Infrastructure Connectivity Certification Test Procedures for Infrastructure-Based Connected Automated Vehicle Components

Personal Safety Message – SAE J2735

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16. Abstract

The successful deployment and operation of connected vehicle systems will require that devices, systems, and applications developed by different providers be compatible, interoperable, non-interfering, and, in some instances perhaps, interchangeable. In addition, some devices, systems, and applications, e.g., active safety applications, may be required to meet minimum operational performance standards. A list of questions was distributed to potential stakeholders to gather information on which aspects of the industry should be considered for certification. The results of this effort were compiled and consolidated into a list of recommendations that yielded five test plans to be addressed under this project. Two separate test plans certify signal phase and timing (SPaT) messages and applications related to the following two items: National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) 1202 v3 objects and SAE International (SAE) J2735 messages. The other three test plans certify the MAP message, traveler information message (TIM), and personal safety message (PSM) as defined in SAE J2735. This document contains the test plan and test design for one of the five messages: PSM. The scope of the test cases contained in this document is to evaluate the output of a PSM application which encodes elements of PSM data into a SAE J2735 PSM over available wireless technology. This test plan is intended to evaluate the format, structure, and encoding of the PSM. SAE J2735 Standard governs the PSM format and structure. The message is presented in the Abstract Syntax Notation One (ASN.1) format, which is UPER Hex encoded for broadcast. The scope for testing includes various mandatory data elements and their corresponding values, along with the verification of the various format conversions. Various sources for the PSM information would be considered. This document focuses on the ingestion of the information from its source and its eventual conversion to UPER Hex for broadcast.

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Chapter 1. Introduction

Background

The United States Department of Transportation's (USDOT) Connected Vehicle Program aims to improve safety, enhance mobility, and reduce the environmental footprint of our transportation systems through connected vehicle technology. In support of that goal, the Federal Highway Administration (FHWA) Office of Operations Research and Development (HRDO) performs transportation operations and research and development (R&D) at the Saxton Transportation Operations Laboratory (STOL), established at the Turner-Fairbank Highway Research Center (TFHRC).

Connected transportation systems use connected vehicle technology to link vehicles and mobile devices to each other, to transportation infrastructure, and to the larger communication infrastructure requiring trusted communications and interoperability. USDOT is assessing services and applications that realize the full potential of connected vehicles, travelers, and infrastructure to enhance current operational practices and transform future surface transportation systems. To realize this potential, connected vehicle equipment and applications must meet minimum performance requirements; conform to common technical standards, guidelines, and specifications; and interoperate with one another. Certification testing provides a formal means of verifying that a device, application, or service conforms to these requirements.

The successful deployment and operation of connected vehicle systems requires that devices, systems, and applications developed by different providers are compatible, interoperable, non-interfering, and in some instances, perhaps, interchangeable. Some devices, systems, and applications, such as active safety applications, may be required to meet minimum operational performance standards. A list of questions was distributed to potential stakeholders to gather information on which aspects of the industry should be considered for certification. The results were compiled and consolidated into a list of recommendations that yielded five test plans to be addressed under this project. Two separate test plans certify signal phase and timing (SPaT) messages and applications related to the following two items: National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) 1202 v3 objects and SAE International (SAE) J2735 messages. The other three test plans certify the MAP message, traveler information message (TIM), and personal safety message (PSM) as defined in SAE J2735. This document contains the test plan and test design for one of the five messages: PSM.

PSMs may be sent to the roadside equipment (RSE) through various channels. The first use case is sending the PSM constructor elements (i.e., position, speed, heading, etc.) from a nomadic device (e.g., cell phone) over a wireless network to a web server hosted on the RSE. Other methods include obtaining PSM constructor data using systems like cameras or LIDAR to detect vulnerable road users and provide those constructor data to the RSE. In either case, the RSE broadcasts PSMs on behalf of the vulnerable road users who do not have the capability to do so themselves.

Test Scope

The scope of the test cases is to evaluate the output of a PSM application, which encodes elements of PSM data into an SAE J2735 PSM over available wireless technology. This test plan is intended to outline the evaluation and testing of the format, structure, and encoding of the PSM. SAE J2735 Standard governs the PSM format and structure. The message is represented in the Abstract Syntax Notation One (ASN.1) format, which is UPER Hex encoded for broadcast. The scope for testing includes various mandatory data elements and their corresponding values, along with verification of the various format conversions. Various sources for

the PSM information would be considered. This document will focus on the ingestion of the information to ASN.1 format and its eventual conversion to UPER Hex for broadcast.

