

IUMPR Data Collection Process

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Prepared for

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ABSTRACT

This is the for data collection methodology in support of 13 CCR 1971.1 (l)(2.3.3). This data collection methodology is written for HD engines that use SAE J1939-73 for compliance to 13 CCR 1971.1 (h). The data collection methodology is intended as a means to source data for submission in support of the requirements of 13 CCR 1971.1 (l)(2.3.3). 13 CCR 1971.1 (l)(2.3.3) requires manufacturers to provide evidence that In Use Monitor Performance Ratio (IUMPR) data operate (increment) as defined in 13 CCR 1971.1. The methodology is broadly based on SAE J1699-3.

The April 27th version of this document captures the meeting comments from April 27th. The May 23rd version instituted the 4th draft which relates to a report mockup and was coordinated with this mockup report. Changes from the April 27th document are shown with underlined text. The May 24th version captures meeting discussion including some comments from ARB's May 20th comments. The June 1st version adds content for improving the VIN file check by adding a date comparison for each VIN in the preexisting file, while maintaining the correlation to the report mockup. The June 6th version incorporates additional ARB feedback. The July 8th version, the 5th draft, adds checks for Time Since Code Clear to Function F, adds a Function F call to Function C, and adds Functions J, K, and H. The July 19th version finalizes the gap in Time Since Code Clear to 60 minutes.

Implementation Assumptions

This methodology will support vehicles built using either 250K or 500K baud communications. It may be assumed that the vehicle implements HD OBD required communications using SAE J1939-73, for the purposes of establishing a communications connection. However, the communications speed may not be assumed to be only 250K or only 500K baud. Connection methods for SAE J1939-based tools are discussed in SAE J1939-03, SAE J1939-13, and SAE J1939-16. The software shall avail itself of the capabilities of an SAE J2534 or a TMC RP1210C standard interface for 29-bit CAN communications.

The query and response mechanism for SAE J1939-73 DMs is described in SAE J1939-21. Some messages queried are defined in SAE J1939DA and SAE J1939-71 in addition to SAE J1939-73. Proper use of the principles in SAE J1939-21, SAE J1939-71, and SAE J1939-73 are expected for the implementation of the procedures below. Section 6 of SAE J1939-84 summarizes the key principles needed for successful implementation. For example, each query shall be permitted at least 3 retries; the retries shall (at a minimum) be at least 1000 ms apart.

The monitoring process assumes that the engine ECM is always powered and will provide an engine speed of 0 to the data bus, when the vehicle supports a stop start system for stop lights or a (hybrid) electric drive using a charge depletion operating mode. Hybrid systems that purport to provide SPN 7315 as on with no engine speed (SPN 190) from the engine ECM are not believed to exist, nor are believed to be likely to exist in the future. [When there is no engine speed there can be no data obtained from the engine in VIN, CAL ID, DM5 and DM20 query responses and the data log becomes a sea of timeout errors].

