Attachment A

HD OBD System Certification 'A-S' Document

A. Cover Letter - 1971.1(j)(2.16), (2.20), (2.21)
B. Checklist - 1971.1(j)(2.17)
C. Summary Table - 1971.1(j)(2.2)
D. Durability Demonstration Engine (DDE) Data - 1971.1(j)(2.4)
E. Misfire Catalyst Damage, Disablement and Detection Charts, Probability of Detection (POD) Charts - 1971.1(j)(2.5), (2.6)
F. Applicable Test Cycle, Emission Threshold Monitor Data and Adjustment Factors - 1971.1(j)(2.7), (2.30)
G. Input Output Signals List - 1971.1(j)(2.8)
H. Closed Loop/Feedback Descriptions - 1971.1(j)(2.9)
I. Diagnostic Link Connector (DLC) Location and Connector Picture - 1971.1(j)(2.11)
J. Crankcase Ventilation (CV) System Description - 1971.1(j)(2.12)
K. Auxiliary Emission Control Device (AECD) and Emission Increasing AECD (EI-AECD) Descriptions - 1971.1(j)(2.13)
L. NOx and PM Not-To-Exceed (NTE) Carve-Out - 1971.1(j)(2.14)
M. Standardization Data - 1971.1(j)(2.10), (2.18), (2.19)
N. Non-OBD Components - 1971.1(j)(2.29)
O. Inducement Strategies Descriptions - 1971.1(j)(2.27)
P. Engine Purchaser/Chassis Manufacturer Build Specifications and Agreements - 1971.1(j)(2.15)
Q. Cold Start Emission Reduction Strategy (CSERS) Information - 1971.1(j)(2.22)
R. NOx Sensor Information - 1971.1(j)(2.24)
S. Other Certification Documentation Information – 1971.1(j)(2.23), (2.25), (2.26), (2.28), (2.31), (2.32), (2.33), (2.34), (2.35)

A. Cover Letter

Manufacturer Letterhead

April 24, 2019

Mr. Allen Lyons, Chief
Emissions Certification and Compliance Division
California Air Resources Board
9480 Telstar Avenue, Suite 4
El Monte, CA 91731

Subject: Manufacturer ABC 2019 MY Certification

Dear Mr. Lyons:

Please find enclosed the application documents for the HD OBD systems on the 2019 model year engine families KABCD0123EFG and KABCD0456EFG.

This cover letter includes a list identifying: (1) all concerns and deficiencies applicable to the equivalent engine families from a previous model year and the changes and/or resolution of each concern or deficiency for the current model year for engine family KABCD0123EFG, (2) all known concerns and deficiencies (e.g., from different engine families having the same underlying concern/deficiency) applicable to engine family KABCD0456EFG, and (3) a list of modifications to the OBD system that were made as part of a running change or field fix applied to the previous model year (for this engine or another engine). The list is as follows:

<Include list of concerns/deficiencies and running changes/field fixes here or as attachment to the cover letter>

This letter also contains a timeline showing the start of engine production, start of vehicle production, the time the vehicles will be first introduced into commerce, and the deadlines for production engine/vehicle evaluation testing for the engine families listed above. This information is provided below. If the timeline changes in the future, Manufacturer ABC will update the XXX file ***<e.g., "Certification Schedule" file>*** in DMS with the updated timeline.

This letter also contains a table listing all engine families and ratings scheduled for the 2019 model year. This table is also provided below.

Manufacturer ABC also hereby submits a statement of compliance to the California Air Resources Board for the 2019 model year that covers the engine families listed above. Manufacturer ABC makes the following statements of compliance regarding the aforementioned engine families:

1) The engine families comply with the requirements of title 13, California Code of Regulations section 1971.1, with the exception of the deficiencies indicated above.

2) Manufacturer ABC will comply with the required deadlines indicated below for submission of results/data for production engine/vehicle evaluation testing under sections 1971.1(l)(1) through (l)(3).

Thanks in advance for your prompt attention to this matter. Should you have any questions, please feel free to contact me at xxx-xxx-xxxx.

Sincerely,

Jane Smith
ABC Motors OBD Certification Representative

Production Vehicle Evaluation (PVE) Timeline

Engine Family	Engine Rating	Start of Engine Production Date	Start of Vehicle Production Date	Date Introduced into Commerce	Section 1971.1 PVE (l)(1) Deadline	Section 1971.1 PVE (l)(2) Deadline	Section 1971.1 PVE (l)(3) Deadline
KABCD0123EFG	ABCD	1/1/2019	2/1/2019	3/1/2019	4/1/2019	8/1/2019	3/1/2020
KABCD0123EFG	EFGH	1/1/2019	3/1/2019	4/1/2019	4/1/2019	9/1/2019	4/1/2020
KABCD0456EFG	IJKL	3/1/2019	5/1/2019	6/1/2019	6/1/2019	11/1/2019	6/1/2020

B. Checklist

STATE OF CALIFORNIA
California Environmental Protection Agency
AIR RESOURCES BOARD
ECARSD/OBD-119 (REV. 9/15)

