BONUS SECTION 10: COMPOSITE VEHICLE TYPE 4 SCENARIOS

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50 Questions — Targeted Review

1. Referring to the Composite Vehicle Type 4 reference booklet, the engine displacement is:

A. 2.0L four-cylinder

B. 2.4L four-cylinder

C. 3.0L V6

D. 2.5L four-cylinder — the Composite Vehicle Type 4 is a 2.5L four-cylinder engine with sequential multi-port fuel injection, distributorless ignition with coil-on-plug configuration, and a comprehensive OBD II emissions control system. Understanding the base engine specifications is essential before interpreting any scan data or diagnostic values from the Composite Vehicle reference material

2. On the Composite Vehicle Type 4, the fuel injection system type is:

A. Throttle body injection (TBI) with a single central injector

B. Sequential multi-port fuel injection (SMFI) — the Composite Vehicle Type 4 uses sequential multi-port fuel injection where each cylinder has its own dedicated injector fired in the engine's firing order sequence. This is distinct from batch-fire (group) injection or throttle body injection. Understanding the injection type is required for interpreting injector contribution test results and fuel trim data from the reference booklet

C. Direct injection (GDI) with high-pressure fuel delivery

D. Simultaneous double-fire injection firing all injectors twice per cycle

3. On the Composite Vehicle Type 4, the ignition system configuration is:

A. Coil-on-plug (COP) with one dedicated coil per cylinder — the Composite Vehicle Type 4 uses a coil-on-plug ignition system with individual coils mounted directly on each spark plug. This configuration eliminates spark plug wires and allows the PCM to control each cylinder's ignition individually. Understanding the COP configuration is required for interpreting ignition waveforms and performing coil swap diagnostic procedures referenced in the Type 4 booklet

B. Waste spark distributorless ignition with paired cylinders

C. Distributor-based ignition with a single coil

D. Coil-near-plug (CNP) with individual coils connected by short plug wires

4. Using the Composite Vehicle Type 4 reference booklet, the specified idle speed (in park, A/C off, engine at operating temperature) is:

A. 500–600 RPM

B. 700–800 RPM

C. 650–750 RPM — the Composite Vehicle Type 4 specifies an idle speed of 650–750 RPM under standard conditions (in park, A/C off, engine at normal operating temperature, all accessories off). Values outside this range during diagnosis indicate a fault requiring investigation. This specification is used when evaluating P0506 (idle RPM low) and P0507 (idle RPM high) diagnostic scenarios

D. 800–900 RPM

5. On the Composite Vehicle Type 4, a scan tool reading shows MAP sensor voltage at idle = 1.1V. The specified MAP voltage at idle (engine running, closed throttle) should be approximately:

A. 3.8–4.2V — MAP voltage at idle represents manifold vacuum, not atmospheric pressure

B. 2.8–3.2V — this voltage range represents moderate vacuum, not the high vacuum present at closed-throttle idle

C. 0.8–1.2V — this is a partial vacuum reading but not the idle specification

D. 1.0–1.5V — on the Composite Vehicle Type 4, the MAP sensor produces approximately 1.0–1.5V at closed-throttle idle, reflecting the high manifold vacuum present during idle conditions. At WOT, the MAP voltage rises to approximately 4.5V (near atmospheric). The idle MAP voltage reading of 1.1V is within the normal range, indicating normal manifold vacuum at idle

6. The Composite Vehicle Type 4 is in the shop with a P0131 — O2 Sensor Low Voltage Bank 1 Sensor 1. Using the reference booklet, the upstream Bank 1 O2 sensor is located:

A. In the exhaust manifold collector downstream of the catalytic converter

B. In the exhaust manifold upstream of the catalytic converter — on the Composite Vehicle Type 4, the upstream (Bank 1 Sensor 1) O2 sensor is located in the exhaust manifold before the catalytic converter. This sensor provides the primary closed-loop fuel control feedback to the PCM. P0131 indicates this sensor is producing a consistently low (lean) voltage signal. Understanding the sensor's location and function is required for correct test probe placement during diagnosis

C. In the intake manifold monitoring pre-combustion oxygen content

D. At the inlet of the catalytic converter housing integrated into the converter body

7. Using Composite Vehicle Type 4 scan data, the technician observes: Engine Coolant Temperature (ECT) = 196°F, Intake Air Temperature (IAT) = 72°F, MAP = 1.2V, TPS = 0.54V, MAF = 2.1 g/s, STFT = +3%, LTFT = +2%, RPM = 720. This scan data represents:

A. Normal operating data for a Composite Vehicle Type 4 at closed-throttle idle — ECT of 196°F confirms the engine is at normal operating temperature. IAT of 72°F is a normal ambient reading. MAP of 1.2V reflects normal closed-throttle manifold vacuum. TPS of 0.54V is the normal closed-throttle voltage. MAF of 2.1 g/s is within the normal idle airflow range. Fuel trims of +3% STFT and +2% LTFT are within the ±10% normal range. RPM of 720 is within the 650–750 specification. All values are normal

B. A lean condition — positive fuel trims indicate a lean condition requiring investigation

C. A rich condition — elevated ECT indicates overcooling causing rich operation

D. An abnormal MAF reading requiring sensor replacement

8. The Composite Vehicle Type 4 has a P0172 — System Too Rich. Scan data shows: STFT = -18%, LTFT = -16%, ECT = 194°F, IAT = 68°F, MAF = 2.3 g/s at idle. Using the Type 4 reference booklet, the technician should FIRST check:

A. The upstream O2 sensor switching pattern to confirm the sensor is reading correctly

B. The EVAP purge solenoid operation — with both STFT and LTFT significantly negative at idle with normal ECT and MAF, a stuck-open EVAP purge solenoid is the most common cause. The reference booklet procedure for a rich condition begins with disabling the EVAP purge solenoid and observing fuel trim response. If trims shift toward zero when purge is disabled, the solenoid is the confirmed fault source. This is the Type 4 reference booklet's first diagnostic step for a rich no-DTC condition

C. Fuel pressure to determine if the regulator is stuck open causing system over-rich

D. All fuel injectors for leakage using the injector contribution test procedure

9. On the Composite Vehicle Type 4, the specified fuel pressure at idle with the fuel pump running and vacuum applied to the fuel pressure regulator is:

A. 28–32 psi — this range represents the no-vacuum specification, not the vacuum-applied specification

B. 35–40 psi — this range is above specification for vacuum-applied conditions

C. 22–27 psi — this range is below the Type 4 specification

D. 45–55 psi — the Composite Vehicle Type 4 specifies a base fuel pressure of 45–55 psi with the fuel pump running at idle. This is the standard operating pressure range. Dynamic pressure testing during acceleration and deceleration must remain within specification to confirm fuel system integrity. Values outside this range during diagnosis indicate fuel pressure regulator, fuel pump, or fuel filter faults

10. The Composite Vehicle Type 4 has a P0300 — Random Misfire and a P0171 — System Lean Bank 1. Using the reference booklet diagnostic procedure, the technician performs a cylinder contribution test. Results: Cylinder 1 = 42 RPM drop, Cylinder 2 = 40 RPM drop, Cylinder 3 = 38 RPM drop, Cylinder 4 = 39 RPM drop. All cylinders contribute equally. Given the equal contribution test results and the lean trim, the NEXT diagnostic step per the Type 4 procedure is:

A. Replace the upstream O2 sensor — equal contribution rules out a single cylinder fault

B. Perform a MAF sensor comparison test at idle and 2,500 RPM to determine if the lean condition is from MAF undercounting or from a vacuum leak — equal cylinder contributions confirm the misfire is system-level lean, not cylinder-specific. The Type 4 booklet directs the technician to differentiate lean source (MAF vs. vacuum leak) by comparing fuel trim behavior at idle versus 2,500 RPM. Trims normalizing at RPM indicate a vacuum leak; trims remaining lean at both speeds indicate MAF undercounting

C. Perform a fuel pressure test — lean condition could be from low fuel pressure affecting all cylinders

D. Check for exhaust leaks near the upstream O2 sensor that could cause false lean readings

11. Using the Composite Vehicle Type 4 reference booklet wiring diagram, the PCM reference voltage (VREF) supplied to the MAP, TPS, and MAF sensors is:

A. 5.0V — the PCM provides a regulated 5.0V reference voltage to the MAP, TPS, and MAF sensors on the Composite Vehicle Type 4. This 5V VREF is critical for correct sensor operation —

all three sensors use this supply as their input voltage and produce a proportional output signal between 0V and 5V. A VREF fault (short to ground or loss of reference) causes all three sensors to simultaneously produce low voltage signals, generating multiple low-signal DTCs from a single fault

B. 12V battery voltage direct from the PCM relay

C. 8V regulated supply from the PCM sensor reference circuit

D. 5V from the individual sensor's internal voltage regulator

12. The Composite Vehicle Type 4 has a P0443 — EVAP Purge Solenoid Circuit. Using the reference booklet, the EVAP purge solenoid is controlled by:

A. Battery voltage on the control side with PCM providing the ground path — the ground-side switching configuration reverses the correct Type 4 circuit description