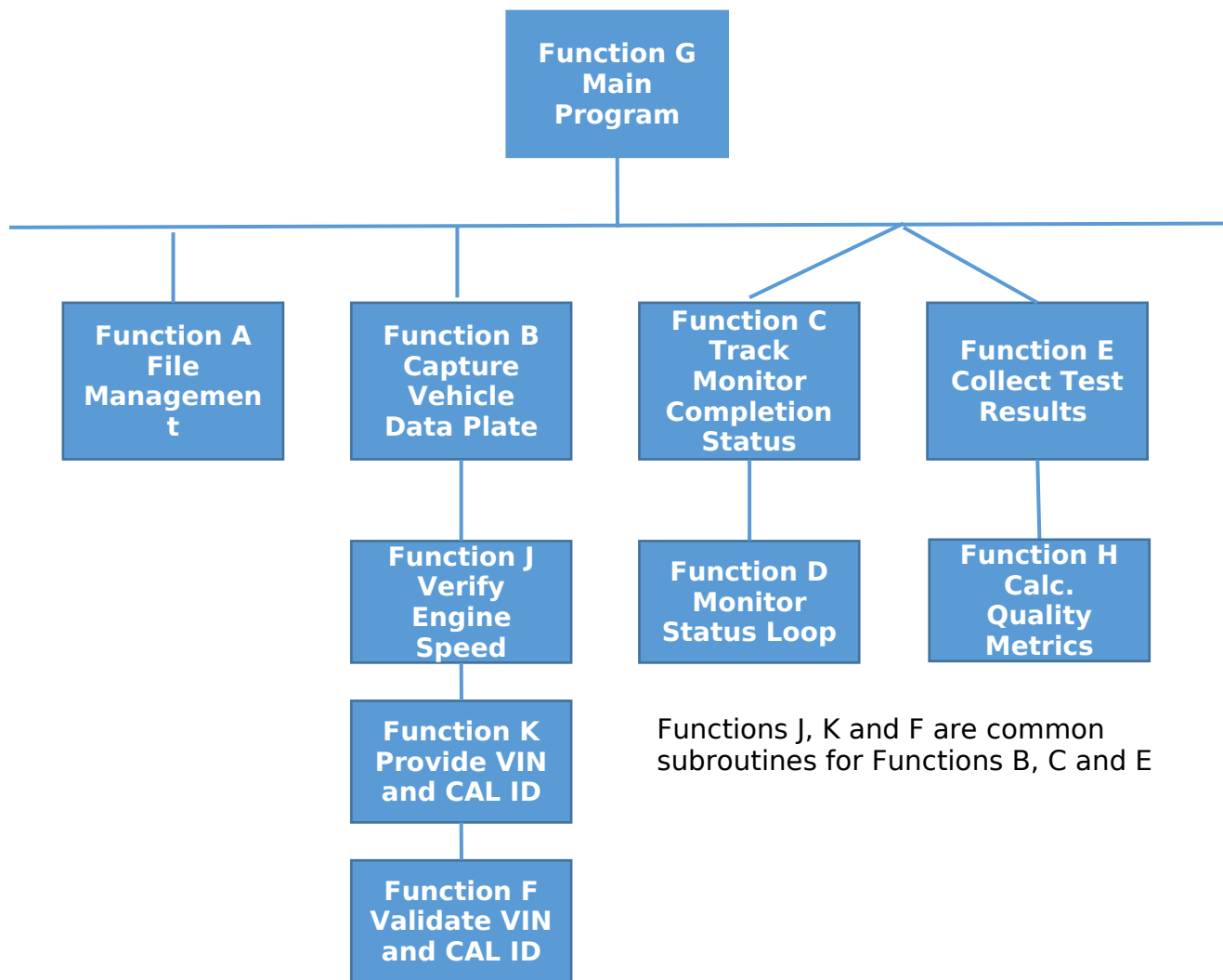
The process summaries proposed below are notional for the intended, completed software content. They are not intended to provide a complete software detailed design for any software

programming language. Detailed elements have been omitted. The process summary is intended to coordinate with an annotated example output file that represents the main elements of the IUMPR process, Functions B, C, D, and E.

Proposed Call Tree Structure

Here the term CSCI (Computer Software Configuration Item) is used to provide an initial organizational architecture for the data collection methodology. The term Function is used to identify key subprograms to be included in the CSCI. One CSCI is contemplated in this discussion. The displayed sequence of steps is not intended to define a proscriptive or directed architecture that is required of all compliant implementations. It is intended that a non-recursive structure is created to minimize the size of the heap needed to support the implementation. An example structure is shown below titled proposed call tree structure.

The figure below shows a call tree structure for the functions and procedures comprising the 3rd Draft IUMPR Data Collection Process. Function G provides the main program. Function G calls Function A and then calls Function B. Function B provides a vehicle data plate record for the log. The user then selects either Function C or Function E. Function C queries DM5 and DM20 using Function D, and prints the values from DM5 and DM20 every 3 minutes. Function E provides the final DM5, DM20 and DM30 values documenting the performance ratios with completed test results. Function E calls function H to calculate query and error statistics. Functions J, K, and F provide common error detection and display features for Functions B, C, and E.



Program Initiation Discussion

The program initiation choices revolve around the question of what operating system capabilities may be limited by initiation from a console session. In particular, the file system authority for reading and writing data onto local hard drives is commonly limited by corporate information technology. [In order, for example, to follow a corporate vision for thin client and cloud based service infrastructure]. The ability to access network server hosts for data storage may dictate a program initiation means that does not match either of the two alternatives below. Moreover, implementation of a user interface concept that minimizes memory utilization may require the use of a window structure instead of a console terminal (e.g. ansi.sys). The detailed steps required for Function A may change based on the program initiation method chosen.

