AIAM

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TO: AIAM Service Subcommittee
AIAM Environment & Energy Subcommittee

FROM: John M. Cabaniss, Jr.
Director, Environment & Energy

RE: **ONBOARD DIAGNOSTICS - November 14, 2000 Industry Meeting With CARB - Summary - Next Meeting December 13, 2000 - Industry Conference Call November 29, 2000**

Attached is a summary of the November 14, 2000 Alliance/AIAM ad hoc OBD work group meeting with CARB to discuss issues on the upcoming OBD regulatory changes which CARB is planning. Also attached are two handouts provided by CARB at the meeting. The next meeting between the industry and CARB on OBD is scheduled for 9:00 am PST, Wednesday, December 13, 2000, at CARB offices in El Monte, CA.

An Alliance/AIAM conference call is scheduled for 2:00 pm EST, on Wednesday, November 29, 2000 to discuss CARB handout #2, "Standardized Monitoring Conditions". The call-in number is 1-703-736-7230 and the PIN is 479 0424.

JMC:dp

CLI4199

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Process Following November 14, 2000 Meeting

- **CARB is drafting language and will provide the proposed draft language as soon as it is available.**

- **CARB still intends to address all of the issues associated with OBD (SB 1146, Technical changes in this document, and "standardized monitoring conditions") in one hearing at a date yet to be determined.**

- **CARB will hold a workshop before the Board hearing; date to be determined.**

- **At the end of the November 14 meeting, CARB handed out a document (handout #2) called "Standardized Monitoring Conditions," which is their proposal to address when monitors run. Some preliminary discussion ensued, but most discussion on this document was deferred to the next meeting.**

ISSUES RESOLVED AT THE OCTOBER 17 MEETING

1.1 Pending (Mode $07) Fault Codes

-100% implementation for all faults in 2003-model year

Industry agreed with this proposal.

11/14/00: No further discussion.

1.3 OBD DDV vehicles

-Require up to 3 vehicles per year (depending on number of engine test groups—not number of OBD development groups or number of OBD test groups)(1 DDV for 1-5 test groups, 2 for 6-10, 3 for 10+)
-Allow use of approved ADP vehicle/components instead of actual high mileage
-Allow use of 'less than perfect' FTP tests for 2 of 3 DDVs (e.g., allow use of internal sign-off mock demos which may include forced cool-downs, test cells with less QC stringency, etc.)
-ARB can confirmatory test any of the 3 vehicles (using official procedure)
-Required for 2003 and newer model year

Industry agreed with this proposal.

11/14/00:

- **Section (h)(1.4): The only remaining question is what to do for 2002 MY vehicles. ARB is considering allowing OEMs to opt into this in the 2002 MY.**

1.4 Cold Start/Warm-up strategies

-Going forward with AAM language.
-Essentially requires manufacturer to set tolerances for individual components used for strategy (e.g., engine speed, mass air flow, injection timing, injected fuel quantity, secondary air volume, etc.) and determine (on a representative vehicle) where the malfunction thresholds need to be established to detect 1.5 x standard failures. Manufacturer can then apply those same thresholds across their product line without additional demonstration and can carry it over from year to year unless significant changes (as determined by ARB) are made to the strategy.
-Phase-in on vehicles meeting ARB II standards beginning with 2005 MY
-Required on all PZEVs from 2005 on.

ARB agreed with the following proposed language:

(b)(12.1.1)(D) **If the emission control system incorporates a specific engine control strategy ~~to accelerate catalyst light off~~ (CARB change) to reduce cold start emissions, the key control or feedback parameters used to effect that strategy (e.g., engine speed, mass air flow, etc.) shall be monitored (either directly or indirectly) while the control strategy is active to ensure proper operation of the control strategy. The individual components associated with the strategy shall be considered malfunctioning if any component fails, such that emissions exceed 1.5 times the standards. Malfunction criteria shall be based on data obtained from a representative cross section of a manufacturer's engine offerings. An engineering evaluation shall be provided for establishing malfunction criteria for the remainder of engine families in the manufacturer's product line. The Executive Officer shall waive the evaluation requirement each year if, in the judgment of the Executive Officer, technological changes do not affect the previously determined malfunction criteria. Manufacturers shall implement these requirements on applications certified to the ARB II emission standards beginning with the 2005 model year.**

11/14/00:

- **ARB accepted this but stated they may revise the format in the regulation.**

1.6 *Software CVN*

-No prescribed phase-in for 2000 and 2001.
-Still need to resolve how best to incorporate this into I/M check regarding conditions under which the diagnostic is carried out, how a database will be created to store this info, etc.
-Propose to require (for all 2003 and newer model year vehicles) calculation be carried out once per driving cycle, must be stored and able to be output to a scan tool at all times (e.g., stored until updated by new calculation each drive cycle). Must be able to be output to a scan tool with engine running and within 5 seconds of the scan tool request.
-Only required for emission or diagnostic critical powertrain controllers

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ARB and industry agreed with this requirement with the following provisions:

- **The requirement will begin in MY 2005 (or MY 2006 if the final regulation is not adopted before September 2001).**

- **ARB agreed to provide exceptions to the requirement for "within 5 seconds" in cases where the battery was disconnected or the PROM was flashed.**

11/14/00:

- **See CARB handout #1, section d(3.7)**
- **ARB intends to replace J1979 with ISO 15031-5 throughout the regulation.**
- **There was discussion, but no conclusion, on the definition of CVN.**
- **Section (3.7.1) Database – Several questions were raised but not resolved regarding this database of CVNs:**
    - **What is "standardized format?" Excel, Access, keyed on VIN, Engine Family, etc.**
    - **How will ARB and EPA ensure the security of the database?**
    - **How often will the database that state I/M programs use be updated?**

- **It was agreed that CARB and EPA need a work group to include California and other state I/M represenatives to work out details on access, format, update rate, which agency does what, and security.**

1.8 Certification Documentation

- ARB will continue to allow manufacturers to submit 'representative' ARB descriptions for multiple engine test groups. If necessary, we can define 'representative' or create an "ARB Test group" as vehicles with the same ARB II systems and similar calibrations or something like that.
-DDV data (and description of deteriorated components, test protocol) will still be required to be submitted prior to ARB II certification/approval of the DDV engine test groups.
-Written description (1.1), flowchart (1.3), input/output listing (1.8) will still be required to be submitted prior to certification.
-Block diagram for calculated load and fuel trim (2.1) will be required by January 1
-Scale drawing of MIL (2.2) could be moved to Section (3) (Available upon request).

Industry agreed with this proposal, provided there is flexibility for submission of certain data for certification (i.e., conditional certification).

11/14/00:

- **ARB agreed to allow "conditional certification" if all of the data cannot be provided at the time of certification. They were initially looking at putting this in Section (h)(1.4)**

- **Section (h)(1.11): ARB agreed to delete "and the assigned...powertrain control unit." From this section.**

1.9 Evaporative Leak Detection Fleet Average Orifice Size

-ARB does not plan to allow fleet averaging of leak size to meet 0.020" requirements
-Nightmare for compliance testing, certification, service technicians, etc.

Industry agreed with this proposal.

11/14/00: This proposal was dropped long ago.

1.11 I/M Program Issues

-Probably will not require standardized off-board initiation of evap monitor. ARB will, however, require disclosure to ETI of enhanced software/scan tool routines and parameters to initiate manufacturer-specific off-board leak checks.
-No changes planned to existing allowance for bypass logic under extreme conditions
-Will allow use of MIL to blink I/M readiness status in a standardized manner (e.g., 15-20 secs. of KOEO MIL on, then either 3-5 1Hz blinks if not ready or no blinks if ready, then MIL either remains on or off for rest of KOEO.)

ARB agreed with the following industry proposal:

Add to (a) General Requirements, the end of paragraph (1.1):

As an option, manufacturers may use the following protocol to indicate the status of the I/M Readiness codes defined in SAE J1979 using the MIL: The MIL shall be illuminated in the key on/engine off (KOEO) position for 15 to 20 seconds. If one or more readiness codes are not cleared, the MIL shall blink once per second for 5 to 10 seconds, then remain illuminated until engine cranking. If all readiness codes are cleared, the MIL shall not blink, but shall remain illuminated until engine cranking.

11/14/00:

- **EPA (Arvon Mitcham) was still not comfortable allowing the I/M readiness MIL display to be optional. ARB was. Basically, EPA wants all OEMs to use the same standard or none of them to use that standard. EPA and ARB agreed to discuss this separately.**

- **ARB agreed to allow alphanumeric displays indicating OBD system status, provided EO approval of the displayed language was obtained.**

2.1 Small volume definition

-Reference definition of small volume manufacturer in LEV II regulations

Industry agreed with this proposal.

11/14/00: No further discussion.

2.2 Certification Documentation

-Require description of parameters necessary to begin closed loop operation (e.g., ECT > xx°C, O2 sensor voltage >xx or < yy, time after start > 15 secs, etc.)
-Require phase-in summary charts/tables to be submitted at the beginning of certification that identifies which test groups are meeting which phase-ins (e.g., full-range misfire, 0.020", PCV, etc.)
-Document which communication protocol is used by the vehicle for generic scan tool communications

Industry agreed with this proposal.

11/14/00: No further discussion.

2.8.1 MIL/Bulb Check

-require data stream value (Mode $01, PID 01, Data A, bit 7) to read MIL commanded 'off' during bulb check
-require bulb check to be at least 15-20 seconds in KOEO

Industry agreed with this proposal.

11/14/00: No further discussion.

2.8.2 ALDL/scan tool connector location

-Further confine connector location to driver's side of center console in the footwell area. No longer allow connectors in the center console (horizontal or vertical face) or passenger side of centerline.
-ARB can cite examples (if necessary) of why we are becoming more proscriptive.

Industry agreed with this proposal, provided the requirements are consistent with EPA's guidance.