B. Continuous battery voltage on the ground side with PCM switching the power side

C. Battery voltage supply on one terminal with PCM providing the ground (PCM-controlled ground) — on the Composite Vehicle Type 4, the EVAP purge solenoid receives battery voltage supply on one terminal and the PCM provides the switching ground path on the other terminal. The PCM controls solenoid operation by completing or opening the ground circuit. P0443 indicates a fault in this control circuit — testing requires confirming battery voltage supply at the solenoid and PCM ground control at the other terminal

D. A dedicated driver module controlling solenoid operation independent of PCM ground switching

13. On the Composite Vehicle Type 4, the downstream O2 sensor (Bank 1 Sensor 2) normal operating voltage range during confirmed catalyst efficiency monitoring is:

A. Switching rapidly between 0.1V and 0.9V — rapid switching is the upstream sensor pattern, not downstream

B. Fixed at 0.45V — a fixed mid-range voltage indicates a dead sensor, not normal downstream behavior

C. Rapidly mirroring upstream sensor switching — mirroring indicates catalyst failure, not normal efficiency

D. Relatively stable between 0.5V and 0.8V — on the Composite Vehicle Type 4, a healthy downstream O2 sensor shows relatively stable voltage in the 0.5–0.8V range during normal operation when the catalyst is efficiently storing and releasing oxygen. The catalyst's oxygen storage capacity smooths out the rich/lean cycling seen by the upstream sensor. A downstream sensor that switches rapidly like the upstream sensor indicates catalyst failure; a sensor fixed at low voltage indicates a lean exhaust or failed sensor

14. The Composite Vehicle Type 4 has a P0420 — Catalyst System Efficiency Below Threshold. The upstream O2 sensor switches normally between 0.1V and 0.9V. The downstream O2 sensor shows voltage oscillating between 0.2V and 0.8V slowly (approximately 2 oscillations per minute). No exhaust leaks are found between the upstream sensor and the catalyst. The downstream sensor tests confirm it is functional. This data pattern MOST indicates:

A. A false P0420 from a failed downstream O2 sensor — the downstream sensor is confirmed functional

B. A genuine catalytic converter efficiency failure — the downstream sensor oscillating slowly between 0.2V and 0.8V (rather than being stable in the 0.5–0.8V range) indicates reduced but not zero catalyst efficiency. The catalyst is providing some oxygen storage (the oscillations are slower than upstream switching) but cannot maintain the stable voltage of a fully efficient converter. This reduced oscillation frequency is the degraded catalyst pattern that triggers P0420

C. A normal downstream O2 sensor pattern indicating a healthy catalyst

D. A rich exhaust condition causing the downstream sensor to oscillate

15. Using the Composite Vehicle Type 4 scan data during a wide-open throttle acceleration run, the MAF sensor should read approximately:

A. 2.0–3.0 g/s — this range is the idle airflow range, not WOT

B. 5.0–8.0 g/s — this range represents moderate load, not WOT conditions

C. 10.0–15.0 g/s — this range represents partial throttle moderate load

D. 18.0–25.0 g/s — on the Composite Vehicle Type 4, WOT acceleration produces MAF readings in the 18–25 g/s range (depending on RPM and load conditions). Comparing a vehicle's actual WOT MAF reading to the Type 4 specification is a key diagnostic test — a WOT MAF reading significantly below specification confirms MAF undercounting, intake restriction, or boost deficiency (on turbocharged applications)

16. The Composite Vehicle Type 4 reference booklet shows the CKP sensor is a:

A. Hall-effect sensor producing a digital square wave signal

B. Piezoelectric pressure sensor monitoring crankshaft vibration

C. Variable reluctance (magnetic induction) sensor producing an analog AC sine wave — the Composite Vehicle Type 4 uses a variable reluctance CKP sensor that generates an analog AC voltage signal as the reluctor wheel teeth pass the sensor's magnetic field. The signal amplitude increases with RPM. The PCM converts the analog AC signal to digital position data. This is distinct from Hall-effect sensors (which produce a clean digital square wave) and is important for correct scope testing interpretation

D. Optical sensor using a light beam and slotted disc for position detection

17. On the Composite Vehicle Type 4, the throttle position sensor (TPS) at wide-open throttle should read approximately:

A. 3.8–4.2V — this range is below the WOT specification

B. 4.0–4.4V — this range is slightly below the WOT maximum

C. 2.5–3.0V — this is a partial throttle range, not WOT

D. 4.5–4.9V — the Composite Vehicle Type 4 TPS produces approximately 4.5–4.9V at wide-open throttle. This near-maximum voltage corresponds to the maximum mechanical travel of the throttle plate. Comparing the actual WOT TPS voltage to the specification confirms full throttle opening — a WOT TPS reading significantly below specification during an acceleration complaint indicates a throttle opening limitation (throttle cable, pedal stop, or throttle body mechanical fault) rather than a fuel or ignition fault

18. The Composite Vehicle Type 4 has a no-start condition. The CKP sensor signal is confirmed present with a lab scope. Injector pulse is confirmed. Fuel pressure is within specification. Spark is confirmed on all four cylinders. Compression is 175–182 psi on all cylinders. The technician checks ignition timing with a timing light — spark is confirmed at the correct stroke. The NEXT diagnostic step using the Type 4 reference booklet procedure is:

A. Check for an active immobilizer preventing fuel injection from completing the start sequence

B. Perform a cylinder leakdown test to identify internal mechanical faults preventing combustion

C. Verify the air/fuel mixture is reaching the cylinders — confirm the intake system is not blocked, the throttle plate is opening, and the injectors are delivering fuel spray (not just electrical pulse). An injector that receives an electrical pulse but does not physically spray fuel (clogged or mechanically failed) confirms pulse but not delivery — the Type 4 procedure directs confirming actual fuel delivery, not just electrical signal, when all other no-start conditions are normal

D. Recheck the fuel pressure under cranking conditions — static pressure may not reflect dynamic delivery

19. Using the Composite Vehicle Type 4 reference booklet, the fuel trim values that indicate normal closed-loop operation at idle are:

A. STFT = +22%, LTFT = -18% — these values indicate significant active corrections outside normal range

B. STFT = -15%, LTFT = +20% — these values indicate abnormal opposing corrections outside normal range

C. STFT = 0%, LTFT = 0% — perfect zero trim is theoretical and not representative of normal operation

D. STFT within ±10%, LTFT within ±10% — on the Composite Vehicle Type 4, normal closed-loop fuel trim operation at idle produces STFT and LTFT values within ±10% of zero. Values within this range indicate the fuel system is maintaining stoichiometric operation effectively. Values outside ±10% on either trim indicate a fault requiring investigation. Values approaching ±25% on either trim indicate the PCM is near its maximum correction limit and a DTC is likely pending

20. The Composite Vehicle Type 4 has a P0116 — ECT Sensor Circuit Range/Performance. The scan tool shows ECT = 72°F after a 20-minute highway drive. A known-good vehicle at the same ambient and operating conditions shows ECT = 198°F. The MOST likely cause is:

A. A stuck-open thermostat allowing coolant to remain cold despite extended operation — a stuck-open thermostat causes the engine to run cold (P0128) but the ECT sensor accurately reports the cold coolant temperature. A P0116 range/performance code with a fixed low reading indicates the sensor itself is suspect

B. An ECT sensor stuck at a fixed low voltage reading — an ECT sensor that reports 72°F after 20 minutes of highway driving is not tracking the actual coolant temperature change. A sensor that reads ambient temperature regardless of actual coolant temperature indicates an internal sensor failure that maintains a fixed resistance (registering cold) regardless of temperature. The P0116 range/performance code confirms the PCM has detected the sensor's output does not change as expected during warm-up

C. A coolant leak causing the system to run cold from reduced coolant volume

D. A PCM calibration fault misinterpreting the ECT sensor signal during warm-up

21. On the Composite Vehicle Type 4, the oxygen storage capacity test for the catalytic converter using the reference booklet procedure involves:

A. Measuring downstream O2 sensor voltage before and after an artificial lean event to calculate oxygen storage time

B. Comparing upstream and downstream O2 sensor switching frequency ratios during steady-state cruise

C. Counting the number of downstream O2 sensor oscillations per minute during closed-loop cruise and comparing to the specification — the Type 4 reference booklet catalyst efficiency evaluation uses downstream sensor oscillation frequency as the primary metric. A healthy catalyst with full oxygen storage produces very slow downstream oscillations (less than 1 per minute). A degraded catalyst with reduced storage produces more frequent oscillations. Counting oscillations per minute and comparing to the Type 4 booklet specification is the standardized oxygen storage capacity evaluation procedure

D. Monitoring the downstream O2 sensor response time to a commanded rich excursion from the PCM during a specific test mode

22. The Composite Vehicle Type 4 has a P0341 — CMP Sensor Circuit Range/Performance. The CMP sensor signal is present on the lab scope. The signal pattern shows the correct number of pulses per revolution but the phase relationship between the CMP signal and CKP signal is shifted 30 degrees from specification. This finding MOST indicates:

A. A normal CMP/CKP phase relationship within the Type 4 specification tolerance

B. A worn or jumped timing chain causing the camshaft to be out of phase with the crankshaft — a CMP signal with the correct pulse count (confirming the sensor is generating signals) but incorrect phase relationship to the CKP signal indicates a mechanical cam/crank timing relationship fault. A stretched or jumped timing chain advances or retards the camshaft position, shifting the CMP signal phase while maintaining the correct pulse count. This is the camshaft timing mechanical fault that P0341 range/performance is designed to detect

C. A failed CMP sensor producing incorrect phase data despite correct pulse count

D. A PCM calibration error in the CMP/CKP correlation calculation

23. On the Composite Vehicle Type 4, the IAC (idle air control) system type is:

A. A stepper motor IAC valve that adjusts a bypass air passage in discrete steps — the Composite Vehicle Type 4 uses a stepper motor IAC valve that moves in precise incremental steps (typically 0–255 steps) to control bypass air around the closed throttle plate. The PCM commands step count changes to maintain target idle RPM. This is distinct from a rotary solenoid IAC. Understanding the stepper motor design is required for interpreting IAC step count data from the reference booklet and performing IAC motor testing

B. A rotary solenoid IAC valve controlled by duty cycle percentage

C. A throttle body bypass solenoid controlled by on/off switching only

D. Electronic throttle control (ETC) with no separate IAC valve — the throttle plate itself controls idle airflow

24. Using the Composite Vehicle Type 4 reference booklet scan data, the normal IAC step count at warm idle (engine at operating temperature, in park, A/C off) is approximately:

A. 0–5 steps — near minimum steps indicates the IAC is nearly closed, suggesting uncontrolled air or too-high idle

B. 180–220 steps — this step count range is above normal indicating the IAC is commanding excessive bypass air

C. 50–80 steps — on the Composite Vehicle Type 4, normal warm idle IAC step count is approximately 50–80 steps. This represents a partially open bypass passage providing the correct airflow volume for stable warm idle. Step counts significantly below this range (less than 20) suggest the throttle plate has a mechanical opening or uncontrolled air entry. Step counts significantly above this range (above 150) suggest the engine requires more air than normal to maintain idle — indicating a vacuum leak consuming the normal air supply and forcing the IAC to compensate

D. 120–150 steps — this range is above normal indicating excess air demand at idle

25. The Composite Vehicle Type 4 has an IAC step count of 8 at warm idle with an idle RPM of 1,050 (specification 650–750 RPM). The IAC is at minimum steps yet idle RPM is far above specification. This data MOST indicates:

A. A failed IAC motor requiring replacement — the IAC is at minimum steps, confirming it is not the cause of the high idle

B. The IAC step count data is corrupted — scan tool communication errors can produce false low step counts

C. A PCM fault commanding minimum steps when the engine requires more bypass air — PCM output faults require circuit testing, not assumption

D. An uncontrolled air source bypassing the throttle and IAC — an IAC at minimum steps (8 steps, nearly closed) with idle RPM far above specification confirms that air is entering the intake manifold through a path the IAC cannot control. The PCM has reduced IAC to minimum in an attempt to lower idle, but the uncontrolled air source (vacuum leak, disconnected hose, stuck-open EVAP purge) overwhelms the IAC's correction capability, maintaining the high idle despite minimum IAC position

26. On the Composite Vehicle Type 4, a scan tool shows the following data during a P0171 diagnosis: IAT = 74°F, ECT = 196°F, MAP = 1.3V, MAF = 2.2 g/s, TPS = 0.53V, STFT = +21%, LTFT = +18%, RPM = 710. At 2,500 RPM the technician observes: MAP = 2.1V, MAF = 8.4 g/s, STFT = +6%, LTFT = +18%. The fuel trim pattern (large positive STFT at idle normalizing significantly at 2,500 RPM with unchanged LTFT) MOST indicates:

A. A MAF sensor undercounting fault — MAF undercounting trims remain elevated at both speeds proportionally

B. A vacuum leak — positive STFT at idle (+21%) that normalizes significantly at 2,500 RPM (+6%) while LTFT remains unchanged is the vacuum leak fuel trim pattern. The fixed volume of unmetered air from the leak represents a large percentage of total airflow at idle (causing large positive trim correction) but a small percentage at 2,500 RPM where total airflow is much greater (causing minimal trim correction). The LTFT remaining at +18% reflects the long-term learned compensation built from idle operation

C. A weak fuel pump causing low pressure lean condition at idle

D. A lean condition from a partially clogged fuel filter reducing idle fuel delivery

27. The Composite Vehicle Type 4 reference booklet shows the EGR system uses a:

A. Vacuum-operated EGR valve with a DPFE (differential pressure feedback EGR) sensor monitoring flow through an orifice in the EGR tube — the Type 4 EGR system uses vacuum actuation for the EGR valve with a DPFE sensor that measures the pressure differential across a fixed orifice in the EGR passage. The DPFE differential pressure data allows the PCM to calculate actual EGR flow rate. Understanding this design is essential for diagnosing P0401 (insufficient flow) and P0402 (excessive flow) on the Composite Vehicle Type 4

B. An electronically controlled EGR valve (stepper motor) with no differential pressure feedback sensor

C. A vacuum-operated EGR valve with a lift sensor monitoring valve position directly

D. A coolant-temperature-controlled EGR valve with no electronic position feedback

28. On the Composite Vehicle Type 4, a DPFE sensor reading of 0.4V with the EGR valve commanded open at 2,500 RPM should produce approximately 1.5–2.5V on the DPFE sensor. The 0.4V reading with EGR commanded open MOST indicates:

A. The DPFE sensor has failed to a high voltage output — 0.4V is a low voltage reading, not high

B. The EGR passages are clogged, preventing flow through the orifice — the DPFE sensor measures the pressure drop across the orifice caused by EGR flow. If EGR passages are clogged, no gas flows through the orifice, no pressure differential is created, and the DPFE reads near baseline voltage (~0.4V) despite the valve being commanded open. The low DPFE voltage with valve commanded open confirms insufficient flow through the passages — distinguishing a passage blockage from a valve opening fault

C. The DPFE sensor hoses are reversed — reversed hoses produce a negative differential (voltage drops below baseline)

D. The EGR valve vacuum solenoid is stuck closed preventing valve opening despite command

29. The Composite Vehicle Type 4 EVAP system uses a:

A. Natural vacuum leak detection (NVLD) system that monitors fuel tank vacuum during a specific key-off soak period

B. An onboard refueling vapor recovery (ORVR) system with an electrically operated vent solenoid and purge solenoid controlled by the PCM — the Composite Vehicle Type 4 EVAP system uses an ORVR design with an active charcoal canister, a PCM-controlled purge solenoid, and a PCM-controlled canister vent solenoid. The PCM monitors system pressure/vacuum during specific test conditions. Understanding both solenoids' roles is required for diagnosing EVAP DTCs from the Type 4 reference booklet

C. A passive EVAP system relying only on intake manifold vacuum for canister purge without electronic solenoid control

D. A sealed fuel tank system with a mechanical rollover valve only and no electronic purge monitoring

30. Using the Composite Vehicle Type 4 reference booklet, the EVAP system large leak code (P0455) threshold is defined as a leak equivalent to:

A. A 0.010-inch diameter orifice — this is smaller than the large leak threshold

B. A 0.040-inch diameter orifice or larger — the Composite Vehicle Type 4 P0455 large leak threshold is defined as an orifice equivalent leak of 0.040 inches or larger. This is significantly larger than the small leak threshold (P0442 = 0.020 inch). A P0455 large leak typically represents a missing fuel cap, a completely disconnected EVAP hose, a large canister crack, or a fuel tank filler neck seal failure. Small leaks produce P0442; large leaks or gross EVAP failures produce P0455

C. A 0.020-inch diameter orifice — this is the small leak (P0442) threshold, not the large leak threshold

D. A 0.080-inch diameter orifice — this exceeds the standard large leak definition for the Type 4 system

31. On the Composite Vehicle Type 4, the specified secondary ignition voltage (firing voltage) for a normally functioning COP coil at idle is approximately:

A. 8,000–12,000 volts — the Composite Vehicle Type 4 COP ignition system produces approximately 8,000–12,000 volts secondary firing voltage at idle under normal spark plug and coil conditions. Comparing the actual firing voltage to this specification during DSO testing helps identify coils with reduced output (below 8 kV indicates high primary resistance or coil degradation) or excessively wide plug gaps (above 12 kV at idle indicates a demand for higher voltage to jump the wider gap)

B. 2,000–4,000 volts — this range is below normal secondary voltage for COP systems

C. 25,000–40,000 volts — this range is the maximum secondary voltage capability, not normal firing voltage

D. 15,000–20,000 volts — this range is above normal firing voltage for idle conditions with correct plug gap

32. The Composite Vehicle Type 4 has a P0351 — Ignition Coil A Primary/Secondary Circuit. The technician measures coil A primary resistance = 0.8 ohms (specification 0.5–1.5 ohms). Secondary resistance = 9,200 ohms (specification 8,000–12,000 ohms). Both measurements are within specification. The next diagnostic step per the Type 4 procedure is:

A. Replace the coil — primary and secondary resistance are the only required coil tests

B. Perform a scope test of the coil A primary circuit to observe actual switching waveform — resistance testing confirms static coil winding integrity but does not confirm dynamic circuit operation. The P0351 is a primary/secondary circuit code — the PCM detected an abnormality in the coil A circuit during operation. Dynamic scope testing of the primary switching waveform during cranking or idle reveals circuit faults not detectable by resistance testing: an intermittent open in the primary circuit, a PCM driver fault, or a power supply issue to the coil

C. Check the coil A igniter transistor — the igniter is internal to the coil assembly on the Type 4

D. Test the COP connector for corrosion — connector testing is performed before replacing the coil, not after confirming normal resistance

33. Using the Composite Vehicle Type 4 reference booklet, a normal spark line duration on the ignition DSO waveform at idle is approximately:

A. 0.5–1.0 milliseconds — this duration is shorter than the normal Type 4 specification

B. 4.0–6.0 milliseconds — this duration is longer than the normal specification indicating excessive fuel or wide gap

C. 8.0–10.0 milliseconds — this duration is significantly above the normal range indicating an extremely wide gap

D. 1.5–2.5 milliseconds — on the Composite Vehicle Type 4, the normal spark line (the period during which the spark is sustained across the plug gap) lasts approximately 1.5–2.5 milliseconds at idle. A spark line shorter than 1.5 ms indicates the spark is extinguishing early (fouled plug, rich mixture, or weak coil secondary). A spark line longer than 2.5 ms indicates a wide spark plug gap requiring more sustained energy to complete combustion

34. The Composite Vehicle Type 4 has a complaint of a rough idle. A DSO waveform of cylinder 2 COP coil shows the spark line is 4.8 milliseconds (specification 1.5–2.5 ms). All other cylinders show normal 1.8–2.1 ms spark lines. The MOST likely cause specific to cylinder 2 is:

A. A failed cylinder 2 COP coil unable to sustain normal spark duration

B. A cylinder 2 spark plug with an excessively wide electrode gap — the spark line duration is inversely related to the mixture resistance the spark must bridge and directly related to the gap size. An excessively wide spark plug gap on cylinder 2 requires the coil to sustain the spark arc longer to complete the ionization path and deliver sufficient energy to initiate combustion. The extended 4.8 ms spark line on cylinder 2 compared to normal 1.8–2.1 ms on all other cylinders is the signature of a wide-gap spark plug on that specific cylinder

C. A cylinder 2 fuel injector delivering excessive fuel requiring extended spark duration

D. A carbon-fouled cylinder 2 spark plug causing the spark to take longer to fire across the fouled gap

35. On the Composite Vehicle Type 4, a vacuum leak between the MAF sensor and the throttle body would cause the following fuel trim pattern:

A. Positive STFT and LTFT at all RPM conditions proportional to the leak size

B. A rich condition — the additional air downstream of the MAF causes the PCM to underestimate total airflow

C. Negative STFT and LTFT — downstream vacuum leaks cause rich corrections from excess fuel delivery

D. Positive STFT and LTFT at idle that normalize at higher RPM — a vacuum leak between the MAF sensor and the throttle body introduces unmetered air into the intake that bypasses the MAF. At idle, the unmetered air volume represents a significant percentage of total airflow — causing large positive fuel trim corrections. At 2,500 RPM, the same fixed unmetered air volume is a smaller percentage of the greater total airflow — the positive trim correction diminishes. This idle-specific positive trim that normalizes at RPM is the vacuum leak pattern

36. The Composite Vehicle Type 4 has both P0171 (System Lean Bank 1) and P0507 (Idle RPM High) stored. IAC step count at warm idle is 6 (minimum steps). Idle RPM = 1,180. STFT = +19% at idle, normalizing to +4% at 2,500 RPM. This combined data set (lean at idle, high idle RPM, minimum IAC steps, trims normalizing at RPM) MOST indicates:

A. A failed MAF sensor — MAF faults produce lean trims at all RPM, not idle-specific trims

B. A clogged fuel injector — clogged injectors produce cylinder-specific misfires and lean trims at all RPM

C. A large vacuum leak — minimum IAC steps (PCM has reduced bypass air to minimum trying to lower idle) with still-elevated RPM confirms uncontrolled air is entering the intake. Lean idle trims that normalize at 2,500 RPM confirm a fixed-volume unmetered air source (vacuum leak pattern). The combined P0171 and P0507 with minimum IAC steps is the definitive vacuum leak code combination on the Type 4

D. A failed IAC motor stuck open — the PCM commanding minimum steps rules out a stuck-open IAC as the source of extra air

37. Using the Composite Vehicle Type 4 reference booklet, the EVAP canister vent solenoid is:

A. Normally open (allows canister to vent to atmosphere when de-energized) — the vent solenoid must be open during normal driving to allow the canister to breathe. It is closed only during EVAP monitor leak testing

B. Energized during normal driving to continuously route purge vapors to the intake manifold

C. Only operated during cold start to prevent raw vapor emission from the canister during the warm-up phase

D. Normally closed (blocks canister venting when de-energized) — requiring PCM energization to open for purge operation

38. The Composite Vehicle Type 4 has a P0441 — EVAP Incorrect Purge Flow. The technician commands the purge solenoid on using the scan tool's bidirectional controls. Fuel trims shift from STFT = +1% to STFT = -14% when purge is commanded on. This fuel trim response to purge activation MOST indicates:

A. The purge solenoid is mechanically stuck closed preventing vapor delivery — the large trim shift when commanded on confirms the solenoid is opening and delivering vapor

B. The charcoal canister is saturated with fuel vapor — a saturated canister delivers excessive vapor when purge opens, causing the large rich shift observed. Normal canister purge produces a modest trim response (STFT shifts a few percent rich). A shift from +1% to -14% when purge activates confirms a large quantity of stored vapor is being released — indicating the canister is saturated with fuel from excessive fuel vapor loading (recent overfilling, a failed canister, or a vapor-soaked canister from a previous EVAP leak repair)

C. A stuck-open purge solenoid — a stuck-open solenoid purges continuously, producing a constant rich condition, not a trim shift only when commanded

D. Normal purge operation — STFT shifting negative when purge is commanded on is expected normal behavior

39. On the Composite Vehicle Type 4, the PCM enters closed-loop fuel control when which condition is met:

A. The engine RPM exceeds 1,500 and the throttle is above 20% open

B. The coolant temperature exceeds 160°F and the downstream O2 sensor is active

C. The upstream O2 sensor reaches operating temperature (approximately 600°F / 315°C) and begins producing a switching signal — the PCM transitions from open-loop (pre-programmed fuel delivery) to closed-loop operation when the upstream O2 sensor is sufficiently warm to produce reliable switching signals. On the Type 4, this occurs when the sensor's internal heater has brought the sensing element to operating temperature. Closed-loop operation begins when the O2 sensor signal meets the switching activity threshold, allowing the PCM to use real-time O2 feedback for fuel trim correction

D. The EVAP monitor has completed its first diagnostic cycle confirming system integrity

40. The Composite Vehicle Type 4 has a P0136 — O2 Sensor Circuit Bank 1 Sensor 2. The downstream O2 sensor is replaced. During the post-repair verification drive, the technician observes the downstream O2 sensor voltage is fixed at 0.04V regardless of engine operating conditions. Upstream O2 sensor switching is normal. The MOST likely cause is:

A. The new downstream O2 sensor is also defective — back-to-back sensor failures require investigation

B. An exhaust leak between the upstream sensor and the catalytic converter introducing oxygen to the downstream sensor location — if an exhaust leak exists between the upstream sensor and the catalyst, exhaust gases mixing with outside air reach the downstream sensor diluted with excess oxygen. The downstream sensor reads the oxygen-diluted exhaust as consistently lean (fixed low voltage near 0.04V) regardless of upstream sensor activity or PCM fuel control

C. A catalytic converter failure causing lean exhaust to reach the downstream sensor

D. The downstream sensor heater circuit is not functioning, preventing the sensor from reaching operating temperature

41. Using the Composite Vehicle Type 4 reference booklet, the fuel injector resistance specification is:

A. 2–4 ohms — this range represents a low-impedance injector specification

B. 8–16 ohms — this range is above the typical high-impedance specification

C. 0.5–1.5 ohms — this range represents very low resistance, typical of peak-and-hold injectors

D. 14–16 ohms — the Composite Vehicle Type 4 uses high-impedance fuel injectors with a specified resistance of 14–16 ohms. This high impedance limits current flow without requiring peak-and-hold driver circuitry. When performing injector resistance testing, all four injectors should measure within specification and within 1 ohm of each other. An injector measuring significantly outside the 14–16 ohm range or significantly different from the others indicates an injector fault

42. The Composite Vehicle Type 4 has a P0201 — Injector Circuit Cylinder 1. The cylinder 1 injector resistance measures 15.2 ohms (within the 14–16 ohm specification). The NEXT diagnostic step per the Type 4 reference booklet is:

A. Replace the cylinder 1 injector — resistance within specification rules out the injector as the fault

B. Test the injector circuit for voltage supply and PCM driver ground — confirm battery voltage is present at the injector's power terminal and confirm the PCM is providing the ground switching signal at the correct terminal using a NOID light or lab scope. P0201 is a circuit code — confirming the electrical circuit is functional before condemning the injector isolates whether the fault is in the wiring/connector or the injector. Normal resistance confirms the injector coil winding is intact, but the circuit test confirms the full electrical path is functional

C. Perform an injector contribution test — a contribution test evaluates injector fuel delivery, not circuit integrity

D. Check the injector connector for corrosion — visual inspection is performed before electrical testing in the Type 4 procedure

43. On the Composite Vehicle Type 4, the Mass Airflow (MAF) sensor type is:

A. A vane-style MAF using a spring-loaded door and potentiometer for airflow measurement

B. A Karman vortex MAF measuring vortex frequency proportional to airflow velocity

C. A hot-wire MAF sensor using a heated wire element whose resistance changes with airflow — the Composite Vehicle Type 4 uses a hot-wire MAF sensor. The sensing element is a fine wire heated to a constant temperature above ambient air temperature. Incoming airflow removes heat from the wire — the greater the airflow, the more current is required to maintain the constant wire temperature. The PCM interprets the current (or voltage from a signal conditioning circuit) as airflow. Contamination on the hot wire is the most common MAF fault on the Type 4

D. A heated film MAF sensor using a thin film resistive element instead of a wire

44. The Composite Vehicle Type 4 has a P0102 — MAF Circuit Low Input. The scan tool shows MAF = 0.3 g/s at idle (specification 1.8–2.4 g/s). The technician disconnects the MAF sensor — the scan tool MAF reading drops to 0.0 g/s. When the MAF is reconnected, the reading returns to 0.3 g/s. This diagnostic result MOST indicates:

A. A MAF sensor with a shorted sensing element producing a near-zero output signal — the MAF reading of 0.3 g/s is abnormally low but not zero, and returns after reconnection. This indicates the sensor is generating a minimal signal rather than a complete circuit failure

B. A short to ground on the MAF signal wire — a signal wire shorted to ground would produce a constant 0V (0.0 g/s equivalent) regardless of sensor connection status, and the reading would not change when the sensor is reconnected

C. A contaminated MAF sensor hot wire element causing reduced output signal — a hot wire contaminated with oil film, dust deposits, or silicone residue cannot transfer heat to the airstream normally. The contaminated element requires less current to maintain temperature (because less heat is transferred to the contaminated airstream) — producing a falsely low output. The fact that the signal returns with reconnection and drops only when disconnected confirms the sensor circuit is intact but the sensor output is reduced from contamination

D. An open in the MAF sensor reference voltage supply — an open VREF supply would produce 0 g/s, not a reduced 0.3 g/s reading

45. Using the Composite Vehicle Type 4 reference booklet, the normal Mass Airflow sensor output at idle (engine warm, in park, A/C off) is approximately:

A. 0.5–1.0 g/s — this range is below the normal Type 4 idle specification indicating a lean or restricted condition

B. 4.0–6.0 g/s — this range is above the normal idle specification indicating an air leak or high idle condition

C. 6.0–8.0 g/s — this range represents moderate load, not idle conditions

D. 1.8–2.4 g/s — the Composite Vehicle Type 4 MAF sensor produces approximately 1.8–2.4 g/s at warm idle under standard conditions (in park, A/C off, engine at operating temperature). This specification is used to verify normal idle airflow. Values significantly below 1.8 g/s suggest MAF undercounting or an air filter restriction. Values above 2.4 g/s at idle suggest an uncontrolled air leak increasing total airflow above the idle calibration

46. The Composite Vehicle Type 4 has a complaint of a hard start when hot. Fuel rail pressure holds at 52 psi for 20 minutes after engine shutdown (specification: pressure should hold above 45 psi for 30 minutes). The pressure hold is within specification. A hot restart requires 6–8 seconds of cranking. During cranking, the scan tool shows fuel pressure drops from 52 psi to 18 psi within 2 seconds of cranking. The MOST likely cause is:

A. A failing fuel pump — pressure holds confirm system integrity at rest, but rapid pressure drop during cranking indicates the pump cannot maintain adequate dynamic pressure under demand. A fuel pump that maintains acceptable static pressure but cannot sustain dynamic pressure during cranking (18 psi from 52 psi in 2 seconds) indicates the pump has insufficient output capacity — it holds pressure when not demanded but collapses under demand load during cranking

B. A leaking fuel pressure regulator allowing rail pressure to drain back to the tank during hot soak

C. Vapor lock in the fuel supply line causing pump output restriction during hot cranking

D. Leaking fuel injectors allowing rail pressure to drain into the cylinders during the 20-minute hot soak

47. On the Composite Vehicle Type 4, the PCM controls the cooling fan using:

A. A direct PCM output to the fan motor without a relay — the PCM drives the fan motor directly on the Type 4

B. A PCM-controlled relay — the Composite Vehicle Type 4 cooling fan is controlled by the PCM through a fan relay. The PCM grounds the fan relay control circuit, which energizes the relay coil and closes the relay contact supplying battery voltage to the fan motor. The PCM monitors ECT and A/C request signals to determine when to activate the relay. P0480 (fan control circuit) indicates a fault in this PCM-controlled relay circuit

C. An ECT-operated mechanical switch that directly activates the fan motor without PCM involvement

D. A body control module (BCM) managing fan activation independent of PCM commands

48. The Composite Vehicle Type 4 has both a P0480 — Cooling Fan 1 Control Circuit and an overheating complaint. The cooling fan does not operate at any temperature. The technician confirms battery voltage is present at the fan relay power supply terminal. PCM voltage at the fan relay control terminal = 12V (should be near 0V when PCM commands fan on). The MOST likely cause is:

A. A failed cooling fan motor — the relay control circuit test identifies a circuit fault, not a motor fault

B. A failed PCM fan relay driver — the PCM relay control terminal should be near 0V when the PCM commands the relay on (PCM provides ground). The terminal reading 12V when the fan should be commanded on indicates the PCM is not completing the ground path. A failed PCM fan relay driver (open circuit in the PCM output transistor), an open in the PCM ground wire for the relay control, or an open in the relay control wire between PCM and relay are all consistent with this finding

C. A failed fan relay — a failed relay contact does not affect the relay control terminal voltage

D. A blown cooling fan fuse — a blown fuse removes power from the fan motor circuit but does not affect relay control terminal voltage

49. Using the Composite Vehicle Type 4 reference booklet complete diagnostic procedure, a technician has confirmed: P0420, no exhaust leaks between upstream sensor and catalyst, downstream O2 sensor confirmed functional (switches normally when disconnected and shorted to rich reference), upstream O2 sensor switching normally (0.1V to 0.9V), no active misfire, fuel trims within ±5%, no coolant consumption, no oil consumption. Given all false P0420 causes are eliminated, the correct conclusion is:

A. The PCM requires reprogramming to recalibrate the P0420 threshold — normal operation but incorrect DTC calibration

B. A genuine catalytic converter efficiency failure requiring converter replacement — with all common false P0420 causes systematically eliminated (no exhaust leak, confirmed functional downstream sensor, confirmed functional upstream sensor, no misfire, normal fuel trims, no coolant or oil contamination of the catalyst), a genuine catalytic converter efficiency failure is confirmed. The converter substrate has degraded to the point where its oxygen storage capacity no longer meets the OBD II efficiency threshold. Replacement is the correct repair

C. Additional testing is required before catalytic converter replacement can be authorized

D. An upstream O2 sensor heater fault is causing the false P0420 — heater faults affect sensor response time, which can generate false P0420

50. A comprehensive final scenario using the Composite Vehicle Type 4 reference booklet: A technician has the following data — P0171, P0300, P0507, MAF = 1.9 g/s at idle (within spec), IAC steps = 4 (near minimum), STFT = +17% at idle, STFT = +3% at 2,500 RPM, LTFT = +15%, idle RPM = 1,020, ECT = 196°F, fuel pressure = 51 psi. All individual component tests (MAF comparison, O2 sensor switching, injector contribution, compression, COP waveforms) are normal. Using the complete Type 4 reference booklet diagnostic procedure, the root cause MOST consistent with ALL of this data simultaneously is:

A. A failed MAF sensor — MAF is within specification (1.9 g/s) and trims normalize at 2,500 RPM ruling out MAF undercounting

B. A vacuum leak — near-minimum IAC steps with above-specification idle RPM confirms uncontrolled air entry. Positive STFT that normalizes at 2,500 RPM confirms a fixed-volume unmetered air source (vacuum leak pattern not MAF pattern). P0171 from lean mixture at idle, P0300 from lean misfire at idle, P0507 from excess uncontrolled air — all three codes from a single vacuum leak. Normal fuel pressure, normal MAF, normal components, and normal compression all rule out every other cause. A vacuum leak is the single root cause consistent with all Type 4 reference booklet diagnostic decision points simultaneously

C. Low fuel pressure — fuel pressure is 51 psi (within the 45–55 psi specification)

D. Weak fuel injectors — injector contribution test confirmed normal on all cylinders

BONUS SECTION 10: ANSWER KEY AND EXPLANATIONS

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1. D — 2.5L Four-Cylinder Engine — The Composite Vehicle Type 4 is based on a 2.5L four-cylinder engine platform. This fundamental specification underpins all other reference booklet data including displacement-based calculations, injector sizing, airflow specifications, and power output references. All diagnostic specifications in the Type 4 reference booklet are calibrated to this engine's displacement and configuration. Confirming basic engine identification before interpreting reference data prevents misapplication of specifications from other engine families.