The test considers three major processes and data structures for effective testing:

- Input: PSM data
- Processing: ASN.1 format
- Output: UPER Hex encoded payload

Evaluations will be performed on the following functional areas:

- Content verification for critical PSM data elements according to SAE J2735
- Format verification for generated ASN.1 PSM
- ASN.1 {J2735 (PSM) message format} to UPER Hex encoding verification

The test does not consider security (i.e., signed or encrypted messages) because those features are addressed by other test plans.

Items and Features to Be Tested

- Completeness of PSM elements
    - To successfully encode an SAE J2735 PSM, it is necessary to obtain critical elements for this message. This test plan tests the completeness of PSM critical elements. These PSM elements could be generated from various sources, such as pedestrian detection systems, hypertext transfer protocol (HTTP) post messages, or Extensible Markup Language (XML) messages from nomadic devices, hand held radios, etc.).
- PSM formatting verification according to SAE J2735
    - Interoperability is important for connected automated vehicle (CAV) deployment. A key approach to interoperability is ensuring that different CAV messages are correctly and uniformly encoded. After PSM elements are encoded to an SAE J2735 PSM, the format of this message will be verified.

Analysis and Report Findings

The test conductors will analyze the test results and prepare a test report for each vendor and submit the report to the vendor. The reports provide information to vendors about implementations that do not meet, or only partially meet, the requirements that were evaluated in this test. The reports are not official approval, confirmation, or certification by USDOT. The test conductors may also support briefings with vendors to explain the results. Test conductors may also support information exchange and collaboration on recommended next steps.

Test Objective

The objective of this document is to describe the process for certifying and evaluating implementations of the SAE J2735 PSM. The testing agency will be able to test the PSM through the various stages of message creation. Certification will be used as a procurement tool for deployers of connected vehicle devices.

Chapter 2. Test Environment

Tests will be conducted at a certification test laboratory (CTL), such as OmniAir and its affiliates. This test is designed for PSM J2735 message set; it includes testing of various elements starting with the PSM data input to the UPER Hex output by linking the various stages to the J2735 message set directory.

Test Environment Requirements

To conduct tests, each test environment must have the following configuration and equipment:

- A power source appropriate to the device under test (DUT)
- An optional global positioning system (GPS) to provide location and system time. GPS can be provided by:
    - Access to open sky
    - A GPS repeater (license may be required)
    - A GPS simulator (for accuracy, time synchronization is required across all testing devices)
- Network backhaul to allow connection to a hardware which includes a PSM application
- A laptop with internet protocol (IP) packet sniffer and UPER decoder
- A test tool to log encoded packets over the available communication medium
- An optional PSM data broadcast device

Qualification Criteria

The qualification will be determined at the various stages of testing. This will determine that the message is converted in the correct format while maintaining the mandatory standards and fields. Each value will be checked that it is within the acceptable range as stated in the standards documents. The CTL is expected to have sufficient resources (e.g., equipment and personnel with related expertise) to complete all tests identified in this test plan.

Chapter 3. Test Schedule, Personnel, and Documentation

This section contains a high-level test schedule, required personnel to execute tests, and a description of several documents that should be used to record test activities and results.

Test Schedule

Table 1 lists the anticipated activities of the evaluation process after a device is admitted to the certification testing process. These activities are required for each vendor under test.

Table 1. Test Activities

ID	Name	Estimated Duration
1	Initial hardware inspection	1 day
2	Initial configuration to operate in the applicable test environment	1 day
3	Full evaluation	2 weeks
4	Document results and submit final report	1 week

Personnel

The required number and qualifications of staff to complete testing activities will depend on the organization. Table 2 lists the staff anticipated to complete the activities in the estimated duration shown in **Error! Reference source not found.**.

Table 2. Test Personnel

Title	Minimum Number
Test director/manager	1
Test conductor	1
Test operator	1–2
Roadside equipment technology expert	1
Vendor representative	1 per vendor
Test observers	As desired

Test Director (Quality Assurance Manager)

The test director supervises and controls all tests, reviews and approves the test procedures, has the authority to direct all test activities, and is responsible for communicating test status to all stakeholders. The test director notifies key stakeholders of the test schedule in advance of the scheduled start.

Test Conductor

The test conductor is responsible for running daily test activities and remains in contact with vendors, as needed, to communicate which tests are being run and receive support input during testing. The test conductor distributes test scripts, forms, and other pertinent information, and answers questions.

Throughout the test day, the test conductor verifies that entrance criteria have been met for each test run, verifies readiness of test participants and equipment, and announces the start and end of each testing period. The test conductor also ensures other participants execute tests according to procedures. At all times, the test conductor is responsible for judging how to proceed if incidents or exceptions occur and canceling and rescheduling tests in the event a failure prevents a test from being executed. At the end of the test period, the test conductor writes up the results of various completed test runs and incidents or exceptions that occurred. The status report is emailed to relevant stakeholders.

