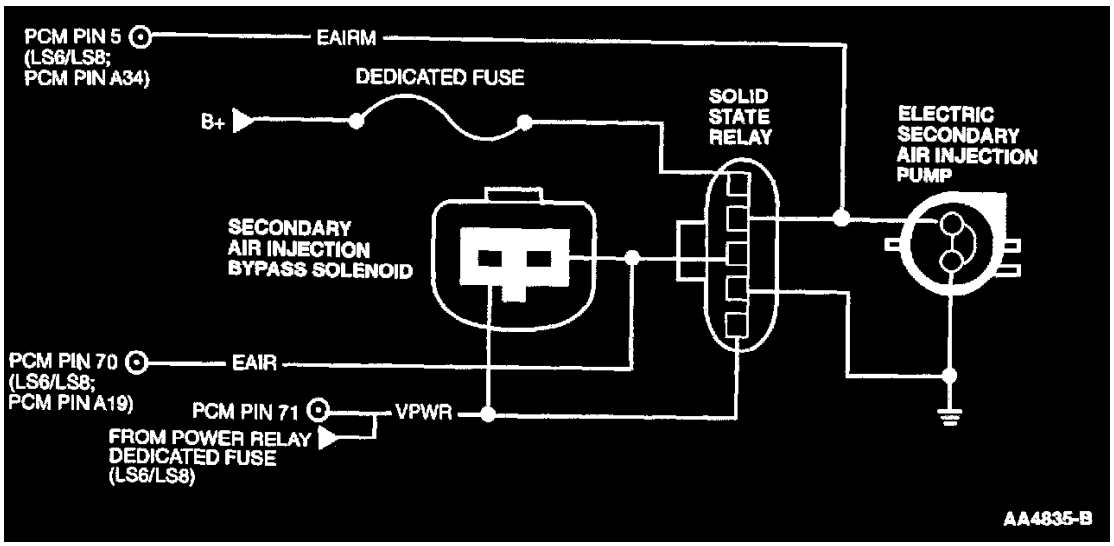
Computers and Control Systems: Pinpoint Tests
HM - Secondary Air Injection (AIR) System

Test Notes

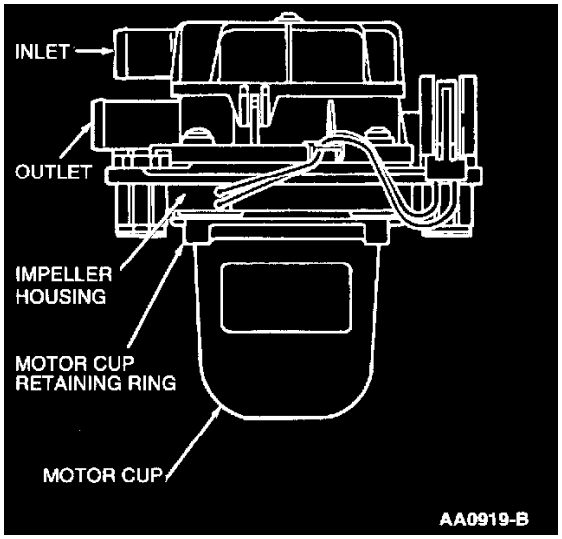
This Pinpoint Test is intended to diagnose the following:

- Harness circuits: B+, EAIR, EAIR Monitor, Ground, AIRB, AIRD
- Solid State Relay **(SSR)**
- Electric secondary air injection (AIR) pump
- Secondary air injection bypass solenoid
- Powertrain Control Module **(PCM)**
- Secondary air injection diverter solenoid
- Secondary air injection diverter valve
- Vacuum supply
- Air silencer
- Secondary air injection check valve

Pinpoint Test Schematics



System Schematic



Electric AIR Pump

NOTE: Not all applications are equipped with both AIR Bypass or AIR Diverter solenoids.

	Test Step	Result ▶	Action to Take
HM1	CHECK B+ VOLTAGE TO SOLID STATE RELAY		
	Diagnostic Trouble Code (DTC) P0412 indicates EAIR primary circuit fault. • Disconnect SSR. • Key on, engine off. • Measure voltage of B+ circuit at SSR harness connector and battery negative post. • **Is voltage greater than 10.5 volts?**	Yes ▶ No ▶	Supplied voltage is OK, GO to HM2. GO to HM6.
HM2	CHECK EAIR CIRCUIT FOR OPEN IN HARNESS		
	• Key off. • Disconnect AIR bypass solenoid. • Remove Secondary Air Injection System dedicated fuse temporarily. • Disconnect PCM. • Measure resistance of EAIR circuit between PCM harness connector pin and SSR harness connector and AIR bypass harness connector. • **Is resistance less than 5.0 ohms?**	Yes ▶ No ▶	GO to HM3. REPAIR open circuit.