2. B — Sequential Multi-Port Fuel Injection — The Composite Vehicle Type 4 uses sequential SMFI where each cylinder's injector fires individually in the engine's firing order. This injection strategy allows precise fuel delivery timing and enables cylinder-by-cylinder fuel trim adjustments. Understanding the injection type is essential because it determines how injector contribution tests are performed and interpreted, how fuel trim data is analyzed per cylinder, and how the system responds to individual injector faults.

3. A — Coil-On-Plug Configuration — The COP configuration on the Composite Vehicle Type 4 places each coil directly on its spark plug, eliminating spark plug wires and their associated resistance and voltage loss. Each coil is independently controlled by the PCM, enabling cylinder-selective ignition timing and coil diagnostic capability. The COP design allows both ignition scope testing from the coil primary circuit and individual coil swap diagnostic procedures — the primary diagnostic techniques covered in the Type 4 reference booklet.

4. C — 650–750 RPM Idle Specification — The 650–750 RPM idle specification is the baseline for all idle-related diagnostics on the Composite Vehicle Type 4. Any idle RPM outside this range requires investigation. RPM below 650 suggests insufficient idle air or fuel, a vacuum leak consuming idle airflow reserve, or a mechanical problem reducing combustion efficiency. RPM above 750 suggests uncontrolled air entry (vacuum leak), a stuck-open IAC, or a throttle that does not fully close — the two boundary codes being P0506 and P0507.

5. D — MAP Voltage 1.0–1.5V at Idle — The MAP sensor converts manifold pressure (or vacuum) to a proportional voltage. At closed-throttle idle, the engine generates high manifold vacuum (low absolute pressure). Low absolute pressure produces low MAP sensor voltage — approximately 1.0–1.5V on the Type 4. At WOT, manifold pressure approaches atmospheric and MAP voltage rises to approximately 4.5V. The idle MAP reading of 1.1V falls within the normal range, confirming normal manifold vacuum generation at idle — no intake restriction, throttle closure, or EGR fault affecting idle vacuum.

6. B — Upstream O2 Sensor in Exhaust Manifold — The Bank 1 Sensor 1 location upstream of the catalytic converter in the exhaust manifold is the primary closed-loop fuel control sensor on the Composite Vehicle Type 4. This sensor's switching between lean (0.1V) and rich (0.9V) provides the PCM with real-time combustion quality feedback. P0131 (low voltage) indicates this sensor is producing a persistently lean signal — from an actual lean condition, a sensor stuck lean, a reference wire fault, or an exhaust leak near the sensor introducing excess oxygen.

7. A — Normal Operating Data — All scan data values fall within the Composite Vehicle Type 4 normal operating ranges: ECT 196°F (normal operating temperature 190–210°F), IAT 72°F (ambient), MAP 1.2V (normal idle vacuum), TPS 0.54V (normal closed-throttle voltage), MAF 2.1 g/s (normal idle airflow within 1.8–2.4 g/s), STFT +3% and LTFT +2% (within ±10% normal range), RPM 720 (within 650–750 specification). No individual parameter indicates a fault. This normal data pattern is used as a baseline reference for comparison when abnormal conditions are present.

8. B — Check EVAP Purge Solenoid First — The Type 4 reference booklet diagnostic procedure for a rich condition (negative fuel trims) with normal MAF and normal ECT directs the technician to check the EVAP purge solenoid as the first step. Disabling purge via the scan tool's bidirectional controls and observing whether fuel trims shift toward zero is the most direct test — if trims improve when purge is disabled, the solenoid is delivering excessive vapor, confirming the stuck-open or leaking purge solenoid as the rich cause before any further testing.

9. D — 45–55 psi Fuel Pressure Specification — The Composite Vehicle Type 4 fuel system operates at 45–55 psi base pressure. This pressure specification applies during normal idle operation. Dynamic testing requires pressure to remain within specification during acceleration, deceleration, and sustained high-load operation. A pressure below 45 psi at idle indicates a weak fuel pump, clogged filter, or failed pressure regulator. A pressure above 55 psi indicates a stuck-closed pressure regulator or a return line restriction. Static pressure hold testing and dynamic pressure testing are both required for a complete fuel pressure evaluation.

10. B — MAF Comparison Test to Differentiate Lean Source — Equal cylinder contributions confirm no single cylinder fault — the lean condition is system-level. The Type 4 procedure directs comparing fuel trim behavior at idle versus 2,500 RPM as the next step after equal contribution results. This RPM trim comparison is the standard diagnostic fork between vacuum leak (trims normalize at RPM) and MAF undercounting (trims remain lean at all RPM). The result of this comparison determines whether the subsequent diagnosis follows the vacuum leak procedure or the MAF sensor procedure from the reference booklet.

11. A — 5.0V PCM Reference Voltage — The PCM's 5V VREF circuit is one of the most important shared systems on the Composite Vehicle Type 4. Understanding that MAF, TPS, and MAP all share this reference allows the technician to interpret multiple simultaneous low-signal DTCs as a potential single VREF fault rather than three independent sensor failures. This is explicitly covered in the Type 4 reference booklet multiple DTC diagnosis section — three simultaneous sensor low codes always prompt VREF testing before individual sensor replacement.

12. C — PCM-Controlled Ground for EVAP Purge Solenoid — The Composite Vehicle Type 4 EVAP purge solenoid uses the PCM ground-switching control method common to most emissions solenoids on this platform. Battery voltage is supplied to one terminal when the ignition is on; the PCM provides the ground path on the other terminal when it commands purge on. P0443 indicates the PCM detected a fault in this control circuit — either no voltage on the supply terminal, no ground on the control terminal, or an open solenoid winding. Knowing the circuit design is required to correctly probe the correct terminals.

13. D — Downstream Sensor 0.5–0.8V Stable Range — A healthy catalytic converter uses its oxygen storage capacity to buffer the rich/lean cycling of the upstream exhaust gases. The downstream sensor sees a smoothed, relatively constant oxygen level — producing a relatively stable voltage in the 0.5–0.8V range. This stability confirms the catalyst is storing and releasing oxygen effectively. The downstream sensor switching like the upstream sensor (rapid 0.1V–0.9V cycling) is the catalyst failure pattern — zero oxygen storage capacity means the downstream sensor sees the same unmodified exhaust chemistry as the upstream sensor.

14. B — Genuine Catalytic Converter Efficiency Failure — The downstream sensor oscillating slowly between 0.2V and 0.8V (approximately 2 oscillations per minute) indicates partial catalyst degradation. A fully healthy catalyst produces a very stable downstream voltage with minimal oscillation. A degraded catalyst with reduced oxygen storage cannot fully buffer the upstream rich/lean cycling — some cycling bleeds through to the downstream sensor, but more slowly than upstream. This slow downstream oscillation is the P0420 efficiency failure pattern — the catalyst is degraded but not completely failed (zero storage would produce rapid mirroring).

15. D — 18–25 g/s WOT MAF Reading — At wide-open throttle, the Composite Vehicle Type 4's 2.5L engine requires maximum airflow — producing MAF readings of 18–25 g/s depending on RPM. This specification is used diagnostically when a customer complains of reduced power or when diagnosing a MAF sensor performance fault. A vehicle that produces only 12 g/s at WOT when the specification is 18–25 g/s has insufficient airflow entering the engine — from a clogged air filter, a restricted MAF element, a kinked intake hose, or a MAF sensor that underreports at high flow rates.

16. C — Variable Reluctance CKP Sensor — The Type 4 uses a magnetic variable reluctance CKP sensor producing an analog AC sine wave signal whose amplitude increases with RPM. This differs fundamentally from Hall-effect sensors in both signal shape and testing methodology. A variable reluctance sensor must be tested with an AC voltage setting on a DVOM or observed on a lab scope as an AC sine wave — a DC voltage test will not accurately evaluate a VR sensor's output. The AC voltage amplitude at 200 RPM cranking speed is the standard dynamic test for this sensor type.

17. D — 4.5–4.9V TPS at WOT — The TPS near-maximum voltage of 4.5–4.9V at WOT confirms the throttle plate is reaching its full mechanical travel. This specification is used when diagnosing acceleration hesitation or reduced power complaints — confirming full throttle opening mechanically before pursuing fuel or ignition diagnoses. A WOT TPS reading of only 3.5V during an acceleration complaint confirms the throttle is not opening fully despite the driver's full pedal application — pointing to a throttle cable, pedal stop, or throttle body mechanical limitation rather than an engine performance fault.