Test Operator

The test operator defines and executes test procedures to evaluate each device and records the outputs and overall results of each test.

Roadside Equipment Technology Expert

The RSE technology expert has extensive knowledge of the technology under test. This includes use cases, underlying and enabling technologies, communication protocols; data transfer mechanism(s), and security. The technology expert advises the test conductor, as needed.

Vendor Representative

The vendor representative supports the test conductors and test operators during all testing phases, as required. Support is provided in person or remotely. A representative of the vendor of each device being certified should be involved in the testing.

Test Observers

Test observers witness test runs at the CTL's discretion. Note: Some roles can be combined such that a single person can assume up to two roles (i.e., the test conductor can also be the test operator).

Documentation

Test Records

Specific test information, including test environment, test execution, and attendees/participants/observers, are captured for each test. Each requirement evaluated will be marked with a P or an F, indicating success (pass) or failure (fail). All failures, work-arounds, and deviations from procedure are recorded in a comments section of the form. These entries are entered electronically during testing.

Risks and Mitigation

Risks include product risks and project risks. Risks to the product include flaws in the content or structure of a message due to misunderstandings or errors in implementation, which may be expected. These risks may be mitigated by accepting from reputable manufacturers devices whose primary functionalities have gone through other qualification testing or have been used in the field. Risks to the project include lack of trained staff due to new and evolving test tools, rigid deadlines, and changing industry standards and requirements.

Other risks include the possibility of using unknown PSM data formats as input. The PSM application under test may not be robust enough to handle subtle changes in the input data, which are caused by multiple options available. This may be mitigated by defining the standard set of input variables required for conversion. Early deployers will have to adhere to the specific PSM data input formats for successful testing and implementation. As noted in the SAE J2735 standard, the PSM is still being developed, which means that some fields could potentially be added or removed from the message. Any changes to the PSM definition would drive the need for a change in this test plan.

Chapter 4. Test Case Specifications

This section contains information about individual test case specifications, which are used to certify and evaluate whether RSE could provide critical and necessary SAE J2735 PSM objects for target connected vehicle applications.

General Test Environment Setup

Chapter 2 presented the minimum requirements for devices for executing the below test cases. Figure 1 shows a general test environment setup. A physical wireless broadcasting DUT needs to be compatible with the SAE J2735 standard messages. A computer is needed to conduct all test cases. A packet capture (.pcap decoder) tool is expected to be on the device.

The following steps are necessary to configure the wireless broadcasting device and logging computer before conducting test cases:

- Configure the DUT
    - Power on the device using power-over-Ethernet (PoE) or other available power source
    - Connect to the DUT using an appropriate connection (e.g., Ethernet/Wi-Fi)
    - Multiple ways are available for data capture based on the functions available for the DUT:
        - Configure the device to log the encoded SAE J2735 PSM on the DUT, to be accessed by the logging device
        - Forward the PSM to the Ethernet interface pointing to the IP address of the logging device
        - Alternatively, a packet capture tool may be used over the available wireless technology to be able to capture and log the packets for further analysis on the device
- Configure personal computer (PC)
    - Power on the PC
    - Configure the DUT using secure shell (ssh) or other available communication method to enable logging of encoded SAE J2735 PSM packets using any of the three methods mentioned in the section above
    - Configure a software package that can monitor and collect data on the target communication layer, or decode logged .pcap files for analysis
- Decode the message
    - The encoded SAE J2735 PSM needs to be decoded before it can be checked for mandatory fields. This can be achieved using multiple methods:
        - Configure the packet capture device to decode the SAE J2735 user datagram protocol packet to unpack the various layers and decode the payload
        - Use an available ASN.1 or other such decoder to decode the encoded payload to an object value defining output for analysis