HD OBD Diesel Monitoring Requirements Checklist

Component/ System	List the DTC or SPN-FMI of the monitor that detects the following failure mode: MONITORING REQUIREMENTS:										
Fuel System	(e)(1.2.1) Pressure Emission Threshold	(e)(1.2.1) Pressure Functional Monitor in Lieu of Emission Threshold	(e)(1.2.2) Quantity Emission Threshold	(e)(1.2.2) Quantity Functional Monitor in Lieu of Emission Threshold	(e)(1.2.3) Timing Emission Threshold	(e)(1.2.3) Timing Functional Monitor in Lieu of Emission Threshold	(e)(1.2.4)(A and B) Feedback: Slow/fails to Enter, Default OL	(e)(1.2.4)(C) Adaptive Limits Reached			
Misfire	(e)(2.2.1) Continuous Misfire	(e)(2.2.2) Emission Threshold Misfire									
EGR	(e)(3.2.1) Low Flow Emission Threshold	(e)(3.2.1) Low Flow Functional Monitor In Lieu of Emission Threshold	(e)(3.2.2) High Flow Emission Threshold	(e)(3.2.2) High Flow Functional Monitor in Lieu of Emission Threshold	(e)(3.2.3) Slow Response Emission Threshold	(e)(3.2.3) Slow Response Functional Monitor in Lieu of Emission Threshold	(e)(3.2.4)(A and B) Feedback: Slow/fails to Enter, Default OL	(e)(3.2.4)(C) Adaptive Limits Reached	(e)(3.2.6) EGR Catalyst Functional Monitor		
EGR Cooler	(e)(3.2.5) Cooler Emission Threshold	(e)(3.2.5) Cooler Functional Monitor in Lieu of Emission Threshold									
Boost Pressure	(e)(4.2.1) Underboost Emission Threshold	(e)(4.2.1) Underboost Functional Monitor in Lieu of Emission Threshold	(e)(4.2.2) Overboost Emission Threshold	(e)(4.2.2) Overboost Functional Monitor in Lieu of Emission Threshold	(e)(4.2.3) Slow Response Emission Threshold	(e)(4.2.3) Slow Response Functional Monitor in Lieu of Emission Threshold	(e)(4.2.5)(A and B) Feedback: Slow/fails to Enter, Default OL	(e)(4.2.5)(C) Adaptive Limits Reached			
Charge Air Cooler	(e)(4.2.4) Charge Air Cooler Emission Threshold	(e)(4.2.4) Charge Air Cooler Functional Monitor in Lieu of Emission Threshold									
NMHC Catalyst	(e)(5.2.2) Conversion Efficiency Emission Threshold	(e)(5.2.2) Conversion Efficiency Functional Monitor in Lieu of Emission Threshold	(e)(5.2.2) Missing Substrate Functional Monitor	(e)(5.2.3)(A) Aftertreatment Assistance DPF Regen Functional Monitor	(e)(5.2.3)(B) Aftertreatment Assistance SCR Feedgas Functional Monitor	(e)(5.2.3)(C) Aftertreatment Assistance Downstream PM Filter Functional Monitor	(e)(5.2.3)(D) Aftertreatment Assistance Downstream SCR Functional Monitor				
NOx Catalyst	(e)(6.2.1) Conversion Efficiency Emission Threshold	(e)(6.2.1) Conversion Efficiency Functional Monitor in Lieu of Emission Threshold	(e)(6.2.1) Missing Substrate Functional Monitor	(e)(6.2.2)(A) Reductant Delivery Emission Threshold	(e)(6.2.2)(A) Reductant Delivery Functional Monitor in Lieu of Emission Threshold	(e)(6.2.2)(B) Reductant Tank Empty Functional Monitor	(e)(6.2.2)(C) Proper Reductant in Tank Functional Monitor	(e)(6.2.2)(D)(i and ii) Feedback: Slow/fails to Enter, Default OL	(e)(6.2.2)(D)(iii) Adaptive Limits Reached		
NOx Adsorber	(e)(7.2.1) NOx Adsorber Performance Emission Threshold	(e)(7.2.1) NOx Adsorber Performance Functional Monitor in Lieu of Emission Threshold	(e)(7.2.1) Missing Substrate Functional Monitor	(e)(7.2.2) Failure to Achieve Desorption Functional Monitor	(e)(7.2.3)(A and B) Feedback: Slow/fails to Enter, Default OL	(e)(7.2.3)(C) Adaptive Limits Reached					
PM Filter	(e)(8.2.1) Filter Emission Threshold	(e)(8.2.1) Filter Functional Monitor in Lieu of Emission Threshold	(e)(8.2.2) Regeneration Frequency Emission Threshold	(e)(8.2.2) Regeneration Frequency Functional Monitor in Lieu of Emission Threshold	(e)(8.2.3) Incomplete Regeneration Functional Monitor	(e)(8.2.4) NMHC Conversion Emission Threshold	(e)(8.2.4) NMHC Conversion Functional Monitor in Lieu of Emission Threshold	(e)(8.2.5) Missing Substrate Functional Monitor	(e)(8.2.6) Active Injection Functional Monitor	(e)(8.2.7)(A and B) Feedback: Slow/fails to Enter, Default OL	(e)(8.2.7)(C) Adaptive Limits Reached

