



SURFACE VEHICLE RECOMMENDED PRACTICE

J1939™-82

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(R) SAE J1939 Network Compliance

RATIONALE

This document was revised to include updated SAE J1939 requirements for physical layer, data link layer, cyber security, autobaudrate detection, etc.

FOREWORD

The SAE J1939 communications network is defined using a collection of individual SAE J1939 documents based upon the layers of the Open System Interconnect (OSI) model for computer communications architecture. The SAE J1939-82 document describes the compliance tests and procedures to verify an SAE J1939 ECU will operate correctly on a SAE J1939 network. This compliance document may be used for SAE J1939 applications.

The SAE J1939 communications network is a high-speed ISO 11898-1 CAN-based communications network that supports real-time closed loop control functions, simple information exchanges, and diagnostic data exchanges between electronic control units (ECUs) physically distributed throughout the vehicle.

The SAE J1939 communications network is developed for use in heavy-duty environments and suitable for horizontally integrated vehicle industries. The SAE J1939 communications network is applicable for light-duty, medium-duty, and heavy-duty vehicles used on-road or off-road, and for appropriate stationary applications which use vehicle derived components (e.g., generator sets). Vehicles of interest include, but are not limited to, on-highway and off-highway trucks and their trailers, construction equipment, and agricultural equipment and implements. The physical layer aspects of SAE J1939 reflect its design goal for use in heavy-duty environments. Horizontally integrated vehicles involve the integration of different combinations of loose package components, such as engines and transmissions, that are sourced from many different component suppliers. The SAE J1939 common communication architecture strives to offer an open interconnect system that allows the ECUs associated with different component manufacturers to communicate with each other.

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1. SCOPE

SAE J1939-82 compliance describes the compliance tests and procedures to verify an SAE J1939 electronic control unit (ECU) operates correctly on a SAE J1939 network. The purpose of these compliance procedures is to generate one or more test documents that outline the tests needed to assure that an ECU that is designed to operate as a node on a SAE J1939 network would do so correctly. SAE does not certify devices and these tests and their results do not constitute endorsement by SAE of any particular ECU. These tests are presented to allow testing of an ECU to determine self-compliance by the manufacturer of an ECU. The manufacturer can use its record of what procedures were run successfully to show the level of compliance with SAE J1939.

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 J1939 Serial Control and Communications Heavy-Duty Vehicle Network - Top-Level Document

SAE J1939-11 Physical Layer, 250 kbps, Twisted Shielded Pair

SAE J1939-14 Physical Layer, 500 kbit/s

SAE J1939-15 Reduced Physical Layer, 250 kbps, Un-Shielded Twisted Pair (UTP)

SAE J1939-16 Automatic Baud Rate Detection Process

SAE J1939-17 CAN FD Physical Layer, 500 kbps/2 Mbps

SAE J1939-21 Data Link Layer

SAE J1939-22 CAN FD Data Link Layer

SAE J1939-31 Network Layer

SAE J1939-81 Network Management

SAE J2403 Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature

2.2 Related Publications

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

2.2.1 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 J1455 Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications

2.2.2 ISO Publications

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

ISO 11898-1 Road Vehicles - Controller Area Network (CAN) - Part 1: Data Link Layer and Physical Signaling

3. DEFINITIONS

Terms and definitions are defined in SAE J1939, except the following:

3.1 CERTIFICATION

Public announcement, using documentation with signatures from a member of a duly recognized competent body (i.e., UL, TUV, CSA), to give notice that a given device has been tested and found to meet all necessary issues of a particular requirement or standard, whether legislated or of purely common industrial usage.

3.2 COMPLIANCE

Announcement that a device has been tested and found to meet a particular set (not necessarily all) of issues of a particular requirement or standard, without any supporting signatures from a recognized standard agency as performed by a third-party investigator.

3.3 SELF-COMPLIANCE

Announcement that a device has been tested and found to meet a particular set (not necessarily all) of issues of a particular requirement or standard, without any supporting signatures from a recognized standard agency.

4. ABBREVIATIONS

BAM	Broadcast Announce Message
CA	Controller Application
CAI	Controller Application Identity
CTC	Compliance Test Computer
DUT	Device Under Test

Note that abbreviations used in [Appendix A](#) are not listed here, but can be found in the referenced document of the table.

5. EQUIPMENT

The standard test configuration shall contain two nodes, the compliance test computer (CTC) and the device under test (DUT), with appropriate media and termination, as well as power supplies and DUT loads.

5.1 Compliance Test Computer (CTC)

A compliance test computer with the following capabilities:

5.1.1 Message Transmission

Must be able to send any specified message.