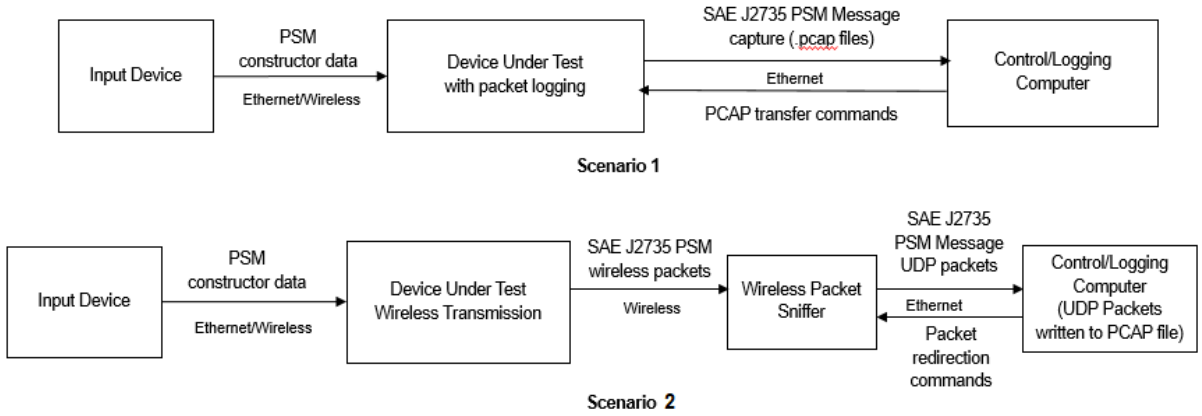

Figure 1. Diagram. Typical Test Environment Setup

The DUT can be any physical device that builds PSM according to the J2735 standard. After configuring the DUT, logging computer, and, alternatively, the Wireless packet capture device, any two devices communicating through the Ethernet interface must be connected within a subnet by using an Ethernet cable or a network switch. The test operator must ensure communication between two devices is properly set up. The wireless interface of the DUT is the preferred method for collecting the output data. In either scenario, the control/logging computer may also be used as the input device to provide the PSM constructor data to the DUT.

Field Existence

The test cases in this section evaluate whether the mandatory fields exist in the PSM broadcast from the DUT.

Table 3. DSRCmsgID existence

Test Case #	**EXIST-01**
Test Case	**DSRCmsgID existence**
Reference	*SAE J2735 2016: Section 7.40*
Objective	Verify DSRCmsgID field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	DSRCmsgID field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM.

Test Case #	EXIST-01
Test Case	**DSRCmsgID existence**
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of DSRCmsgID values. • Certain test tools may include DSRCmsgID under “choice Index.”

Table 4. basicType existence

Test Case #	EXIST-02
Test Case	**basicType (PersonalDeviceUserType) existence**
Reference	*SAE J2735 2016: Section 7.137*
Objective	Verify basicType field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator’s computer
Exit Criteria	basicType field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of basicType values.

Table 5. secMark existence

Test Case #	EXIST-03
Test Case	**secMark (Dsecond) existence**
Reference	*SAE J2735 2016: Section 7.39*
Objective	Verify secMark field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator’s computer
Exit Criteria	secMark field in the PSM exists and the results are documented

Test Case #	EXIST-03
Test Case	**secMark (Dsecond) existence**
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of secMark values.

Table 6. msgCnt existence

Test Case #	EXIST-04
Test Case	**msgCnt (MsgCount) existence**
Reference	*SAE J2735 2016: Section 7.104*
Objective	Verify msgCnt field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	msgCnt field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of msgCnt values.

Table 7. id existence

Test Case #	EXIST-05
Test Case	**id (TemporaryID) existence**
Reference	*SAE J2735 2016: Section 7.187*
Objective	Verify id field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer

Test Case #	EXIST-05
Test Case	**id (TemporaryID) existence**
Exit Criteria	id field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of id values.

Table 8. position existence

Test Case #	EXIST-06
Test Case	**position (lat, lon) existence**
Reference	*SAE J2735 2016: Section 6.87*
Objective	Verify position field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	position field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of position values. • OPTIONAL: The Elevation field is optional, but it should be noted if this field is implemented so that the value may be verified in a later step.

Table 9. accuracy existence

Test Case #	EXIST-07
Test Case	**accuracy (semiMajor, semiMinor, orientation) existence**
Reference	*SAE J2735 2016: Section 6.88*
Objective	Verify accuracy field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard

Test Case #	EXIST-07
Test Case	**accuracy (semiMajor, semiMinor, orientation) existence**
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	accuracy field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of accuracy values.

Table 10. speed existence

Test Case #	EXIST-08
Test Case	**speed (Velocity) existence**
Reference	*SAE J2735 2016: Section 7.216*
Objective	Verify speed field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	speed field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of speed values.

Table 11. heading existence

Test Case #	EXIST-09
Test Case	**heading (Heading) existence**
Reference	*SAE J2735 2016: Section 7.53*
Objective	Verify heading field exists in the PSM broadcast from the RSE

Test Case #	EXIST-09
Test Case	**heading (Heading) existence**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	heading field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of heading values.

Table 12. accelSet existence

Test Case #	EXIST-10
Test Case	**accelSet (long, lat, vert, yaw) existence**
Reference	*SAE J2735 2016: Section 6.1*
Objective	Verify accelSet field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	accelSet field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of accelSet values.