Intended Program Initiation

1. Turn vehicle on
2. Start a console session [File system assistance / research will be needed ...]
3. Change directory to the program installation directory ... to resolve how to best implement this content].
4. Type the program name on the command line and press return
[The command line may include the name of a subdirectory on the current path for data as may be determined to provide the easiest method for separating the data directory from the program directory.
The command line may also include a new/append switch(es) to facilitate actions in FUNCTION A and B]

Alternate Program Initiation

1. Turn vehicle on
2. Start a console session [The result may impact desired DM11 processing].
3. Change directory to the desired data collection directory
4. Type the installation path followed by the program name on the command line and press return
[The installation path may be included in an environment variable or other macro facility and not directly typed. The command line may include the name of a subdirectory on the current path for data as may be determined to provide the easiest method for separating the data directory from the program directory.
The command line may also include a new/append switch(es) to facilitate actions in FUNCTION A and B]

FUNCTION A: File Management.

1. Accept File Name from User Input whether Dialog Box / Current Path/Command Line
2. Check Directory for File Name
3. If file name not found, then display file name and confirm creation of new file in user defined path.
4. If file system error, then display file name, display error condition, and end program.
5. If file name found, then display file name and confirm append data collection to new file.
6. If file system error, then display file name, display error condition, and end program.
7. If existing file used, then advance file pointer to the end of the file [A File system dialog box would be nice.]
8. If file system error, then display file name, display error condition, and end program.
9. Save File Creation Status for use in Function B
10. Create report header including date and time stamp

FUNCTION B: Capture Vehicle Data Plate.

[Steps 1, 2 and 3 are not a protocol speed selection and connection scheme too. Additional steps will be needed to establish and manage a connection. The communications adaptor should automate some of this without the need to describe communications connection management in detail here.]

- 1: Call Function J Verify Engine Speed
- 2: Display file name access selection, file name, and connection speed to user.
- 3: Display claimed addresses to user.
- 4: If Function 0 is not found, then warn user that Address claim is not supported by the ECM.
- 5: Call Function K: Provide VIN-CAL-ID and Time SCC and save for Function F.
- 6: If user switch is append and file opened
- 7: Then Call FUNCTION F: Validate VIN in FILE
 [Files that contain mismatched VINs and mismatched CAL IDs will be aborted.
 Ideally they can be used with the matching truck the next time around].
 [ARB still to review criteria for inter-/intra- collection session checking ... using Time Since Code Clear].
- 8: If Function F result <> Success
- 9: Then DO
- 10: Handle Function F Result ()
- 11: Return (Function F result) END DO;
- 12: Print Data Collection Tool Version and Release Date
- 13: Print Data Plate Report Banner.
- 14: Print file name access selection, file name, and connection speed to user.
- 15: Perform address claim function, claim service tool preferred address F9.
- 16: Print claimed addresses to data file.
- 17: If Function 0 is not found, then Print warning message to data file.
- 18: Store VIN, CAL ID/CVN (DM19) for use in Functions C and E.
- 19: Print VIN and CAL ID/CVN to User and data file:
- 20: Print Time Since Code Clear to data file [This will be the
before code clear value ...]
- 21: Print Time SCC Gap Message
- 22: Query DM5 to identify OBD modules for data collection.
- 24: Display identified modules.
- 25: Query Component ID and display to user and data file, displaying ESN for Function 0 [SA 0].
- 26: Display file name and create append/status to user,
- 27: Ask user to affirm vehicle and file system data
- 28: If vehicle data or file system data is not correct then End Program:
- 29: If user switch is create and file opened as new Then DO
- 30: Send Request with DM11 PGN.
- 31: Wait 5000 ms;
- 32: Display N/ACK in log.
- 33: If NACK[Error] is received, then confirm End Program with user. End DO
- 34: Query Monitor Readiness [DM5], and display to user and data file
- 35: Query Monitor Trip Status [DM26], and display to user and data file.
- 36: Query In Use Ratios [DM20] and display to user and data file.
- 37: Iterate steps 33 through 35 for up to 3 attempts per query. Wait 1000 ms between query attempts.
- 38: If no response for DM5, DM26, and DM20 then abort program for monitor data response failure.
- 39: Save DM5 and DM20 replies for comparison in FUNCTION C (Saved DM5/DM20 Data).
- 40: Query DM6, DM12, DM23 and DM28 and display to user and data file. [Quality control
measure for data collection].
- 41: If DTCs are displayed, then confirm data collection with user.
- 42: If user elects to abort, then abort.
- 43: Query DM21 [Time Since Code Cleared] and display to user and data file [... This is
the after code clear value]
- 44: Query Vehicle Distance and Display SPN 245 Total Vehicle Distance in km and miles.
- 45: Query Engine Hours and Display SPN 247 Engine Total Hours of Operation.
- 46: Display End of Report Notice for Data Plate Report
- 47: Set user switch to append