Test Step	Result ▶	Action to Take
HM3 CHECK EAIR CIRCUIT FOR SHORT TO POWER AND GROUND WITH DISCONNECT AIR BYPASS SOLENOID		
• Measure resistance between EAIR and VPWR circuits at the PCM harness connector. • Measure resistance between EAIR at the PCM harness connector and battery negative post. • **Is each resistance greater than 10,000 ohms?**	Yes ▶ No ▶	The EAIR harness is OK. GO to HM4. REPAIR short circuit.
HM4 CHECK EAIR CIRCUIT FOR SHORT TO POWER AND GROUND		
• Reconnect AIR bypass solenoid. • Measure resistance between EAIR and VPWR circuits at the PCM harness connector. • Measure resistance between EAIR at the PCM harness connector and battery negative post. • **Is each resistance greater than 10,000 ohms?**	Yes ▶ No ▶	EAIR circuit with AIR bypass solenoid OK. GO to HM5. REPLACE AIR bypass solenoid.
HM5 CHECK EAIR CIRCUIT FOR SHORT TO POWER AND GROUND WITH SOLID STATE RELAY RECONNECTED		
• AIR bypass solenoid disconnected. • Reconnect solid state relay. • Measure resistance of EAIR circuit between VPWR and PWR GND circuits at the PCM harness connector. • **Is each resistance greater than 10,000 ohms?**	Yes ▶ No ▶	**If DTC P0411 is present:** GO to HM9. **All others:** GO to HM14. REPLACE solid state relay.
HM6 CHECK B+ CIRCUIT FOR OPEN IN HARNESS		
• Measure resistance of B+ circuit between solid state relay harness connector and Secondary Air Injection System dedicated fuse. • **Is resistance less than 5.0 ohms?**	Yes ▶ No ▶	REPLACE Secondary Air Injection System dedicated fuse, then GO to HM8 to check electric AIR pump. RECONNECT solid state relay. REPAIR open circuit. RECONNECT solid state relay and fuse.
HM7 VISUALLY INSPECT ELECTRIC AIR PUMP HOSES		
DTC P0411 indicates Secondary Air not detected. In order to test the pump, it must be capable of driving the HO2S lean. • Visually inspect electric AIR pump hoses from the electric AIR pump to the AIR diverter valves. • Inspect air hose for cracks, binding, obstructions, water or ice. • **Are electric AIR pump hoses OK?**	Yes ▶ No ▶	GO to HM8. DRAIN all water from hoses or REPLACE damaged parts.

Test Step	Result ▶	Action to Take
HM8 CHECK ELECTRIC AIR PUMP OPERATION		
• Disconnect air hose from either AIR diverter valve(s). **WARNING: BEWARE OF MOVING VEHICLE COMPONENTS AND HEAT.** • Check air flow at the open hose by placing a hand over the outlet of the hose. Caution must be observed while performing this test. • Key on, engine running. • After a 5-second delay, air will be present between 30 and 90 seconds. • **Is air flow present?**	Yes ▶ No ▶	KEY OFF. GO to HM15 to check electric AIR pump for water contamination. KEY OFF. REPLACE air hose to AIR diverter valves for leaks or blockage. If OK, GO to HM11.
HM9 CHECK FOR VACUUM AT AIR DIVERTER VALVES		
• Disconnect vacuum control line from the AIR diverter valve(s). • Key on, engine running. • After a 5-second delay, vacuum will be present between 30 and 90 seconds. • **Is vacuum present at the AIR Diverter valve(s)?**	Yes ▶ No ▶	GO to HM10. GO to HM30.
HM10 CHECK AIR DIVERTER VALVE(S) INTEGRITY		
CAUTION: Caution must be observed while performing this test. NOTE: On a two valve system make sure that air is flowing from both valves. • Reconnect vacuum control line. • Disconnect air tube from AIR diverter valve(s) outlet side. • Cork off the air tube to prevent exhaust gases from escaping. • Inspect AIR diverter valve(s) outlets for damage from hot exhaust gases. Repair as necessary. • Key on, engine running. • After a 5-second delay, air will be present between 30 and 90 seconds. • **Is air present from the AIR diverter valve(s)?**	Yes ▶ No ▶	KEY OFF. Repair the exhaust tubes from the AIR diverter valve to the exhaust manifold(s). KEY OFF. REPLACE hose from electric AIR pump to AIR diverter valve. If OK, REPLACE the appropriate AIR diverter valve(s).
HM11 CHECK VOLTAGE ON EAIR MONITOR CIRCUIT		
• Disconnect electric AIR pump. • Key on, engine running. • Measure voltage of EAIR monitor circuit between electric AIR pump harness connector and battery negative post. • **Is voltage greater than 10.5 volts for 20 to 30 seconds after a 5 to 10-second delay?**	Yes ▶ No ▶	GO to HM13. GO to HM12.