11/14/00:

- **See CARB handout #1, section d(1.0)**

- **ARB is rewording this to be clear that they mean the connector can be located anywhere on the driver's side of centerline (or for vehicles equipped with a console anywhere on the driver's side of the console), and below the steering wheel column. ARB and EPA will ensure consistency.**

- **ARB agreed that implementation would not begin before MY 2005.**

- **ARB is considering specifying that voltage not exceed 12 volts. The group discussed this requirement. Industry warned against adopting regulations that contradict industry standards (i.e., ISO, SAE), particularly when there doesn't appear to be any need for a contradictory standard.**

2.8.3 Generic Scan tool communication

-Require demonstration by manufacturer for each calibration released that vehicle can communicate with a generic scan tool. May require industry/ARB to contract out for a true "generic" piece of software which will be used to judge compliance or develop standardized procedures like SAE J1699. Given importance of communications in an I/M inspection, it is imperative that all vehicles truly meet the communication specifications.
-May be able to rely on a compliance statement in certification application where a manufacturer representative signs off on a statement that he has verified that the vehicles produced have been tested with multiple generic scan tools, etc. and determined that the vehicle does indeed meet all of the communication protocol and message content specifications.
-Avoid problems like wrong header bytes, wrong ECU address designations or responses, communication bit timing out of specification issues, readiness codes not clearing when fault codes cleared, etc.

Industry agreed with the first bullet of this proposal. ARB also agreed to delete the remaining bullets and contract an organization to develop a generic tool to access the OBD system to ensure it performs and responds appropriately to generic scan tool interrogation.

11/14/00:

ARB will follow up by awarding a contract. The contractor would develop hardware specifications which could be used by tool manufacturers, and software that ARB that they would make available to anyone.

2.8.4 Readiness Codes

-Clarify readiness codes are not required for thermostat or PCV monitors
-Require readiness code to be set right after the monitor completes (can't wait until engine shut-off if the monitor ran during the driving cycle).
-Clarify, if needed, how to handle with EWMA applications (have to wait until enough decisions are registered to really know if you are going to pass or fail)
-Require readiness code to be set on first driving cycle if monitor passes (instead of allowing it as an option right now—require it to improve I/M testing).
-Evap readiness code handling with 0.020 vs 0.040 vs gross leak

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Industry agreed with this proposal, with the exception of the last bullet. The last bullet will be discussed in Issue 2.4

11/14/00

- **See CARB handout #1, section d(3.1.2)**

- **ARB will require the readiness to be set after the first trip if the vehicle passes the monitor.**

- **ARB will base readiness on 0.02" monitor, unless the vehicle has a 0.04" engine-on monitor, in which case the readiness code will be based on the operation of the 0.04" monitor.**

2.8.5 Calibration ID (CAL ID)

-Must, at a minimum, uniquely identify vehicle model, model year, engine displacement, emission standard, and emission test group.
-Running changes that affect OBD or emissions must have a different Cal ID

ARB agreed to simply require the specific Calibration ID - industry agreed.

11/14/00:

- **See CARB handout #1, section d(3.6)**

- **ARB agreed to provide definitions of "Diagnostic or Emissions Critical" and "Unique Calibration or Software Set" in the glossary of the regulation.**

2.9.3 Mode $06 test results further defined

-All test results have to report a minimum and a maximum
-Test results equal to minimum or maximum have to be passing test results
-Test results and test limits shall be initialized to 0 upon code clear/battery disconnect
-Test results to report $FF if data is invalid (e.g., monitor ran but did not collect sufficient data to produce a valid result
-Test results need to report useable values (e.g., the actual calculated catalyst oxygen storage or conversion efficiency or switch ratio, not the number of speed-load cells in which the calculated ratio exceeded the threshold.)
-All test results should always be reported, even if they have not run yet (e.g., can't have different TID/CID combinations that report only when it passes and others that report only when it fails).
-Each monitor should have a unique TID/CID assignment (e.g., you can't use the same TID/CID to report both 0.040" and 0.020" test results and just keep overwriting each other).
-Misfire (even though a continuous monitor) must be reported through Mode $06 in the form of individual cylinder misfire counters.
-Exclude thermostat and PCV from Mode 06
-Require Mode 06 info to be made available—set-up a liaison person for each manufacturer to have third parties contact to get info for all 96 and newer cars. Discuss current request from I-ATN to get all Mode 06 info.

Industry agreed to all of this, provided the changes are consistent with ISO 15031-5 and apply only to CAN. Mike McCarthy agreed to handle the last bullet by turning over all Mode $06 data he has collected to IATN.

11/14/00:

- **ARB agreed to ensure changes are consistent with ISO 15031-5 and applicable to CAN.**

2.9.4 Service Information

-Allow manufacturers to meet EPA rules instead of making info available in J2008 format
-Require general description of monitoring strategy, typical monitoring conditions, typical fault criteria, time required, associated Mode $06 test results and fault codes, etc. as specified by Burton Bill (e.g., analogous to what Ford has provided on i-ATN).
-Make available information to use Mode $06 test results on all 1996 and newer cars (e.g., conversion factors to engineering units, TID/CID definitions, associated fault codes, etc.)

ARB stated that they are working with EPA to ensure that EPA's Service Information rule incorporates all of the service information items in SB 1146 (Burton). ARB will then

incorporate the EPA regulations by reference and address the other issues in SB 1146 (Burton) separately.

Industry agrees with this approach.

11/14/00:

- **See CARB handout #1, section d(4.0)**
- **ARB reported that they are considering breaking out Service Information into a separate document. They have not yet decided.**
- **EPA reported that they are working on finalizing the Service Information NPRM and hope to have it out by the end of THIS year.**

2.10 Alternate fuels

-Clarify that exemption provisions that go through 2005 model year only allow ARB to waive requirements for which monitoring reliability is unknown due to the use of the alternate fuel (e.g., not a general clause that allows us to waive communication to a generic scan tool or the use of standardized fault codes, etc.—only allows waiving catalyst monitor or oxygen sensor response monitor, etc. where use of alternate fuel may impact monitoring reliability).

Industry agreed with this proposal.

11/14/00: No further discussion.

2.11 PTO (power take-off) disablement

-Continue to allow disablement of monitors when PTO equipment is active but do not allow readiness codes to revert to 'previous' state when PTO activation ceases (e.g., reset all readiness codes to "not ready" when PTO equipment is turned off rather than default back to status before PTO equipment was activated).

ARB agreed to eliminate this proposed requirement.

11/14/00: ARB plans to eliminate they proposed requirement but may change the terminology.

2.12 Diesel catalyst monitoring

-Harmonization with EPA may require adoption of a diesel catalyst monitor (e.g., presence detection or whatever technical feasibility proves out as capable)

Industry agreed to this noting that ARB should consult EMA for their input on the diesel side.

11/14/00: No further discussion.

2.13 Hybrid vehicle monitoring requirements

-Discussion at workshop and in staff report but probably won't adopt additional regulatory language at this time
-Identify common items that require monitoring on hybrid vehicle, generalized description of criteria used by ARB to determine which components need monitoring (e.g., failures/malfunctions that decrease the electric-only range or electric-assist, etc.)
-clarify driving cycle definition for hybrid vehicles (engine off at idle strategy still counts as first drive cycle)

ARB agreed to the attached proposal subject to review to ensure the proposal is consistent with the Honda and Toyota systems. Toyota provided their input in the attached revised document.

11/14/00: No further discussion.

2.18 Glow Plug Monitoring

-Clarify that new engines must be able to identify the specific malfunctioning glowplug (current reg allows 'to the extent feasible without adding hardware).

Industry agreed to this noting that ARB should consult EMA for their input on the diesel side.

11/14/00: No further discussion.

2.19 Default or substitute values/strategies

-Example: fuel level used for evap monitor but in case of fuel level fault, no MIL and defaults to a fuel level that enables all diagnostics.
-Must be documented in certification application
-If the good signal is used differently than the default value (e.g. fuel level used to modify evap leak detection malfunction threshold) but defaults to a fixed value (e.g., 40% fill so malfunction threshold no longer a function of fuel level), MIL must be illuminated. Currently, ARB forced to live with no MIL and less reliable/less accurate/less robust monitoring result due to use of default value.
-If use of substitute/default value results in an emission impact or affects (e.g., not just disables but delays or reduces monitoring window) other OBD II monitors, MIL must be illuminated.
-Default/limp-home strategies only have to turn on MIL if they affect emissions or other OBD II monitors. MIL does not have to be illuminated on first driving cycle if default/limp-home is not automatically used at the start of the next driving cycle (e.g., it waits until the problem is again detected on the second drive cycle before going to default/limp-home operation).
-ARB may request demonstration that the default strategy operates correctly (e.g., when the fuel level sender is broken, the other OBD II monitors do indeed still run and detect malfunctions).

ARB agreed to eliminate this proposal for the time being but review it later.

11/14/00:

- **ARB stated that they did NOT agree to eliminate this proposal. We discussed it at length. They understood our argument, and appear to be leaning toward eliminating this proposal, but wanted more time to consider our concerns.**

2.20 Electronic Throttle systems

-May need to clarify what faults need to illuminate MIL. (e.g., failure of first redundant sensor may not require MIL illumination if remaining sensor still has rationality check, etc. to make sure it is working properly, limp-home modes that go to forced idle operation may not require MIL operation but modes that 'de-rate' power may if they allow significant driving capability but do not allow all monitors to operate, etc.).

ARB agreed to eliminate this proposal pending review of a NHTSA rule, which is due out in December 2000.

11/14/00: ARB agreed to eliminate this again.

FURTHER CLARIFICATION - PROPOSED RESOLUTION

1.12 Misfire Monitoring

-ARB will adopt 1% floor for Type 'B' (4 x 1000 and first 1000) misfire
-Willing to consider floor of 5% for Type 'A' catalyst damage misfire
-ARB will not allow the use of a separately calibrated, higher misfire threshold for first 1000 revs. Same threshold as used for Type 'B' 4 x 1000 rev failure must be used (1% floor also).

Industry agrees with the first two bullets, and proposes modifying the final bullet to allow 1% DETECTED misfire during the first 1000 revolutions, provided the probability of detection is at least 75% during the first 1000 revolutions.

11/14/00:

- **ARB agreed to include the 75% probability of detection threshold during the first 1000 revolutions and will include it in the next iteration of regulatory language.**

2.3 Misfire monitor

-Define when disablement shall be allowed (not allow disablement for certain items that we have in the past such as changes from idle to off-idle, changes in misfire algorithm calculations, light to medium 'tip-ins', etc.)
-Clarify zero delay after engine start is engine start plus two crankshaft revolutions
-Engine start is 150 rpm below normal, warmed-up idle speed (eliminate reference to normal spark and fuel).
-Clarify when a P0300 should be stored and when individual cylinder misfire codes should be stored (e.g., if >90% of counted misfires occur in a single cylinder, ok to store single cylinder code. However, if more than one cylinder has >10% of the counted misfires, a multiple misfire fault code must be stored and individual codes are optional.)