Upstream Exhaust Gas Sensor	(e)(9.2.1)(A)(i) Emission Threshold	(e)(9.2.1)(A)(ii) Open Circuit	(e)(9.2.1)(A)(ii) Out-of-Range High	(e)(9.2.1)(A)(ii) Out-of-Range Low	(e)(9.2.1)(A)(iii) Feedback: Slow/fails to Enter, Default OL	(e)(9.2.1)(A)(iv) Sufficient for Other Diagnostics	(e)(9.2.4)(A) Heater Performance	(e)(9.2.4)(B) Heater Circuit Continuity			
Downstream Exhaust Gas Sensor	(e)(9.2.1)(B)(i) Emission Threshold	(e)(9.2.1)(B)(ii) Open Circuit	(e)(9.2.1)(B)(ii) Out-of-Range High	(e)(9.2.1)(B)(ii) Out-of-Range Low	(e)(9.2.1)(B)(iii) Feedback: Slow/fails to Enter, Default OL	(e)(9.2.1)(B)(iv) Sufficient for Other Diagnostics	(e)(9.2.4)(A) Heater Performance	(e)(9.2.4)(B) Heater Circuit Continuity			
NOx Sensor #1	(e)(9.2.2)(A) Emission Threshold	(e)(9.2.2)(B) Open Circuit	(e)(9.2.2)(B) Out-of-Range High	(e)(9.2.2)(B) Out-of-Range Low	(e)(9.2.2)(C) Feedback: Slow/fails to Enter, Default OL	(e)(9.2.2)(D) Sufficient for Other Diagnostics	(e)(9.2.4)(A) Heater Performance	(e)(9.2.4)(B) Heater Circuit Continuity			
NOx Sensor #2	(e)(9.2.2)(A) Emission Threshold	(e)(9.2.2)(B) Open Circuit	(e)(9.2.2)(B) Out-of-Range High	(e)(9.2.2)(B) Out-of-Range Low	(e)(9.2.2)(C) Feedback: Slow/fails to Enter, Default OL	(e)(9.2.2)(D) Sufficient for Other Diagnostics	(e)(9.2.4)(A) Heater Performance	(e)(9.2.4)(B) Heater Circuit Continuity			
PM Sensor	(e)(9.2.2)(A) Emission Threshold	(e)(9.2.2)(B) Open Circuit	(e)(9.2.2)(B) Out-of-Range High	(e)(9.2.2)(B) Out-of-Range Low	(e)(9.2.2)(C) Feedback: Slow/fails to Enter, Default OL	(e)(9.2.2)(D) Sufficient for Other Diagnostics	(e)(9.2.4)(A) Heater Performance	(e)(9.2.4)(B) Heater Circuit Continuity			
Other Exhaust Gas Sensors	(e)(9.2.3) Per EO Approved Plan	(e)(9.2.4)(A) Heater Performance	(e)(9.2.4)(B) Heater Circuit Continuity								
VVT System	(e)(10.2.1) Target Error Emission Threshold	(e)(10.2.3) Target Error Functional Monitor in Lieu of Emission Threshold	(e)(10.2.2) Slow Response Emission Threshold	(e)(10.2.3) Slow Response Functional Monitor in Lieu of Emission Threshold							
Cold Start Strategy	(e)(11.2.1) Single Element Functional Monitor	(e)(11.2.2) System Emission Threshold	(e)(11.2.3) Individual Element Emission Threshold in Lieu of System Monitor								
Engine Cooling System	(g)(1.2.1)(A) Time to Reach Threshold Temp	(g)(1.2.1)(B) Maintain Threshold Temp	(g)(1.2.2)(A) ECT Open Circuit	(g)(1.2.2)(A) ECT Out-of-Range High	(g)(1.2.2)(A) ECT Out-of-Range Low	(g)(1.2.2)(B) Time to Reach Closed Loop	(g)(1.2.2)(C) ECT Stuck Below Highest Minimum Enable Temp	(g)(1.2.2)(D) ECT Stuck Above Lowest Maximum Enable Temp			
Crankcase Ventilation	(g)(2.2.2) Disconnection	(g)(2.2.7) Open CV Functional Monitor									

	List the DTC or the SPN-FMI of the comprehensive component monitor that detects the following failure mode:										
Monitor/System	Input Out-of-Range High	Input Out-of-Range Low	Input Open Circuit	Input Rationality Low	Input Rationality High	Input Other Rationality	Output Functional	Output Shorted High	Output Shorted Low	Output Open Circuit	
[Insert name of Comprehensive Component #1] *(e.g., exhaust temp sensor #1, barometric pressure sensor, MAF sensor, etc.)*											
[Insert name of Comprehensive Component #n]											

Note: This sheet is partially locked. You are not allowed to modify rows 1-4, nor add columns, or edit column or row labels. You can insert as many rows as needed to provide more lines of data for comprehensive components.

Please use the latest versions of the HD OBD monitor checklists. They can be found at the CARB OBD website here:
HD OBD diesel checklist: https://ww3.arb.ca.gov/msprog/obdprog/hdobd_diesel_monitor_checklist.xls
HD OBD gasoline checklist: https://ww3.arb.ca.gov/msprog/obdprog/hdobd_gas_monitor_checklist.xls

C. Summary Table

Engine Family								
KABCD0123EFG								
Component/ System	**Fault Code**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters**	**Enable Conditions**	**Time Required**	**MIL illum.**
NOx Catalyst	4364.31	Conversion Efficiency	Average conversion	< 30	Exhaust flow rate	>200 g/s	Immediate	1 trip
		Emission Threshold	efficiency		Exhaust flow rate	< 350 g/s		
					SCR Inlet NOx sensor	>50 ppm		
					SCR Inlet NOx sensor	<1200 ppm		
					Ammonia to NOx ratio	>0.5		
					DEF injection rate	>0.2 ml/sec for 80 s		
EGR System	3058.18	Low Flow Emission	Delta between Estimated	>2.5 kg/min	EGR flow	> 2 kg/min	100 sec	2 trips
		Threshold	EGR and EGR flow		EGR flow	<10 kg/min		
					Flow area	> 2 cm^2		
					Flow area	<120 cm^2		
					Total fueling	> 45 mg/stroke		
					Total fueling	<300 mg/stroke		
Aftertreatment DOC Intake Temperature Sensor								
Out-of-Range High	4765.2	DOC intake temperature	DOC intake temperature	> 1100 degC	Keyswitch	On	15 sec	2 trips
		drifted high	Intake gas temperature	< 3 V				
			voltage					
			Intake gas temperature	< 5000 Ohms				
			thermocouple impedance					
Out-of-Range Low	4765.21	DOC intake temperature	DOC intake temperature	<-60 degC	Keyswitch	On	15 sec	2 trips
		drifted low	Intake gas temperature	> 1 V				
			voltage					
Rationality Low and High	4765.2		DOC intake temperature -					
		DOC intake temperature	DOC outlet temperature	>65 degC	Elapsed time since	>500 sec	200 sec	2 trips
			DOC intake temperature -					
		data erratic intermittent	DOC outlet temperature	<-60 degC	last regeneration event			
		or incorrect						