Test Step	Result ▶	Action to Take
HM12 CHECK ELECTRIC AIR PUMP GROUND FOR OPEN IN HARNESS • Measure resistance of EAP ground circuit between electric AIR pump harness connector and battery negative post. • **Is resistance less than 5 ohms?**	Yes ▶ No ▶	GO to HM19. REPAIR open circuit.
HM13 CHECK AIR HOSE TO ELECTRIC AIR PUMP • Disconnect inlet air hose. • Visually inspect inlet air hose for binding, obstructions, water or ice to the electric AIR pump. • **Is the hose integrity or orientation OK?**	Yes ▶ No ▶	GO to HM15. DRAIN all water from air hose. REPLACE or RE-ORIENT hose as appropriate. GO to HM15.
HM14 CHECK SOLID STATE RELAY OUTPUT • Reconnect AIR bypass solenoid. • Connect PCM. • Key on, engine off. • Enter output test mode. • Access AIR PID. • Access AIRM PID. • Compare AIR and AIRM PIDs. • **Were both PIDs on?**	Yes ▶ No ▶	REPLACE solid state relay. REPLACE PCM.
HM15 CHECK AIR PUMP FOR WATER NOTE: Water ingested in the electric AIR pump will reduce the life of the pump. • Disconnect electric AIR pump connector and air hoses. • Carefully tilt electric AIR pump in various positions to verify if any water is present. • **Is any water present?**	Yes ▶ No ▶	REPLACE electric AIR pump. If fuse was replaced in HM6, Testing is complete. All others, GO to HM9.
HM17 CHECK B+ CIRCUIT VOLTAGE TO SOLID STATE RELAY DTC P1413 indicates EAIR monitor circuit is low while the electric AIR pump was commanded ON. • Disconnect solid state relay. • Key on. • Measure voltage of B+ circuit between solid state relay harness connector and chassis ground. • **Is voltage greater than 10.5 volts?**	Yes ▶ No ▶	GO to HM18. GO to HM24.

Test Step	Result ▶	Action to Take
HM18 CHECK FOR VPWR TO SOLID STATE RELAY • Key on, engine off. • Measure VPWR circuit voltage at the solid state relay harness connector. • **Is voltage greater than 10.5 volts?**	Yes ▶ No ▶	GO to HM19. **For LS6/LS8:** GO to Pinpoint Test Step B5. **All others:** REPAIR open VPWR circuit between the solid state relay and Electronic Engine Control power relay (and dedicated fuse on LS6/LS8)..
HM19 CHECK VOLTAGE ON EAIR MONITOR CIRCUIT • Reconnect solid state relay. • Disconnect electric AIR pump. • Key on, engine off. • Enter output test mode. • Access AIRM PID. • **Is PID on?**	Yes ▶ No ▶	GO to HM23. REMAIN in output test mode. If DTC P0411 is present, REPLACE electric AIR pump. GO to HM20. REMAIN in output test mode.
HM20 CHECK EAIR MONITOR VOLTAGE TO PCM • Disconnect PCM. • Key on, engine off. • Access AIRM PID. • **Is PID on?**	Yes ▶ No ▶	REPLACE PCM. GO to HM21.
HM21 CHECK EAIR MONITOR CIRCUIT FOR OPEN IN HARNESS • Disconnect solid state relay. • Measure resistance of EAIR monitor circuit between PCM harness connector and solid state relay harness connector. • Measure resistance of EAIR monitor circuit between the solid state relay harness connector and the electric AIR pump harness connector. • **Is each resistance less than 5.0 ohms?**	Yes ▶ No ▶	GO to HM22. REPAIR open EAIR monitor circuit.
HM22 CHECK EAIR MONITOR CIRCUIT FOR SHORT TO GROUND IN HARNESS • Measure resistance between EAIR monitor and PWR GND circuits at the PCM harness connector. • **Is each resistance greater than 10,000 ohms?**	Yes ▶ No ▶	REPLACE solid state relay. REPAIR short circuit.
HM23 CHECK EAIR MONITOR VOLTAGE TO PCM • Reconnect electric AIR pump. • Reconnect PCM. • Key on, engine off. • Access AIRM PID. • **Is PID on?**	Yes ▶ No ▶	REPLACE PCM. REPAIR open EAIR circuit.