ARB intends to eliminate all misfire disablements except:

- **Rough roads**
- **Throttle Stabs**
- **Manual Transmission shifts**

Specific regulatory language is needed to fully determine the impact of this change.

11/14/00:

- **ARB is considering various definitions of "throttle stabs." One consideration is anything acceleration greater than that provided on the US06. Industry pointed out that this favors high-power vehicles since some low-power vehicles cannot maintain the US06 trace, and would consequently not receive any allowance for throttle stab.**
- **Industry maintains concerns about false MIL illumination and lead-time.**
- **ARB agreed that this would not take effect until MY2005.**
- **Industry will still need to see the specific regulatory language to ascertain the impact of this regulation.**

2.4 Evaporative system leak detection

-Change requirements to allow for engine off diagnostics (which generally require more than two driving cycles to determine a malfunction).

-Still require separate 0.040" and 0.020" checks or allow 0.020" to replace 0.040" if 0.020" runs frequently? To be discussed at workshop. (readiness code handling an issue too).
-Pressure-based evap monitoring strategies—No further movement by ARB to try and prohibit positive pressure based evaporative monitoring strategies.
-Further definition of "orifice" as a sharp-edge or square-edge orifice.

Industry provided regulatory language at the October 17 meeting. We intend to provide modifications to that language at the November 14 meeting to better capture the concept we discussed.

11/14/00:

- **Industry agreed to provide ARB with the changes to the regulatory language discussed above.**

2.6 Oxygen sensor

-Require continuous circuit continuity monitoring (e.g., like comprehensive components) instead of once per driving cycle as allowed.

The Alliance proposes the following changes to accommodate this proposal:

(b)(8.1.1) The diagnostic system shall monitor the output voltage, response rate, , and any other parameter which can affect emissions, of all primary (fuel control) oxygen (lambda) sensors for malfunction. It shall also monitor all secondary oxygen sensors (fuel trim control or use as a monitoring device) for proper output voltage and/or response rate. Response rate is the time required for the oxygen sensor to switch from lean-to-rich once it is exposed to a richer than stoichiometric exhausts gas or vice versa (measuring oxygen sensor switching frequency may not be an adequate indicator of oxygen sensor response rate, particularly at low speeds).

(b)(8.2.1) An oxygen sensor shall be considered malfunctioning when the voltage, response rate, or other criteria are exceeded and causes emissions from a vehicle equipped with the sensor(s) to exceed 1.5 times any of the applicable FTP standards, or when the sensor output characteristics are no longer sufficient (e.g., lack of sensor switching) for use as a diagnostic system monitoring device (e.g., for catalyst efficiency monitoring). <u>The sensor shall also be considered malfunctioning when lack of activity exceeds manufacturer specified limits.</u>

(b)(8.3.1) For primary oxygen sensor(s) used for fuel control, the output voltage shall be monitored continuously during closed-loop operation and the response rate (delete - and output voltage) shall be monitored for malfunction before the end of the first idle period after the vehicle has commenced closed-loop operation, if the necessary checking condition for acceptable oxygen sensor(s) performance has been encountered. The performance of the sensor can only be judged acceptable by one or more of the following means: within any 20 second reasonably steady speed condition as defined in (b) (1.3.2), within any deceleration of 3 seconds or more, or during the first idle period of at least 20 seconds after closed loop operation begins (i.e., not during an acceleration condition); not withstanding, unacceptable performance can be determined at any time. Other monitoring conditions may be used provided the manufacturer provides a monitoring strategy and supporting data showing equivalent monitoring reliability and timeliness in detecting a malfunctioning sensor compared to the above monitoring conditions and the Executive Officer approves. Continuous monitoring for output voltage may consist of either circuit continuity monitoring or a continuous check of sensor activity while in closed-loop operation. <u>Sensor activity monitoring shall occur every time the manufacturer-defined monitoring conditions are met.</u>

11/14/00:

- **Industry agreed with ARB's proposal contained in CARB handout #1, section b(8.2.1).**

- **ARB agreed with industry's proposal on Section b(8.3.1).**

2.7 Comprehensive Components

-Require rationality monitors (input components) to run every time monitoring conditions are met, not just once per driving cycle (e.g., MAF, TPS, etc.) unless it is an intrusive check.
-Require functional monitors (output components) to run every time monitoring conditions are met, not just once per driving cycle (e.g., shift solenoids, etc.) unless it is an intrusive check.
-May add maximum emission limit of 1.5 x standard for a couple of comprehensive components that are suspected of having a large emission impact on SULEV type applications and are not part of an adaptive feedback system (e.g., swirl control valves or variable length intake manifold runners may get an emission cap of 1.5 x standard on functional checks but MAF sensor would not because it is somewhat compensated for by closed-loop fuel system)

Industry recommends the following:

(12.3.1) Input Components: Input components shall be monitored continuously for proper range of values and circuit continuity. For rationality monitoring (where applicable), manufacturers shall define appropriate operating conditions during which monitoring shall occur, subject to the limitation that the monitoring conditions shall be encountered at least once during the first engine start portion of the applicable FTP test. Rationality monitoring shall occur at least once per driving cycle during which the manufacturer-defined monitoring conditions are met. Unless intrusive, rationality monitoring shall occur every time the manufacturer-defined monitoring conditions are met.

(12.3.2) Output Components: Monitoring for circuit continuity and proper range of values (if applicable) shall be conducted continuously. For functional monitoring, manufacturers shall define appropriate operating conditions during which monitoring shall occur, subject to the limitation that the monitoring conditions shall be encountered at least once during the first engine start portion of the applicable FTP test. However, functional monitoring may be conducted during non-FTP driving conditions, subject to Executive Officer approval, if the manufacturer provides data and/or an engineering evaluation which adequately demonstrate that the component does not normally function, or monitoring is otherwise not feasible, during applicable FTP test driving conditions. Functional monitoring shall occur at least once per driving cycle during which the manufacturer-defined monitoring conditions are met. [No change]

11/14/00:

- **ARB agreed with industry proposal but intended to reword the last two sentences of Section (12.3.1)**

- **With respect to CARB handout #1, section d(3.4.1), ARB agreed that this requirement would not begin before MY 2005.**

2.8.7 Drive cycle info

-Require drive cycles, drive cycle info, or monitoring conditions to be made available (for all 1996 and newer) to exercise monitors needed to set readiness codes. Must allow technicians to be able to operate all the diagnostics on a single drive cycle and to individually operate diagnostics (to verify only repaired component or set remaining one or two "not ready" monitors).

ARB agreed that manufacturers would need to provide the information in the first sentence of this proposal (i.e., drive cycles, drive cycle info, OR monitoring conditions needed to set readiness codes). Other organizations can then develop the specific drive cycle traces discussed in the second sentence.

Industry agrees with this proposal.

11/14/00:

- **See CARB handout #1, section d(4.5)**

- **Industry agreed to review the specific language and provide comments.**

2.9.2 New generic data stream parameters

-Add standardized support for EGR duty cycle (commanded and actual, if available), commanded purge duty cycle, time elapsed since engine start, distance elapsed since MIL illuminated, number of warm-up cycles (?) since battery disconnect or code clear, monitor status on this drive cycle (e.g., ran, not yet ran, or disabled?)(only for monitors associated with a readiness code).
-Possibly add evaporative system/tank pressure sensor, injector pulse width, fuel level, catalyst model temperature, ???

ARB and industry agreed to the following:

- **Implementation should not begin before 2005.**

- **Delete injector pulse-width from the last bullet.**

Industry and ARB also discussed information that state I/M coordinators asked for in a meeting with ARB:

- **<u>Odometer Reading from OBD System</u>: Industry reported this was impossible with current systems and unnecessary for future systems. I/M coordinators evidently want to completely automate the I/M inspections. This prevents possible errors when the I/M station types in the mileage.**

- **<u>DTC History (i.e., DTC set, date DTC set, and/or mileage when DTC was set)</u>: Industry pointed out that this was not only infeasible without considerable cost, but would provide no beneficial information.**

<u>11/14/00</u>:

- **SAE and ISO need to draft a document, then CARB will either reference it or adopt portions. This will take up to 2 years.**

- **State I/M officials want the odometer and DTC history. Industry opposes. CARB not strong on the latter.**

2.9.5 EEPROM

- require use of EEPROM for OBD II & emission-related ECU's (e.g., ECM and TCM)

In general, industry opposes CARB's proposed design specification for OBD and emission related ECUs. Moreover, since the automotive trend is towards re-programmable engine and transmission ECUs, we believe the perceived benefit for such a requirement is minimal. (Please see the attached summary chart of Alliance members' 2007MY plan for engine and transmission control units.)

<u>11/14/00</u>:

- **ARB is still considering this one. However, they indicated that they may drop it, since most manufacturers are going this way on their own. They may consider a separate "lock box" for VIN.**

2.9.6 Mode $07 fault codes

-Clarify that Mode $07 fault code must always report the most recent result (e.g., on the second driving cycle, when a fault matures to a hard code (Mode $03) and illuminates the MIL, it should also still be stored in Mode $07 if it failed on that driving cycle.

11/14/00:

- **See CARB handout #1, section d(3.4)**

- **Industry agreed to this provision provided it doesn't begin before MY 2005.**

2.16 New emission control technologies

-Formerly section (a)(1.10) which required manufacturers to present a plan for monitoring
-Need to establish guidelines as to whether a new component falls under (a)(1.0) or comprehensive components
-Monitoring plan may also need to include plans for DDV type testing

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Industry does not believe this requires clarification or changes and thus proposes maintaining the current requirements.

11/14/00:

- **All new emission control devices will go through Section (a)(1.10). CARB still considering this but leaning toward industry position.**

2.17 Near-Zero and Zero Evap components

- intake air filter charcoal elements cannot be part of removable filter unless monitored. Must be non-service interval part, downstream of air filter, and not likely to be removed.
- Charcoal Filter on fresh air vent of canister does not require any additional functional monitoring but must be part of the leak check.
- Additional valves (mechanical or electrical) used in evap system that could have an emission impact (e.g., bypass valves during refueling, etc.) must be functionally checked by OBD system.

Industry will provide additional feedback when regulatory language is provided.