D. Durability Demonstration Engine (DDE) Data

For engines selected for DDE testing under section 1971.1(i), include all the demonstration testing information required under section 1971.1(j)(2.4).

For engines not selected for DDE testing under section 1971.1(i), include a statement to this effect.

Example: **This engine was not selected for Durability Demonstration Engine Testing for the 2019 Model Year.**

E. Misfire Catalyst Damage, Disablement and Detection Charts, Probability of Detection (POD) Charts

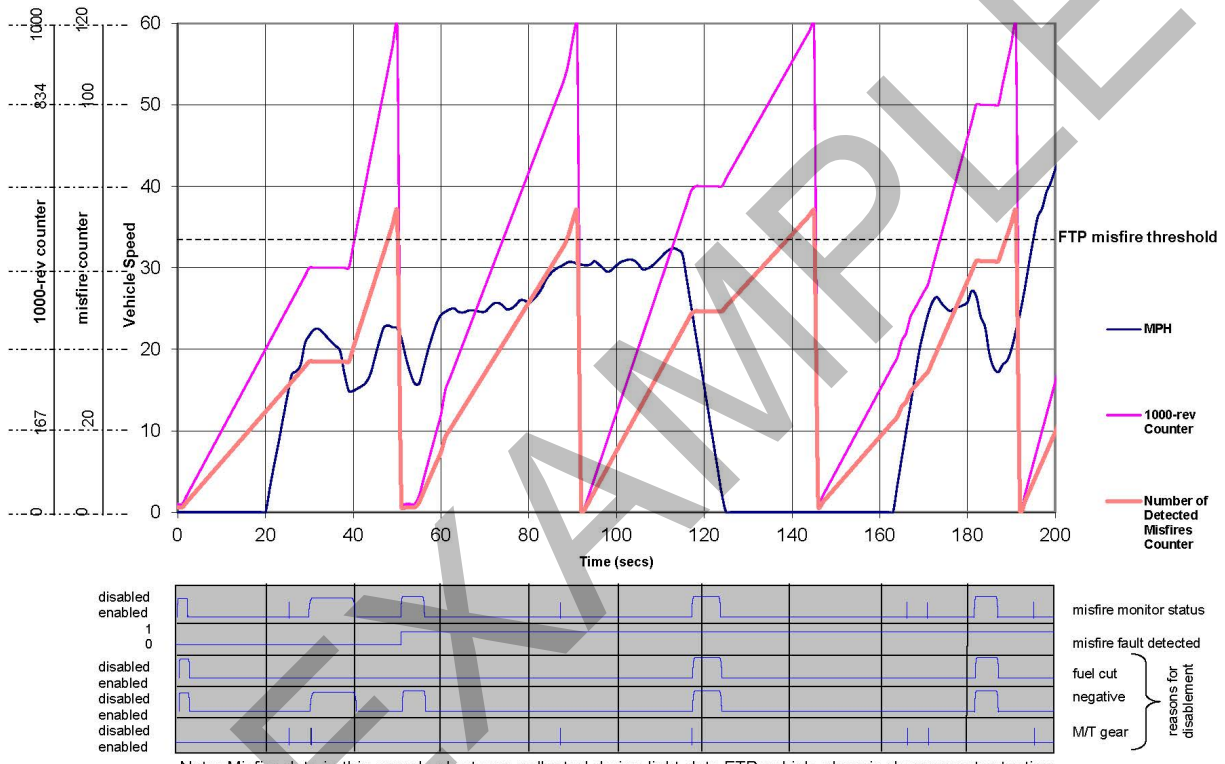
Misfire Catalyst Damage:

For gasoline engines, include support data demonstrating the established percentage of misfire that can be tolerated without damaging the catalyst over the full range of engine speed and load conditions.

Misfire Disablement and Detection Charts and POD Charts:

For all applicable engines, submit the misfire disablement and detection charts and POD charts. Examples of such charts are provided below.

Attachment A:
Misfire Disablement and Detection Chart



Note: Misfire data in this sample chart was collected during light-duty FTP vehicle chassis dynamometer testing.

Number of 1000-revs completed during test (1372 secs): ____
Number of 1000-revs where number of detected misfires exceeded threshold: ____

Probability of Detection Chart

Misfire Pattern: One Cylinder Out

Engine Speed (rpm)

Calculated Load (%)	Idle	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	Redline
Zero Torque	1.00	1.00	1.00	1.00	1.00	1.00	NR	NR	NR	NR	NR	NR	NR
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	NR	NR	NR	NR	NR	NR
30	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	NR
50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	NA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WOT	NA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NA Not Achievable
NR Not Required per 1971.1 Section (e)(2.3.3)(A)

F. Applicable Test Cycle, Emission Threshold Monitor Data and Adjustment Factors

Applicable Test Cycle

For all engines, indicate which monitors run and complete on the FTP cycle. For monitors that do not run and complete during the FTP cycle, indicate the alternate test cycle or driving conditions during which the monitor runs and completes.

