

IUMPR Data Collection Tool Test Plan

Revision 2

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Overview

The IUMPR Data Collection Tool testing will consist of automated system tests, scripts to be run by a user exercising the application, and on-board testing. The automated system tests will be JUnit 4 test cases and test suites. The test scripts will be sets of step-by-step instructions to be followed by a user interacting with the IUMPR Data Collection Tool.

A JUnit Test Report (HTML) will be provided for the results returned by running the automated JUnit 4 tests. A text report will be provided for each test script including actions and results.

Test Items, Test Approach, and Items to be Excluded from Testing

All automated tests and interactive test scripts will be repeated on each required Operating System platform: i.e., Windows 7-10. (On-board testing will be done with a single Windows Operating System platform.) Test scripts will exercise the user interface interaction specified in IUMPR Data Collection Process including, start, abort, and affirm vehicle and file system management. Some test scripts will include abnormal system exits and include the examination of any resulting report artifacts for consistency.

Tests will include cases where the tool will be communicating with -

- A software module simulating an engine controller
- An engine module as part of a bench test
- An engine module in an idling vehicle (on-board testing)

On-board testing will be on an International Truck (at idle) only. For all automated system tests, the Data Collection Tool will be communicating with a simulated engine controller or an engine module on a test bench. Besides an integrated system test, the individual software modules will be independently tested. The modules to be tested and the process to test each are shown below.

Connection State Testing

The IUMPR Data Collection Tool will be tested to ensure that it correctly establishes communication channels to modules on the data bus as well as the operating system file system. It will be tested to ensure it provides an appropriate response to the user when communication channels cannot be established as well as when these communication channels are lost during a data collection session.

Functional Module Testing

The IUMPR Data Collection Tool architecture includes a set of Functional Modules and a set of software Controllers to generate the report data and output information to the user interface. Each Functional Module is responsible for generating one or more Report Data Elements in response to a request from a Controller. A Result structure will be used to communicate between the Functional Modules and a Controller and allow the Test System to examine intermediate data. The Functional Modules and the Report Data Elements for each are listed in Table A.

Functional Module	Responsibility	Report Data Elements
Banner Module	Generate report headers and footers	Header (date, time, tool version and release date) Footer
Comparison Module	Responsible for comparing information from the Report File to the Vehicle (uses Date/Time Module, Vehicle Information Module, and Diagnostic Readiness Module)	VIN, Calibration Identification, Calibration Verification Number, Time Since Code Clear
Date/Time Module	Generate current date and time	Current Date/Time, comparison to report Date/Time

Diagnostic Readiness Module	Request and parse DM5, DM20, DM21, and DM26 packets	Number of active trouble codes, number of previously active trouble codes, OBD compliance of module, continuously monitored system support/status, Non-continuously monitored system support/status, time since code cleared, trip status
DTC Module	Request and parse DM6, DM12, DM23, DM28, DM11	Pending DTCs, MIL-on DTCs, previous MIL-on DTCs, permanent DTCs (also clears active DTCs)
Engine Speed Module	Read engine speed	Engine speed
Monitor Tracking Module	Query the vehicle for DM5, DM20, DM26 and DM21 messages every 10 seconds	Diagnostic Readiness (DM5) and Monitor Performance Ratio (DM20)
OBD Tests Module	Request and parse DM24, DM7	SPNs supported by each controller, incomplete tests (no data)
Report File Module	Write all report information to the Report File as well as parsing current report for quality metrics	Total number of requests made to vehicle, number of requests that timed-out, number of data log attempts, number of time SCC excess time warnings
Vehicle Information Module	Request VIN, calibration information, and vehicle information	Vehicle Identification Number, Calibration Identification, Calibration Verification Number, total vehicle distance total engine hours

Table A. IUMPR Data Collection Tool Functional Modules

Each functional module will be tested for the report data elements they produce. Automated tests will use an Engine Simulator. Test data to be provided by IUMPR Tool client.

For each report data element, the test system will simulate a Controller using the following process to test the Functional Module responsible for generating the report data element.

- Test System schedules the expected response packet for report data elements to Engine Simulator.
- Test System calls functional module to collect report data element.
- Functional Module sends request (if required) to Engine Simulator.

- Engine Simulator responds with Response.
- Functional Module takes reads Response.
- Functional Module takes action based on Response.
- Test System compares Functional Module action based on Response against expected action.
 - No response (Is this 1st try? 2nd try? Etc. - check for correct alternate action)
 - Improper response (There may be more than one flavor of improper responses to be checked - check for correct alternate action)
 - Proper response (continue below)
- Functional Module parses Response to create Result.
- Test System compares Result to expected Result.