48: Return (Success)

FUNCTION C: Track Monitor Completion Status

1: Call Function J Verify Engine Speed
2: If engine speed < 300 RPM, remind user to start the engine.
3: Call Function K: Provide VIN-CAL-ID and Time SCC and save for Function F
4: Call FUNCTION F: Validate VIN in FILE
 [Files that contain mismatched VINs and mismatched CAL IDs will be aborted.]
5: If Function F result <> Success
6: Then DO
7: Handle Function F Result ()
8: Return (Function F result) END DO;
9: Print Data Collection Tool Version and Release Date
10: Print Data Monitor Log Banner
11: Print VIN and CAL ID/CVN to data file:
12: Print Time Since Code Clear to data file
13: Print Time Since Code Clear Gap Message
14: Initialize Last DM5/DM20 data to the value stored (Saved DM5/DM20 Data).
 [Use both
numerators and DM5 Monitor Status]
15: While DM5/DM20 Storage is not null AND Saved DM5/DM20 data = Last DM5/DM20 data,
 AND engine speed is provided then Do
16: Call Function D (DM5/DM20 Storage)
17: Display Date and Time in log.
 [Function D runs for 3 minutes]
18: Display Last DM5/DM20 Data in Log
 display is every 3 minutes] [Therefore this
19: End DO
20: If Saved DM5/DM20 data <> Last DM5/DM20 data THEN DO
21: Display Date, Time, and DM5/DM20 Data Changed in Log END DO
22: Display Vehicle Composite of DM5 Data
23: Display Old DM20 data and New DM20 data in a tabular format
24: Query DM21 (Time Since Code Cleared) and display to user and data file
25: Query Total Vehicle Distance and display to user and data file.
26: Query Engine Hours and display to user and data file
27: Display End of Report Notice for Data Monitor Log

Note: 13 CCR 1971.1 (d)(4.3.2)(G) defines an 800 minute denominator. Must all 800 minutes to be documented by Functions C and D? [800 minutes (13.33 hours) / 3 minutes = 267 log entries. 267 log entries * 5 lines / 50 lines per page = 27 pages (single spaced). Would 200 (3.33 hours) minutes of log time (7 single spaced pages) until the (d)(4.3.2)(G) value increments suffice?]

FUNCTION E: Collect Test Results for Completed Monitors

- 1: Call Function J Verify Engine Speed
- 2: Call Function K: Provide VIN-CAL-ID and Time SCC and save for Function F
- 3: Call FUNCTION F: Validate VIN in FILE
- 4: Print Data Collection Tool Version and Release Date
- 5: Print Data Collection Log Banner
- 6: Print VIN to data files.
- 7: Print CAL/ID and CVN to user and data files:
- 8: Print Time Since Code Clear
- 9: Print Time Since Code Clear Gap Message
- 10: For I = 1 to Number of OBD Modules DO
- 11: Query DM24
- 12: If positive DM24 response, Display DM24 list of SPNs with test results.
- 13: If NACK(BUSY) received, then wait 5000 ms.
- 14: Iterate steps 11 to 13 until at least 3 attempts for each OBD Module have been made or DM24 data is received.
- 15: If no DM24 response received then warn user and prompt for abort or continue.
- 16: End DO Number of OBD Modules
- 17: For each OBD module supporting test results DO
- 18: For each SPN supporting test results in DM24 reply from OBD Module DO
- 19: Send DM7 with SPN, FMI 31 and TID 247 ...
- 20: If NACK(BUSY) received then wait 1000 ms
- 21: Iterate steps 19 and 20 until DM30 data is received or 3 attempts have been made
- 22: Display Test Results in Log for SPN
 [If Test data not received then log "No Test Data for SA XX SPN YYYY TID 247"]
- 23: Enter any incomplete test results including SA, SPN and FMI into a list END DO For each SPN
- 24: End DO For each OBD Module
- 25: If the list of incomplete test results is null (or an empty set)
- 26: Then Display No Incomplete Test Results for an empty set
- 27: Else DO For each test result in list of incomplete test results by SA, SPN, and FMI DO
- 28: Display incomplete test result including SA, SPN and FMI End DO
- 29: Display count of incomplete test results. End DO
- 30: Query Monitor Readiness [DM5], and display to user and data file
- 31: Query Monitor Trip Status [DM26], and display to user and data file
- 32: Query In Use Ratios [DM20] and display to user and data file.
- 33: Save DM5 and DM20 replies for comparison in FUNCTION C and FUNCTION D.
- 34: Query Time Since Code Cleared and display to user and data file
- 35: Query Total Vehicle Distance and display to user and data file.
- 36: Query Engine Hours and display to user and data file
- 38: Call Function H Quality Metric Calculation
- 37: Display VIN and CAL ID to data file
- 39: Display End of Report Notice for Data Collection Log