Example:

All monitors run on the FTP cycle except for the following monitors:

Monitor	Fault Code	Test Cycle/Driving Conditions during which the monitor runs
Monitor A	XXXX.YY	SET cycle
Monitor B	YYYY.ZZ	When conditions 1) through 3) are met for >XX seconds: 1) vehicle speed > XX mph 2) engine speed >XXXX rpm 3) intake air temperature > XX degrees Celsius
Monitor C	ZZZZ.XX	Active regen event

Emission Threshold Monitor Data and Adjustment Factors

For all engines, provide the data supporting the criteria used to detect a malfunction for each emission threshold monitor.

For gasoline engines with emission controls that experience infrequent regeneration events, indicate the adjustment factor (and how it was calculated) for each emission threshold monitor in accordance with section 1971.1(d)(6.2).

For diesel engines, indicate which test cycle and standard (FTP or SET) is more stringent (i.e., results in higher emissions with the same level of monitored component malfunction) and the corresponding adjustment factor (and how it was calculated) for each applicable emission threshold monitor, in accordance with sections 1971.1(d)(6.1) and (6.2), respectively. See next page for example.

Example: Adjustment Factors for Each Monitor

Threshold/ Functional Monitor	Most Stringent Emission Cycle for Each Applicable Monitor: FTP or SET	D [1] (FTP Cycles)	d [2] (FTP Cycles)	F_{FTP} [3]	D [1] (SET Cycles)	d [2] (SET Cycles)	F_{SET} [3]	EF_L [4] (g/bhp-hr)*				EF_H [5] (g/bhp-hr)*				UAF [6] (g/bhp-hr)*				Comments
								NOx	NMOG	CO	PM	NOx	NMOG	CO	PM	NOx	NMOG	CO	PM	
Baseline	N/A	52.4	2	0.037	68.5	1	0.014	0.135	0.012	0.185	0.001	0.69	0.145	0.365	0.01	0.008	0.002	0.003	0.0002	-
Boost Pressure Overboost	FTP	32.7	2	0.058	48.6	1	0.020	0.17	0.009	0.16	0.001	0.67	0.085	0.29	0.003	0.010	0.002	0.000	0.0000	-
Boost Pressure Underboost	SET	52.4	2	0.037	68.5	1	0.014	-	-	-	-	-	-	-	-	0.008	0.002	0.003	0.0002	Failure does not increase F or EF_H - so baseline UAF used. (Note: Provide engineering analysis justifying the use of baseline UAF.)

* Emissions are based on the most stringent emission cycle

Notes:

1. D is the fractional number of test cycles to fill device
2. d is the number of test cycles with regeneration emissions, rounded up to the nearest whole number (e.g., 1.2 cycles rounds to 2 cycles)
3. F is the frequency of regeneration: F = d/(D+d)
4. EF_L are the measured emissions during a test without a regeneration event
5. EF_H are the measured emissions during a test with a regeneration event
6. UAF is the upward adjustment factor: UAF = $(F)(EF_H - EF_L)$

The following information should be provided:

- How was F calculated? Manufacturers should identify how many cycles are needed to calculate the frequency of regeneration and the regeneration trigger criteria (e.g., soot model, time, etc.).
- How was EFL calculated? Manufacturers should provide detailed information (e.g., was it based on multiple hot FTP HD Transient Cycles? Weighted FTP HD Transient Cycle?).
- How was EFH calculated? Manufacturers should provide detailed information (e.g., was it based on multiple hot FTP HD Transient Cycles with a regeneration event? Weighted FTP HD Transient Cycle?).

G. Input Output Signals List

	Input Signal					Output Signal
X	Front Oxygen Sensor (left bank)	⇨		⇨		Malfunction Indicator Light
X	Rear Oxygen Sensor (left bank)	⇨		⇨		Fuel Pump Relay
X	Front Oxygen Sensor (right bank)	⇨	**Engine Control Module**	⇨	X	Exhaust Camshaft Position Actuator (bank 1)
X	Rear Oxygen Sensor (right bank)	⇨		⇨	X	Exhaust Camshaft Position Actuator (bank 2)
	Cruise Control Switch	⇨		⇨	X	Intake Camshaft Position Actuator (bank 1)
X	Intake Air Temperature Sensor 1	⇨		⇨	X	Intake Camshaft Position Actuator (bank 2)
X	Intake Air Temperature Sensor 2	⇨		⇨	X	Output Component 1 - n
X	Input Sensor 1 - n	⇨				
X	Network Input Signal 1 - 5	⇨				
	Network Input Signal 6 - 11	⇨				

X – Signals that are monitored by OBD system

See Monitor Checklist in Section B. for corresponding fault codes.

H. Closed Loop Description

Include a description of all parameters and conditions necessary to begin closed loop/feedback control of emission control systems.

Example:

Closed loop/Feedback Control Mode	**Parameter**	**Condition**
SCR Operation		
Cold start mode	SCR midbed temperature	< 195 deg C
Open loop dosing	SCR midbed temperature	> 195 deg C
Closed loop dosing	SCR midbed temperature	> 195 deg C
	SCR outlet temperature	> 205 deg for 200 sec
Exhaust Gas Recirculation		
Closed loop	Engine coolant temperature	> 5 deg C
	DOC inlet temperature	> 90 deg C for 20 sec
	Engine state	running
	Exhaust gas temperature sensor	No fault code

I. Diagnostic Link Connector (DLC) Location and Connector Picture

Include pictorial representations of the DLC, including any covers or labels, and its location.