Table 13. long existence (pathHistory)

Test Case #	EXIST-11
Test Case	**pathHistory → initialPosition → long (Longitude) existence**
Reference	*SAE J2735 2016: Section 7.53*

Test Case #	EXIST-11
Test Case	**pathHistory → initialPosition → long (Longitude) existence**
Objective	Verify long field exists in the PSM broadcast from the RSE **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	long field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of long values.

Table 14. lat existence (pathHistory)

Test Case #	EXIST-12
Test Case	**pathHistory → initialPosition → lat (Latitude) existence**
Reference	*SAE J2735 2016: Section 7.53*
Objective	Verify lat field exists in the PSM broadcast from the RSE **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	lat field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM.

Test Case #	EXIST-12
Test Case	**pathHistory → initialPosition → lat (Latitude) existence**
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of lat values.

Table 15. heading existence (pathHistory)

Test Case #	EXIST-13
Test Case	**pathHistory → initialPosition → heading (Heading) existence**
Reference	*SAE J2735 2016: Section 7.53*
Objective	Verify heading field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	heading field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of heading values.

Table 16. latOffset existence (pathHistory)

Test Case #	EXIST-14
Test Case	**pathHistory → crumbData → PathHistoryPoint → latOffset (OffsetLL-B18) existence**
Reference	*SAE J2735 2016: Section 7.179*
Objective	Verify latOffset field exists in the PSM broadcast from the RSE **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer

Test Case #	EXIST-14
Test Case	**pathHistory → crumbData → PathHistoryPoint → latOffset (OffsetLL-B18) existence**
Exit Criteria	latOffset field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of latOffset values.

Table 17. lonOffset existence (pathHistory)

Test Case #	EXIST-15
Test Case	**pathHistory → crumbData → PathHistoryPoint → lonOffset (OffsetLL-B18) existence**
Reference	*SAE J2735 2016: Section 7.179*
Objective	Verify lonOffset field exists in the PSM broadcast from the RSE **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	lonOffset field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of lonOffset values.

Table 18. timeOffset existence (pathHistory)

Test Case #	EXIST-16
Test Case	**pathHistory → crumbData → PathHistoryPoint → timeOffset (TimeOffset) existence**
Reference	*SAE J2735 2016: Section 7.179*

Test Case #	EXIST-16
Test Case	**pathHistory → crumbData → PathHistoryPoint → timeOffset (TimeOffset) existence**
Objective	Verify timeOffset field exists in the PSM broadcast from the RSE **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	timeOffset field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of timeOffset values.

Table 19. speed existence (pathHistory)

Test Case #	EXIST-17
Test Case	**pathHistory → crumbData → PathHistoryPoint → speed (Speed) existence**
Reference	*SAE J2735 2016: Section 7.179*
Objective	Verify speed field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	speed field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of speed values.

Table 20. posAccuracy existence (pathHistory)

Test Case #	EXIST-18
Test Case	**pathHistory → crumbData → PathHistoryPoint → posAccuracy (semiMajor, semiMinor, orientation) existence**
Reference	*SAE J2735 2016: Section 6.88*
Objective	Verify posAccuracy field exists in the PSM broadcast from the RSE
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	PSM from the logging device and the IP address with listening port configured by the test operator
Data Outputs	PSM contained in a .pcap file on the test operator's computer
Exit Criteria	posAccuracy field in the PSM exists and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to check for the presence of posAccuracy values.

Input Verification

The test cases listed in this section evaluate whether the mandatory fields in the PSM broadcast from the RSE match with the input.

Table 21. DSRCmsgID input verification

Test Case #	VERIFY-01
Test Case	**DSRCmsgID input verification**
Reference	*SAE J2735 2016: Section 7.40*
Objective	Verify the DSRCmsgID field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message DSRCmsgID exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with DSRCmsgID field by comparing the encoded PSM logs to the test operator generated PSM input source

Test Case #	VERIFY-01
Test Case	**DSRCmsgID input verification**
Exit Criteria	The DSRCmsgID data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the DSRCmsgID value with the original PSM file used for store and repeat. • Certain test tools may include DSRCmsgID under “choice Index.” • The acceptable values are: Integer 32 – PSM. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 22. basicType input verification

Test Case #	VERIFY-02
Test Case	**basicType (PersonalDeviceUserType) input verification**
Reference	*SAE J2735 2016: Section 7.137*
Objective	Verify the basicType field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message basicType exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with basicType field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The basicType data in the PSM broadcast is verified with the input and the results are documented

Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM.
	• The test operator configures the test PC to receive the encoded PSM.
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the basicType value with the original PSM file used for store and repeat.
	• The acceptable values are:
	  ○ Unavailable (0).
	  ○ aPEDESTRIAN (1).
	  ○ aPEDALCYCLIST (2).
	  ○ aPUBLICSAFETYWORKER (3).
	  ○ anANIMAL (4).

