

# General Requirements

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- MIL specifications and protocol
- Fault code handling
- Monitoring conditions
- Other terminology/structure



# Malfunction Indicator Light (MIL) Specifications

- Dedicated, single lamp for all OBD faults
  - ISO engine symbol
  - Without text
  - Consistent with NHTSA proposal
- MIL cannot be used for other purposes
  - e.g., maintenance, non-emission faults...



# MIL and Fault Code Logic

- OBD requires statistical fault detection
  - first fault detection sets a pending code
  - fault detection on two consecutive driving cycles requires confirmed (active) code and MIL on
- MIL extinguished when:
  - three consecutive driving cycles occur with no fault detected (monitor runs and passes); or
  - scan tool used to clear codes
- Confirmed (previously active) codes:
  - stay in memory for 40 warm-up cycles after MIL extinguished



# Permanent Fault Code Logic

- “Permanent” code stored in NVRAM for:
  - Any confirmed (active) code currently commanding MIL on
- “Permanent” code erased when:
  - MIL is extinguished by the OBD system (e.g., when the active code changes to a previously active).
  - Cannot be erased by scan tool or battery disconnect
- Helpful feature for roadside/fleet self-inspections
  - Easy to identify vehicles with faults that have not been verified as repaired



# Driving Cycle Definition

- Basic Definition:
  - Engine start, monitor runs once, engine shut-off
- Heavy-duty has unique operator habits
  - Engine may be running on a single start for hours, days, or even weeks at a time
- Alternate definition needed:
  - Monitors required to run only “once-per-driving cycle” would be re-enabled after four hours of continuous engine on operation



# Monitoring Conditions

- Manufacturer-defined for each monitor
  - Must be technically necessary for robust monitoring
  - Must be broad enough to allow frequent in-use operation
- Manufacturer also defines fault mature time (how long a condition has to be present to be called a fault)
  - Again, must be limited to technically necessary for robust monitoring and allow frequent monitoring



# Monitoring Frequency

- System must log in-use frequency of several monitors (“rate-based” or “in-use performance”)
  - Provides objective criteria to determine if a monitor runs “frequently” in-use.
- Only required for the major monitors
  - catalyst, PM filter, adsorber, EGR, exhaust gas sensor, boost pressure



# Monitoring Frequency (cont)

- Requires on-board computer to keep a count of how often each major monitor has run and could have detected a fault
  - The “numerator”
- Requires a separate counter to record how often the vehicle has been operated
  - The “denominator”
- Ratio of the two gives an indication of in-use frequency





# Monitoring Frequency (cont)

- No minimum required ratio in 2010-2012 MY
- Minimum ratio of 0.100 required for 2013+ MY
  - Number will be modified as necessary after more in-use data are gathered



# Malfunction Thresholds

- The level of deterioration or malfunction that needs to be detected
- Defined by an emission level for several major monitors
  - e.g., deteriorated to the point that tailpipe emissions reach a certain level
- Defined by other criteria for most monitors
  - e.g., at control limits, out-of-range



# Emission Thresholds

- Calibrated one fault at a time
  - Start with an engine with properly working emission controls
    - Representative of end of useful life
  - Determine which test cycle will hit emission threshold first
    - Use engineering analysis or run one FTP and one ESC test with a malfunction to see which is higher
  - Implant progressively worse faults of a single component (e.g., increased plugging of EGR system) on the one test cycle



# Emission Thresholds (cont'd)

- Goal: Every engine variant has properly calibrated emission threshold monitors
  - Like tailpipe standards, OBD monitors should be calibrated to the right threshold on every engine
- Interim Step: Reduce workload and in-use liability for not getting it right the first time
  - Calibrate a representative engine variant to meet the emission thresholds
  - Use engineering judgment to carry-over the malfunction thresholds to other similar variants