Example:

J. Crankcase Ventilation (CV) System Description

Include pictures and/or diagrams of the CV system, including all CV system connections, and corresponding fault codes stored when a disconnection occurs.

K. Auxiliary Emission Control Device (AECD) and Emission-Increasing AECD (EI-AECD) Descriptions

Provide a statement indicating that the document containing the AECD (including EI-AECD) descriptions has been submitted to On-Road Certification.

Example: **AECD/EI-AECD descriptions have been submitted to On-Road Certification section. Please refer to the document uploaded to the On-Road Certification domain on DMS.**

The AECD document should include, but is not limited to, the following AECD strategies:

- Default actions (e.g., EGR shutoff, engine derate)
- Adaptations (e.g., DEF dosing adaptations, ammonia storage model adaptations)
- Intrusive OBD monitors

The AECD document should also include identification of each EI-AECD relative to the data required to be tracked and reported in the standardized format specified in section 1971.1(h)(5). The document should specifically identify which SAE J1979 Parameter IDs (PIDs) or which SAE J1939 Parameter Group Numbers (PGNs) are used to track each of the EI-AECDs and, if applicable, what criteria were used to determine when to track time under Timer 1 versus under Timer 2 per the OBD regulation and SAE J1979 or J1939 specifications.

See examples on next pages.

Example 1: Table 1 EI-AECD PID Tracking Table (For Systems Using SAE J1979)

SAE J1979 PID	PID Name	Data Bytes Supported?	Manufacturer identification of EI-AECD being tracked
$81	**Engine Run Time for AECD #1 - #5**		
	Total run time with EI-AECD #1 Timer 1 active		
	Total run time with EI-AECD #1 Timer 2 active		
	Total run time with EI-AECD #2 Timer 1 active	x	"Engine overheat protection based on engine coolant temperature" (see section X.XXX in application)
	Total run time with EI-AECD #2 Timer 2 active	x	"Engine overheat protection based on engine coolant temperature" (see section X.XXX in application)
	Total run time with EI-AECD #3 Timer 1 active		
	Total run time with EI-AECD #3 Timer 2 active		
	Total run time with EI-AECD #4 Timer 1 active	x	"Catalyst temperature protection" (see section Y.YYY) in application)
	Total run time with EI-AECD #4 Timer 2 active		
	Total run time with EI-AECD #5 Timer 1 active		
	Total run time with EI-AECD #5 Timer 2 active		
$82	**Engine Run Time for AECD #6 - #10**		
	Total run time with EI-AECD #6 Timer 1 active		
	Total run time with EI-AECD #6 Timer 2 active		
	Total run time with EI-AECD #7 Timer 1 active		
	Total run time with EI-AECD #7 Timer 2 active		
	Total run time with EI-AECD #8 Timer 1 active		
	Total run time with EI-AECD #8 Timer 2 active		
	Total run time with EI-AECD #9 Timer 1 active		
	Total run time with EI-AECD #9 Timer 2 active		
	Total run time with EI-AECD #10 Timer 1 active		
	Total run time with EI-AECD #10 Timer 2 active		

Example 2: Table 2 EI-AECD PGN Tracking Table (For Systems Using SAE J1939)

SAE J1939 PGN	PGN Name	Data Bytes Supported?	Manufacturer identification of EI-AECD being tracked
41216	**Engine Run Time for AECD #1 - #5**		
	Total run time with EI-AECD #1 Timer 1 active		
	Total run time with EI-AECD #1 Timer 2 active		
	Total run time with EI-AECD #2 Timer 1 active	x	"Engine overheat protection based on engine coolant temperature" (see section X.XXX in application)
	Total run time with EI-AECD #2 Timer 2 active	x	"Engine overheat protection based on engine coolant temperature" (see section X.XXX in application)
	Total run time with EI-AECD #3 Timer 1 active		
	Total run time with EI-AECD #3 Timer 2 active		
	Total run time with EI-AECD #4 Timer 1 active	x	"Catalyst temperature protection" (see section Y.YYY) in application)
	Total run time with EI-AECD #4 Timer 2 active		
	Total run time with EI-AECD #5 Timer 1 active		
	Total run time with EI-AECD #5 Timer 2 active		
	Total run time with EI-AECD #6 Timer 1 active		
	Total run time with EI-AECD #6 Timer 2 active		
	Total run time with EI-AECD #7 Timer 1 active		
	Total run time with EI-AECD #7 Timer 2 active		
	Total run time with EI-AECD #8 Timer 1 active		
	Total run time with EI-AECD #8 Timer 2 active		
	Total run time with EI-AECD #9 Timer 1 active		
	Total run time with EI-AECD #9 Timer 2 active		
	Total run time with EI-AECD #10 Timer 1 active		
	Total run time with EI-AECD #10 Timer 2 active		

L. NOx and PM NTE Carve-Out Information

If applicable, please include a description of each NOx and PM NTE emission carve-out used, including:

- the sensor signals and/or calculated values used to invoke each NTE carve-out,
- the engineering data and/or analysis demonstrating the need for such an NTE carve-out,
- the actions taken when each NTE carve-out is activated,
- the expected in-use frequency of operation of each NTE carve-out, and
- the expected emission impact from each NTE carve-out activation

M. Standardization Data

Communication Protocol:

Indicate if engine uses the ISO 15765-4 or SAE J1939 protocol

OBD Test Results:

Include test results required to be made available under section (h)(4.5)

