

SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

SAE J1978

REV.
FEB98

Issued 1992-03
Revised 1998-02

Superseding J1978 JUN94

OBD II SCAN TOOL

Foreword—Title 13, California Code of Regulations, Section 1968.1 "Malfunction and Diagnostic System Requirements 1994 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles With Feedback Control Systems," more commonly known as OBD II (On-Board Diagnostics version II), defines diagnostic functions required to be supported by vehicles and functions to be supported by test equipment that interface with the vehicle diagnostic functions.

While a range of test equipment (e.g., handheld scan tools, PC based diagnostic computers, etc.) may be used to perform the required interface support functions, the term OBD II Scan Tool is used in this document to refer to any test equipment that meets the requirements of this document.

TABLE OF CONTENTS

1.	Scope	3
2.	References	3
2.1	Applicable Publications	3
2.1.1	SAE Publications	3
2.1.2	ISO Publications	3
2.1.3	Other Publications	3
3.	Definitions.....	3
4.	Application	3
5.	Required Functions and Support.....	4
6.	Vehicle Interface.....	4
6.1	Communication Data Link and Physical Layers	4
6.1.1	SAE J1850 Recommended Practice Class B Data Communication Network Interface	4
6.1.2	ISO 9141-2:1994(E) Road Vehicles—Diagnostic Systems—CARB Requirements for Interchange of Digital Information	4
6.1.3	ISO/DIS 14230-4:1997(E)—Road Vehicles—Diagnostic Systems—Keyword Protocol 2000—Part 4: Requirements for Emission-Related Systems	5
6.2	Connector	5
6.3	Messages	5
6.4	Automatic Hands off Determination of the Communication Interface Used in a Given Vehicle	5
6.4.1	General.....	5

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS <http://www.sae.org>

Copyright 1998 Society of Automotive Engineers, Inc.
All rights reserved.

Documents
Document Sharing Hub
Printed in U.S.A.

SAE J1978 Revised FEB98

6.4.2	Initialization Details	6
6.5	On-Board Diagnostic Evaluations	6
6.5.1	Completed On-Board System Readiness Tests	6
6.5.2	Supported On-Board System Readiness Tests	6
6.5.3	Malfunction Indicator Light	7
6.6	Handling of No Response from Vehicle	7
6.7	Connections to the Vehicle in Addition to the SAE J1962 Diagnostic Connector	7
6.8	Use of Stop Communication Service Associated with ISO/DIS 14230 (Optional)	7
7.	System Interaction Capability	7
7.1	Obtain and Display OBD II Emissions Related Diagnostic Trouble Codes	7
7.2	Obtain and Display OBD II Emissions Related Current Data, Freeze Frame Data, and Test Parameters and Results	7
7.3	Responses from Multiple Modules	8
7.4	Code Clearing	8
8.	General Characteristics	8
8.1	Display	8
8.2	User Input	9
9.	Power Requirements if Powered by the Vehicle Through the SAE J1962 Diagnostic Connector	9
10.	Electromagnetic Compatibility (EMC)	9
11.	Conformance Testing	9
11.1	General	9
11.2	Determine OBD II Communication Type	10
11.3	On-Board System Readiness Tests	11
11.4	Select Functions	11
11.5	Select and Display Items	11
11.6	Verify Requests to Clear Codes	12
11.7	General Diagnostic Communication Tests	12
11.8	Capacitance and Impedance at the SAE J1962 Connector	12
11.9	Operating Voltage and Current Draw	12
11.10	Protocol Check	12
11.11	Alphanumeric Display	13
11.12	User Manual and Help Facility	13
12.	Notes	13
12.1	Marginal Indicia	13

1. **Scope**—This SAE Recommended Practice defines the requirements of OBD II Scan Tools, i.e., test equipment that will interface with vehicle modules in support of the OBD II diagnostic requirements. It covers the required capabilities of and conformance criteria for OBD II Scan Tools.

2. **References**

2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issues of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1113—Electromagnetic Susceptibility Measurements Procedures for Vehicle Components (Except Aircraft)

SAE J1850—Class B Data Communication Network Interface

SAE J1930—Electrical/Electronic Systems Diagnostic Acronyms, Terms and Definitions

SAE J1962—Diagnostic Connector

SAE J1979—E/E Diagnostic Test Modes

SAE J2012—Recommended Format and Messages for Diagnostic Trouble Codes

2.1.2 ISO PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ISO 7637—Road vehicles—Electrical disturbance by condition and coupling

ISO 9141-2:1994(E)—Road vehicles—Diagnostic systems—Carb requirements for interchange of digital information

ISO/FDIS 14230-3:1997(E)—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 3: Application layer

ISO/DIS 14230-4:1997(E)—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 4: Requirements for emission-related systems

2.1.3 OTHER PUBLICATIONS

California Code of Regulations, Section 1968.1, Title 13—Malfunction and Diagnostic System Requirements 1994 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles with Feedback Control Systems

Environmental Protection Agency 40 CFR Part 86 Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines; Regulations Requiring On-Board Diagnostic Systems on 1994 and later Model Year Light-Duty Vehicles and Light-Duty Trucks

3. **Definitions**—SAE J1930 is hereby referenced as the basis for all such terms in this document.

4. **Application**—The requirements contained in this document apply to all test equipment (e.g., handheld scan tool, PC based test equipment, inspection and maintenance equipment, etc.) that will be used to access the OBD II functions supported in vehicles.

Only tools passing the conformance test(s) specified in this document may claim or advertise that they meet or exceed the requirements of this document.

Nothing in this document precludes the inclusion of additional capabilities or functions in test equipment.