FUNCTION D: Monitor Status Loop

- 1: Initialize timer storage (Save Current Time)
- 2: Initialize Counter to 1:
- 3: While Counter < 19 AND Saved DM5/DM20 data = Last DM5/DM20 data
AND engine speed is provided DO
- 4: Set Save Current Time to Current Time()
- 5: Query In use ratios [DM20] and display to user and data file.
- 6: Query Monitor Completion [DM5], and display to user and data file.
- 7: Query Monitor Trip Status [DM26], and display to user and data file.
- 8: Query DM12 and display Time and Distance since code clear to user
- 9: Save DM5 and DM20 data as Last DM5/DM20 Data [18 iterations at 10 seconds is 3 minutes]
- 10: Wait (10s - (CurrentTime() - Save Current Time))
- 11: End Do

Note: 13 CCR 1971.1 (d)(4.3.2)(G) defines an 800 minute denominator. Must all 800 minutes to be documented by Functions C and D? [800 minutes (13.33 hours) / 3 minutes = 267 log entries. 267 log entries * 5 lines / 50 lines per page = 27 pages (single spaced). Would 200 (3.33 hours) minutes of log time (7 single spaced pages) until the (d)(4.3.2)(G) value increments suffice?]

FUNCTION J: Verify Engine Speed

- 1: Check data stream for a broadcast Engine Speed (SPN 190)
- 2: if Engine Speed is not found, then prompt user to turn the key on or abort.
- 3: Iterate steps 1 and 2 until 3 attempts to obtain engine speed have been provided.
- 4: If engine speed is not found then abort.
- 5: [If engine speed was found,] Perform address claim function, claim service tool preferred address F9.
- 6: return (success)

FUNCTION K: Provide VIN CAL-ID and Time SCC

- 1: Query VIN
- 2: If NACK(BUSY) is received then wait 1000 ms
- 3: Iterate steps 1 and 2 until at least 3 attempts have been made or VIN data is received.
- 4: If no VIN data is received then warn user, and prompt for abort or continue.
- 5: Else Save VIN Data received for Function F:
- 6: If user selects abort, close files and end program.
- 7: Otherwise, Query DM5 to affirm HD OBD Modules.
- 8: Query CAL/ID and CVN (DM19).
- 9: If NACK(BUSY) is received then wait 1000 ms
- 10: Iterate steps 7 through 9 until at least 3 attempts have been made or DM5 and CAL ID/CVN data is received.
- 11: If CAL ID (DM19) or DM5 is not received then warn user and prompt for abort or continue.
- 12: Otherwise, Display CAL/IDs and CVNs received.
- 13: Query Time Since Code Clear (DM21)
- 14: Iterate steps 13 until at least 3 attempts have been made or DM21 data is received.
- 15: If Time Since Code Clear is not Received, then warn user and prompt for abort or continue
- 16: Otherwise save time since code clear for function F.
- 17: Display VIN to user.
- 18: Display DM5 OBD Compliance to User
- 19: Display CAL/ID and CVN to user
- 20: Display Time Since Code Clear to user
- 21: Return (Success)

FUNCTION F: Validate VIN in FILE (Current VIN, Current CAL ID and CVN, Current Time SCC)

[This checks the VIN & CAL ID and Time SCC vs the Data collected in Functions B, C and E]

[Files that contain mismatched VINs and mismatched CAL IDs will be aborted.