11/14/00:

- **Industry needs to see draft regulatory language on this issue.**

UNRESOLVED ISSUES

1.2 Air Conditioning Component/Strategy Monitoring

-Only require monitoring if malfunction can disable/significantly affect other OBD II monitors
-Ignore emission impact except if any single component failure can cause emissions to exceed 1.5 x standard. This would include the two failure modes where the A/C fuel control/timing strategy is invoked when A/C is not really on and where the A/C fuel control/timing strategy is not invoked when the A/C is on—if either failure caused emissions to exceed 1.5 x standard, monitoring for that failure would be required.

11/14/00:

- **See CARB handout #1, page 1**
- **CARB language generally okay. GM (John Van Gilder) agreed to provide proposed language on this.**
- **There is a question about testing vehicles and to what standard, since AC has separate test procedure and part of SFTP standard.**

1.5 Thermostat monitoring

-Still need to allow for some alternate compliance on vehicles with rear heaters that do not normally reach warmed-up operation on colder starts.
-Could allow the use of variable warmed-up temperature threshold (as a function of engine start) to still be able to catch failures on warmer starts all the way up to normal regulating temperature but also allow a lower threshold temp (and more reasonable fault times) on colder starts.
-Could abandon regulating temp - 20°F for cars with rear heat and require monitoring only to highest enable temp. (How do we prevent every manufacturer with a 'large' passenger compartment from requesting the same leeway?) (Regs currently allow this but only with emission demonstration).

11/14/00:

- **ARB is developing language to specify the diagnostic should run as indicated for starts when ambient temperatures are above 50F.**
- **ARB is also considering another diagnostic when ambient temperatures are below 50F.**

1.7 Fault code usage

-use of P0xxx codes whenever possible
-use of P1xxx codes requires ARB approval prior to certification (approval based on lack of P0xxx code availability, rejection from J2012 to assign a new P0xxx code, estimated additional benefit to service technician, and how widespread the usage of that component/failure across product lines)
-separate fault codes must be used for circuit continuity failures from rationality/functional failures ("smart" chip/sensors with integrated signal processors that self-diagnose and do not have the capability to separately identify to the ECM what type of failure occurred need to be designed to separately identify certain failure modes described below).
-single code may be used for low side and high side rationality
-separate codes must be used for circuit high failures and circuit low failures. Open circuit failures may be combined with one of the circuit high or circuit low failures if not able to be distinguished separately.

11/14/00:

- **See CARB handout #1, section d(3.4)**
- **Industry agreed to this proposal, provided appropriate flexibility is provided in the regulation, which ARB agreed to provide.**
- **ARB does not intend to address legacy codes.**

1.10 Oxygen Sensor Diagnostic

-ARB does plan to add failure mode of "front sensor bias or drift" to the list of criteria that a manufacturer has to diagnose for failures that cause 1.5 x standard. Depending on the current level of diagnostics, some manufacturers may be able to demonstrate that no changes are needed to detect failures of this type. Others may need to incorporate new diagnostics.
-Will be a workshop topic

11/14/00:

- **CARB is still reviewing this.**

1.13 NOx Catalyst Monitor

-Final threshold of 1.75 x standard for 2007 model year
-Interim thresholds of 2.5 x NOx std for LEVII and ULEVII, 3.0 x NOx std for SULEV) during 2005 and 2006 model years.
-As always, revisit thresholds at next biennial review
-Required on all 2005 and newer vehicles certified to LEV II standards
-SULEVs qualifying for PZEV credit would meet same requirements (e.g., 3.0 x NOx std for 2005 and 2006, 1.75 x std for 2007 and newer, no NOx cat monitor prior to 2005 model year).

11/14/00: This was discussed with the LEV II Threshold issue (1.15).

- **ARB proposes the following:**
  - ***SULEV Threshold*** **= 2.5 x STANDARD for HC, CO, and NOx for all monitors EXCEPT**
    - **Misfire = 1.5 x STANDARD (1% Floor)**
    - **2005, 2006 NOx Catalyst Monitor = 3.0 x STANDARD**
  - ***PZEV OBD*** **= SULEV OBD**
- **Industry maintains that these thresholds are too low, particularly the NOx catalyst monitor.**
- **Industry objected to proposed Section (g)(4.4.5) in handout #1, which requires reporting for HC and NOx conversion efficiencies and finds catalyst efficiencies of <50% unacceptable. ARB had previously agreed to manufacturers simply reporting the catalyst efficiencies. ARB would then make a determination at a later time. Industry still supports this proposal.**

1.14 Comprehensive Components

-Still undecided how to proceed here

-Can appreciate Industry's concern regarding sensitivity and impact on I/M but have not yet figured out a reasonable alternative that accounts for all different failure modes, combination of deteriorated parts, prevents other monitors from being disabled.
-Probably will not be decided until after public discussion at workshop

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11/14/00:

- **ARB is still undecided.**

1.15 LEV II malfunction criteria

-ARB not going to propose use of 1.5 x ULEVI standard for LEV II vehicles.
-Sticking with 1.5 x standard for now.
-However, SULEV can use interim threshold of 2.5 x std (for all monitors except misfire which remains at 1.5 x std) through the 2003 model year.
-Willing to review progress at next biennial review

11/14/00:

- **See discussion under 1.13.**

1.16 Deficiencies

-Still to be determined
-Considering elimination of deficiencies or, at a minimum, mandatory fines for deficiencies
-Regardless of path taken, further definition of what can be granted a deficiency is needed (distinguish between major and minor monitors?, lack of monitor, lack of specific type of monitor such as rationality check, define 'good faith', distinguish between 'new' monitoring requirement vs. old)
-Further clarify that carry-over of deficiencies is not automatic—must be re-approved each year with progress/good faith effort shown from year to year to remove deficiency.

11/14/00:

- **ARB will establish more stringent guidelines. They are currently considering the following:**
    - **Deficiencies reported prior to 3 months after production begins will be handled as deficiencies (i.e., manufacturers would be allowed 2 or 3 deficiencies and then the manufacturer would pay $25 to $50 per deficiency per vehicle).**
    - **Deficiencies reported or found after Production + 3 Months would be considered non-compliance, and subject to the non-compliance penalties of up to $5000 per non-compliance per vehicle.**

- **EPA could have problems with allowing retroactive deficiencies.**

2.5 Secondary Air monitor

-Eliminate clause to allow only a functional check (instead of a low/high flow check) based on a materials demonstration that the system is unlikely to deteriorate. (ARB staff are not materials engineers and not properly qualified to ensure to review materials design specs). Change requirement to detect deterioration in flow that causes 1.5x standard. Still have general option to only do functional check if complete failure does not cause tailpipe emissions to exceed 1.5 x standard.

11/14/00:

- **ARB intends this to be a 1.5 x Standard requirement.**
- **Industry objects and reports that this will require hardware (flow meters, pressure sensors, etc.)**
- **No resolution was reached.**

2.8.6 VIN

-Standardized electronic access (Mode $09) of VIN in all ECMs by 2005

11/14/00:

- **CARB intends to propose this requirement.**
- **CARB will follow up with individual manufacturers that have a problem.**

2.8.8 PID count and ECM ID

-Require manufacturers to help create a database of number of supported PIDs and ECM/TCM ID for 1996 and newer cars to avoid clean-screening.

11/14/00:

- **Industry reported that this requirement would result in a tremendous amount of work, particularly for OEMs with reprogrammable EPROMs, since it requires that every calibration be installed on the vehicle and the PID count determined.**
- **ARB reported that organizations are already compiling this information.**
- **Industry prefers these organizations compile the information.**

2.9.1 Generic scan tool communication protocol

-Allow CAN for 2003 and later model year. (Use of CAN, however, also requires use of standardized Mode $06).
-Put end date for ISO 9141, KWP2000, and J1850 of 2007(?) model year after which it will no longer be allowed.
-Clarify that, effective retroactively to 1996 model year, 100msec delay between scan tool requests can be eliminated.

11/14/00:

- **ISO 9141, KWP 2000: ARB intends to sunset. Industry agrees**
- **J1850: ARB also intends to sunset. Industry does not agree.**
- **J1939: ARB will address this once the Heavy Duty OBD issues are resolved, otherwise this standard is still acceptable.**

2.14 PZEV vehicles

-No deficiencies allowed on PZEVs
-No interim thresholds allowed on PZEVs (other than the NOx catalyst in 2005 and 2006)

11/14/00:

- **ARB is deleting this proposal.**

2.15 Variable Valve Timing and EGR

-Increased use of VVT systems in lieu of EGR (or in addition to) may lead ARB to consider VVT systems as EGR systems making them liable to 1.5 x standard testing like EGR.
-Monitoring must be able to determine a "one tooth slipped" failure.

11/14/00

- **No new language available**

Attachment 1 – Alliance Proposal on OBD Regulations for HEVs

1. **All current OBD requirements apply to the conventional (fossil fuel) engine except:**

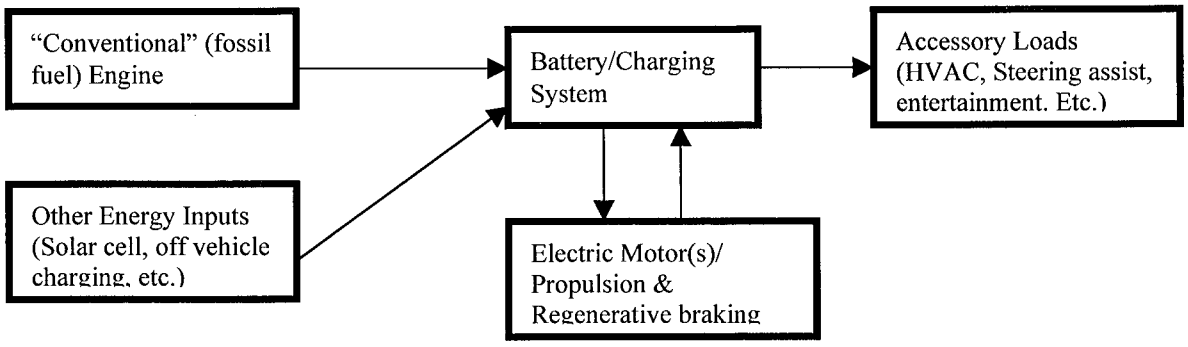
   (a) The OBD system demonstration protocol may need to be modified from the emissions certification schedule.
   (b) Agreement on a formal definition of "1.5" times the standard thresholds.