5. Required Functions and Support—The following are the basic functions that the OBD II Scan Tool is required to support or provide:

- a. Automatic hands-off determination of the communication interface used
- b. Obtaining and displaying the status and results of vehicle on-board diagnostic evaluations
- c. Obtaining and displaying OBD II emissions related diagnostic trouble codes (DTC's)
- d. Obtaining and displaying OBD II emissions related current data
- e. Obtaining and displaying OBD II emissions related freeze frame data
- f. Clearing the storage of OBD II emissions related diagnostic trouble codes, OBD II emissions related freeze frame data storage and OBD II emissions related diagnostic tests status
- g. Obtaining and displaying OBD II emissions related test parameters and results as described in SAE J1979
- h. Provide a user manual and/or help facility

6. Vehicle Interface—The following specifies the minimum vehicle interfaces to be supported by an OBD II Scan Tool.

6.1 Communication Data Link and Physical Layers—The OBD II Scan Tool must be able to communicate with vehicle control modules using the communication interfaces as described as follows. The OBD II Scan Tool must perform the communications required to support the State of California requirements referenced in the introduction to this document.

- 6.1.1 SAE J1850 RECOMMENDED PRACTICE CLASS B DATA COMMUNICATION NETWORK INTERFACE—SAE J850 describes the data link and physical layers for a Class B vehicle serial multiplex bus network. The OBD II Scan Tool must support both of the SAE J1850 protocols in a manner that is transparent to the user.
- 6.1.2 ISO 9141-2:1994(E) ROAD VEHICLES—DIAGNOSTIC SYSTEMS—CARB REQUIREMENTS FOR INTERCHANGE OF DIGITAL INFORMATION—ISO 9141 describes the physical and data link layers of a vehicle serial diagnostic bus.

The following specifications clarify and, if in conflict with ISO 9141-2, override any related specifications in ISO 9141-2:

- a. The maximum sink current to be supported by the OBD II Scan Tool is 100 mA
- b. The range for all tests performed relative to ISO 7637 is -1.0 to $+40.0V$
- c. The minimum bus idle period before the tool shall transmit an address, shall be 300 ms

ISO 9141-2 specifies a time within which a module(s) that has successfully been initialized must receive a message or the module(s) will return to the address mode. Unless the OBD II Scan Tool user has indicated he/she wishes to terminate communication, once a module(s) has successfully been initialized, the OBD II Scan Tool must automatically send a message, to be identified as the idle message, before this time can elapse. Any use of any response received due to the idle message is left to the discretion of the scan tool manufacturer.

The SAE J1979 mode 1 PID 0 request message is the recommended idle message.

- 6.1.3 ISO/DIS 14230-4:1997(E)—ROAD VEHICLES—DIAGNOSTIC SYSTEMS—KEYWORD PROTOCOL 2000—PART 4: REQUIREMENTS FOR EMISSION-RELATED SYSTEMS—Describes the application layer of a vehicle serial diagnostic bus.

ISO/DIS 14230-4 specifies a time within which modules that have successfully been initialized must receive a message or the modules will return to the address mode. Unless the OBD II Scan Tool user has indicated he/she wishes to terminate communication, once modules have successfully been initialized, the OBD II Scan Tool must automatically send a message, to be identified as the idle message, before this time can elapse. Any use of any response received due to the idle message is left to the discretion of the scan tool manufacturer.

When ISO/DIS 14230-4 is the protocol being used to satisfy the OBD II serial communication requirements in a vehicle, the use of the Tester Present service defined in ISO/DIS 14230-3 is the recommended way to satisfy this requirement. The SAE J1979 mode 1 PID 0 request message may also be used to satisfy this requirement.

When ISO/DIS 14230-4 is the protocol being used to satisfy the OBD II serial communication requirements in a vehicle, negative response messages may be received. Processing of these responses is optional, however, the P2 timer must be reset when a negative response is received.

- 6.2 **Connector**—The OBD II Scan Tool must use a male SAE J1962 Diagnostic Connector to mate with the female SAE J1962 Diagnostic Connector required in vehicles. The OBD II Scan Tool must support the Standard Pin Assignments defined in SAE J1962. The electrical interface in the OBD II Scan Tool for the manufacturer discretionary pin assignments, shall be effectively open circuit as a default condition or state.

- 6.3 **Messages**—SAE J1979 describes the request messages to be sent by the OBD II Scan Tool to the vehicle and the response messages to be sent by the vehicle to the OBD II Scan Tool in order to perform the services required by OBD II.

6.4 Automatic Hands-off Determination of the Communication Interface Used in a Given Vehicle

- 6.4.1 **GENERAL**—While there are three types of communication interfaces that could be used to access the OBD II functions in a given vehicle (i.e., SAE J1850 41.6 Kbps PWM, SAE J1850 10.4 Kbps VPW, ISO 9141-2, and ISO/DIS 14230-4), only one is allowed to be used in any one vehicle to access all supported OBD II functions.

When connected to a vehicle and/or when the OBD II support is selected when such a selection is necessary, the OBD II Scan Tool will automatically attempt to determine which of the possible communication interfaces is being used in the vehicle to support OBD II related functions. The tool will continue to try to determine which interface is being used until it is successful in doing so. No user input will be required, nor allowed, to determine the appropriate interface.

Indications or messages will be displayed during this process informing the user that initialization is taking place and, if all interface types have been tested and none is responding properly to the request for OBD II services, the OBD II Scan Tool must indicate to the user:

- a. To verify that the ignition is on.
- b. To check the Emissions Label or vehicle service information to verify that the vehicle is OBD II equipped.
- c. To check that the tool is connected to the vehicle correctly.

If the ignition is on and the vehicle emissions label or service information indicates the vehicle is OBD II equipped, then there is a Data Link fault.