5.1.2 Message Reception

Must be able to receive all bus messages.

5.1.3 Time Stamp

Must be able to time stamp at the beginning of received messages at the required resolution.

5.1.4 Time Resolution

Must possess a minimum time resolution of 10 μ s. The actual time resolution must be specified.

5.1.5 Time Stamp Accuracy

The error between any two timestamps shall be less than 1% of the time difference between the two timestamps or 1 ms, whichever is greater.

5.1.6 Time Stamp Latency Error

Must be less than one count of the time resolution.

5.1.7 Transmission Synchronization

Must be able to control the time between messages it transmits.

5.1.8 Reception Timeout

In cases where DUT should have "no response," the CTC must be able to monitor that no response message is transmitted by the DUT for a minimum time equal to the allowed transmission response time plus two times the allowed latency (for example, when transmission should be within 200 ms and 50 ms latency is allowed, then CTC must check for a minimum time of 300 ms). Longer times are at the discretion of the designers.

5.1.9 CAN Interface

At least one CAN interface is required. Two CAN interfaces are required for testing bridge functions.

6. DEVICE UNDER TEST (DUT)

The device under test with the following features:

6.1.1 Operation

Must be able to perform its normal intended use (not operating any special testing mode of operation).

6.1.2 Controls

Must be able to initiate the action under test when directed.

7. SETUP

The setup shall consist of a minimum network with two nodes. Any additional requirements for a specific test procedure will be specified within that procedure.

7.1 Minimum Network

Two nodes, the DUT and the CTC, with terminations, a short length of the appropriate media, power supplies.

7.2 Message Traffic

Minimal normal network traffic, only the messages necessary for the specific test procedure (see [5.2.1](#)).

7.3 Test Message Set

Messages that are applicable to a specific test procedure shall be listed in the test outline. This message list shall be broken into two pieces: those supported for reception and those supported for transmission.

8. TEST SELECTION

The procedure to select a test or set thereof, necessary to check for compliance to a particular function or set of functions from the standard, are outlined within [Appendix A](#). [Appendix A](#) is broken into tables, which identify functions, based on which document section(s) they are described within. Some tests will be pointed to by more than one entry.

8.1 Document Identifying Test

The specific document identifying a particular function will be outlined with any necessary cross-references within a table for the specific task force document.

8.2 Requirement Versus Device Characteristics

The “SAE and User Requirements” status of each function shall be cross referenced with the device characteristics (such as: arbitrary address capable, command configurable, diagnostic tool, etc.) that will affect whether a device should provide said function.

9. RUNNING A TEST

The steps necessary to run a test are outlined as follows:

9.1 Identify Test

Using [Appendix A](#), the reviewer should identify the test number(s) necessary to check any particular function(s) that they desire. Note that all tests are not applicable to all systems. The “Requiring Document” column refers the reviewer to the appropriate document section the test is intended to cover.

9.2 Report Generation

Using [Appendix A](#), the reviewer should document the test(s) performed and the results, as well as whether the device had requirement exceptions (additions or exclusions) for each of the particular functions.

10. REPORTING COMPLIANCE TEST RESULTS

[Appendix A](#) contains columns in the forms for reporting the results of compliance testing. These columns are used to report the test date, whether a particular test is required for the specific device being tested and whether the test has been run, as well as whether the device passed (complied with) the test.

10.1 Self-Compliance

[Appendix A](#) is intended to be used by an OEM as self-compliance documentation. When certifying a device, the OEM can indicate whether that the device is intended to provide each function, as well as the general level to which the device is designed. The passage of each function by the particular device can then be documented along with the date of testing. The inclusion of the specific test number(s) should enable future comparison among devices, as well as among testers.

10.2 Device Support

The reporting forms record the test(s) conducted, the test results, and whether a device is intended to support a particular function, which makes these reporting forms very helpful to a customer locating a desired device.

11. NOTES

11.1 Revision Indicator

A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE TRUCK BUS CONTROL AND COMMUNICATIONS NETWORK COMMITTEE

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APPENDIX A - COMPLIANCE TESTS

A.1 INTRODUCTION TO TESTS

Tables herein describe tests and/or procedures needed to check compliance of a device against each requirement of the SAE J1939 document set. The sections are divided by document title with section number references to the specific text defining a function and its operation. The tables include all described network functions, not simply minimum requirements. The requirement to perform a test or procedure for an ECU can be discerned by looking in the applicable ECU class columns under the “SAE and User Requirements” heading. See [A.2.5](#) for more details about interpreting testing requirements.