Software Controller Testing

The IUMPR Data Collection Tool software Controllers call Functional Modules to generate data for the report and for display in the user interface. The three Controllers are: Vehicle Information Controller (Function B in IUMPR Data Collection Process document), Monitor Completion Status Controller (Function C in IUMPR Data Collection Process document), and Test Results Controller (Function E in UMPR Data Collection Process document). Table B shows the Controllers and the Functional Modules they use.

Controller Name	Functional Modules
Vehicle Information Controller	Engine Speed Module Comparison Module Banner Module Vehicle Information Module Diagnostic Readiness Module DTCs Module Report File Module
Monitor Completion Status Module	Engine Speed Module Comparison Module Banner Module Vehicle Information Module Diagnostic Readiness Module Monitor Tracking Module Report File Module
Test Results Controller	Engine Speed Module Comparison Module Banner Module Vehicle Information Module Diagnostic Readiness Module OBD Tests Module

	Report File Module
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Table B. IUMPR Data Collection Tool Software Controllers

A Controller test will call the serving Functional Module tests in the appropriate sequence. The Controller will call the Report File Module to write to the report file. Test System will compare the modified output file to the expected output file. This will be repeated for the available test data. Test data to be provided by IUMPR Tool client.

System Testing

A IUMPR Data Collection Tool system test will consist of calling the Controller tests in the appropriate sequence for each test script and compare resulting output file to the expected output file. This will be repeated for the available test data. Test scripts will be written to correspond to test data provided. Test data to be provided by IUMPR Tool client.

Testing Pass/Fail Criteria

The standards for judging the success or failure of each unit and system test will be comparison of actual results to expected results. Each test will specify entrance and exit criteria. Some tests will exercise the Data Collection Tool's action to abnormal test conditions (e.g., no connectivity to vehicle, inability to write selected file). Test progress will be tracked with a test tracking and reporting system. This system will record which modules are ready for testing, which modules have completed test suites and test scripts developed, and the results of the most recent running of these tests.

Test Deliverables

The test deliverables include the following: test tracking and reporting system artifact (spreadsheet), an HTML JUnit Test Report for the automated tests, and a text report for each test script including actions and results.

Test Environment Setup

Three coherent test environments will be used to test the Data Collection Tool:

- 1) A software-only environment where the Test System will run Data Collection Tool tests using an engine simulator
- 2) A bench environment that will include an engine module that will replace the engine simulator in environment #1
- 3) A test environment on an idling vehicle where the Data Collection Tool will be tested interfacing with actual vehicle modules (on one International Truck only).

Test Schedule

Plan Step	Start	End
Information Gathering	1/9/2017	2/10/2017
Test Planning	2/13/2017	3/24/2017
Test Case Design	3/27/2017	4/21/2017
Test Development - Functional Modules	2/6/2017	3/24/2017
Test Development - Controllers	3/27/2017	4/21/2017
Test Development - Test Scripts	3/20/2017	4/14/2017
Test Execution and Evaluation	4/17/2017	5/25/2017

Risks and Contingency Plans

The following are known Test Plan Assumptions and Risks:

- Quantity of Test Data is unproven
- Availability of vehicle, mechanic, and other test resources outside of Solid Design's control
- Inability to test on non-International vehicles
- No test planned for conditions where vehicle is being driven
- Changes to the original requirements or designs

Test Cases

Test Case ID Legend. 5 characters, position 1 alpha, positions 2-5 numeric

Position 1: IUMPR Function (A-H, J-K)

Positions 2-3: requirement number (01-99) for function specified in position 1

Positions 4-5: test number (01-99) for requirement specified in positions 1-3

User Interface Controller

Function G – Main Program

G01 User must be able to select an installed adapter

G0101 – success

G0102 – no installed adapters

G0103 – communication could not be established with selected adapter

G02 User must be able to change selected adapter prior to reading Vehicle Data Plate

G0201 – success

G03 User must Capture Vehicle Data Plate (Function B) before proceeding to Track Monitor Completion Status (Function C) or to Collect Test Results (Function E)

G0301 – “Track Monitor Completion Status” and “Collect Test Results” buttons disabled until Function B executes

Report File Selector

Function A – File Management

A01 User must be able to create a new report file

A0101 – success

A0102 – failure (file creation exception)

A02 User must be able to select an existing report file for append and system must be able to read from and write to selected report file