2. **All energy input devices to the electrical propulsion systems must be diagnosed as comprehensive component monitor. This requirement is applicable to, but not limited to, battery performance, charging systems, electric motor performance. Regenerative braking must also be diagnosed if the electric motor diagnostic is not sufficient to cover this function. Some exemption will be allowed in the following cases:**

   (a) The failure causes the vehicle to stop.
   (b) The failure causes the vehicle to enter a "limp home" mode with limited range.
   (c) There is no significant difference in emission between the normal and failure operation. (A demonstration will be required.)
   (d) Failure of the component can be diagnosed as a system malfunction by a system monitor. When a malfunction is detected, either the component to be repaired will be identified by the service procedure, or the system including the malfunctioning component will be replaced.

3. Manufacturers are not required to diagnose the performance of accessory loads.

Proposed regulatory implementation: New section of the OBD regulation.
Proposed regulatory language: To be developed.



CARB Handout #1 11/14/00

Cold start/Warm-up strategy Language

If the emission control system incorporates a specific engine control strategy to reduce cold start emissions, the key control or feedback parameters used to effect that strategy (e.g., engine speed, mass air flow, etc.) shall be monitored (either directly or indirectly) while the control strategy is active to ensure proper operation of the control strategy. The individual components associated with the strategy shall be considered malfunctioning if any component malfunctions such that emissions exceed 1.5 times the standards. Malfunction criteria shall be based on data obtained from a representative cross section of a manufacturer's product line. An engineering evaluation shall be provided for establishing malfunction criteria for the remainder of the manufacturer's product line. The Executive Officer shall waive the evaluation requirement each year if, in the judgement of the Executive Officer, technological changes do not affect the previously determined malfunction criteria. Manufacturers shall implement these requirements on all 2005 model year and newer applications certified to LEV II emission standards.

A/C language:

The diagnostic system shall monitor all air conditioning system input and output components for singular malfunctions that effectively disable a diagnostic strategy for any other monitored system or component or cause emissions to exceed 1.5 times any of the applicable FTP standards.

Additionally, for all non-continuous OBD II diagnostics that require more than 15 seconds of continuous idle operation, manufacturers shall not be allowed to disable the diagnostic when the air conditioning compressor cycles changes state (i.e., from on to off or off to on). Manufacturers may, however, design diagnostics that collect data regardless of air conditioning compressor cycling or prevent the air conditioning compressor from changing state until the diagnostic completes.

O2 sensor language

(b)(8.2.1) An oxygen sensor shall be considered malfunctioning when the voltage, response rate, or other criteria are exceeded and causes emissions from a vehicle equipped with the sensor(s) to exceed 1.5 times any of the applicable FTP standards, or when the sensor output characteristics are no longer sufficient (e.g., lack of sensor switching) for use as a diagnostic system monitoring device (e.g., for catalyst efficiency monitoring), or when a sensor malfunction causes the fuel system to stop using that sensor as a feedback input.

(h) CERTIFICATION DOCUMENTATION: The manufacturer shall submit the following documentation for each ~~engine family at the time of certification~~ test group at the time specified with each documentation requirement. If any of the items listed below are standardized for all test groups, the manufacturer may submit one copy. The manufacturer may define OBD II groups subject to Executive Officer approval and submit information based on these groups in lieu of submitting

information for every test group. An OBD II group shall be defined as test groups belonging to the same durability group and having the same OBD II strategies and similar calibrations. The manufacturer shall select one or more representative test group(s) per OBD II group subject to Executive Officer approval and submit one copy of the information required below per representative test group. At a minimum, the representative test group(s) shall include the most stringent emission standards and OBD II monitoring requirements and cover all the emission control devices within an OBD II group. With Executive Officer approval, one or more of the documentation requirements specified in this section may be waived or altered if the information required would be redundant or unnecessarily burdensome to generate:

(h)(1.0) The following information shall be submitted before an Executive Order will be issued (i.e., with Part 1 of the certification application):

(1.1) A written description of the functional operation of the diagnostic system ~~to be included in Section 8 of manufacturers' certification applications~~.

(1.2) A table providing the following information for each monitored component or system (either computer-sensed or -controlled) of the emission control system:
- (A) corresponding fault code
- (B) monitoring method or procedure for malfunction detection
- (C) primary malfunction detection parameter and its type of output signal
- (D) fault criteria limits used to evaluate output signal of primary parameter
- (E) other monitored secondary parameters and conditions (in engineering units) necessary for malfunction detection
- (F) monitoring time length and frequency of checks
- (G) criteria for storing fault code
- (H) criteria for illuminating malfunction indicator light
- (I) criteria used for determining out of range values and input component rationality checks

(1.3) A logic flowchart describing the general method of detecting malfunctions for each monitored emission-related component or system. To the extent possible, abbreviations in Society of Automotive Engineers' (SAE) J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms", ~~September, 1995~~ May 1998, shall be used. J1930 is incorporated by reference herein. The information required in the chart under (1.2) above may instead be included in this flow chart, provided all of the information required in (1.2) is included.

(1.4) Emission test data specified in subsection (g).

(1.5) Data supporting the selected degree of misfire which can be tolerated without damaging the catalyst. For vehicles designed to meet the expanded misfire monitoring conditions (section (b)(3.3.2) or (b)(3.3.3)), representative data demonstrating the capability of the misfire monitoring system (i.e., probability of detection of misfire events) to detect misfire over the full engine speed and load operating range for selected misfire patterns (i.e., random cylinders, one cylinder out, paired cylinders out).

(1.6) Data supporting the limit for the time between engine starting and attaining the designated heating temperature for after-start heated catalyst systems.

(1.7) A description of the modified or deteriorated components used for fault simulation with respect to the demonstration tests specified in section (g).

(1.8) A listing of all electronic powertrain input and output signals.

(1.9) A written description of all parameters and conditions necessary to begin closed loop operation.

(1.10) A summary table identifying every test group and each of the OBD II phase-in requirements that apply to each test group.

(1.11) A written identification of the communication protocol utilized by each test group for communication with an SAE J1978 generic scan tool and the assigned physical address and number of supported parameter identification (PID) values for each diagnostic or emission critical powertrain control unit.

redundant w/ CVN & Cal ID

(1.12) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this section.

(h)(2.0) The following information shall be submitted by January 1st of the applicable model year (i.e., with Part 2 of the certification application):

(2.1) A listing and block diagram of the input parameters used to calculate or determine calculated load values and the input parameters used to calculate or determine fuel trim values.

(2.2) A scale drawing of the MIL and the fuel cap indicator light, if present, which specifies location in the instrument panel, wording, color, and intensity.

(h)(3.0) The following information shall be submitted upon request:

(3.1) For Low Emission Vehicles, data supporting the criteria used to indicate a malfunction when catalyst deterioration causes emissions to exceed the applicable threshold specified in section (b)(1.2.2).

(3.2) For Non-Low Emission Vehicles, data supporting the criteria used to indicate a malfunction when catalyst deterioration leads to a 1.5 times the standard increase in HC emissions. If a steady state catalyst efficiency check is employed in accordance with section (b)(1.2.4), data supporting the criteria used by the diagnostic system for establishing a 60 to 80 percent catalyst efficiency level shall be provided instead.

(3.3) Data supporting the criteria used to detect evaporative ~~purge~~ system leaks.

(3.4) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this section.

DDV vehicle selection/testing

(g)(1.0) REQUIREMENT Each year a manufacturer shall provide emission test data obtained from a certification durability vehicle(s) for one or more test groups ~~engine family~~ that ~~has~~ have not been used previously for purposes of this section. If a test group designated for testing is different than the durability vehicle, the Executive Officer shall permit a manufacturer to satisfy this requirement with data from a representative high mileage vehicle(s) or from a vehicle(s) equipped with the appropriate bench-aged components. Bench-aged components used to satisfy the requirements of this section shall include the same components/systems and be aged by the same procedures as used for the durability vehicle of a test group designated for OBD II demonstration. For applications certified on engine dynamometers, engines may be used instead of vehicles. The Air Resources Board (ARB) shall determine the test group(s) to be demonstrated. Each manufacturer shall notify the Executive Officer prior to applying for certification of the test groups planned for a particular model year in order to allow selection of the test group(s) to be demonstrated. A manufacturer certifying one to five test groups in a model year shall demonstrate one test group. A manufacturer certifying six to ten test groups in a model year shall demonstrate up to two test groups. A manufacturer

certifying eleven or more test groups in a model year shall demonstrate up to three test groups. ~~If a manufacturer does not have a certification durability vehicle available which is suitable for the engine family designated for testing, the Executive Officer shall permit a manufacturer to satisfy this requirement with data from a representative high mileage vehicle or vehicles (or a representative high operating hour engine or engines) acceptable to the Executive Officer to demonstrate that malfunction criteria are based on emission performance. The Air Resources Board (ARB) shall determine the engine family to be demonstrated. Each manufacturer shall notify the Executive Officer prior to applying for certification of the engine families planned for a particular model year in order to allow selection of the engine family to be demonstrated. Demonstration tests shall be conducted on the certification durability vehicle or engine at the end of the required mileage or operating hour accumulation. For non-LEVs, until a NOx standard applicable for more than 50,000 miles is established in California, the federal 50,000 to 100,000 mile NOx standard shall be used for demonstration purposes.~~

(g)(4.4.5) For Low Emission Vehicle catalyst efficiency demonstration, if HC and NOx emissions do not exceed the applicable emission thresholds specified in sections (b)(1.2.2) and (b)(1.2.4), and the MIL is illuminated, no further demonstration shall be required. However, if HC or NOx emissions exceed the threshold and the MIL is illuminated, the vehicle shall be retested with average FTP HC or NOx (whichever is applicable) conversion capability of the catalyst system increased by no more than 5 percent (i.e., 5 percent more engine out hydrocarbons or NOx are converted). For the OBD II system to be approved, the vehicle must then meet the above emission levels when re-tested. The MIL shall not illuminate during this demonstration. Manufacturers shall also report the HC and NOx conversion efficiencies of the monitored portion of the catalyst system. Efficiencies less than 50 percent shall not be accepted.