A.2 TEST OUTLINE TABLE STRUCTURE AND COLUMN DEFINITIONS

The following definitions and values are identified to enable completion of the entries into the respective columns of the compliance test tables.

A.2.1 Row

Provides a numeric tag to use in references to particular tests.

A.2.2 Test Name

Name or title for the particular test.

A.2.3 Requiring Document

Specifies the source of the particular item. Usually this will be a particular section of a SAE J1939-xx document.

A.2.4 Description

Provides a short outline of the identified feature and the test.

A.2.5 SAE and User Requirements

The “SAE and User Requirements” column consists of several “ECU Classes” columns and a “User” column. The set of columns under the “ECU Class” heading are used to identify the necessity to check compliance to a particular test, based upon the ECU class. The column under the “User Add/Excl” heading is provided to allow users to customize the necessity to check compliance to a particular test. An “X” in any of the “ECU Classes” columns implies the test is required by SAE for that ECU class (see [A.2.5.2](#) for ECU class definition). A “D” in the user column implies this test is desired as an additional feature for the particular ECU under test. An “E” implies that the ECU under test is not required to provide this feature even when it might be a requirement.

- The presence of a code in an “ECU Class” column conveys a requirement to evaluate the test for an ECU of that class.
- The presence of a code in the “User Add/Excl” column conveys a requirement to evaluate the test per the requirements of the “user.”
- The absence of a code in a “SAE and User Requirements” column indicates there is no explicit requirement to evaluate the test for an ECU of that class or per the requirements of the “user.”

A.2.6 Requirement Codes

There are currently three codes defined to denote the requirement for evaluating a particular test. New codes will be added as the need is identified. The test requirement codes supported for the test outlines are summarized in [Table A1](#).

Table A1 - Test requirement code

Code	Meaning	Specified By
X	Compliance to the test is required by SAE for that ECU class	SAE J1939 Committee
D	Compliance to the test is desired as an additional feature for the particular ECU under test	User
E	Compliance to the test is not required (i.e. may be excluded) for the test ECU, even though the test might be a requirement for the ECU class	User

For example, an “X” in any of the “ECU Classes” columns implies the test is required by SAE for that ECU Class. A “D” in the “User Add/Excl” column implies this test is desired as an additional feature for the particular ECU under test. An “E” in the “User Add/Excl” column implies that the ECU under test is not required to provide this feature even when it might be a requirement. The marking of these extra conditions would enable the tables to be used for test reporting or purchasing specification, as well as to identify all the compliance tests.

A.2.7 ECU and CA Class

There are currently seven ECU or CA classes defined for testing requirement association. New classes shall be added as the need is identified. The class codes supported for the test outlines are summarized in Table A2.

Table A2 - ECU/CA class codes

ECU/CA Class Code	Code Description	Description of Applicable ECUs
ALL	All ECUs	All SAE J1939 ECUs, regardless of the ECU's design function or specifications
BDG	Network Interconnect ECUs	General network interconnect devices (bridge, router, etc.)
AAC	“Arbitrary Address Capable” ECUs	ECUs or controller applications that are “arbitrary address capable” regarding address claim
CC	“Command Configurable” Address ECUs	ECUs or controller applications that support “command configurable” addressing
SC	“Self-Configurable” Address ECUs	ECUs or controller applications that are “self-configurable” regarding address claim
TOO	Tool	ECU's that are to function as a “tool”
EMS	On-Highway Emissions Regulated ECUs	ECU's are operating with on-highway emissions regulated engines

A.2.8 User Add/Excl

The “User Add/Excl” column provides a place for the “user” to indicate the addition (D) or exclusion (E) of the test for a test ECU. The “user” is the user of this document and could be a purchasing agent, a system specifier, a supplier, a tester, etc. The marking of these extra conditions enable the tables to be used for test reporting or other specification, such as purchasing specification, as well as to identify all the compliance tests.

A.2.9 Date Tested

Identifies the date the test was conducted.

A.2.10 Pass-Fail

Record the test results. The designation choices are “P” for pass and “F” for fail.

A.2.11 Test Result Comments

Record the comments the tester or others can be included.

A.3 COMPLIANCE TESTS FOR DATA LINK LAYER (SAE J1939-21)

A.3.1 Data Link Layer Tests - Transmit Behavior

The compliance tests in [Table A3](#) evaluate the general message transmit behaviors of the DUT. The tests for evaluating the behaviors of the DUT as the data source using the transport protocols are presented in [Tables A5](#) and [A7](#).