Ideally they can be used with the matching truck the next time around

Files that have Time SCC Errors will be allowed to collect additional data with error messages added to the report(s)].

```
1: If user switch is new, and file created THEN DO
2:   Set Last Date / Time Stamp to Get Current Time and Date ()
3:   Set Last VIN to Current VIN
4:   Set Last CAL ID and CVN to Current CAL ID and CVN
5:   Set Last Time Since Code Clear to Current Time Since Code Clear
7:   Return (success) END DO
8: Else If user switch is append and file opened THEN DO
9:   Set file pointer to 0 (beginning of file)
10:  Set Last Date Time Stamp to Null;           [ Checking Time SCC Instead].
11:  Set Last Date/Time Stamp to Find Next Date Time Stamp ()
12:  If Date Time Stamp is Null, then return (Missing Date)
13:  Set Last VIN to Null;
14:  Set Last CAL ID and CVN to Null;
15:  While file pointer <> EOF DO
16:    Set Last VIN to Find Next VIN ();
[Search file for VIN:]:
17:    If Last VIN <> Current VIN, then return (VIN_Match_ERROR);
                                [If VIN does not match last vehicle query return or was not found
then abort program]
18:    Set New Date / Time Stamp to Find Next Date Time Stamp ();
19:    If Last date time stamp > New Date Time Stamp then return (Date_Sequence_Error)
                                [if dates for VIN displays do not monotonically increase then abort
program]
20:    Set Last CAL ID and CVN to Find Next CAL ID (); Search file for CAL ID
21:    If Last CAL ID and CVN <> Current CAL ID and CVN, then return (CAL ID Match ERROR)
                                [if CAL / ID and CVN (DM19 reply) last vehicle query do not match
then abort program]
22:  End DO While
23:  If Last VIN = NULL, then return (VIN Not Found)
24:  If Last CAL ID and CVN = NULL, then return (CAL ID and CVN Not Found)
25:  Set file pointer to 0
26:  Set Last Time Since Code Clear to Null;
27:  While file pointer <> EOF DO
28:    Set Next Time Since Code Clear to Find Next Time Since Code Clear ();
[Search file for Time SCC]
29:    If Next Time Since Code Clear <> Null
30:      then Set Last Time Since Code Clear to Next Time Since Code Clear
30:  End DO While
31:  If Last Time Since Code Clear = Null           [Check only the last Time SCC found against
the current engine display]
32:    then return(Time SCC Not Found Error)
33:  Else If Last Time Since Code Clear > Current Time Since Code Clear
34:    then return(Time SCC Reset Error)
35:  Else If ((Last Time Since Code Clear + 60 minutes) < Current Time Since Code Clear
36:    then return(Time SCC Excess Gap Error)
37: End DO
38: Set file pointer to end of file
39: Return (success)
```


FUNCTION H: Calculate Quality Metrics

- 1: Set File Pointer to 0
- 2: Set Number_of_Requests to Count_Appearances ("Request", File Handle)
- 3: Set File pointer to 0
- 4: Set Number of Time outs to Count_Appearances ("Timed Out", File Handle)
- 5: Set File pointer to 0
- 6: Set Number of Data Collection Logs to Count Appearances ("Collection Log - END OF Report", File Handle)
- 7: Set File Pointer to 0
- 6: Set Number of Data Collection Logs to Count Appearances ("Excess Time Since", File Handle)
- 7: Set File Pointer to <EOF>
- 8: Reopen file for append (if required)
- 9: Print Total Queries to data file, and display to user.
- 10: Print number of time out errors substituting no for zero, and display to user.
- 11: Print number of [prior] data collection logs, and display to user.
- 12: Print number of Time SCC excess gaps substituting no for zero, and display to user.
- 13: return (success)

FUNCTION G: Main Program

- 1: Validate Command Line Content
- 2: Initialize File System handles
- 3: Call Function A (Create/Append Switch, File System Handles)
- 4: Print Data Collection Tool Version and Release Date
- 5: Initialize DM5 Monitor Status and DM20 Ratio Storage
- 6: Initialize VIN Storage
- 7: Initialize CAL ID/ID and CVN Storage
- 8: Call Function B (DM5/DM20 Storage) [This initializes Saved DM5/DM20 Data for Function C and D].
- 9: CASE User Input:
- 10: Input E: Call Function E Test Data Collection
- 11: Input C: Call Function C Track Monitor Completion Status (Saved DM5/DM20 Data))
- 12: Not C and Not E: Break
- 13: END CASE;
- 14: Iterate steps 7 through 12 until Not C and Not E
[Function D will exit if the engine is turned off and no engine speed data is present].
- 15: Close Files
- 16: End Program

Reference User Interface Display Examples

At a minimum the user status display for functions B shall include:

1. Error Status from VIN, DM5, DM19, and DM20 queries:
2. Abort options for query errors.
3. DM11 Query Status, when run.
4. VIN Received
5. CAL ID Received
6. Engine Hours Received
7. Total Vehicle Distance Received
8. Time Since DTCs Cleared (DM21)
9. Distance Since DTC Cleared (DM21)
10. Prompt to Continue

At a minimum the user status display for functions E shall include:

1. Error Status from VIN, DM5, DM19, and DM20 queries:
2. Abort options for query errors.
3. VIN Received.
4. CAL ID Received
5. Engine Hours Received
6. Total Vehicle Distance Received
7. Time Since DTCs Cleared (DM21)
8. Distance Since DTC Cleared (DM21)
9. Number of incomplete tests
10. Number of missing test results.

