shall fulfill the timing requirement as specified in ISO 15765-4.

The device shall limit the time when it requests data in order to let other internal diagnostic clients access the in-vehicle network, e.g., not requesting data when the user/operator is not using the device, in case of a device supporting user interface. If the device does not retrieve data from the vehicle for a certain time (10 minutes, for example), or after every crank event, a new initialization sequence according to ISO 15765-4 shall be executed if the vehicle is not responding as expected.

NOTE: The on-board diagnostic clients can check for a pause in the transmission of diagnostic requests and if that pause is longer than 10 minutes (for example), then the on-board diagnostic client may start its own diagnostic requests and continue until it detects a new initialization.

The device shall utilize the P2 reload scheme, as defined in ISO 14229-2, for robust communication.

Both SAE J1979 services and vehicle manufacturer-specific (e.g., ISO 14229-3) services are possible to use, if supported by the vehicle. The device vendor should check with the OEM for guidelines before using vehicle manufacturer-specific information to get the correct description/translation file for the supported data, information of supported services, and which timing or ECU addresses to use. Both SAE J1979 and ISO 14229-1 include details of how the communication works and what positive and negative responses exist; therefore, this document does not include that information.

Reading data is not a problem, but other services may cause problems. Intrusive diagnostic services may cause disturbances for the on-board systems and should only be used when the vehicle is stationary, e.g., vehicle speed is zero and gear selection is in park or neutral for automatic transmissions, or in neutral with the park brake engaged for manual transmissions.

NOTE: If the vehicle is equipped with gateway functionality according to SAE J3138, those intrusive diagnostic services will be blocked. Refer to SAE J3138. There are many ways a device's implementation of datalink communication strategy may cause disturbances to a vehicle network. Bus overload conditions can occur if the update frequency is too high, or the device requests a service that directly affects the behavior of the vehicle. Care shall be taken to determine what the capabilities of the vehicle are before using the device. See A.4.1, A.6.1, and A.7.1 for guidance on data request rates.

Many diagnostic services or diagnostic routines have been developed to be used by a skilled service technician and in a controlled environment such as in a workshop and are not intended to be used while the vehicle is moving. The detection of pre-conditions for using those diagnostic routines can vary between vehicle manufacturers and also between ECUs in a vehicle, e.g., an ISO 14229-1 service 0x11 ECUReset while the vehicle is moving may cause one ECU to execute the service and make a reset while another ECU sends a negative response indicating that it will not make the reset. The ECU making the reset may not be fully operational for a short time, usually some seconds and this may affect the behavior of the vehicle. The device shall not use any diagnostic services which either forces the ECU to end its normal operation (e.g., ECUReset or a diagnostic session change to programmingSession) or affects its data link communication (e.g., CommunicationControl or LinkControl).