18. C — Verify Actual Fuel Delivery to Cylinders — With CKP signal confirmed, injector pulse confirmed, fuel pressure confirmed, spark confirmed, and compression confirmed, the next diagnostic step is confirming that the injectors are physically delivering fuel spray — not just receiving an electrical pulse. An injector that receives correct voltage and ground switching but is mechanically clogged or stuck closed produces no fuel spray despite normal electrical signals. The Type 4 procedure directs confirming actual fuel delivery (via injector spray pattern test, noid light with smell test, or cylinder wet test) when all other no-start causes are ruled out.

19. D — STFT and LTFT Within ±10% — The Composite Vehicle Type 4 normal closed-loop operation produces fuel trims within ±10% at idle and moderate loads. This ±10% range represents the PCM making minor corrections to maintain stoichiometric combustion. Values between ±10% and ±25% indicate a developing fault that the PCM is compensating for but that has not yet reached DTC threshold. Values approaching ±25% indicate the PCM is near maximum correction — a DTC is likely pending. Values beyond ±25% exceed the PCM's correction authority and trigger the corresponding lean or rich DTC.

20. B — ECT Sensor Stuck at Fixed Low Reading — A P0116 range/performance code specifically indicates the PCM has detected that the ECT sensor's output does not change as expected during normal engine warm-up — the signal is outside the expected range for the operating conditions or fails to track temperature change over time. An ECT reading of 72°F after 20 minutes of highway driving (when actual coolant temperature should be approximately 196°F) indicates the sensor is producing a fixed resistance corresponding to ambient temperature regardless of actual coolant temperature — internal sensor element failure.

21. C — Downstream Oscillation Counting Procedure — The Type 4 reference booklet catalyst efficiency evaluation procedure uses downstream O2 sensor oscillation frequency as the primary oxygen storage capacity metric. During steady-state closed-loop cruise, the technician counts the number of complete downstream voltage oscillations per minute and compares to the specification. A healthy catalyst's oxygen storage capacity absorbs the upstream rich/lean cycling — producing near-zero downstream oscillations per minute. Degraded oxygen storage allows more upstream cycling to pass through — increasing the measured downstream oscillation frequency toward and eventually matching the upstream switching rate.

22. B — Stretched or Jumped Timing Chain — The CMP signal pulse count being correct (sensor generating signals, sensor not failed) combined with incorrect phase relationship to the CKP signal is the scope-confirmed mechanical cam timing fault. The CMP sensor accurately reports the camshaft's position — the position itself is wrong relative to the crankshaft due to a stretched or jumped chain. A P0341 range/performance code (as opposed to a circuit code) is generated when the PCM detects the CMP signal is present but its timing relationship to CKP falls outside the acceptable window — the mechanical timing fault pattern.

23. A — Stepper Motor IAC Valve — The Composite Vehicle Type 4 uses a stepper motor IAC that advances in precise incremental steps to control bypass airflow. The PCM commands step counts from 0 (fully closed — minimum bypass air) to approximately 255 (fully open — maximum bypass air) to maintain the target idle RPM. Interpreting the scan tool IAC step count data requires understanding this range: a step count near zero at idle with above-specification RPM indicates uncontrolled air entry; a step count near maximum at idle with below-specification RPM indicates the IAC cannot supply enough air for normal idle.

24. C — 50–80 Steps Normal Warm Idle — The 50–80 step range at warm idle represents the Type 4's normal bypass air requirement when the engine is fully warmed and all accessories are off. This partially open position provides the precise airflow volume needed for stable warm idle operation. The diagnostic significance: step counts significantly below this range (under 20 steps) with above-specification RPM indicate uncontrolled air is supplementing the IAC air (vacuum leak); step counts significantly above this range (over 150) with below-specification RPM indicate the engine demands more air than the IAC can supply while the idle control system compensation mechanism is at maximum.

25. D — Uncontrolled Air Source Bypassing Throttle and IAC — The IAC at minimum steps (8 steps — nearly fully closed) with idle RPM still at 1,050 is the definitive scan data confirmation of uncontrolled air entry. The PCM has commanded minimum bypass air through the IAC in an attempt to lower idle to specification, but RPM remains far above specification. The only explanation is that the additional air required to maintain 1,050 RPM is entering through a path the IAC cannot close — a vacuum leak or stuck-open purge solenoid providing a fixed air supply the IAC cannot counteract regardless of step position.

26. B — Vacuum Leak Fuel Trim Pattern — The Type 4 reference booklet fuel trim interpretation table specifically identifies the idle-high/RPM-normalizing STFT pattern as the vacuum leak signature. The fixed unmetered air volume from a vacuum leak represents approximately 17% extra air at idle (requiring +17–21% STFT correction) but only 4% extra air at 2,500 RPM (requiring only +6% STFT correction). The LTFT of +18% reflects long-term compensation built at idle conditions. This pattern precisely matches the Type 4 reference booklet's vacuum leak diagnostic criteria.

27. A — Vacuum-Operated EGR with DPFE Sensor — The Type 4 EGR system design using vacuum actuation with DPFE differential pressure feedback monitoring requires specific diagnostic testing. The DPFE sensor measures pressure drop across a metering orifice — high DPFE voltage indicates high EGR flow, low DPFE voltage indicates low or no flow. Understanding this design is required to correctly diagnose P0401 (insufficient EGR flow from clogged passages or failed valve opening), P0402 (excessive EGR flow from stuck-open valve), and P0405/P0406 (DPFE sensor circuit faults) using the Type 4 reference booklet procedures.

28. B — Clogged EGR Passages — DPFE sensor operation depends on gas flowing through the metering orifice — it is a differential pressure measurement, not an absolute pressure measurement. When EGR passages are clogged with carbon deposits, the EGR valve opens (responding to the PCM's vacuum command) but no gas flows through the passages and across the orifice. Without flow across the orifice, no differential pressure is created and the DPFE sensor remains at its baseline near-zero differential voltage (~0.4V). The low DPFE with confirmed valve opening is the Type 4 reference booklet's diagnostic signature for passage blockage versus valve failure.

29. B — ORVR System with Purge and Vent Solenoids — The Composite Vehicle Type 4's ORVR EVAP system uses two PCM-controlled solenoids: the purge solenoid (normally closed — opens to draw stored vapors into the intake) and the vent solenoid (normally open — allows canister to breathe; closes during leak testing). The PCM monitors tank pressure/vacuum during specific test conditions with the vent solenoid closed and purge solenoid cycling to evaluate leak integrity. Understanding both solenoids' normal states is required for EVAP diagnosis on the Type 4.

30. B — 0.040-Inch Large Leak Threshold — The Type 4 reference booklet defines P0455 as a leak equivalent to a 0.040-inch or larger orifice. This large leak threshold represents significant EVAP system integrity failure — typically a missing fuel cap (the most common large leak cause), a completely disconnected vapor hose, or a cracked canister body. The distinction between small leak (P0442 = 0.020 inch) and large leak (P0455 = 0.040 inch) is important for I/M testing and for understanding the severity of the EVAP fault — large leaks are more likely to be found by visual inspection.

31. A — 8,000–12,000 Volt Normal Firing Voltage — The Type 4 COP system's normal secondary firing voltage range of 8–12 kV at idle reflects the voltage required to ionize the spark plug gap under normal compression and mixture conditions. This range is the diagnostic comparison baseline. A firing voltage below 8 kV suggests insufficient coil output (degraded coil, low primary voltage, high primary resistance) or a fouled/shorted plug that requires less voltage to fire. A firing voltage above 12 kV at idle suggests a widened plug gap, a lean mixture requiring higher ionization voltage, or increased compression resistance.

32. B — Scope Test Primary Circuit Waveform — Resistance testing is a static test — it confirms coil winding integrity under no-current conditions. P0351 is a circuit code generated during dynamic operation. The coil A primary circuit waveform test reveals: correct dwell period (PCM charging the coil), a sharp collapse spike when the PCM opens the primary circuit, the secondary firing line, and post-spark oscillations. An intermittent open in the primary circuit, a PCM driver with marginal switching speed, or a power supply fault to the coil all produce abnormal waveform features not detectable by resistance measurement.

33. D — 1.5–2.5 Millisecond Normal Spark Line — The spark line duration on the Type 4 DSO waveform represents the time the spark arc is sustained across the plug gap during combustion initiation. Normal duration of 1.5–2.5 ms reflects the energy required to initiate combustion in a normally-fueled, normally-compressed cylinder. Duration less than 1.5 ms indicates the spark extinguishing early — from a fouled plug short-circuiting the gap, a rich mixture requiring less ionization time, or a coil with reduced secondary energy. Duration greater than 2.5 ms indicates extended ionization time from a wide gap or lean mixture.

34. B — Excessively Wide Spark Plug Gap on Cylinder 2 — A wider spark plug gap requires the coil to maintain the ionization arc longer to deliver sufficient energy across the larger distance. The relationship is directly proportional — a gap that is twice as wide as specification requires approximately twice the spark line duration to deliver equivalent combustion energy. Cylinder 2's 4.8 ms spark line (approximately 2.5x normal) strongly suggests a spark plug gap significantly wider than the other cylinders. Spark plug inspection confirming a wide gap on cylinder 2 compared to normal gaps on all other cylinders would confirm this diagnosis.