Test Case #	VERIFY-02
Test Case	**basicType (PersonalDeviceUserType) input verification**
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 23. secMark input verification

Test Case #	VERIFY-03
Test Case	**secMark (Dsecond) input verification**
Reference	*SAE J2735 2016: Section 7.39*
Objective	Verify the secMark field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message secMark exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with secMark field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The secMark data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the secMark value with the original PSM file used for store and repeat. o The acceptable values are: 0.65535 (milliseconds). • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 24. msgCnt input verification

Test Case #	VERIFY-04
Test Case	**msgCnt (MsgCount) input verification**
Reference	*SAE J2735 2016: Section 7.104*
Objective	Verify the msgCnt field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message msgCnt exists
Data Inputs	Encoded PSM and test operator generated PSM input source

Test Case #	VERIFY-04
Test Case	**msgCnt (MsgCount) input verification**
Data Outputs	A report verifying the value associated with msgCnt field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The msgCnt data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the msgCnt value with the original PSM file used for store and repeat. • The acceptable values are: 0..127. ○ The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 25. id input verification

Test Case #	VERIFY-05
Test Case	**id (TemporaryID) input verification**
Reference	*SAE J2735 2016: Section 7.187*
Objective	Verify the id field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message id exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with id field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The id data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the id value with the original PSM file used for store and repeat. • The acceptable values are: 4 octet random device identifier (OCTET STRING (SIZE(4)). ○ The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 26. position input verification

Test Case #	VERIFY-06
Test Case	**position (lat, lon) input verification**
Reference	*SAE J2735 2016: Section 6.87*
Objective	Verify the position field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message position exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with position field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The position data in the PSM broadcast is verified with the input and the results are documented

Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM.
	• The test operator configures the test PC to receive the encoded PSM.
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the position value with the original PSM file used for store and repeat.
	• The acceptable values are:
	  o lat: -900000000..900000001, units of 1/10 micro degrees.
	  o lon: -1799999999..1800000001, units of 1/10 micro degrees.
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.
	• OPTIONAL: The Elevation field is optional, but should be checked, if included. The acceptable values are:
	  o -4096..61439, units of 10 centimeters.

Table 27. accuracy input verification

Test Case #	VERIFY-07
Test Case	**accuracy (semiMajor, semiMinor, orientation) input verification**
Reference	*SAE J2735 2016: Section 6.88*
Objective	Verify the accuracy field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message accuracy exists
Data Inputs	Encoded PSM and test operator generated PSM input source

Test Case #	VERIFY-07
Test Case	**accuracy (semiMajor, semiMinor, orientation) input verification**
Data Outputs	A report verifying the value associated with accuracy field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The accuracy data in the PSM broadcast is verified with the input and the results are documented

Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM.
	• The test operator configures the test PC to receive the encoded PSM.
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the accuracy value with the original PSM file used for store and repeat.
	• The acceptable values are:
	  o semiMajor: 0..255, units of 0.05 meters.
	  o semiMinor: 0..255, units of 0.05 meters.
	  o orientation: 0..65535, units of 360/65535 deg.
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 28. speed input verification

Test Case #	VERIFY-08
Test Case	**speed (Velocity) input verification**
Reference	*SAE J2735 2016: Section 7.216*
Objective	Verify the speed field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message speed exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with speed field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The speed data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the speed value with the original PSM file used for store and repeat. • The acceptable values are: o Speed: 0..8191, units of 0.02 m/s.

Test Case #	VERIFY-08
Test Case	**speed (Velocity) input verification**
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 29. heading input verification

Test Case #	VERIFY-09
Test Case	**heading (Heading) input verification**
Reference	*SAE J2735 2016: Section 7.53*
Objective	Verify the heading field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message heading exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with heading field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The heading data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the heading value with the original PSM file used for store and repeat. • The acceptable values are: ○ heading: 0..28800, units of 0.0125 deg. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 30. accelSet input verification

Test Case #	VERIFY-10
Test Case	**accelSet (long, lat, vert, yaw) input verification**
Reference	*SAE J2735 2016: Section 6.1*
Objective	Verify the accelSet field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message accelSet exists

Test Case #	VERIFY-10
Test Case	**accelSet (long, lat, vert, yaw) input verification**
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with accelSet field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The accelSet data in the PSM broadcast is verified with the input and the results are documented

Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM.
	• The test operator configures the test PC to receive the encoded PSM.
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the accelSet value with the original PSM file used for store and repeat.
	• The acceptable values are:
	  ○ long: -2000..2001, units of 0.01 m/s^2.
	  ○ lat: -2000..2001, units of 0.01 m/s^2.
	  ○ vert: -127..127, units of 0.02 G.
	  ○ yaw: --32767..32767, units of 0.01 deg/s.
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 31. long input verification (pathHistory)

Test Case #	VERIFY-11
Test Case	**pathHistory → initialPosition → long (Longitude) input verification**
Reference	*SAE J2735 2016: Section 7.53*
Objective	Verify the long field in the PSM broadcast from the RSE matches with the input source **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message long exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with long field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The long data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM.