A0201 – success

A0202 – unable to read or write selected file

A03 System must not allow use of selected report file if it is internally inconsistent (VIN, Cal ID, Time Stamp)

A0301 – success (consistent VINs and Cal IDs, monotonically increasing time stamps)

A0302 – no VIN in report file

A0303 – inconsistent VINs in report file

A0304 – no Cal IDs in report file

A0305 – inconsistent Cal IDs in report file

- A0306 – non-monotonically increasing time stamps in report file
- A04 System must warn user of excess time since code clear in report file
 - A0401 – time SCC in report file less than 60 minutes before current time
 - A0402 – no time SCC in report file
 - A0403 – time SCC in report file after current time
 - A0404 – time SCC gap between in report file and current time greater than 60 minutes
- A05 User must be able to change selected report file before reading Vehicle Data Plate but not after reading Vehicle Data Plate
 - A0501 – success (report file selection disabled after reading Vehicle Data Plate)

Engine Speed Module

Function J – Verify Engine Speed

- J01 System must be able to communicate with engine module
 - J0101 – success
 - J0102 – failure to communicate

Comparison Module

Function F – Validate VIN and Cal ID

- F01 System must detect mismatch between vehicle and report file (VIN, Cal ID) and not allow writing to report file when this is detected
 - F0101 – successful match
 - F0102 – VIN mismatch
 - F0103 – Cal ID mismatch

Vehicle Information Controller

Function B – Capture Vehicle Data Plate

- B01 User will have the option to affirm vehicle and file system data, monitor for data response failure, and abort report generation.
 - B0101 – display results, user continues with report generation
 - B0102 – display results, user aborts report generation
- B02 If engine speed not found (via SPN 190), prompt user to turn key on or start engine or abort
 - B0201 – engine speed found via SPN 190
 - B0202 – engine speed not found via SPN 190, system prompts user to turn key on or start engine or abort
- B03 Warn user if Address claim is not supported by ECM
 - B0301 – Address claim supported by ECM
 - B0302 – Address claim not supported by ECM, system warns user

04 Query VIN and Cal ID from vehicle and read VIN and Cal ID from report file (if not a new report file)

B0401 – new report file

B0402 – success (consistent VINs and Cal IDs, monotonically increasing time stamps)

B0403 – no VIN in report file

B0404 – inconsistent VINs in report file

B0405 – no Cal IDs in report file

B0406 – inconsistent Cal IDs in report file

B0407 – non-monotonically increasing time stamps in report file

B05 DM5/DM20 data for HD OBD modules from first run of Function B will be stored for use in Function C: “Track Monitor Completion Status”

B0501 – success (Generate Vehicle Data Plate only done once)

B0502 – success (Generate Vehicle Data Plate done twice with different results)

B06 User may abort data collection if NACK received in response to request to reset any existing non-emission diagnostic trouble codes

B0601 – No NACK received

B0602 – NACK received, system to allow abort of data collection

B07 System will display file name access selection, file name, and connection speed, Claimed Address, Diagnostic Trouble Codes

B0701 – success

B0702 – unsupported Address Claim

B08 System will display to user and save to report file Time Since Code Cleared warnings

B0801 – no Time SCC warnings

B0802 – no response to DM21 (Time Since Code Cleared)

B0803 – time SCC reset error

B0804 – time SCC excess gap error

B09 System will display to user and save to report file Data Collection Tool version and release date, Data Plate report banner header, Data Collection Tool Claimed Address, VIN, CAL ID, CVN, Time since code clear, Time SCC Gap, OBD modules – component ID and serial number, Monitor Readiness (DM5), Monitor Trip Status (DM26), In-Use Ratios (DM20), DM6, DM12, DM23, and DM28, Time since code clear – DM21 (after Clear Code command), Total Vehicle Distance in km and miles, Total Engine Hours of Operation, Data Plate report banner footer

B0901 – success

B0902 – no response to request for OBD modules

B0903 – Monitor Readiness (DM5) failure after 3 attempts

B0904 – Monitor Trip Status (DM26) failure after 3 attempts

B0905 – In-Use Ratios (DM20) failure after 3 attempts

B0906 – no response to DM6

B0907 – no response to DM12

B0908 – no response to DM23

B0909 – no response to DM28

B0910 – no response to DM21 (Time SCC) after clear code command

B0911 – no response to request for Total Vehicle Distance

B0912 – no response to request for Total Engine Hours of Operation

Monitor Completion Status Controller

Function C – Track Monitor Completion Status

C01 System will display to user and save to report file Data Collection Tool version and release date and Data Plate report banner header, Time since code clear, Time SCC Gap, Composite Diagnostic Readiness – DM5, Tabulated Performance Ratios – DM20, Total Vehicle Distance in km and miles, Total Engine Hours of Operation, Data Plate report banner footer