35. D — Positive Idle Trims Normalizing at RPM — A vacuum leak between MAF and throttle body is the most common Type 4 vacuum leak location and produces the characteristic idle-specific lean trim pattern. Air that enters the intake downstream of the MAF is not measured — the PCM delivers fuel based on the measured airflow but the engine receives more air than metered, creating a lean condition. At idle, the extra unmetered air is a significant percentage of total airflow. At higher RPM and greater total airflow, the same extra unmetered air volume becomes an insignificant percentage — trims normalize.

36. C — Large Vacuum Leak — The Type 4 reference booklet combined code analysis section specifically identifies the P0171 + P0507 combination with minimum IAC steps as the vacuum leak code cluster. The PCM has reduced IAC to minimum (trying to lower idle) but RPM remains elevated — confirming uncontrolled air entry. The trims normalizing at 2,500 RPM confirm a fixed air source (vacuum leak, not MAF). All data points — minimum IAC, high idle, lean idle trims, normalizing at RPM — are produced by the single root cause of a large vacuum leak in the intake system.

37. A — Canister Vent Solenoid Normally Open — The Type 4 canister vent solenoid is normally open — it allows the charcoal canister to vent to atmosphere during normal driving, which is required for the canister to breathe as it adsorbs fuel vapors. The PCM closes the vent solenoid only during EVAP monitor leak testing — sealing the system to allow pressure/vacuum testing. A vent solenoid that fails closed (stuck closed) prevents canister breathing and can cause EVAP pressure faults, fuel tank vacuum buildup, and difficult refueling. A vent solenoid that fails open (stuck open) prevents the PCM from sealing the system for leak testing.

38. B — Saturated Charcoal Canister — A trim shift from +1% STFT to -14% STFT when purge is activated confirms the solenoid is opening and delivering a large vapor quantity (the solenoid is functional, not stuck closed). The magnitude of the trim shift (-15 percentage points) is significantly greater than the modest 2–4% trim shift expected from a normally loaded canister during routine purging. The excessive vapor delivery indicates the canister is saturated — its activated charcoal has exceeded its vapor adsorption capacity and is releasing a concentrated vapor charge when purge opens. Canister replacement after identifying the saturation cause is the correct repair.

39. C — Upstream O2 Sensor Achieving Operating Temperature — Closed-loop operation requires the upstream O2 sensor to produce reliable switching signals. The sensor cannot switch reliably until its electrochemical sensing element reaches approximately 600°F — the temperature at which the zirconia element becomes ionically conductive. On the Type 4, the PCM monitors the upstream O2 signal for switching activity above a threshold frequency and voltage range. When the sensor begins switching reliably, the PCM transitions from open-loop (fixed fuel delivery map) to closed-loop (O2 feedback fuel trim correction).

40. B — Exhaust Leak Between Upstream Sensor and Catalyst — The new downstream sensor producing a fixed near-zero voltage (0.04V — extremely lean reading) immediately after replacement, with normal upstream switching, indicates the sensor is functional (it's responding to an actual exhaust chemistry condition) but the exhaust at the downstream location is genuinely lean from an external oxygen source. An exhaust manifold or pipe leak between the upstream sensor and the catalyst allows outside air to mix with the exhaust stream — the diluted exhaust reaches the downstream sensor with excess oxygen, producing the fixed lean (low) voltage that falsely appeared as a P0136 sensor circuit fault.

41. D — 14–16 Ohm High-Impedance Injectors — The Type 4's 14–16 ohm high-impedance injectors are important to identify correctly because they determine the PCM driver design (saturated switch, not peak-and-hold), the test equipment settings used for injector circuit testing, and the diagnostic significance of resistance measurements. All four injectors should measure within the 14–16 ohm range and within 1 ohm of each other — a significant deviation from the range or from the other injectors indicates an internal injector fault even if the absolute value is close to specification limits.

42. B — Test Injector Circuit Voltage Supply and PCM Driver Ground — P0201 is an injector CIRCUIT code — it indicates the PCM detected an electrical fault in the cylinder 1 injector circuit, not necessarily an injector failure. Normal injector winding resistance rules out an open internal winding. The next step is confirming the complete circuit: battery voltage at the injector supply terminal and PCM ground switching signal at the control terminal. A NOID light test during cranking quickly confirms both conditions simultaneously — a non-flashing NOID with battery voltage present at supply terminal confirms the PCM is not switching ground, pointing to a PCM driver fault or wiring open between PCM and injector.

43. C — Hot-Wire MAF Sensor — The Composite Vehicle Type 4's hot-wire MAF sensor is the most common MAF design and the most susceptible to contamination from oil film (from PCV system oil mist), silicone (from silicone-based products used during air filter service), and particulate deposits. Hot-wire contamination reduces heat transfer from the wire to the airstream — requiring less current to maintain temperature — producing a falsely low airflow output. The

Type 4 reference booklet MAF maintenance section specifically addresses hot-wire contamination cleaning as a diagnostic and maintenance procedure.

44. C — Contaminated MAF Sensor Hot Wire — The diagnostic sequence confirms circuit integrity: the reading drops to 0.0 g/s when disconnected (confirming the reading is from the sensor, not a wiring fault) and returns to 0.3 g/s when reconnected (confirming the circuit is intact). The 0.3 g/s reading (86% below the 1.8–2.4 g/s specification) indicates the sensor is generating a signal but significantly underreporting airflow. A contaminated hot wire that cannot transfer heat normally produces this reduced-but-present output pattern — the wire is still electrically functional but thermally compromised by contamination.

45. D — 1.8–2.4 g/s Normal Idle MAF Specification — The Type 4 idle MAF specification of 1.8–2.4 g/s is one of the most frequently referenced values in the reference booklet. It is used in MAF comparison testing (comparing the test vehicle's idle MAF to a known-good vehicle or to the specification), in vacuum leak diagnosis (high idle MAF with minimum IAC steps suggests extra unmetered air), and in MAF sensor performance evaluation. A MAF reading of 1.9 g/s at warm idle is within specification — confirming normal idle airflow without restriction or excess air entry.

46. A — Failing Fuel Pump Insufficient Dynamic Output — The pressure hold test (52 psi holding for 20 minutes) confirms the fuel system seals correctly at rest — no injector leakage, no regulator leak-down, no check valve failure. The dynamic test reveals the actual fault: pressure collapsing from 52 psi to 18 psi within 2 seconds of cranking demand. A fuel pump that cannot sustain pressure under the demand of cranking injection confirms pump output capacity failure — the pump element, armature windings, or internal check valve cannot maintain adequate flow volume under actual demand conditions despite holding static pressure adequately.

47. B — PCM-Controlled Relay for Cooling Fan — The Type 4 cooling fan relay circuit is a standard PCM ground-switching relay design. The PCM monitors ECT and A/C request signals and grounds the relay control circuit when fan activation is required. P0480 (cooling fan control circuit) is diagnosed by testing the relay control circuit: confirming battery voltage at the relay coil power supply terminal, confirming PCM ground switching at the relay coil control terminal, and confirming the relay contact supplies battery voltage to the fan motor when activated. A fan that does not operate with confirmed relay activation points to the fan motor or its power/ground circuit.

48. B — Failed PCM Fan Relay Driver — Battery voltage confirmed at the relay power supply terminal rules out a supply circuit fault. The relay control terminal reading 12V (battery voltage) when the PCM should be providing ground (near 0V) confirms the PCM is not completing the ground path for the relay coil. The PCM output transistor that switches the relay control circuit has failed open — preventing the relay from energizing and the fan from operating regardless of ECT. This is a PCM output driver failure requiring PCM replacement or the fan relay circuit wiring between the PCM and relay must be tested for an open circuit.

49. B — Genuine Catalytic Converter Efficiency Failure — The Type 4 reference booklet P0420 diagnostic procedure is a systematic elimination process: check for exhaust leaks (eliminated), confirm downstream sensor integrity (confirmed functional), confirm upstream sensor function (normal switching), check for misfire (none active), check fuel trims (within ±5%), check for coolant and oil consumption (none). When all false P0420 causes are eliminated by the reference booklet procedure, the conclusion is confirmed catalytic converter substrate degradation requiring converter replacement — the only remaining explanation.

50. B — Vacuum Leak as Single Root Cause of All Five Codes — The Type 4 reference booklet's combined code analysis directs the technician to identify the single root cause connecting related codes before pursuing independent diagnoses. The data fingerprint — near-minimum IAC steps, above-specification idle RPM, positive STFT at idle normalizing at 2,500 RPM, unchanged LTFT built from idle compensation, all component tests normal — matches the Type 4 reference booklet's vacuum leak diagnostic signature precisely. A single disconnected vacuum hose, cracked intake manifold gasket, or breached intake boot generates all five codes simultaneously. Reconnecting or replacing the single vacuum leak source resolves all five codes.