Test Case #	VERIFY-11
Test Case	pathHistory → initialPosition → long (Longitude) input verification
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the long value with the original PSM file used for store and repeat. • The acceptable values are: o long: -1799999999..1800000001, units of 10^-7 deg. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 32. lat input verification (pathHistory)

Test Case #	VERIFY-12
Test Case	pathHistory → initialPosition → lat (Latitude) input verification
Reference	*SAE J2735 2016: Section 7.53*
Objective	Verify the lat field in the PSM broadcast from the RSE matches with the input source **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence.**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message lat exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with lat field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The lat data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the lat value with the original PSM file used for store and repeat. • The acceptable values are: o lat: -900000000..900000001, units of 10^-7 deg. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 33. heading input verification (pathHistory)

Test Case #	VERIFY-13
Test Case	pathHistory → initialPosition → heading (Heading) input verification
Reference	*SAE J2735 2016: Section 7.53*

Test Case #	VERIFY-13
Test Case	**pathHistory → initialPosition → heading (Heading) input verification**
Objective	Verify the heading field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message heading exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with heading field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The heading data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the heading value with the original PSM file used for store and repeat. • The acceptable values are: ○ heading: 0..28800, units of 0.0125 deg. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 34. latOffset input verification (pathHistory)

Test Case #	VERIFY-14
Test Case	**pathHistory → crumbData → PathHistoryPoint → latOffset (OffsetLL-B18) input verification**
Reference	*SAE J2735 2016: Section 7.179*
Objective	Verify the latOffset field in the PSM broadcast from the RSE matches with the input source **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message latOffset exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with latOffset field by comparing the encoded PSM logs to the test operator generated PSM input source

Test Case #	VERIFY-14
Test Case	**pathHistory → crumbData → PathHistoryPoint → latOffset (OffsetLL-B18) input verification**
Exit Criteria	The latOffset data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	➢ The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the latOffset value with the original PSM file used for store and repeat. • The acceptable values are: o latOffset: -131072..131071, units of 10^-7 deg. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 35. lonOffset input verification (pathHistory)

Test Case #	VERIFY-15
Test Case	**pathHistory → crumbData → PathHistoryPoint → lonOffset (OffsetLL-B18) input verification**
Reference	*SAE J2735 2016: Section 7.179*
Objective	Verify the lonOffset field in the PSM broadcast from the RSE matches with the input source **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message lonOffset exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with lonOffset field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The lonOffset data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the lonOffset value with the original PSM file used for store and repeat. • The acceptable values are: o lonOffset: -131072..131071, units of 10^-7 deg.

Test Case #	VERIFY-15
Test Case	**pathHistory → crumbData → PathHistoryPoint → lonOffset (OffsetLL-B18) input verification**
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 36. timeOffset input verification (pathHistory)

Test Case #	VERIFY-16
Test Case	**pathHistory → crumbData → PathHistoryPoint → timeOffset (OffsetLL-B18) input verification**
Reference	*SAE J2735 2016: Section 7.179*
Objective	Verify the timeOffset field in the PSM broadcast from the RSE matches with the input source **Note: This field is listed as optional in the SAE J2735 Message Set, but it is still preferred to check for its existence**
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message timeOffset exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with timeOffset field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The timeOffset data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the timeOffset value with the original PSM file used for store and repeat. • The acceptable values are: ○ timeOffset: 1..65535, units of 0.01 sec. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 37. speed input verification (pathHistory)

Test Case #	VERIFY-17
Test Case	**pathHistory → crumbData → PathHistoryPoint → speed (Speed) input verification**
Reference	*SAE J2735 2016: Section 7.179*

Test Case #	VERIFY-17
Test Case	**pathHistory → crumbData → PathHistoryPoint → speed (Speed) input verification**
Objective	Verify the speed field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message speed exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with speed field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The speed data in the PSM broadcast is verified with the input and the results are documented
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the speed value with the original PSM file used for store and repeat. • The acceptable values are: ○ speed: 0..8191, units of 0.02 m/s. • The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Table 38. posAccuracy input verification (pathHistory)