Test Results (SAE J1979 Example)

On-Board Diagnostic Monitor ID Name	Monitor ID (MID)	Test ID Name	Test ID (TID)	Min. Value[1]	Max. Value[1]	Unit	Monitor Fault Code(s)
Catalyst Bank 1	21	Oxygen storage	AA	0	300	-	P0420
Exhaust Gas Sensor Bank 1 Sensor 1	01	Rich to lean response rate	AB	0	0.6	sec	P014C
		Lean to rich response rate	AC	0	0.6	sec	P014D
		Rich to lean delayed response	AD	0	0.4	sec	P015A
		Lean to rich delayed response	AE	0	0.4	sec	P015B
		Range	AF	0.2	4.7	Volts	P0131, P0132

Footnote 1: For monitors with multiple min/max values (different values based on different driving conditions), only one set of min/max values is required to be included in the table - the table should include a statement indicating the monitor has multiple min/max values and a description of the specific conditions for the min/max values shown in the table (e.g., min/max value when ambient temperature is 25 degrees Celsius).

Test Results (SAE J1939 example)

SPN Description	SPN	FMI Description	FMI	Min. Value[1]	Max. Value[1]	Unit
Aftertreatment 1 Diesel Oxidation Catalyst Conversion Efficiency	5298	Data Valid But Below Normal Operating Range - Moderately Severe Level	17	1	64225	-
Aftertreatment 1 SCR Intake NOx Sensor 1	3216	Data erratic, intermittent or incorrect	2	0	6225.5	PPM
		Data Drifted High	20	0	1750	PPM
		Data Drifted Low	21	0	1250	PPM
		Abnormal Rate of Change	10	-150	149	sec

Footnote 1: For monitors with multiple min/max values (different values based on different driving conditions), only one set of min/max values is required to be included in the table - the table should include a statement indicating the monitor has multiple min/max values and a description of the specific conditions for the min/max values shown in the table (e.g., min/max value when ambient temperature is 25 degrees Celsius).

In-Use Monitor Performance Numerator Denominator Information:

List all components/systems required to track and report in-use monitor performance ratio data, the corresponding diagnostic(s) noted by fault code used to increment each numerator, and the incrementing specifications for each numerator and denominator. See next pages for examples.

In-Use Monitor Performance Numerator/Denominator Information (SAE J1979 Example)

Monitor	Monitor Fault Code(s)	Numerator Incrementing Specifications	Denominator Incrementing Specifications
Catalyst Conversion Efficiency	P0420	EWMA monitor Fast initial response strategy - after code clear event, numerator increment one time for first time after catalyst monitor enable conditions met 3 times (when monitor can make first pass/fail decision). Else, numerator increment one time after each time catalyst monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(B) met.
Primary Oxygen Sensor Bank 1	P014C	Increment one time each time primary oxygen sensor monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(B) met.
	P014D	Increment one time each time primary oxygen sensor monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(B) met.
	P015A	Increment one time each time primary oxygen sensor monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(B) met.
	P015B	Increment one time each time primary oxygen sensor monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(B) met.

In-Use Monitor Performance Numerator/Denominator Information (SAE J1939 Example)

Monitor	Monitor Fault Code(s)	Numerator Incrementing Specifications	Denominator Incrementing Specifications
NMHC Catalyst	5298.18	EWMA monitor Fast initial response strategy - after code clear event, numerator increment one time for first time after catalyst monitor enable conditions met 3 times (when monitor can make first pass/fail decision). Else, numerator increment one time after each time catalyst monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(G) met.
PM Filter Bank 1	3936.2	Increment one time each time monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(B) met.
	5397.31	Increment one time each time monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(F) met, which include all following conditions: 1) criteria under section 1971.1(d)(4.3.2)(B) met, and 2) cumulative mileage >= XX miles.
	3251.10	Increment one time each time monitor enable conditions met.	Increment after criteria in section 1971.1(d)(4.3.2)(H) met.

N. Non-OBD Components

Components not monitored by HD OBD system due to emission test-out criteria under section 1971.1(g)(3.1.1) and (g)(3.1.2)

Component	Engineering Analysis and/or Data	Emission Standard	Emissions Data with No Fault	Emissions data with Fault
Component 1	Information to include description of the function of Component 1. Include description of the worst case configuration (i.e., the test cycle that results in worst case emissions) and how it was determined, and descriptions of the test cycles used to stabilize the system.			
Component 2				

List of components not monitored by HD OBD system due to criteria under section 1971.1(g)(5.7.1)

Component A
Component B
etc.

List of components not monitored by HD OBD system due to criteria under section 1971.1(g)(5.7.2)

Component M
Component N
etc.

O. Inducement Strategies Descriptions

Provide statement indicating the document containing the descriptions of the inducement strategies and all inputs to each strategy has been submitted to On-Road Certification.

Example: **Inducement strategies descriptions (including descriptions of all inputs to each strategy) have been submitted to On-Road Certification section. Please refer to the document named "XXX" uploaded to the On-Road Certification domain on DMS.**

P. Engine Purchaser/Chassis Manufacturer Build Specifications and Agreements

If the engine manufacturer does not build the corresponding vehicle application(s) for the engine, include the following:

- The build specifications provided to the engine purchasers or chassis manufacturers detailing all specifications or limitations imposed on the engine purchaser relevant to OBD requirements or emission compliance (e.g., allowable MIL locations, connector location specifications, cooling system heat rejection rates).
- A description of the method or copies of agreements used to ensure the engine purchasers or chassis manufacturers will comply with the OBD and emission relevant build specifications (e.g., signed agreements, required audit/evaluation procedures).