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Table A3 - Data link transmit tests: general

[illegible]

Table A3 - Data link transmit tests: general (continued)

[illegible]

The compliance tests in [Table A4](#) evaluate the general message receive behaviors of the DUT. The tests for evaluating the behaviors of the DUT as the data recipient using transport protocol are presented in [Tables A6](#) and [A8](#).

Table A4 - Data link receive tests: general

[illegible]

Table A4 - Data link receive tests: general (continued)

[illegible]

Table A4 - Data link receive tests: general (continued)

[illegible]

Table A4 - Data link receive tests: general (continued)

[illegible]

Table A4 - Data link receive tests: general (continued)

[illegible]

Table A4 - Data link receive tests: general (continued)

[illegible]

Table A4 - Data link receive tests: general (continued)

Row	Test Name	Requiring Document	Description	SAE and User Requirements X: Test is Recommended D: Additional Test Desired E: Test Excluded							Date Tested	Pass-Fail	Test Result Comments
				ECU Classes						User			
				A L L	B D G	A A C	C C	S C	T O C	E M S	Add/ Excl		
31	Proper acknowledgement behavior for destination specific request (PG 59904) sent to a different address (DUT as recipient)	SAE J1939-21 5.4.4 5.4.2 Table 5	Verify DUT does not respond to the request message since the request message was not addressed to the DUT.	X									

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The compliance tests in [Table A5](#) evaluate the behaviors of the DUT as the data originator for the SAE J1939 transport protocol BAM service. The SAE J1939 transport protocol RTS/CTS tests for the data originator are presented in [Table A7](#).

Table A5 - Data link transmit tests: TP BAM (originator)

[illegible]

Table A5 - Data link transmit tests: TP BAM (originator) (continued)

[illegible]

The compliance tests in [Table A6](#) evaluate the behaviors of the DUT as the data recipient for the SAE J1939 transport protocol BAM service. The SAE J1939 transport protocol RTS/CTS tests for the data recipient are presented in [Table A8](#).

Table A6 - Data link receive tests: TP BAM (responder)

[illegible]

Table A6 - Data link receive tests: TP BAM (responder) (continued)

[illegible]

Table A6 - Data link receive tests: TP BAM (responder) (continued)

[illegible]

Table A6 - Data link receive tests: TP BAM (responder) (continued)

[illegible]

The compliance tests in [Table A7](#) evaluate the behaviors of the DUT as the data originator for the SAE J1939 transport protocol RTS/CTS service. The SAE J1939 transport protocol BAM tests for the data originator are presented in [Table A5](#).

Table A7 - Data link transmit tests: TP RTS/CTS (originator)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

Row	Test Name	Requiring Document	Description	SAE and User Requirements X: Test is Recommended D: Additional Test Desired E: Test Excluded								Date Tested	Pass-Fail	Test Result Comments
				ECU Classes							User			
				A	B	A								
				L	D	A	C	S	T	E	Add/Excl			
9	RTS/CTS transport: CTS following "hold connection" CTS (DUT as originator)	SAE J1939-21 5.10.3.2 Appendix C 5.10.2.4	Verify DUT sends the appropriate packets in TP.DT when it receives a valid CTS within 1050 ms (T4) following the previous "hold connection" CTS. Verify DUT sends the appropriate packets in TP.DT when "next packet number to be sent" in CTS: - Is the same as "next packet number to be sent" in last CTS before CTS pause started. - Is within the range of packets in last CTS before CTS pause started. - Equals the sum of "next packet number to be sent" plus "number of packets to send" in last CTS just before CTS pause started. Verify DUT sends a TP.Conn_Abort when "next packet number to be sent" in CTS: - Is less than the "next packet number to be sent" in last CTS before CTS pause started. - Is one or more greater than the sum of "next packet number to be sent" plus "number of packets that can be sent" in last CTS before CTS pause started.											

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

Table A7 - Data link transmit tests: TP RTS/CTS (originator) (continued)

[illegible]

The compliance tests in [Table A8](#) evaluate the behaviors of the DUT as the data recipient (responder) for the SAE J1939 transport protocol RTS/CTS service. The SAE J1939 transport protocol BAM tests for the data recipient are presented in [Table A6](#).

Table A8 - Data link receive tests: TP RTS/CTS (responder)

[illegible]

Table A8 - Data link receive tests: TP RTS/CTS (responder) (continued)

[illegible]

Table A8 - Data link receive tests: TP RTS/CTS (responder) (continued)

[illegible]

Table A8 - Data link receive tests: TP RTS/CTS (responder) (continued)

[illegible]

Table A8 - Data link receive tests: TP RTS/CTS (responder) (continued)

[illegible]

Table A8 - Data link receive tests: TP RTS/CTS (responder) (continued)

[illegible]