Test Case #	VERIFY-18
Test Case	**pathHistory → crumbData → PathHistoryPoint → posAccuracy (semiMajor, semiMinor, orientation) input verification**
Reference	*SAE J2735 2016: Section 6.88*
Objective	Verify the posAccuracy field in the PSM broadcast from the RSE matches with the input source
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard and the message posAccuracy exists
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the value associated with posAccuracy field by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The posAccuracy data in the PSM broadcast is verified with the input and the results are documented

Test Case #	VERIFY-18
Test Case	**pathHistory → crumbData → PathHistoryPoint → posAccuracy (semiMajor, semiMinor, orientation) input verification**

Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM.
	• The test operator configures the test PC to receive the encoded PSM.
	• The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare the posAccuracy value with the original PSM file used for store and repeat.
	• The acceptable values are:
	  o semiMajor: 0..255, units of 0.05 m.
	  o semiMinor: 0..255, units of 0.05 m.
	  o orientation: 0..65535, units of 360/65535 deg.
	• The test operator repeats the test with an invalid input, and verifies that an invalid output is not produced.

Multiple Personal Safety Message File Verification

Table 39. Check if the RSE can handle generation of several PSMs

Test Case #	SAMPLE-01
Test Case	**PSM File sample verification**
Reference	*SAE J2735 2016: Section 5.6*
Objective	Verify that the RSE can broadcast various PSMs from multiple PED inputs
Entrance Criteria	The RSE under test is compatible with the SAE J2735 2016 standard
Data Inputs	Encoded PSM and test operator generated PSM input source
Data Outputs	A report verifying the RSE can broadcast pedestrian safety data from different sources by comparing the encoded PSM logs to the test operator generated PSM input source
Exit Criteria	The PSM broadcast are consistent with the input and the results are documented **Note: The RSE should be able to continually produce different PSMs at a rate of 1 ms (i.e., 1,000 messages per second).**
Test Procedures	• The test operator configures the DUT to produce and transmit the encoded PSM. • The test operator configures the test PC to receive the encoded PSM. • The test operator uses the converted SAE J2735 PSM in the ASN.1 or other human readable format to compare with the original PSM file used. • Any inconsistencies between the encoded PSM and the input map files are noted.

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Appendix A. List of Acronyms

ASN.1	Abstract Syntax Notation One
CAV	connected automated vehicle
CTL	certification test laboratory
DUT	device under test
FHWA	Federal Highway Administration
GPS	global positioning system
IP	internet protocol
NTCIP	National Transportation Communications for Intelligent Transportation Systems Protocol
HRDO	Office of Operations Research and Development
HTTP	Hypertext Transfer Protocol
PC	personal computer
PoE	power-over-Ethernet
PSM	personal safety message
R&D	research and development
RSE	roadside equipment
SAE	Society of Automotive Engineers
TIM	traveler information message
TFHRC	Turner-Fairbank Highway Research Center
USDOT	U.S. Department of Transportation

XML	Extensible Markup Language

Appendix B. Test Values for Personal Safety Message Fields

Field under test	Lowest acceptable value	Highest acceptable value	Within acceptable range	Positive invalid value	Negative invalid value
DSRCmsgID	32	32	32	33	-1
basicType	0	4	2	5	-1
secMark	0	65535	64	65536	-1
msgCnt	0	127	64	128	-1
lat (position)	-900000000	900000001	64	900000002	-900000001
lon (position)	-1799999999	1800000001	64	1800000002	-1800000000
semiMajor (accuracy)	0	255	64	256	-1
semiMinor (accuracy)	0	255	64	256	-1
orientation (accuracy)	0	65535	64	65536	-1
speed	0	8191	64	8192	-1
heading	0	28800	64	28801	-1
long (accelSet)	-2000	2001	64	2002	-2001
lat (accelSet)	-2000	2001	64	2002	-2001
vert (accelSet)	-127	127	64	128	-128
yaw (accelSet)	-32767	32767	64	32768	-32768
long (initialPosition)	-1799999999	1800000001	64	1800000002	-1800000000
lat (initialPosition)	-900000000	900000001	64	900000002	-900000001
heading (initialPosition)	0	28800	64	28801	-1
speed (initialPosition → speed)	0	8191	64	8192	-1

latOffset (PathHistoryPoint)	-131072	131071	64	131072	-131073
lonOffset (PathHistoryPoint)	-131072	131071	64	131072	-131073
elevationOffset (PathHistoryPoint)	-2048	2047	64	2048	-2049
timeOffset (PathHistoryPoint)	1	65535	64	65536	-1
speed (PathHistoryPoint)	0	8191	64	8192	-1
semiMajor (PathHistoryPoint → posAccuracy)	0	255	64	256	-1
semiMinor (PathHistoryPoint → posAccuracy)	0	255	64	256	-1
orientation (PathHistoryPoint → posAccuracy)	0	255	64	256	-1

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