Misfire monitoring language

(b)(3.2)(B) The percent misfire evaluated in 1000 revolution increments which would cause emissions from a durability demonstration vehicle to exceed 1.5 times any of the applicable FTP standards if the degree of misfire were present from the beginning of the test. Subject to Executive Officer approval, a manufacturer may employ other revolution increments if the manufacturer adequately demonstrates that the strategy is equally effective and timely in detecting misfire. For the purpose of establishing the percent misfire, the manufacturer shall conduct the demonstration test(s) with the misfire events occurring at equally spaced complete engine cycle intervals, across randomly selected cylinders throughout each 1000 revolution increment. However, the percent misfire established shall be applicable for any misfire condition (e.g. random, continuous, equally spaced, etc.) for the purpose of identifying a malfunction. If the percent misfire determined under this subsection is less than or equal to 1.0

percent, the manufacturer may set the malfunction criterion to 1.0 percent. ~~This criterion may be used for all vehicles with engines containing the same number of cylinders as the demonstration vehicle. The number of misfires in 1000 revolution increments which was determined for the durability demonstration vehicle malfunction criterion may be used to establish the corresponding percent misfire malfunction criteria for engines with other numbers of cylinders. The malfunction criteria for a manufacturer's product line shall be updated when a new durability demonstration vehicle is tested which indicates more stringent criteria are necessary than previously established to remain within the above emission limit.~~

(d) STANDARDIZATION REQUIREMENTS

(1.0) Diagnostic Connector—A standard data link connector based on SAE J1962 "Diagnostic Connector" specifications, incorporated by reference, shall be incorporated in each vehicle. The connector shall be located in the driver's side footwell region of the passenger compartment of the vehicle in the area bound by the driver's end of the instrument panel to a point 200 mm on the driver's side of the vehicle centerline and at a location no higher than the bottom of the steering column. The connector shall not be located on the horizontal faces (e.g., near floor-mounted A/T gear selector, parking brake lever, or cup-holders) or vertical faces (e.g., near the car stereo, climate system, or navigation system controls) of the center console. The location of the connector shall be easily identified by a "crouched" technician entering the vehicle from the driver's side. Any pins in the connector that provide electrical power shall be properly fused to protect the integrity and usefulness of the connector for diagnostic purposes.

(2.0) Communications to a Scan Tool—Manufacturers shall use one of the following standardized protocols for communication of all required emission related messages from on-board to off-board network communications to a scan tool meeting SAE J1978 "OBD II Scan Tool" specifications, incorporated by reference:

(2.1) The communication protocol specified in SAE J1850 "Class B Data Communications Network Interface," incorporated by reference. All required emission related messages using this protocol shall use the Cyclic Redundancy Check and the three byte header, shall not use inter-byte separation or checksums, and shall not require a minimum delay of 100 ms between SAE J1978 scan tool requests. However, this protocol shall not be used on any 2007 or newer model year vehicle.

(2.2) The communication protocol specified in ISO 9141-2 "Road Vehicles-Diagnostic Systems-CARB Requirements for Interchange of Digital Information," incorporated by reference. However, this protocol shall not be used on any 2007 or newer model year vehicle.

(2.3) The communication protocol specified in ISO 14230-4 "Road Vehicles-Diagnostic Systems-KWP 2000 Requirements for Emission-related Systems," incorporated by reference. However, this protocol shall not be used on any 2007 or newer model year vehicle.

(2.4) The communication protocol specified in ISO 15765 "Road Vehicles – Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emission-related systems," November 30, 1999, incorporated by reference. However, this protocol shall not be used on any 2002 or older model year vehicle. If this CAN protocol is used, manufacturers shall also use ISO 15031-5 "Road Vehicles - Communication between vehicle and external test equipment for emission-related diagnostics - Part 5: Emission-related diagnostic services," December 1, 1999, incorporated by reference, in lieu of SAE J1979 for all required functions identified in section (d). All required emission-related messages using this protocol shall use a 500 kbps baud rate.

(3.0) Required Emission Related Functions—The following standardized functions shall be implemented in accordance with the specifications in SAE J1979 "E/E Diagnostic Test Modes", incorporated by reference, to allow for access to the required information by a scan tool meeting SAE J1978 specifications:

(3.1) Readiness Status—In accordance with SAE J1979 specifications, the on-board diagnostic system shall store an indication of the status (i.e., complete or not complete) for each of the installed monitored components and systems identified in section (c)(2.0) through (c)(9.0) since the on-board diagnostic system computer memory was last cleared. The status for each of the components or systems monitored continuously shall always indicate complete. The status for each of the components or systems monitored non-continuously shall immediately indicate complete upon the respective diagnostic(s) completing and indicating a passing result or upon completing the number of decisions necessary for MIL ~~illumination~~. The status for each of the monitored components or systems shall indicate not complete whenever fault information in the on-board diagnostic system computer memory is cleared or erased by a means other than that allowed in section (a)(4.0). Normal vehicle shut down (i.e., key off, engine off) shall not cause the status to indicate not complete.

status

(3.1.1) Subject to Executive Officer approval, if monitoring is disabled for a multiple number of driving cycles due to the continued presence of extreme operating conditions (e.g., cold ambient temperatures, high altitudes, etc), readiness status for the subject monitoring system may be set to indicate complete without monitoring having been completed. Executive Officer approval shall be based on the conditions for monitoring system disablement and the number of driving cycles specified without completion of monitoring before readiness is indicated as complete.

(3.1.2) For the evaporative system monitor, the readiness status shall indicate complete when a full diagnostic check has been completed with respect to the 0.040 inch malfunction criteria (section (c)(4.2.1)) if the monitoring conditions for the 0.020 inch malfunction criteria (section (c)(4.2.2) are

(2.8.4)

constrained relative to the 0.040 inch malfunction criteria. For systems using a 0.020 inch diagnostic that executes during engine off conditions, the evaporative system monitor readiness status shall indicate complete when a full diagnostic check has been completed with respect to the 0.020 inch malfunction criteria.

(3.1.3) For non-continuous misfire monitoring on diesel engines, the readiness status shall indicate complete when a full diagnostic check has been completed.

(3.1.4) If the manufacturer elects to additionally indicate readiness status through the MIL in the key on, engine off position as provided for in section (a)(4.3), the readiness status shall be indicated in the following manner: If the readiness status for all monitored components or systems is complete, the MIL shall remain continuously illuminated in the key on, engine off position for at least 15-20 seconds. If the readiness status for one or more of the monitored components or systems is not complete, after 15-20 seconds of operation in the key on, engine off position with the MIL illuminated continuously, the MIL shall blink once per second for 5-10 seconds. The data stream value for MIL status (section (d)(3.2)) shall indicate commanded off during this sequence unless the MIL has also been commanded on for a detected fault.

(3.2) Data Stream--The following signals (if equipped) shall be made available on demand through the standardized data link connector in accordance with SAE J1979 specifications: calculated load value, number of stored fault codes, engine coolant temperature, fuel control system status (e.g., open loop, closed loop, etc.), fuel trim, fuel pressure, ignition timing advance, intake air temperature, manifold air pressure, air flow rate from mass air flow sensor, engine speed, throttle position, secondary air status (upstream, downstream, or atmosphere), vehicle speed, oxygen sensor output, air/fuel ratio sensor output, and MIL status (i.e., commanded on or commanded off). Additionally, on all 2005 and newer model year vehicles, the following signals (if equipped) shall also be made available via standardized commands and in a standardized format: ambient air temperature, fuel level, barometric pressure (directly measured or estimated), evaporative system vapor pressure, commanded purge valve duty cycle, commanded EGR valve duty cycle, EGR error between actual and commanded status, catalyst temperature (directly measured or estimated for purposes of enabling the catalyst monitor(s)), monitor status (i.e., disabled this driving cycle, complete this driving cycle, not complete this driving cycle) since last engine shut-off for each monitor used for readiness status, time elapsed since engine start, distance elapsed since MIL illuminated, distance elapsed since fault memory last cleared, and number of warm-up cycles since fault memory last cleared. The signals shall be provided in standard units based on the SAE specifications incorporated by reference in this regulation, and actual signals shall be clearly identified separately from default value or limp home signals.

(3.3) Freeze Frame—Upon detection of the first malfunction of any component or system, "freeze frame" engine conditions present at the time shall be stored in computer memory in accordance with SAE J1979 specifications. Should a subsequent fuel system or misfire malfunction occur, any previously stored freeze frame conditions shall be replaced by the fuel system or misfire conditions (whichever occurs first). Stored engine conditions shall include all of the signals required in section (d)(3.2) except: number of stored fault codes, oxygen sensor output, air/fuel ratio sensor output, MIL status, monitor status since last engine shut off, and distance elapsed since MIL illuminated and shall include the fault code which caused the data to be stored. The manufacturer shall choose the most appropriate set of conditions facilitating effective repairs for freeze frame storage. Only one frame of data is required. Manufacturers may at their discretion choose to store additional frames provided that at least the required frame can be read by a scan tool meeting SAE J1978 specifications. If the fault code causing the conditions to be stored is erased in accordance with section (a)(4.0), the stored engine conditions may be cleared as well.

(3.4) Fault Codes--For all monitored components and systems, stored fault codes (including pending fault codes) shall be made available through the diagnostic connector in accordance with SAE J1979 specifications. Standardized fault codes based on SAE J2012, "Recommended Format and Messages for Diagnostic Trouble Codes," incorporated by reference, shall be employed. The fault code used shall pinpoint the likely cause of the malfunction as much as possible. Manufacturers shall use separate fault codes for every diagnostic where the diagnostic and repair procedure or likely cause of the failure is different. In general, input component rationality diagnostics and output component functional diagnostics shall use separate fault codes than the respective circuit continuity diagnostics. Additionally, input component circuit continuity diagnostics shall use separate fault codes for separately detected malfunctions. Manufacturers shall use appropriate SAE-defined fault codes of J2012 (e.g., P0xxx, P2xxx) whenever possible. With Executive Officer approval, manufacturers may use manufacturer-defined fault codes in accordance with SAE J2012 specifications (e.g., P1xxx, P3xxx). Factors to be considered by the Executive Officer for approval shall include the lack of available SAE-defined fault codes, uniqueness of the diagnostic or monitored component, expected future usage of the diagnostic or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians.

(3.4.1) Pending fault codes for all monitored components and systems shall be made available through the diagnostic connector in accordance with SAE J1979 specifications (i.e., Mode $07). The presence or absence of a pending fault code(s) shall be used to indicate the current status of all monitored components or systems, regardless of the MIL illumination status or stored fault code status (i.e., SAE J1979 Mode $03).