At a minimum the user status display for functions G shall include:

1. Error Status from VIN, DM5, DM19, and DM20 queries:
2. Abort options for query errors.
3. VIN Received.
4. CAL ID Received
5. Last Engine Hours Received
6. Last Total Vehicle Distance Received
7. Last Time Since DTCs Cleared (DM21)
8. Last Distance Since DTC Cleared (DM21)
9. Display User Option to
 - a. Run Data Monitor Log (Function C)
 - b. Run Data Collection Log (Function E)
 - c. Save Data
 - d. Exit Program

Reference User Interface Display Examples

At a minimum the user status display for functions C and D shall include:

1. Monitor status from of the DM5/DM26
2. Numerators and denominators from DM20
3. Time Since DTCs Cleared (DM21)
4. Distance Since DTC Cleared (DM21)

The numerators which changed from the initial set of numerators shown from the first DM20 response collected by Function B are shown highlighted with a green background. When all of the numerators are changed, the board will be green from SPN 5321 through SPN 3064. Those DM29 monitors that are disabled shall be highlighted with a red tinted or rose background. Engine and Aftertreatment 1 prefixes may be omitted from SPN titles to facilitate screen sizing. This user interface display shall include the ability to scale or adjust the font size to fit into the user's selected (console?) window size.

Time Since Code Clear	129 minutes
Distance Since Code Clear	145 km (90.1 miles)

<i>Only Show Provided SPN Labels</i>		<i>From DM20 Data</i>	
SPN	Counter/Monitor Name	Numerator	Denominator
3048	Ignition Cycle		128
3049	OBD Monitoring Conditions Encountered Counts		15
5321	Engine Intake Manifold Pressure System Monitor	3	15
3058	EGR System Monitor	15	15
5318	Exhaust Gas Sensor System Monitor	2	15
3055	Fuel System Monitor	5	15
5322	NMHC Converting Catalyst System Monitor	1	4
4792	SCR Catalyst System	3	15
3064	Diesel Particulate Filter System Monitor	1	4

<i>Only show supported monitors</i>	<i>Data from DM5</i>	<i>Data from DM26</i>
Supported Monitors	DM5 Monitor Status	DM26 Monitor Status
Comprehensive components	test complete (0)	test enabled (1)
Misfire monitoring	test complete (0)	test enabled (1)
Fuel system monitoring	test complete (0)	test enabled (1)
Exhaust sensor monitoring	test not complete (1)	test enabled (1)
Exhaust gas sensor heater monitoring	test complete (0)	test enabled (1)

EGR system monitoring	test complete (0)	test enabled (1)
Cold start aid system monitoring	test not complete (1)	test disabled (0)
Boost pressure control	test complete (0)	test enabled (1)
Diesel Particulate Filter (DPF)	test not complete (1)	test enabled (1)
NOx converting catalyst	test complete (0)	test enabled (1)
NMHC converting catalyst	test not complete (1)	test enabled (1)

Reference Display Examples

MM/DD/YYYY 15:59 DM5 0145.935 000 12 18 FE CE 00 00 00 14 37 E0 1E E0 1E

<i>Only show supported monitors</i>	<i>Data from Function B</i>	<i>Data from Function E</i>
Supported Monitors	Initial Status MM/DD/YYYY HH:MM	Last Status MM/DD/YYYY 15:59
Comprehensive components	test complete (0)	test complete (0)
Misfire monitoring	test not complete (1)	test complete (0)
Fuel system monitoring	test not complete (1)	test complete (0)
Exhaust sensor monitoring	test not complete (1)	test complete (0)
Exhaust gas sensor heater monitoring	test not complete (1)	test complete (0)
EGR system monitoring	test not complete (1)	test complete (0)
Cold start aid system monitoring	test not complete (1)	test not complete (1)
Boost pressure control	test not complete (1)	test complete (0)
Diesel Particulate Filter (DPF)	test not complete (1)	test complete (0)
NOx converting catalyst	test not complete (1)	test complete (0)
NMHC converting catalyst	test not complete (1)	test complete (0)