Test Step	Result ▶	Action to Take
HM24 CHECK B+ CIRCUIT FOR OPEN IN HARNESS		
• Measure resistance of B+ circuit between solid state relay harness connector and dedicated fuse B+ circuit. • **Is resistance less than 5 ohms?**	Yes ▶ No ▶	REPLACE solid state relay dedicated fuse. REPAIR open circuit.
HM25 CHECK EAIR MONITOR CIRCUIT FOR OPEN IN HARNESS		
DTC P1414 indicates electric AIR pump commanded off, but PCM indicates electric AIR pump is on. • Disconnect solid state relay. • Disconnect PCM. • Disconnect electric AIR pump. • Measure resistance of EAIR monitor circuit between PCM harness connector and electric AIR pump harness connector. • **Is resistance less than 5 ohms?**	Yes ▶ No ▶	GO to HM26. REPAIR open circuit.
HM26 CHECK ELECTRIC AIR PUMP FOR OPEN		
• Measure electric AIR pump resistance. • **Is resistance between 0.5-5.0 ohms?**	Yes ▶ No ▶	GO to HM27. REPLACE electric AIR pump.
HM27 CHECK EAIR MONITOR CIRCUIT FOR SHORT TO POWER IN HARNESS		
• Key on. • Measure voltage between PCM harness connector and chassis ground. • **Is voltage greater than 10.5 volts?**	Yes ▶ No ▶	REPAIR short circuit. EAIR Monitor circuit is OK. GO to HM28.
HM28 CHECK SOLID STATE RELAY OUTPUT		
• Reconnect AIR bypass solenoid. • Connect PCM. • Key on, engine off. • Enter output test mode. • Access AIR PID. • Access AIRM PID. • Compare AIR and AIRM PIDs. • **Were both PIDs on?**	Yes ▶ No ▶	REPLACE solid state relay. REPLACE PCM.
HM30 CHECK VACUUM HOSE INTEGRITY		
• Key off. • Check vacuum hose between AIR bypass solenoid and AIR diverter valve. • Check for blockage and restrictions. • Check for leaks and cracks. • Check for kinks or disconnects. • **Are the above checks OK?**	Yes ▶ No ▶	GO to HM31. REPLACE the vacuum line connecting the AIR bypass solenoid to AIR diverter valve(s).

Test Step		Result ▶	Action to Take
HM31	CHECK AIR BYPASS SOLENOID ELECTRICAL OPERATION		
	• Key on, engine off. • Access Output Test Mode. • Disconnect AIR bypass solenoid. • Connect digital multimeter to AIR bypass solenoid vehicle harness connector. • Turn the outputs on, then turn outputs off while observing digital multimeter. • **Does EAIR circuit voltage cycle greater than 0.5 volt?**	Yes ▶ No ▶	REMAIN in Output Test Mode. GO to HM32. Key off. GO to HM33.
HM32	CHECK AIR BYPASS SOLENOID FOR MECHANICAL OPERATION		
	• Reconnect AIR bypass solenoid. • Disconnect source vacuum hose from AIR bypass solenoid. • Apply 53 kPa (16 in-Hg) of vacuum to source side of AIR bypass solenoid. • Turn the outputs on, then turn outputs off. • **Was vacuum released?**	Yes ▶ No ▶	REPAIR vacuum hose from manifold vacuum tree to AIR bypass solenoid. REPLACE AIR bypass solenoid.
HM33	CHECK AIR BYPASS SOLENOID RESISTANCE		
	• Disconnect AIR bypass solenoid harness connector. • Measure AIR bypass solenoid resistance. • **Is resistance between 50 and 100 ohms?**	Yes ▶ No ▶	GO to HM34. REPLACE AIR bypass solenoid.
HM34	CHECK VPWR CIRCUIT FOR OPEN IN HARNESS		
	• Key on, engine off. • Measure VPWR circuit voltage at the AIR bypass solenoid harness connector. • **Is voltage greater than 10.5 volts?**	Yes ▶ No ▶	GO to HM35. REPAIR open VPWR circuit (and dedicated fuse on LS6/LS8).
HM35	CHECK EAIR CIRCUIT FOR OPEN IN HARNESS		
	• Disconnect solid state relay. • Disconnect PCM. • Measure resistance of EAIR circuit between PCM harness connector and the AIR bypass solenoid harness connector and at the solid state relay harness connector. • **Is resistance less than 5.0 ohms?**	Yes ▶ No ▶	GO to HM36. REPAIR open EAIR circuit.
HM36	CHECK EAIR CIRCUIT FOR SHORT TO GROUND IN HARNESS		
	• Measure resistance between EAIR and PWR GND circuits at the PCM harness connector. • **Is resistance greater than 10,000 ohms?**	Yes ▶ No ▶	GO to HM37. REPAIR short to ground.
HM37	CHECK EAIR CIRCUIT FOR SHORT TO POWER IN HARNESS		
	• Measure resistance between EAIR and PWR GND circuits at the PCM harness connector. • **Is each resistance greater than 10,000 ohms?**	Yes ▶ No ▶	REPLACE PCM. REPAIR short to power.