(3.5) Test Results--For all monitored components and systems identified in sections (c)(1.0) through (c)(9.0), except misfire detection and fuel system monitoring,

results of the most recent test performed by the vehicle, and the limits to which the system is compared shall be available through the data link in accordance with SAE J1979 specifications. Manufacturers shall report unique test results for each diagnostic (e.g., an evaporative system 0.040" leak diagnostic shall separately report test results from a 0.020" leak diagnostic). Manufacturers shall report the test results such that properly functioning systems do not indicate a failure (i.e., a test value which is outside of the test limits). Manufacturers shall define the test limits and test results such that test results numerically equal to the test limit shall indicate a passing value. The test results shall be stored until updated by a more recent result or fault memory of the on-board diagnostic system computer is cleared. Upon fault memory being cleared, the test results shall be initialized to values that do not indicate a failure (i.e., a test value which is outside of the test limits).

(3.5.1) For vehicles using CAN as the communication protocol (section (d)(2.4)) or any 2007 model year and newer vehicle using any other allowable protocol, the above test results and limits shall be made available in the standardized format specified in ISO 15031-x. Test limits shall include both minimum and maximum acceptable values and shall be reported for all monitored components and systems identified in sections (c)(1.0) through (c)(9), including misfire monitoring. Misfire monitoring test results shall indicate the number of counted misfire events for each cylinder. Monitors that have not yet completed since the last time the fault memory was cleared shall report values of zero for both the test result and test limits while monitors that have executed but do not have valid data shall report a hex value of $FF for the test result.

(3.6) Software Calibration Identification-- On all 2003 and newer model year vehicles, a software calibration identification number (CAL ID) for the diagnostic or emission critical powertrain control unit(s) shall be made available through the standardized data link connector in accordance with the SAE J1979 specifications. A unique CAL ID shall be used for every unique calibration and/or software set. Control units coded with multiple emission or diagnostic calibrations and/or software sets shall indicate a unique CAL ID for each variant in a manner that enables an off-board device to determine which variant is being used by the vehicle.

2.8.5

(3.7) Software Calibration Verification Number--On all 2005 and newer model year vehicles, a calibration verification number (CVN) that verifies the on-board computer software integrity in diagnostic or emission critical electronically reprogrammable powertrain control units shall be made available through the standardized data link connector in accordance with the SAE J1979 specifications. The CVN shall be capable of being used to determine if the emission-related software and/or calibration data are valid and applicable for that vehicle and CAL ID. Manufacturers shall request Executive Officer approval of the algorithm used to calculate the CVN. Executive Officer approval of the algorithm shall be based on the complexity of the algorithm and the difficulty in

1.6

Q. Definition of CVN regarding being "unique" - even 1 bit change, different part #

achieving the same CVN result with modified calibration values. The CVN shall be calculated at least once per driving cycle and stored until the CVN is subsequently updated (e.g., on the next driving cycle). Except for immediately after a reprogramming event or a non-volatile memory clear, the stored value shall be made available through the data link connector within five seconds of a request from a generic scan tool. The stored CVN value shall not be erased when fault code information is erased by a generic scan tool in accordance with SAE J1979 specifications.

or ISO →

(3.7.1) Manufacturers shall make a database available in a standardized electronic format that allows for off-board verification that the CVN result is valid and appropriate for a specific vehicle and CAL ID. The intent of this requirement is to allow for off-board verification of the CVN and CAL ID combination at the time of an Inspection and Maintenance (I/M) test.

Need work group to work out details
- format
- access
- update rate
- who does it (EPA, ARB, contractor)
- security

(3.8) Vehicle Identification Number--On all 2005 and newer model year vehicles, the vehicle identification number (VIN) shall be made available in a standardized format through the standardized data link connector in accordance with SAE J1979 specifications.

limit to being supported by one controller to be designated by OE

(4.0) Service Information--Manufacturers shall make readily available at a fair and reasonable price to the automotive repair industry vehicle repair procedures which allow effective emission related diagnosis and repairs to be performed using only the SAE J1978 generic scan tool and commonly available, non-microprocessor based tools.

(4.1) As an alternative to publishing repair procedures using only the SAE J1978 generic scan tool, manufacturers may additionally publish repair procedures referencing the use of manufacturer-specific or enhanced equipment provided the manufacturers make available the manufacturer-specific commands needed to perform the same emission-related diagnosis and repair procedures (excluding any reprogramming) in a comparable manner as the manufacturer-specific diagnostic scan tool.

2.9.4

(4.2) Standardized Format of Service Information (J2008)--Beginning January 1, 2002, manufacturers shall make available at a fair and reasonable price, all 2002 and newer model year vehicle emission-related diagnosis and repair information provided to the manufacturer's franchised dealers (e.g., service manuals, technical service bulletins, etc.) in the electronic format specified in SAE J2008 Draft Technical Report, "Recommended Organization of Service Information", November, 1995. The information shall be made available within 30 days of its availability to franchised dealers. Small volume manufacturers shall be exempted indefinitely from the J2008 formatting requirement.

(4.2.1) Subject to Executive Officer approval, manufacturers may alternatively comply with the U. S. Environmental Protection Agency's (EPA) "Service Information Rule" to meet the requirements of section (d)(4.2). Executive Officer approval shall be based on the overall equivalence of making service information available in an easily accessible format to technicians.

(4.3) Manufacturers shall make available information to utilize the test results reported as required in section (d)(3.5). Such information shall include a description of the test and test result, associated fault codes with the test result, and scaling, units, and conversion factors necessary to convert the results to engineering units.

(4.4) Manufacturers shall make available a description of each of the diagnostics used to meet the requirements of sections (c)~~(1.0)~~ through (c)~~(9.0) [Note—does Burton bill go beyond this and require this for every single diagnostic?]~~. Such description shall include a text description of how the diagnostic is performed, typical enable conditions, typical malfunction thresholds, typical monitoring time, fault codes associated with the diagnostic, and test results (section (d)(3.5)) associated with the diagnostic. Vehicles that have diagnostics not adequately represented by the typical values identified above shall be specifically identified along with the appropriate values.

(4.5) Manufacturers shall make available information necessary to execute each of the diagnostics used to meet the requirements of sections (c)(1.0) through (c)(9.0). Such information shall either include a description of sample driving patterns designed to be operated in-use or a written description of the conditions the vehicle needs to operate in to execute each of the diagnostics necessary to change the readiness status from not complete to complete for all monitors. The driving pattern description shall identify a single driving cycle to exercise all necessary monitors as well as identify separate driving cycles necessary to individually change the readiness status for each specific monitor from not complete to complete.

2.8.7

CARB Handout #2

Standardized Monitoring Conditions

Introduction:
The current OBD II regulation requires a manufacturer to define appropriate monitoring conditions that are subject to Executive Officer approval and occur during the FTP. While manufacturers originally desired the flexibility this language allows in designing monitors, the ARB has recently been criticized because this language is too subjective and does not provide a definitive enough requirement for OBD II engineers to be able to design an acceptable monitor. There has also been criticism that ARB has not evenly applied the requirements to all manufacturers.

The standardized conditions proposal requires specific monitors to run in an ARB-defined set of vehicle/engine operating conditions. This concept has many inherent benefits that address many of the difficulties encountered with the current regulation including defining a more objective standard as well as leveling the playing field by ensuring all manufacturers are held to the same requirements. A guarantee of sufficient monitoring frequency in-use would be far more likely because the standardized conditions would be based on engineering judgement and data that indicates the conditions would be encountered by the vast majority of the drivers with sufficient frequency. Design and calibration engineers would have a clearly defined target and would be assured of compliance. Comparable in-use monitoring performance from manufacturer to manufacturer would be essentially ensured. Certification would be simplified for both manufacturers and ARB because a manufacturer would basically identify which ARB-defined set of conditions was applicable for each monitor. Compliance and enforcement testing by ARB would be simplified and very objective. Service and repair technicians would be able to easily operate monitors in-use to verify repairs and set readiness codes prior to I/M inspection.

Applicability:
At this time, the standardized monitoring conditions would apply the following monitors:

- Catalyst
- O2 sensor response
- EGR flow/functional
- Secondary air flow/functional
- Evaporative system monitoring.

The staff is also considering applying the standardized conditions to the following monitors:

- O2 heater functional
- Purge valve flow/functional

The standardized conditions would not apply to the continuous monitors. Rather, the existing monitoring requirements would apply to the following monitors:

- Misfire
- Fuel system
- Comprehensive component

-circuit continuity
-out-of-range

The staff believes standardized conditions concept could also apply to the other monitors listed below. However, it should be noted that the staff is not considering standardized monitoring conditions for the following monitors at this time. The monitors listed below would be subject to the existing monitoring requirements.

- Comprehensive components
  - -output component functional
  - -input component rationality
- Thermostat monitor (pseudo-continuous)
- PCV monitor (pseudo covered by other monitors)
- Cold start warm-up strategies (pseudo covered by other monitors)

Standardized Monitoring Conditions:
Four types of monitoring conditions would be defined: idle monitoring, cruise monitoring, deceleration monitoring, and engine off monitoring. As outlined in the table below, different monitoring conditions would be permitted for the various monitors. For these monitors, manufacturers would not be required to demonstrate that the monitors run on the FTP. For each monitor, the manufacturer would be permitted to select one of the options listed for that monitor.

Monitor\Condition	Idle	Cruise	Decel	Engine off
Catalyst	X	X		
O2 Sensor	X	X		
EGR	X	X	X	
AIR	X	X		
Evap				X

The monitoring conditions specified below are staff's preliminary estimates for the specified conditions based on manufacturers' existing calibrations and limited data. The values may change as staff further develops its proposal and investigates the technical feasibility of the concept and the frequency that the specified monitoring conditions will be encountered during in-use driving. However, once ARB has defined the conditions, manufacturers will not be allowed to incorporate any additional enable conditions.

1. "Cruise" Monitoring Conditions:
   - Vehicle Speed:
     The monitor must be enabled when the vehicle is operated in a 30-mph vehicle speed window in the range of 25-75 mph. For example, a monitor could be enabled in the range of 25-55 mph or 40-70 mph. However, the actual enable conditions shall be defined by engine speed and gear ratio, not vehicle speed. On vehicles with automatic transmissions, the lower engine speed limit shall be determined with the torque converter locked up. The upper engine speed limit shall be determined with the torque converter unlocked unless the torque converter cannot be in an unlocked position at that speed/load point. Manual transmission vehicles shall define the appropriate engine speed and load points that would include the gear that would be used when following the manufacturer's recommended shift schedule as well as one gear lower. When the additional conditions (engine load and other cruise conditions) specified below are encountered, the monitor must be enabled. The monitor must be enabled over the entire 30-mph window, but the monitoring strategy cannot require operation over the entire window in order to make a monitoring decision (i.e., if the vehicle is operated at any fixed speed within the 30-mph window, the monitor is required to run.).