C0101 – success

C0102 – no response to request for VIN

C0103 – no response to request for Cal ID and CVN

C0104 – no response to Time since code clear request – DM21

C0105 – excess Time SCC Gap

C0106 – no response to DM5 for Composite Diagnostic Readiness (before clear code command)

C0107 – no response to DM20 for Tabulated Performance Ratios

C0108 – no response to DM5 for Composite Diagnostic Readiness (after clear code command)

C0109 – no response to request for Total Vehicle Distance

C0110 – no response to request for Total Engine Hours of Operation

C02 System will continue to collect DM5 and DM20 data until user stops data collection

C0201 – user stops data collection

C0202 – data collection proceeds, unstopped for 8 hours

C03 System will display to user DM5 and DM20 data changes

C0301 – success

C0302 – change to numerator x (TBD)

C0303 – change to numerator y (TBD)

C0304 – change to numerator z (TBD)

C03xx – (other changes - TBD)

Test Results Controller

Function E – Collect Test Results for Completed Monitors

E01 User will have the option to affirm vehicle and file system data, monitor for data response failure, and abort report generation.

E0101 – display results, user continues with report generation

E0102 – display results, user aborts report generation

E02 If engine speed not found (via SPN 190), prompt user to turn key on or start engine or abort

E0201 – engine speed found via SPN 190

E0202 – engine speed not found via SPN 190, system prompts user to turn key on or start engine or abort

E03 Query VIN and Cal ID from vehicle and read VIN and Cal ID from report file (if not a new report file).

E0301 – new report file

E0302 – success (consistent VINs and Cal IDs, monotonically increasing time stamps)

E0303 – no VIN in report file

E0304 – inconsistent VINs in report file

E0305 – no Cal IDs in report file

E0306 – inconsistent Cal IDs in report file

E0307 – non-monotonically increasing time stamps in report file

E04 If no positive DM24 response is received after 3 attempts (5000 ms delay between attempts, if NACK (busy) is received), warn user

E0401 – success

E0402 – failure after 3 attempts – warn user

E05 Send DM7 for each SPN where controller supports Scaled Test Results until DM30 (scaled test results) message is returned or 3 attempts made

E0501 – success

E0502 – failure after 3 attempts

E06 System will display to user and save to report file Data Collection Tool version and release date, Data Plate report banner header, VIN, CAL ID, CVN, Time since code clear – DM21, Time SCC Gap, DM24 list of SPNs for each OBD-compliant module, Scaled Test Results in log for each SPN where controller supports Scaled Test Results, Service Address, SPN, and FMI for any incomplete Test results, Count of incomplete test results (or “No Incomplete Test Results”), Monitor Readiness (DM5), Monitor Trip Status (DM26), In-Use Ratios (DM20), Time since code clear – DM21 (after clear code command), Total Vehicle Distance in km and miles, Total Engine Hours of Operation

E0601 – success

E0602 – no response to request for VIN

E0603 – no response to request for Cal ID and CVN

E0604 – no response to Time since code clear request – DM21 (before clear code command)

E0605 – excess Time SCC Gap

E0606 – no response to DM24 from OBD-compliant module

E0607 – no response to request for Scaled Test Results

E0608 – no response to request for Service Address, SPN, and FMI for any incomplete

Test results

E0609 – no response to request for Count of incomplete test results

E0610 – no response to request for Monitor Readiness (DM5)

E0611 – no response to request for Monitor Trip Status (DM26)

E0612 – no response to request for In-Use Ratios (DM20)

E0613 – no response to Time since code clear request – DM21 (after clear code command)

E0614 – no response to request for Total Vehicle Distance

E0615 – no response to request for Total Engine Hours of Operation

Function H – Calculate Quality Metrics

H01 System will display to user and save to report file Total Queries for each session, Total Time Outs for each session, Number of Data Collection Logs within this report, Number of Time Since Code Clear excess gaps in this report, Data Plate report banner footer

H0101 – no Time Outs

H0102 – 3 Time Outs

H0103 – one data collection log

H0104 – 3 data collection logs

H0105 – no Time SCC gaps

H0106 – 3 Time SCC gaps