MM/DD/YYYY 15:59 DM20 0131.615 000 57 1C C2 00 00 6A 00 0A 00 C9 14 F8 00 00 0A 00 F2 0B F8 0A 00 0A 00 C6 14 F8 01 00 0A 00 EF 0B F8 03 00 0A 00 CA 14 F8 00 00 03 00 B8 12 F8 00 00 0A 00 F8 0B F8 0F 00 03 00

<i>Only Show Provided SPN Labels</i>		<i>From Function B Data</i>		<i>From Function E Data</i>	
		Initial Status MM/DD/YYYY HH:MM		Last Status MM/DD/YYYY 15:59	
SPN	Counter/Monitor Name	Numerator	Denominator	Numerator	Denominator
3048	Ignition Cycle		120		128
3049	OBD Monitoring Conditions Encountered Counts		10		15
5321	Engine Intake Manifold Pressure System Monitor	0	10	2	15
3058	EGR System Monitor	10	10	15	15
531	Aftertreatment Exhaust Gas	1	10	2	15

8	Sensor System Monitor				
305 5	Fuel System Monitor	3	10	5	15
532 2	Aftertreatment NMHC Converting Catalyst System Monitor	0	3	1	4
479 2	Aftertreatment 1 SCR Catalyst System	0	10	1	15
306 4	Aftertreatment Diesel Particulate Filter System Monitor	0	3	1	4

#

Reference Message Displays

Part 1 Test 8 [Global DM20 (request 59904 for PGN 49664 (SPNs 3048, 3049, 3066-3068))]

0131.175 000 07 18 EA FF F9 00 C2 00 (Tx)
0131.615 000 57 1C C2 00 00 6A 00 0A 00 C9 14 F8 00 00 0A 00 F2 0B F8 0A 00 0A 00 C6 14 F8 01 00 0A
00 EF 0B F8 03 00 0A 00 CA 14 F8 00 00 03 00 B8 12 F8 00 00 0A 00 F8 0B F8 0F 00 03 00 (DM20)

Received SPN 5321 from SA 0 from DM20 with numerator 0, denominator 10
Received SPN 3058 from SA 0 from DM20 with numerator 10, denominator 10
Received SPN 5318 from SA 0 from DM20 with numerator 1, denominator 10
Received SPN 3055 from SA 0 from DM20 with numerator 3, denominator 10
Received SPN 5322 from SA 0 from DM20 with numerator 0, denominator 3
Received SPN 4792 from SA 0 from DM20 with numerator 0, denominator 10
Received SPN 3064 from SA 0 from DM20 with numerator 15, denominator

0145.935 000 12 18 FE CE 00 00 00 14 37 E0 1E E0 1E (DM5)
Global DM5 received from SA 0
Comprehensive components support is: supported (1)
Comprehensive components status is: test complete or not supported (0)
Misfire monitoring support is: supported (1)
Misfire monitoring status is: test not complete (1)
Fuel system monitoring support is: supported (1)
Fuel system monitoring status is: test not complete (1)
Catalyst monitoring support is: not supported (0)
Catalyst monitoring status is: test complete or not supported (0)
Heated catalyst monitoring support is: not supported (0)
Heated catalyst monitoring status is: test complete or not supported (0)
Evaporative system monitoring support is: not supported (0)
Evaporative system monitoring status is: test complete or not supported (0)
Secondary air system monitoring support is: not supported (0)
Secondary air system monitoring status is: test complete or not supported (0)
A/C system refrigerant monitoring support is: not supported (0)
A/C system refrigerant monitoring status is: test complete or not supported (0)
Exhaust sensor monitoring support is: supported (1)
Exhaust sensor monitoring status is: test not complete (1)
Exhaust gas sensor heater monitoring support is: supported (1)
Exhaust gas sensor heater monitoring status is: test not complete (1)
EGR system monitoring support is: supported (1)
EGR system monitoring status is: test not complete (1)
Cold start aid system monitoring support is: not supported (0)
Cold start aid system monitoring status is: test complete or not supported (0)
Boost pressure control support is: supported (1)
Boost pressure control status is: test not complete (1)
Diesel Particulate Filter (DPF) support is: supported (1)
Diesel Particulate Filter (DPF) status is: test not complete (1)
NOx converting catalyst and/or NOx adsorber support is: supported (1)
NOx converting catalyst and/or NOx adsorber status is: test not complete (1)
NMHC converting catalyst support is: supported (1)
NMHC converting catalyst status is: test not complete (1)

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