If the engine manufacturer builds the corresponding vehicle application(s) for the engine, include a statement indicating this.

Example: **Manufacturer ABC is an integrated engine/vehicle manufacturer, so there are no engine purchaser/chassis manufacturer build specifications or agreements.**

Q. Cold Start Emission Reduction Strategy (CSERS) Information

Include descriptions of the following for each cold start emission reduction strategy :

- All the actions taken while the cold start emission reduction strategy is active. This includes a complete description of all measures taken to accelerate the heating of the engine and/or after treatment to operating temperatures and any measures taken to minimize the engine-out emissions when the engine and aftertreatment system is below operating temperatures.
- All parameters and conditions necessary to enable and disable the cold strategy emission reduction strategy. Descriptions must include a list of all parameters manipulated by the control system, parameters used as feedback, and models used. Descriptions must also include sufficient sample values of all parameters to allow staff to comprehend the strategy.

See example on next page.

CSERS description

Actions taken while CSERS is active

CSERS uses torque reserve to accelerate the heating of the catalyst. The controller increases airflow and retards spark to increase exhaust mass flow and temperature. Increased idle speed is evident during the CSERS. The fuel system commands a lean mixture during CSERS to minimize engine-out HC emissions.

CSERS enable/disable conditions

The strategy is activated when the catalyst temperature is below light-off and the engine coolant temperature (ECT) at start is between -10 and 50 degrees Celsius (^{O}C). Once active, the CSERS is considered complete and disabled for the rest of the driving cycle when the modeled catalyst temperature (for the front catalyst) reaches 400^{O}C.

While active, the CSERS will be disabled for the rest of the trip if throttle position is greater than 85% for more than 1.0 seconds or calculated engine load is greater than 75% for more than 1.0 seconds.

While active, the CSERS system will be temporarily disabled during gear shifts and when the vehicle speed exceeds 80 mph. After the gear shift or when vehicle speed drops below 80 mph, the CSERS will be re-activated until the modeled catalyst temperature reaches the target value.

CSERS control parameters

The commanded spark timing while the CSERS is active is a function of ECT. The table below shows the commanded spark timing while the CSERS is active and while the CSERS is inactive.

	ECT at Start (^{O}C)				
(degree CA)	-10	0	10	20	30
CSERS spark timing	0	4	5	8	10
Nominal spark timing	0	0	0	0	0

The commanded airflow at idle while the CSERS is active is a function of ECT. The table below shows the target airflow at idle while the CSERS is active and while the CSERS is inactive.

	ECT at Start (°C)				
(g/sec)	-10	0	10	20	30
CSERS airflow	3.5	3.5	3.5	3.25	3.0
Nominal	3.0	2.0	2.0	2.0	2.0

The air fuel ratio is commanded lean during CSERS. The table below shows the target air fuel ratio while the CSERS is active and while the CSERS is inactive.

	ECT at Start (°C)				
(lambda)	-10	0	10	20	30
CSERS	0.95	1.00	1.02	1.03	1.04
Nominal	0.95	0.99	1.0	1.0	1.0

R. NOx Sensor Information

Include a written description of the following:

- All parameters and conditions that are technically necessary for each NOx sensor to begin reporting NOx concentration data after engine start, and
- All parameters and conditions that cause each NOx sensor to subsequently cease or pause reporting NOx concentration data. Such parameters and conditions should be technically necessary.

Example:

NOx sensor parameters/conditions required to activate NOx sensor (i.e., begin reporting NOx concentration data)

All the following conditions must be met:

- Exhaust gas temperature reaches dew point temperature
- DOC inlet temperature sensor reading reaches 150 deg C
- SCR outlet temperature sensor reading reaches 200 deg C

NOx sensor parameters/conditions required to pause NOx sensor reporting of concentration data

Any of the following conditions must be met:

- DOC inlet temperature sensor reading below 140 deg C
- SCR outlet temperature sensor reading below 150 deg C

S. Other Certification Documentation Information

Include any other information determined by the Executive Officer to be necessary to demonstrate compliance with the HD OBD regulation.

Example:

Test-Out Data for NMHC Catalyst Feedgas Generation Monitor

These are the emissions data to support the monitoring exemption (i.e., test-out) criteria described under section 1971.1(e)(5.2.3)(B)(i) for the diesel oxidation catalyst (DOC).

	FTP (g/bhp-hr)			
	NMHC	**NOx**	**CO**	**PM**
Certification Standard	0.14	0.2	15.5	0.01
30% of Certification Standard	-	0.06	-	-
Baseline (with no fault)	0.11	0.15	5.1	0
Baseline IRAF	0.01	0.02	0.9	0
Adjusted Baseline	0.12	0.17	6	0
With DOC Feedgas Test-Out Part	0.12	0.18	6.1	0
DOC Feedgas Test-Out IRAF	0.02	0.01	1.2	0
Adjusted DOC Feedgas Test-Out	**0.14**	**0.19**	**7.3**	**0**
Emission Difference between Adjusted DOC Feedgas Test-Out and Adjusted Baseline	0.02	0.01	1.3	0
Did Emission Difference Exceed 30% of NOx Certification Standard?	-	No	-	-
Did Adjusted DOC Feedgas Test-Out Exceed NOx Certification Standard?	-	No	-	-

Catalyst Deterioration Plan (section 1971.1(e)(5.2.3)(B)(ii)):
DOC Threshold Part Description: DOC oven-aged @ XXX degC for YYY hours
DOC Feedgas Test-Out Part Description: DOC with Pd-only