   - Engine Load Range:
     The regulation will specify an engine load range when a cruise monitor must be enabled. The monitor must be enabled throughout the engine load range, but the monitoring strategy cannot require operation over the entire range in order to make a monitoring decision (i.e., if the vehicle is operated at any fixed load within the load ranges specified below, the monitor is required to run.). The minimum load values shall be determined with the air conditioning in the off position. The maximum values shall be determined with the air conditioning in the on position and the vehicle loaded to a weight of the average of the curb weight and the gross vehicle weight. The load range must include the following vehicle operating conditions:
     - The vehicle speed window specified above.
     - Vehicle acceleration/deceleration rates $\leq$ 1.5 mph/sec.
     - Uphill/downhill road grades $\leq$ 3%.

   - Other cruise enable conditions:
     - Engine Coolant temperature (ECT): The manufacturer may specify a minimum ECT to enable cruise monitors, however, the required temperature may not be greater than 70°C. The thermostat monitor shall still be required to verify that the highest enable temperature used by any monitor is reached.
     - Time after engine start > f (ECT@start, IAT). The regulation will allow a manufacturer to specify an appropriate minimum time after engine start (e.g., 4 minutes above 50degF, etc.). This time shall not exceed the time for ECT to reach the thermostat monitor threshold temperature under similar conditions.

- Manufacturers may use a catalyst temperature model to enable the catalyst monitor. The manufacturer will be required to demonstrate that the catalyst model temperature will reach the enable temperature within a reasonable time as well as stay in the enable temperature window except when the vehicle is operated in conditions that cause excessive cooling or heating of the catalyst. The staff will develop guidelines for demonstrating acceptable performance of the catalyst temperature model.
- The monitor shall not require an estimated purge concentration less than a value equivalent to the concentration after 6 minutes of an FTP test started with a loaded canister.

2. "Idle" Monitoring Conditions:
   - The idle monitor shall be enabled when engine speed = idle speed +200/-100 rpm. A manufacturer may use a narrower speed window if its idle speed control monitor has the same malfunction thresholds as the enable window.
   - The monitor shall be enabled at vehicle speed less than closed throttle creep (i.e., closed throttle and brakes not applied) on a road with 0% grade. For vehicles with electronic throttle control, closed throttle is the throttle position with the accelerator pedal in the released position.
   - Engine Coolant temperature (ECT): The manufacturer may specify a minimum ECT to enable cruise monitors, however, the required temperature may not be greater than 70°C. The thermostat monitor shall still be required to verify that the highest enable temperature used by any monitor is reached.
   - Time after engine start > f (ECT@start, IAT). The regulation will allow a manufacturer to specify an appropriate minimum time after engine start (e.g., 4 minutes above 50degF, etc.). This time shall not exceed the time for ECT to reach the thermostat monitor threshold temperature under similar conditions.
   - Manufacturers may use a catalyst temperature model to enable the catalyst monitor. The manufacturer will be required to demonstrate that the catalyst model temperature will reach the enable temperature within a reasonable time as well as stay in the enable temperature window except when the vehicle is operated in conditions that cause excessive cooling or heating of the catalyst. The staff will develop guidelines for demonstrating acceptable performance of the catalyst temperature model.
   - An idle monitor may be disabled for 1 second when an Executive Officer approved disable (e.g., power steering change of state, A/C clutch change of state) occurs.
   - The monitor shall not require an estimated purge concentration less than a value equivalent to the concentration after 6 minutes of an FTP test started with a loaded canister.
   - If an idle based monitor has idle stability enable criteria (e.g., delta rpm/s, and delta load/s), the OBD II system must have a separate monitor to verify that the stability criteria are satisfied, or an idle control fault has to be indicated.

3. "Decel" Monitoring Conditions:
   - The monitor must be enabled during closed throttle decelerations that satisfy the conditions specified below. For vehicles with electronic throttle control, closed throttle is defined as the throttle position with the accelerator pedal in the released position.
   - Vehicle speed: The monitor must be enabled in a 15-mph speed window in the range of 0-60 mph. For example, a monitor could be enabled in the range of 5-20 mph or 25-40 mph.
   - Deceleration rate $\geq$ no brake decel on a road with -2% grade & $\leq$ 4mph/sec
   - Engine Coolant temperature (ECT): The manufacturer may specify a minimum ECT to enable cruise monitors, however, the required temperature may not be greater than 70°C. The thermostat monitor shall still be required to verify that the highest enable temperature used by any monitor is reached.
   - Time after engine start > f (ECT@start, IAT). The regulation will allow a manufacturer to specify an appropriate minimum time after engine start (e.g., 4 minutes above 50degF, etc.). This time shall not exceed the time for ECT to reach the thermostat monitor threshold temperature under similar conditions.

4. "Engine-Off" Monitoring Conditions
   Staff is considering allowing manufacturers some freedom in choosing monitoring conditions subject to Executive Officer approval for engine-off leak detection strategies. An engine-off strategy should be designed to detect a malfunction and illuminate the MIL within a week of normal or typical vehicle usage. An engine-off strategy must satisfy the conditions specified below. However, the conditions may be further limited with Executive Officer approval if the manufacturer demonstrates a technical need to do so, and if the manufacturer demonstrates that the monitor will run frequently in-use.
   - The strategy cannot require more than 15 minutes of engine run time to enable monitoring.
   - The strategy cannot require individual soak times greater than 6 hours. An engine-off strategy having a cold start requirement must bypass the cold start requirement if the vehicle has soaked for more than 6 hours.
   - The strategy cannot require more than one refueling event to enable monitoring.
   - The strategy cannot require more than 2 cold starts to enable monitoring.
   - The monitor must be enabled in the range of 15-85% fuel level.
   - The monitor must be enabled in the range of 40-100 degF ambient /intake temperature.

Monitoring Time/Data Accumulation

There are two approaches used to collect monitoring data, continuous data collection and cumulative data collection.

1. Continuous data collection: All the data have to be collected in one continuous interval. If sufficient data are not collected, none of the data are stored or saved for analysis. The following time limits apply to monitors using continuous data collection:
   - Idle monitor: An idle monitor has to complete (i.e., detect a malfunction) in 25 seconds of vehicle operation meeting the idle monitoring conditions.
   - Cruise monitor: A cruise monitor has to complete in 30 seconds of vehicle operation meeting the cruise monitoring conditions. Notwithstanding, if the vehicle operating conditions exceed the monitoring conditions after a cruise monitor is enabled, the monitor must continue to collect data until the vehicle operating conditions have continuously exceeded the monitoring conditions for 5 seconds. If the vehicle operating conditions re-enter the monitoring conditions before 5 seconds have expired, the monitor must continue to collect data, and the data collected while the vehicle was operated outside the monitoring conditions may be filtered from the data set.
   - Decel monitor: A decel monitor has to complete in 8 seconds of vehicle operation meeting the decel monitoring conditions.

2. Cumulative data collection: With this approach, the data are collected in intervals that are typically shorter than the continuous data collection. However, the data are collected for a number of intervals whenever the enable conditions are satisfied until a specified amount of data is collected or accumulated. The following limits apply to monitors using cumulative data collection:
   - Idle monitors: An idle monitor must use intervals less than 15 seconds with a cumulative time of 60 seconds.
   - Cruise monitors: A cruise monitor may use intervals less than 20 seconds with a cumulative time of 200 seconds. Notwithstanding, if the vehicle operating conditions exceed the monitoring conditions after a cruise monitor is enabled, the monitor must continue to collect data until the vehicle operating conditions have continuously exceeded the monitoring conditions for 5 seconds. If the vehicle operating conditions re-enter the monitoring conditions before 5 seconds have expired, the monitor must continue to collect data, and the data collected while the vehicle was operated outside the monitoring conditions may be filtered from the data set.
   - Decel monitor: A decel monitor may use intervals less than 4 seconds with a cumulative time of 16 seconds.

Global Disable Conditions:

- Altitude >8000 feet
- IAT < 20°F
- Battery voltage <11V or >16V
- With Executive Officer approval, a manufacturer may disable a monitor below 40 degrees F ambient/intake temperatures where component freezing may affect monitoring.

Fault Code disablement

With Executive Officer approval, a manufacturer may disable monitors when a relevant pending fault code for another monitor is stored.

Other allowable disable conditions

A manufacturer may disable monitors while an off-board device initiates and executes diagnostic or test routines. With Executive Officer approval, a manufacturer may also disable monitors while another monitor is in progress if the monitor in progress could affect the robustness of the other monitors.

Diagnostic Sequencing

If two or more monitors use the same monitoring conditions or overlapping monitoring conditions (e.g., the catalyst and EGR monitors both run in a speed window of 35-65mph), the manufacturer is not required to run the monitors concurrently. The manufacturer shall specify a priority schedule and document it in the certification application.

For monitors that do not use the same enable conditions, the manufacturer may not require the monitors to run in a certain order or depend on the outcome of other monitors on the same driving cycle. With Executive Officer approval, a manufacturer may, however, hold the results of a monitor as unconfirmed until another relevant monitor runs and completes as long as the other monitor is not required to run and complete on the same driving cycle.

Demonstration Testing

- The manufacturer shall demonstrate that the monitor runs under the standardized conditions. For cruise monitors, the manufacturer shall provide data for the following two operating points: 1) the minimum vehicle speed and minimum load and 2) the maximum vehicle speed and maximum load. This data can be obtained from on-road testing or dynamometer testing. The data shall also show that the monitor satisfies the specified monitoring times.
- Under this proposal, catalyst, O2 sensor, EGR, and AIR are no longer required to run on the FTP. Accordingly a manufacturer is no longer required to demonstrate that the monitoring conditions are encountered during the FTP.
- FTP emission tests are still required to demonstrate that the malfunction criteria have been properly determined.

Certification Requirements

- For each monitor, the manufacturer has to specify which standardized condition is used (i.e., cruise, idle, or decel). Additionally, the manufacturer has to specify all the monitoring conditions (e.g., vehicle speed, engine load, engine speed, ECT, etc…). The certification requirements would remain unchanged for other monitors (e.g., misfire, fuel system and comprehensive components) that are not subject to the standardized monitoring conditions.

Compliance Testing

- To be determined.